

Workshop Manual Audi A2 2001 ➤

**3-cyl. diesel direct injection engine (1.2 ltr. TDI),
mechanics**

Engine ID	ANY							
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Edition 04.2012

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List of Workshop Manual Repair Groups

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- 19 - Cooling
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- 26 - Exhaust system



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

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Audi A2 2001 ►

3-cyl. diesel direct injection engine (1.2 ltr. TDI), mechanics - Edition 04.2012



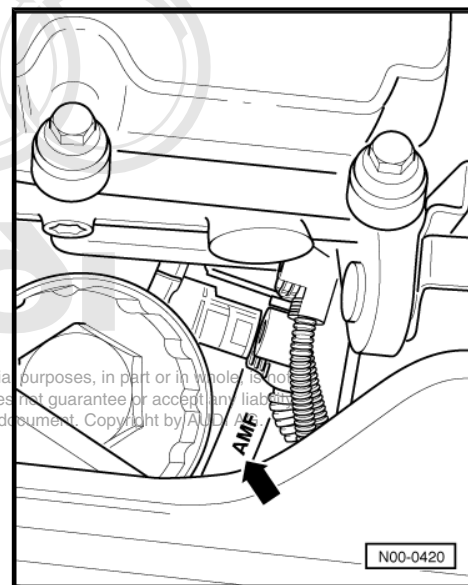
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00 – Technical data

1 Technical data

1.1 Engine number

- ◆ The engine number („Engine code“ and „Serial number“) can be found at the joint between engine and gearbox -arrow-.
- ◆ Additionally there is a sticker on the toothed belt cover showing the „engine code“ and „serial number“.
- ◆ Engine code is also included on vehicle data sticker.



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1.2 Engine data

Code letters		ANY
Capacity	ltr.	1.2
Power output	kW at rpm	45/4000
Torque	Nm at rpm	140/1800
Bore	Ø mm	76.5
Stroke	mm	86.4
Compression ratio		19.0 : 1
CN	at least	49
Firing order		1-2-3
Exhaust gas recirculation		yes
Turbocharging/supercharging		yes
Catalytic converter		yes
Charge air cooling		yes



2 Contact corrosion!

- ◆ Contact corrosion can occur if unsuitable fasteners are used (e.g. bolts, nuts, washers, etc.).
- ◆ For this reason, only fasteners with a special surface coating are used. These parts can be identified by their greenish colour.
- ◆ In addition, all rubber parts, plastic parts and adhesives are made of non-conductive materials.
- ◆ Always fit new components when in doubt about the reusability of old components.



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- ◆ *Only use genuine Audi parts.*
- ◆ *Accessories must be approved by AUDI AG.*
- ◆ *Damage caused by contact corrosion is not covered under warranty.*

3 General repair instructions

3.1 Rules for cleanliness when working on the injection system

Even small amounts of dirt can cause faults in the injection system. When working on the fuel supply/injection system, pay careful attention to the following basic rules:

- ◆ Carefully clean connection points and the surrounding area with engine cleaner or brake cleaner and dry thoroughly before opening.
- ◆ Plug open lines and connections with suitable protective caps immediately.
- ◆ Place parts that have been removed on a clean surface and cover them over. Do not use fluffy cloths.
- ◆ Only install clean components; replacement parts should only be unpacked immediately prior to installation. Do not use parts that have been previously unpacked and stored away loose (e.g. in toolboxes, etc.).
- ◆ When the system is open: Do not work with compressed air. Do not move the vehicle unless absolutely necessary.

3.2 Checking for leaks in the fuel system

- Start the engine and let it run at medium speed for a few minutes.
- Switch off ignition.
- Check the entire fuel system for leaks.
- If leaks are found although the connections have been tightened to the correct torque, the relevant component must be renewed.
- Then carry out a test drive with at least one full-power acceleration.
- Then check the pressurised areas in the system for leaks again.

10 – Removing and installing engine

1 Removing and installing engine

1.1 Detaching bonnet

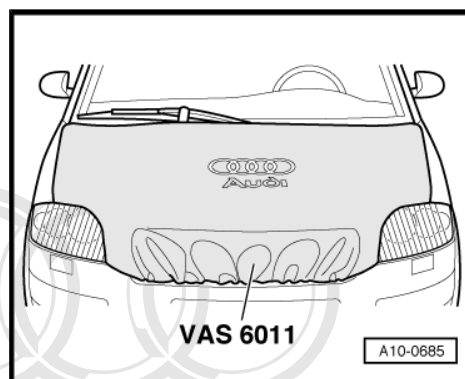
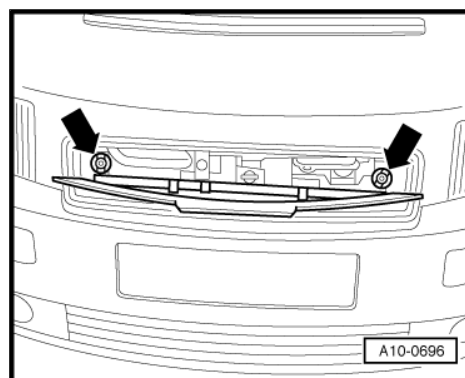
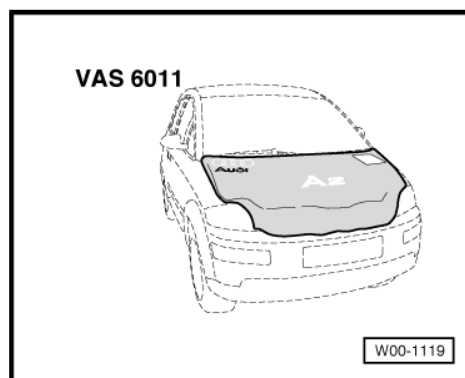
Special tools and workshop equipment required

- ♦ Engine cover protector -VAS 6011-

Procedure

- Wash outer side of bonnet and dry with chamois leather.
- Release service flap from inside the vehicle.
- Release bonnet -arrows- and pull it forwards slightly.

- Fasten protective cover -VAS 6011- over bonnet.



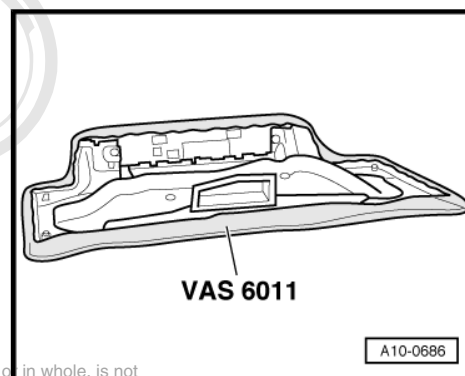
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- Remove bonnet and put aside with the Audi A2 engine cover protector -VAS 6011- facing downwards.

**Note**

Do not store bonnet in upright position.

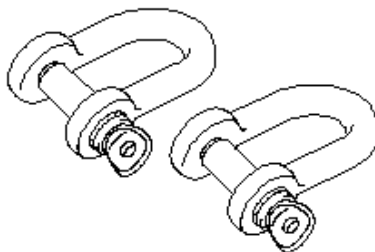
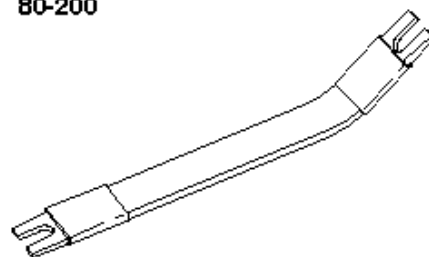
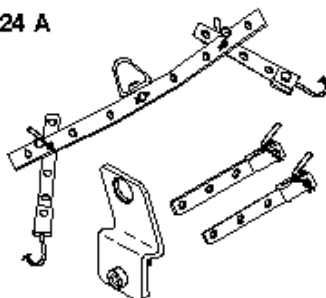
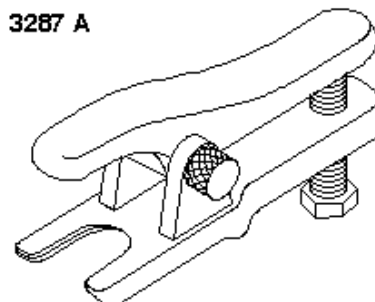
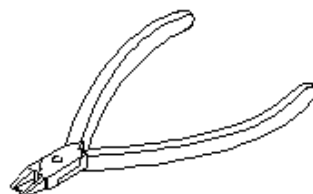
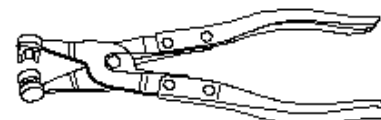


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1.2 Removing engine

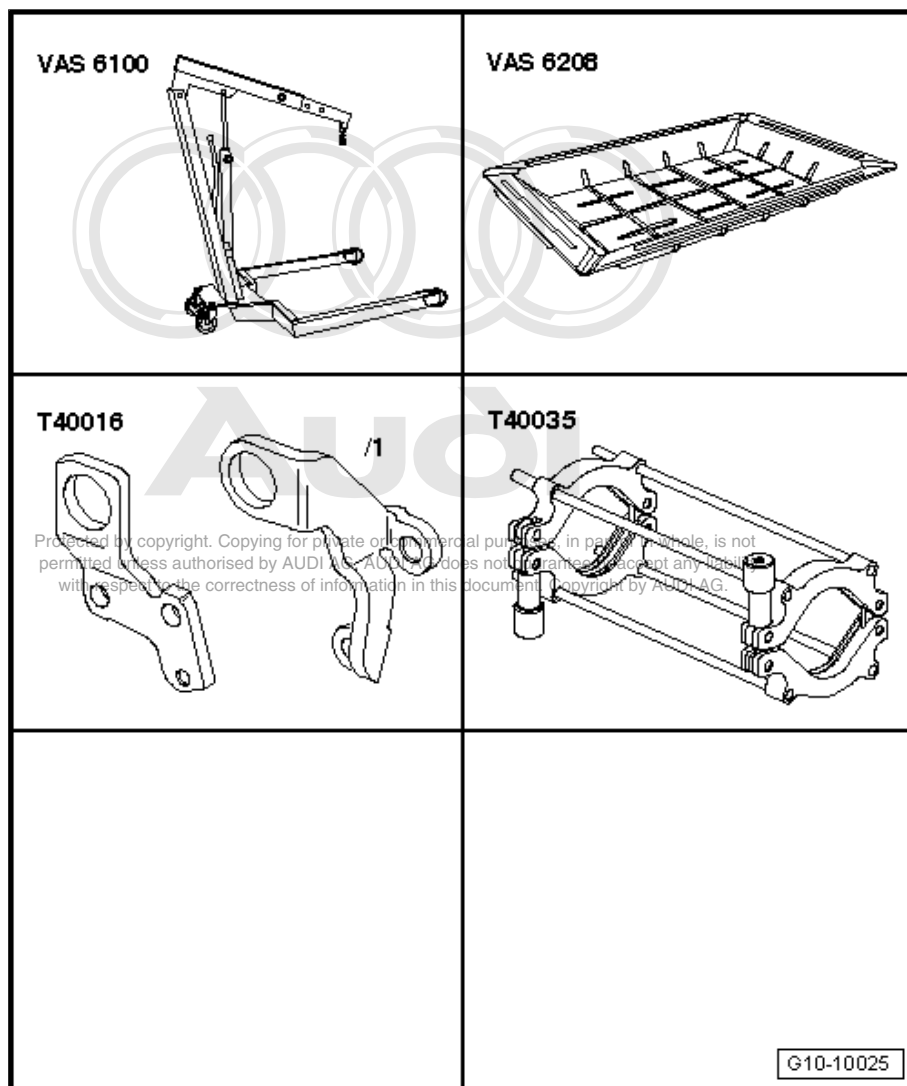
Special tools and workshop equipment required

- ◆ Shackle -10-222 A/12-
- ◆ Removal lever -80-200-
- ◆ Lifting tackle -2024 A-
- ◆ Ball joint puller -3287 A-
- ◆ Pliers -3340-
- ◆ Hose clip pliers -V.A.G 1921-

10-222 A/12**80-200****2024 A****3287 A****3340****V.A.G 1921**

G10-10024

- ◆ Workshop hoist -VAS 6100-
- ◆ Drip tray for workshop hoist -VAS 6208-
- ◆ Transportation shackle - T40016- with -T40016/1-
- ◆ Setting tool -T40035-



Note

- ◆ *The engine is removed together with the gearbox from the front.*
- ◆ *Collect drained coolant in a clean container for re-use or disposal.*
- ◆ *All cable ties which are released or cut open when removing must be fitted in the same position when installing.*



Caution

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

**Note**

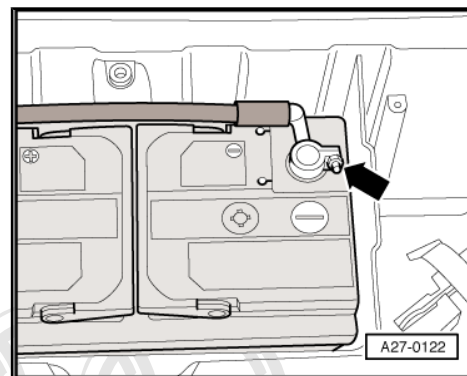
The battery is located in the luggage compartment panel.

- Switch off ignition and remove ignition key.
- Disconnect earth cable -arrow- at battery.
- Remove bonnet ⇒ [page 4](#) .

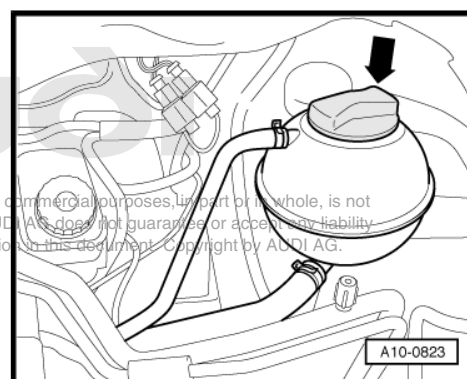
**WARNING**

Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.

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

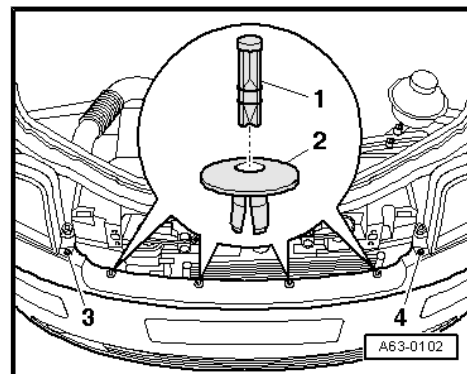


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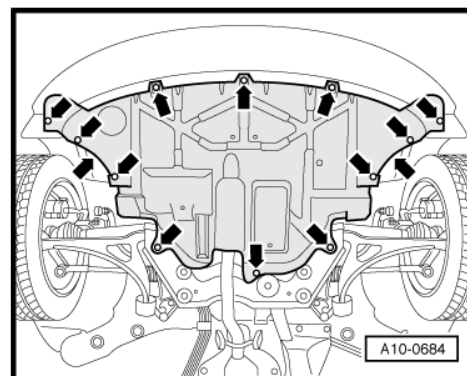
**Note**

Press in pins -1- of fasteners -2- not more than approx. 4 mm to release and remove fastener. Do not press through pin.

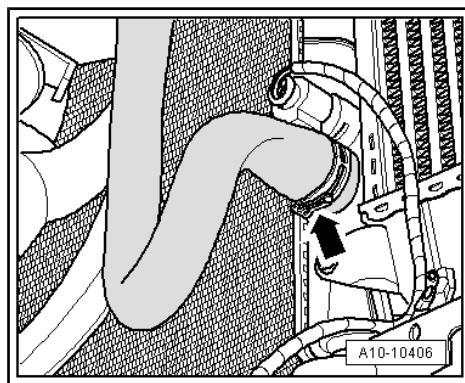
- Release fastener on bumper cover.
- Remove bolts -3- and -4-.



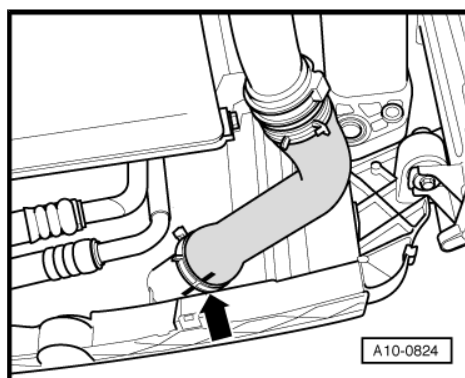
- Remove front wheels.
- Remove noise insulation -arrows-.



- Place drip tray for workshop hoist -VAS 6208- under engine.
- Disconnect coolant hose (bottom) at radiator -arrow- and drain off coolant.



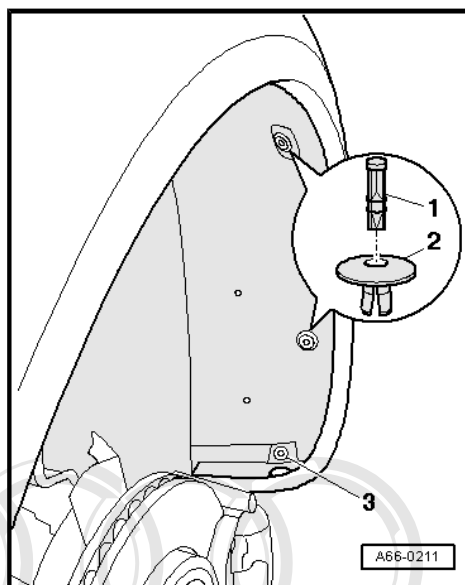
- Remove air intake hose from charge air cooler -arrow-.



Note

Press in pins -1- of fasteners -2- not more than approx. 4 mm to release and remove fastener. Do not press through pin.

- Release fastener on wheel housing liner.
- Remove bolt -3-.
- Detach front sections of wheel housing liners (left and right) .



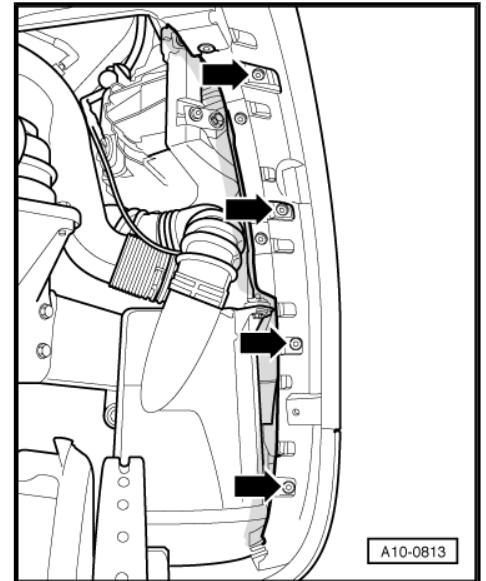
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- Unscrew bolts -arrows- at bumper cover.

**Note**

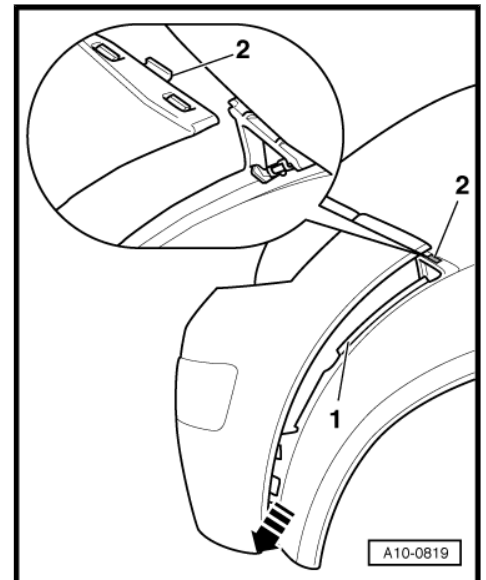
Mark position of bolts for re-installation.



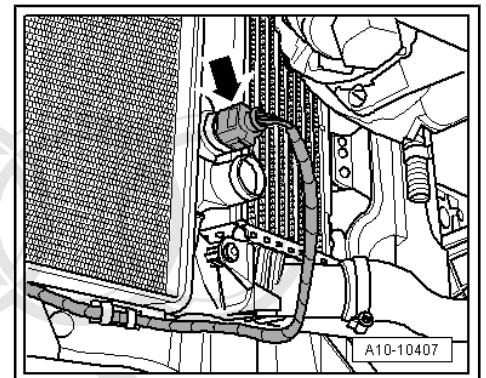
- First press bottom of bumper cover -arrow- out of groove -1-.
- Then unclip upper section from inside -2-.
- Remove bumper cover.
- If fitted, unplug electrical connectors at fog lights.

**Note**

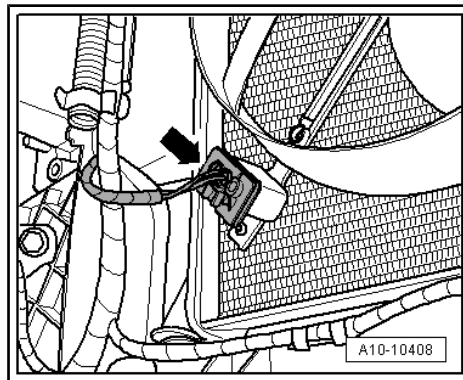
Lay bumper cover aside on a soft surface.



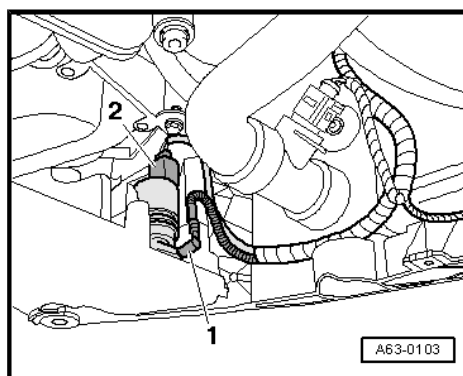
- Unplug electrical connector -arrow- at radiator fan thermostat -F18-.



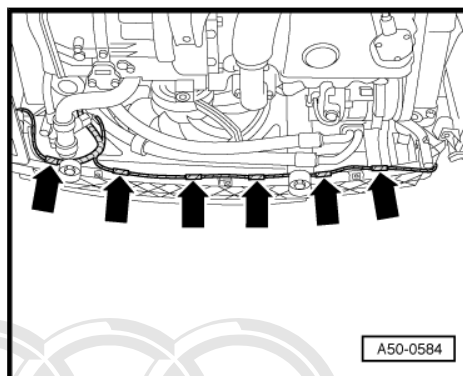
- Unplug electrical connector -arrow- at radiator fan -V7- .



- Unplug electrical connector -2-.
- Detach water hose -1- from windscreen washer fluid pump and plug connection with suitable plug.



- Move wiring harness clear from bottom of lock carrier -arrows-.

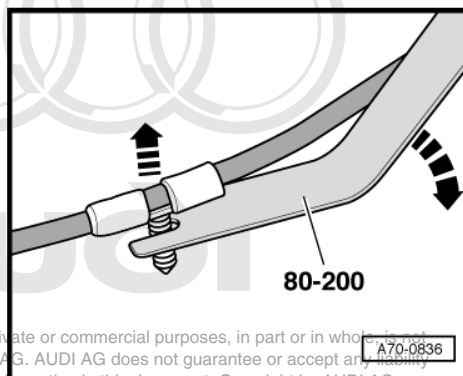


- Use removal lever -80-200- to lever out the wiring harness clips.



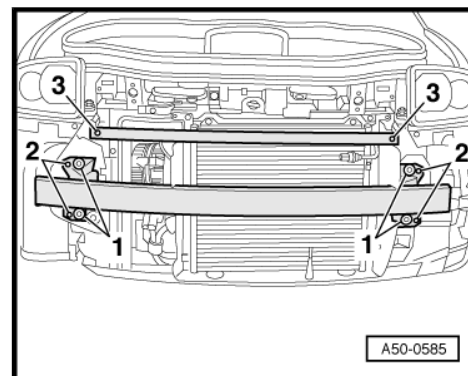
Note

To ease removal, use silicon-free lubricant if necessary.

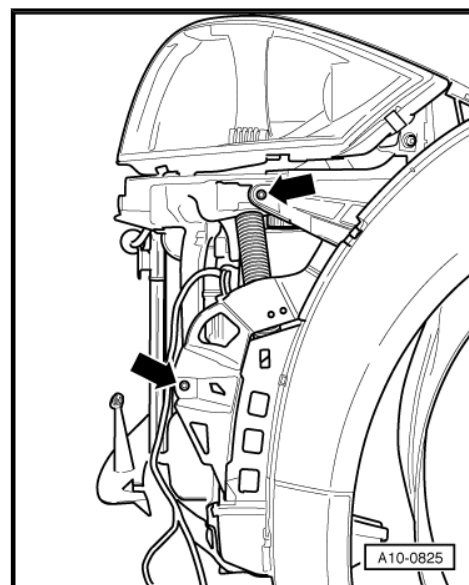


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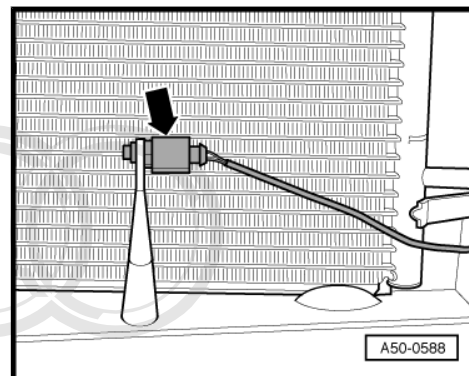
- Unplug electrical connector at horn.
- Remove two bolts each on left and right -3- and detach reinforcement rail.
- Lever off circlips -2-.
- Remove bolts on left and right -1- and detach bumper impact absorber.



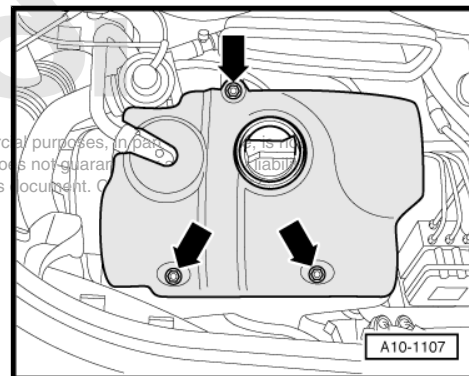
- Remove securing bolts -arrows- for lock carrier on left and right sides.



- Detach electrical connector -arrow- at ambient temperature sensor -G17- .
- Unplug electrical connector at washer fluid warning contact -F77- .
- Detach wiring harness from air duct (left-side) (use removal lever -80-200- to unclip wiring clips).

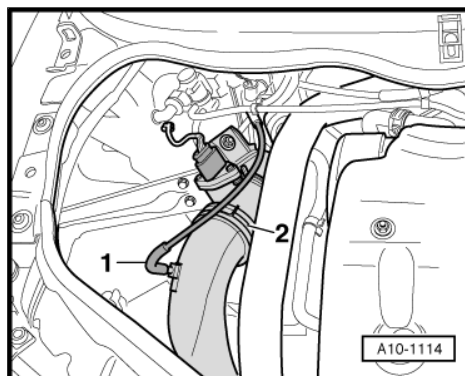


- Take off engine cover panel -arrows-.
- Remove noise insulation underneath (detach crankcase breather hose).

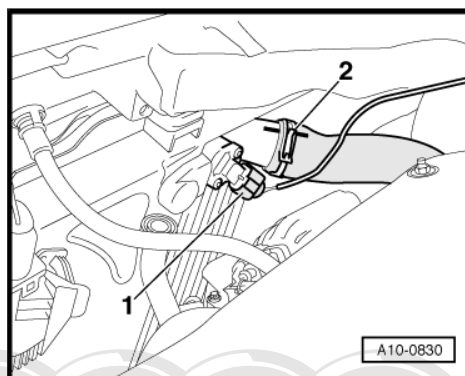


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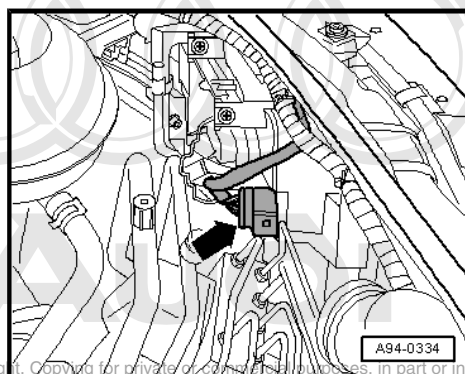
- Detach vacuum hose -1-.
- Detach air intake pipe -2- at air mass meter -G70- .



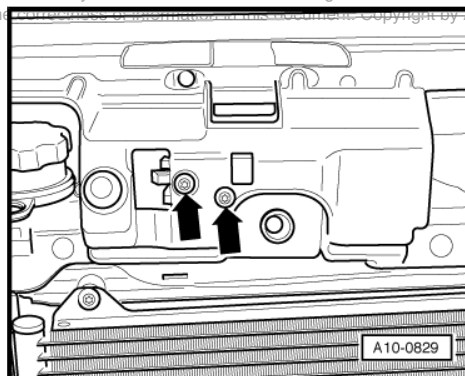
- Unplug electrical connector -1- at intake manifold pressure sender -G71- and move wiring clear.
- Remove air intake hose -2- between charge air cooler and intake manifold.



- Unplug electrical connector -arrow- for headlights on both sides.
- Open cable tie at wiring to headlight (right-side) from lock carrier (use removal lever -80-200- to unclip).



- Unscrew bolts -arrows- and detach bonnet lock cable.

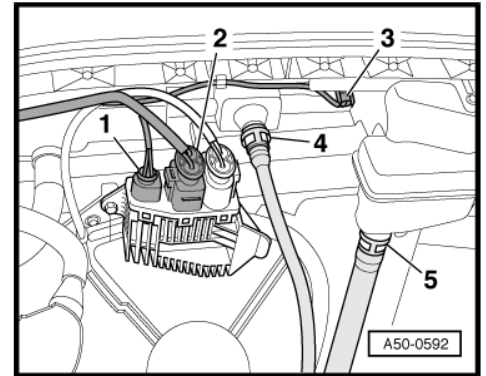


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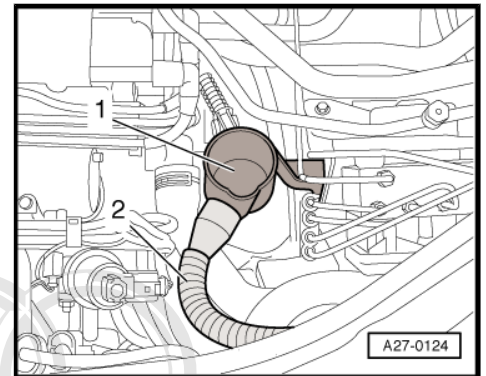
- Detach electrical connector -3- at bonnet contact switch - F266-. Detach wiring harness from lock carrier (use removal lever -80-200- to unclip).
- Pull oil dipstick out of guide tube.
- Detach guide tube -4- for oil dipstick from lock carrier.
- Pull oil filler pipe -5- off oil filler reservoir.

i Note

Disregard items -1- and -2-.



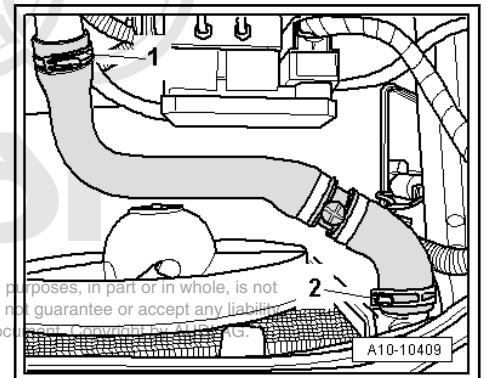
- Pull drain hose -2- off water collector -1-.



- Detach coolant hose (top left) from coolant hose/pipe connection at the location indicated -1-.

i Note

Disregard -item 2-.

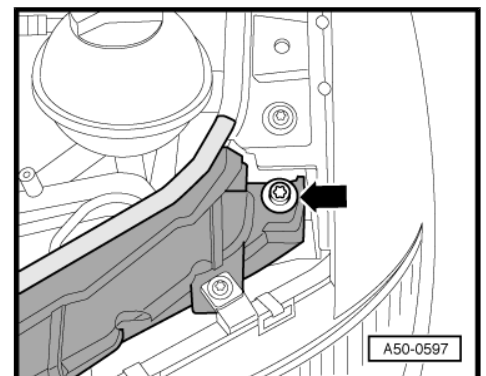


- Remove bolt -arrow- on left and right sides.

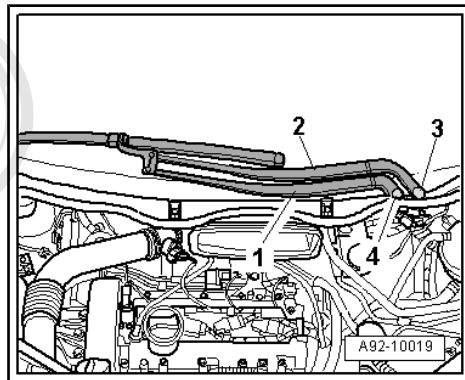
i Note

A second mechanic is required for removing the lock carrier.

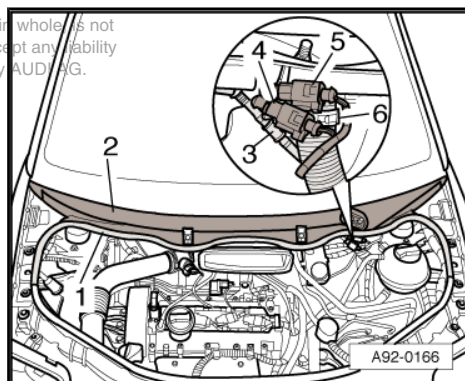
- Remove lock carrier and place down in a secure position.



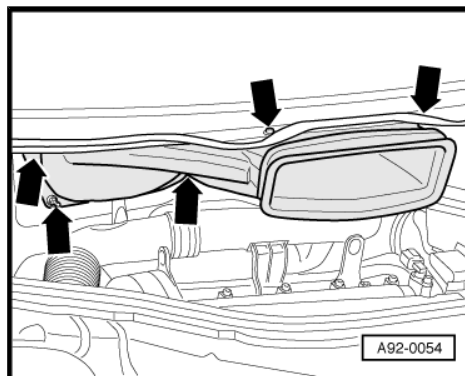
- Use screwdriver to lever off cover caps -3- and -4- from wiper arms.
- Slacken nuts on both wiper arms a few turns.
- Loosen wiper arms -1- and -2- from wiper shafts by tilting slightly.
- Completely remove nuts and take off wiper arms.



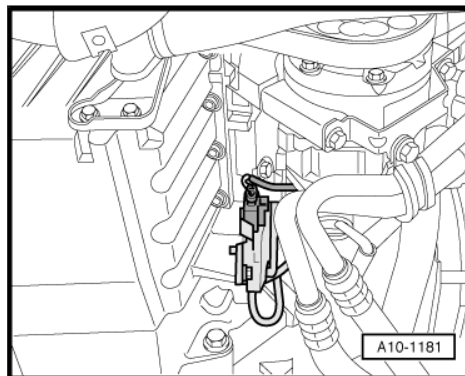
- Disconnect washer fluid hose -3-.
- If fitted, unplug electrical connectors -4- and -5- for heated washer jets.
- Open hose clip -6- using hose clip pliers -V.A.G 1921- and detach water drain hose from cowl panel grille.
- Pull off rubber seal -1- on cowl panel grille.
- Disconnect cowl panel grille -2-.
- Move washer fluid hose clear.



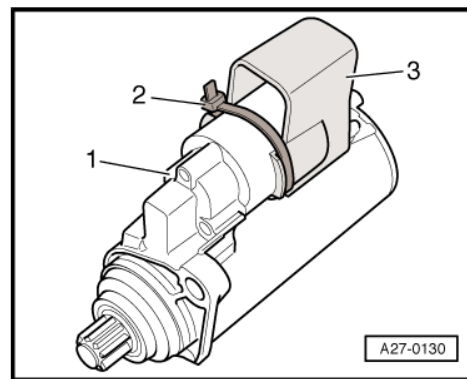
- Unscrew nuts and bolts -arrows-.
- Pull air duct forwards, move it to right side of vehicle and remove.



- Unplug electrical connector at oil level and oil temperature sender -G266-.



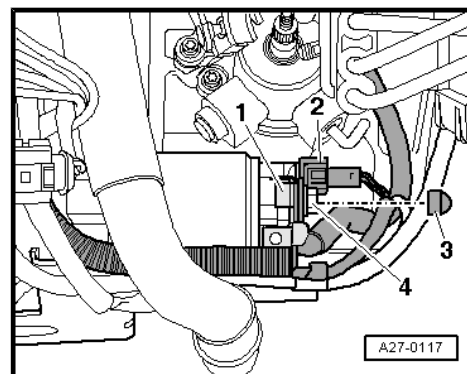
- Cut through cable tie -2- and lift off cover -3- protecting solenoid switch -1-.



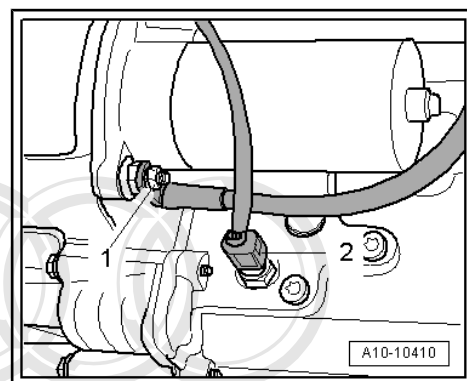
- Detach cover -3-.
- Unplug electrical connector terminal 50 -item 2- at solenoid switch.
- Unscrew nut -4- and detach B+ wiring.

**Note**

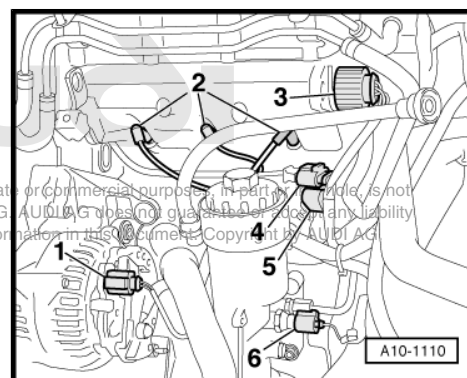
Pay attention to locating element -1-.



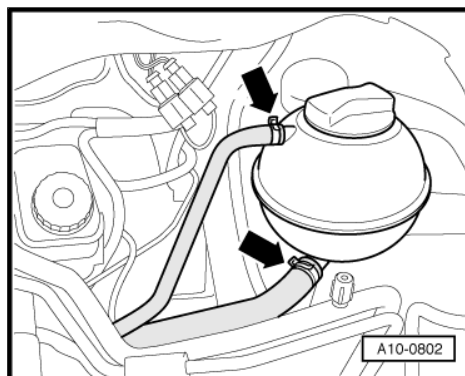
- Unscrew nut and remove earth wire -1-.
- Unplug electrical connector -2- at reversing light switch -F4- and move wiring clear.



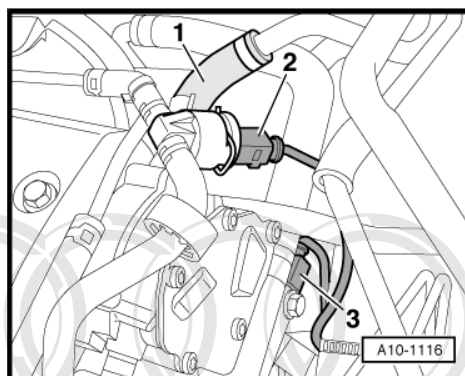
- Unplug electrical connector terminal D+ -item 1- at alternator.
- Unplug electrical connectors -2- on glow plugs.
- Pull retaining tab and loosen knurled nut -3- at main connector for unit injectors.
- Unplug electrical connector for Hall sender -G40- -item 4- and for engine speed sender -G28- -item 5-.
- Unplug electrical connector -6- at oil pressure switch -F1- and move wiring harness clear.



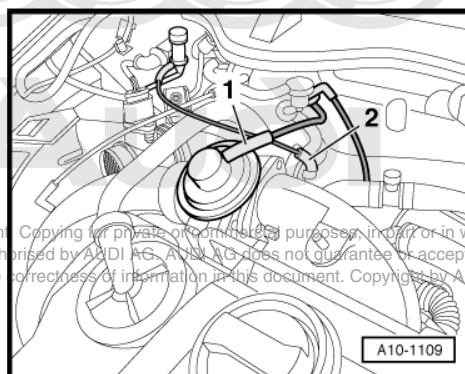
- Unclip coolant hoses from coolant expansion tank -arrows-.



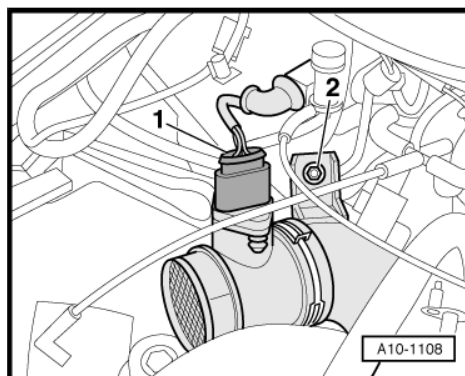
- Detach vacuum hose -1- going to brake servo from tandem pump.
- Unplug electrical connector -2- at fuel temperature sender - G81- and move wiring clear.
- Unplug electrical connector -3- at coolant temperature display sender -G2- / coolant temperature sender -G62- .



- Disconnect vacuum hose -1- from mechanical exhaust gas recirculation valve.
- Disconnect vacuum hose -2- from throttle butterfly valve - N211- .



- Unplug electrical connector -1- at air mass meter -G70- .
- Remove nut -2-.

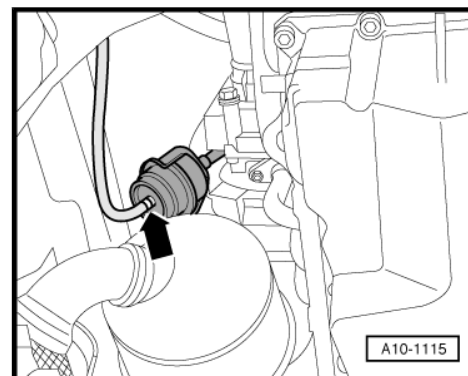


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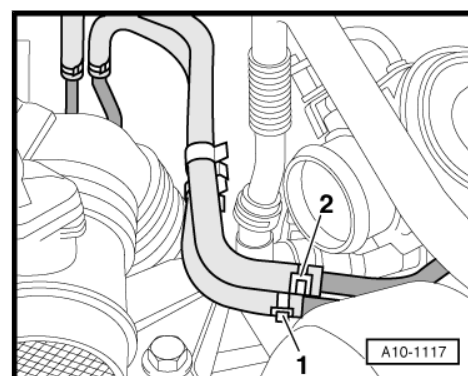
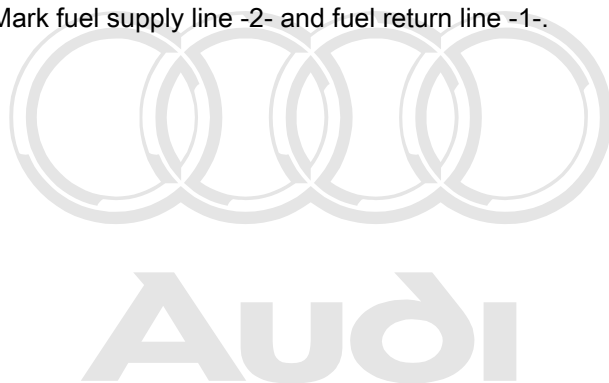
- Detach vacuum hose -arrow- from vacuum unit for charge pressure control.

**WARNING**

- ◆ *In extreme cases the fuel lines and the fuel can reach a temperature of 100 °C on vehicles with unit injector engine. Allow the fuel to cool down before disconnecting the lines - danger of scalding.*
- ◆ *Wear protective gloves.*
- ◆ *Wear safety goggles.*

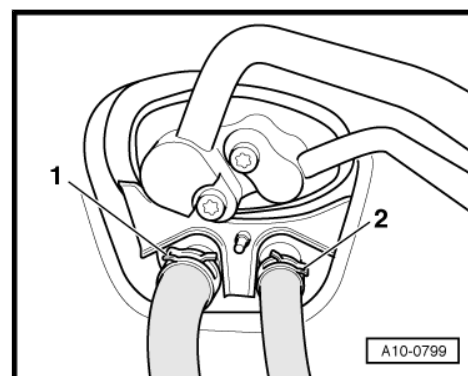


- Mark fuel supply line -2- and fuel return line -1-.

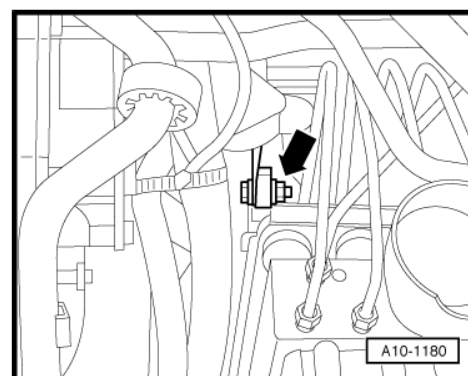


- Mark fuel supply line -1- and fuel return line -2- going to heat exchanger and remove hoses from bulkhead.

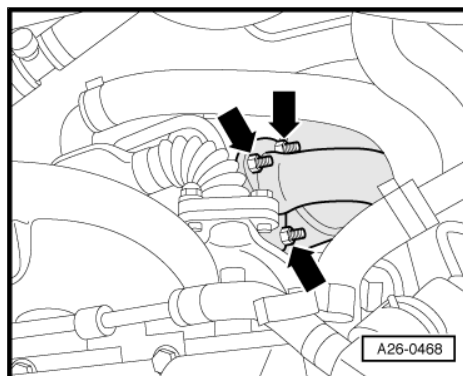
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- Unbolt bracket for wiring harness from gearbox -arrow-.



- Unscrew nuts -arrows- at turbocharger/starter catalytic converter.



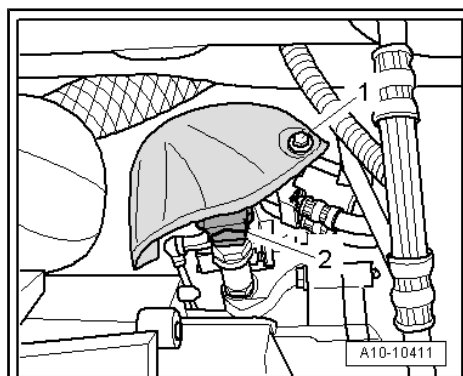
- Remove bolt -1- on gear actuator heat shield.



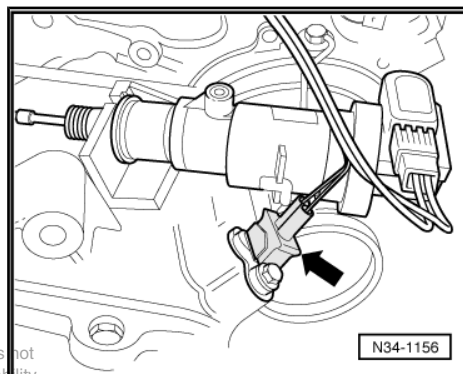
Note

The two remaining bolts at the bottom of the heat shield are unscrewed at a later stage.

- Unplug electrical connector -2- at speedometer sender -G22- .



- Unplug electrical connector -arrow- at gearbox speed sender -G38- .



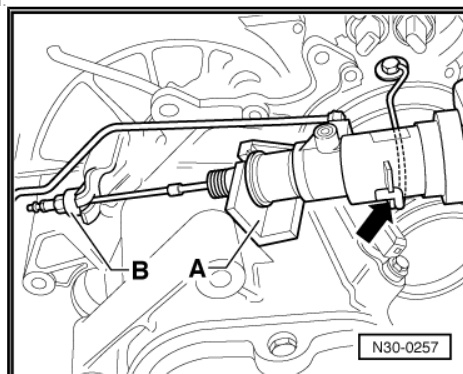
- Slacken lock nut -B- and adjusting nut at clutch cable.
- Disengage clutch cable at actuating lever.



Note

Do not open hydraulic pipe at clutch slave cylinder.

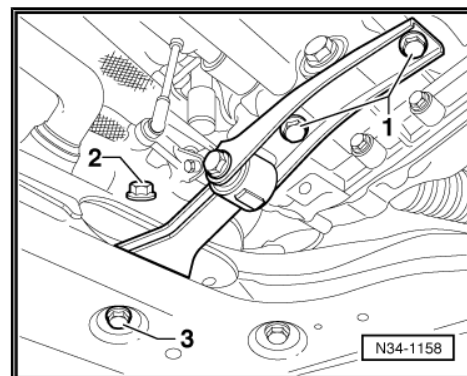
- Disengage retainer at the location indicated -arrow- and detach clutch slave cylinder from support bracket -A-.
- Move clutch slave cylinder clear to one side (do not open hose/ pipe circuit).



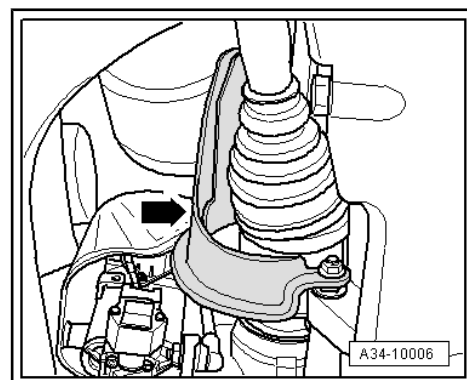
- Remove bolts -1- and -3- and detach pendulum support.

**Note**

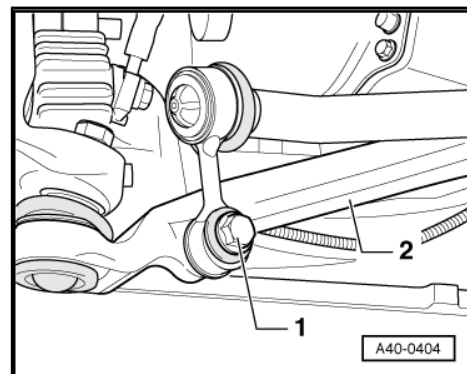
Disregard -item 2-.



- Unbolt heat shield -arrow- for drive shaft (right-side).

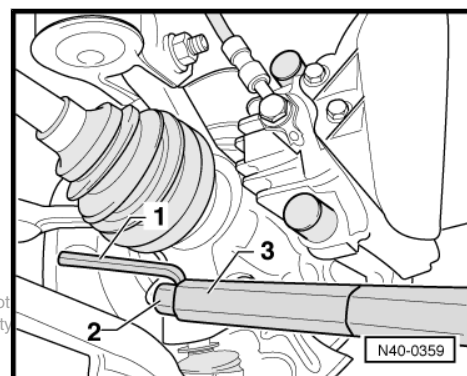


- Remove bolt -1- for coupling rod at suspension link -2-.



- Unscrew nut at swivel joint (counterhold with Allen key 5 mm if necessary).

- 1 - Allen key 5 mm (shortened by approx. 10 mm).
- 2 - Ring insert
- 3 - Torque wrench -V.A.G 1331-



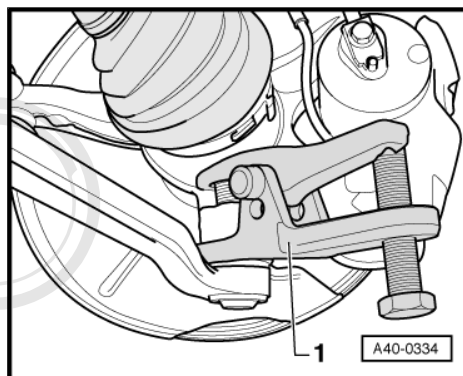
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- Apply ball joint puller -3287 A- -item 1- as shown in illustration and press off swivel joint.



Note

Take care not to damage the boot of the drive shaft when applying ball joint puller.



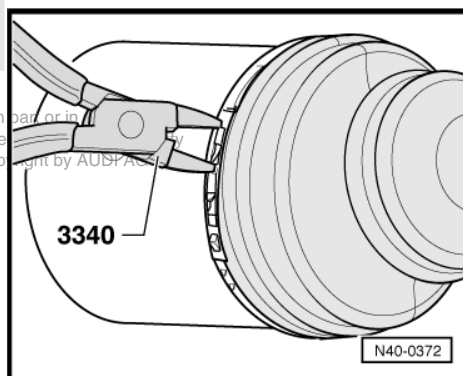
- Mark installation position of drive shaft relative to flange shaft at gearbox for re-installation.
- Cut through cable tie at gearbox side of drive shaft boot using pliers -3340- .

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Caution

- ◆ *Make sure triple rollers do not drop to the ground when pulling drive shaft apart from flange shaft.*
- ◆ *Hold triple rollers in place and secure with adhesive tape.*



- Swivel suspension strut outwards and pull drive shaft apart from flange shaft.
- Repeat procedure on other side of vehicle.
- Tie both drive shafts to front onto longitudinal member.



Note

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

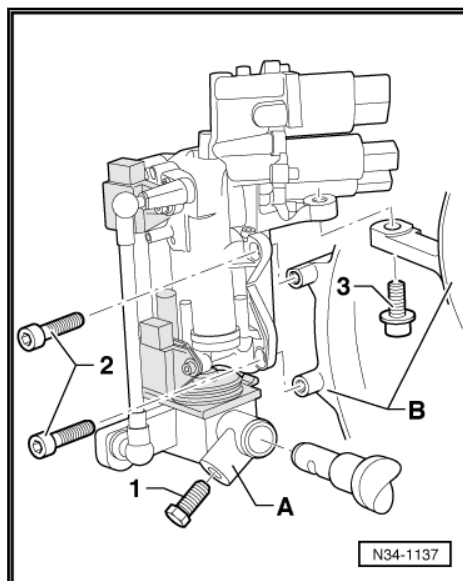
- Remove bottom bolts on heat shield for gear actuator.



Note

Do not open hydraulic pipes at gear actuator.

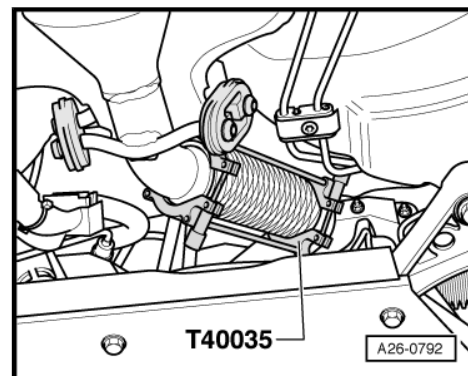
- Slacken bolt -1- a few turns.
- Detach selector finger -A- from gearbox selector rod.
- Remove bolts -2- and -3-.
- Tie up gear actuator to body as far as possible.



**Note**

Do not bend the flexible joint (de-coupling element) between starter catalytic converter and main catalytic converter more than 10°, otherwise it could be damaged.

- Support flexible joint (decoupling element) with fixing tool - T40035- .

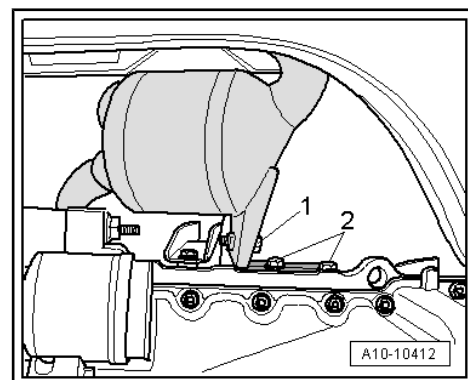


- Remove bolts -2- on bracket for starter catalytic converter.

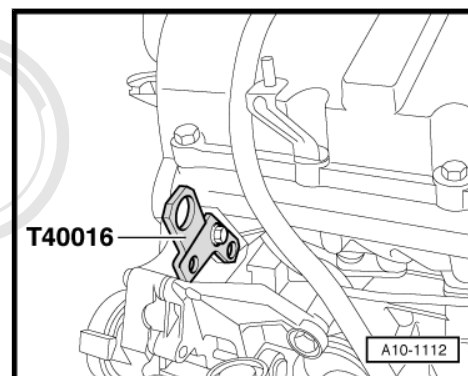
**Note**

Disregard -item 1-.

- Disconnect starter catalytic converter from turbocharger.
- Tie up starter catalytic converter to body.

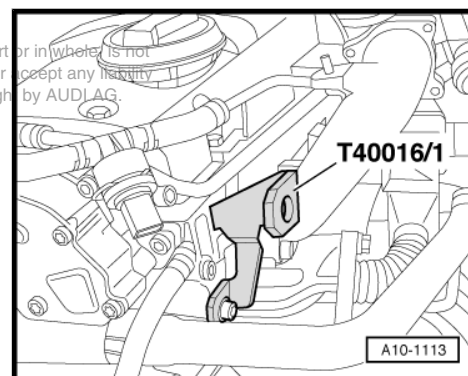


- Screw transportation shackle -T40016- onto front right on cylinder head.



- Screw transportation shackle -T40016/1- onto rear left of cylinder head.

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- Screw both shackles -10-222 A/12- onto transportation shackle -T40016- on rear left of cylinder head.
- Attach lifting tackle -2024 A- to engine and workshop hoist - VAS 6100- as shown in illustration.



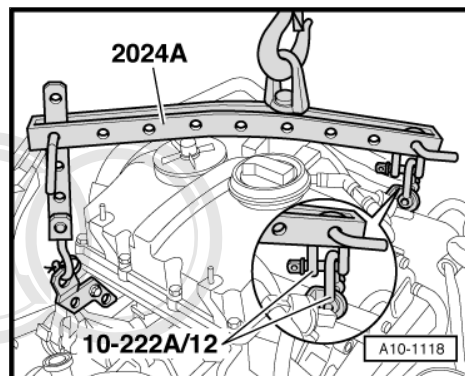
Note

To adjust to the centre of gravity of the assembly, the perforated rails of the support hooks must be positioned as shown.



WARNING

The hook attachments and locating pins on the lifting tackle must be secured with locking pins.



- Slightly lift engine using workshop hoist -VAS 6100-

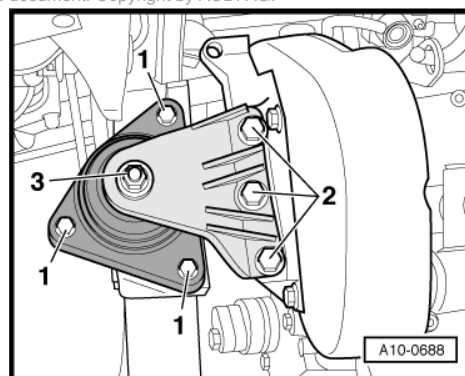
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Note

Do not loosen nut -3- unless renewing engine mounting.

- Remove bolts -1- and -2- and detach support arm with engine mounting.

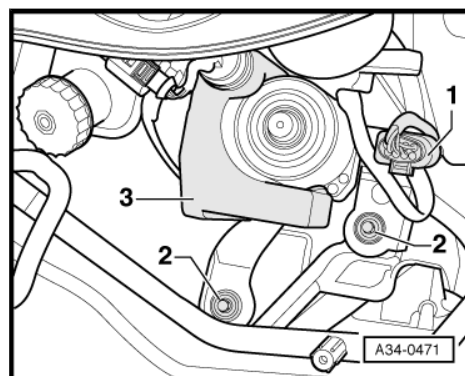


- Remove bolts -2- and move motor/pump unit -3- to side.

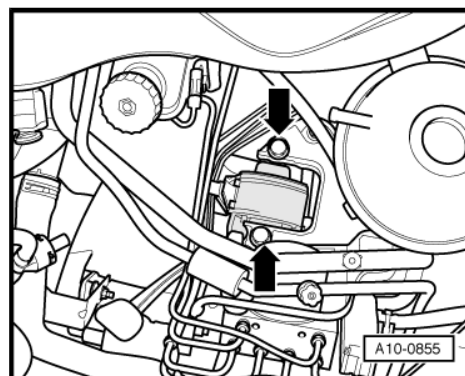


Note

Disregard -item 1-.



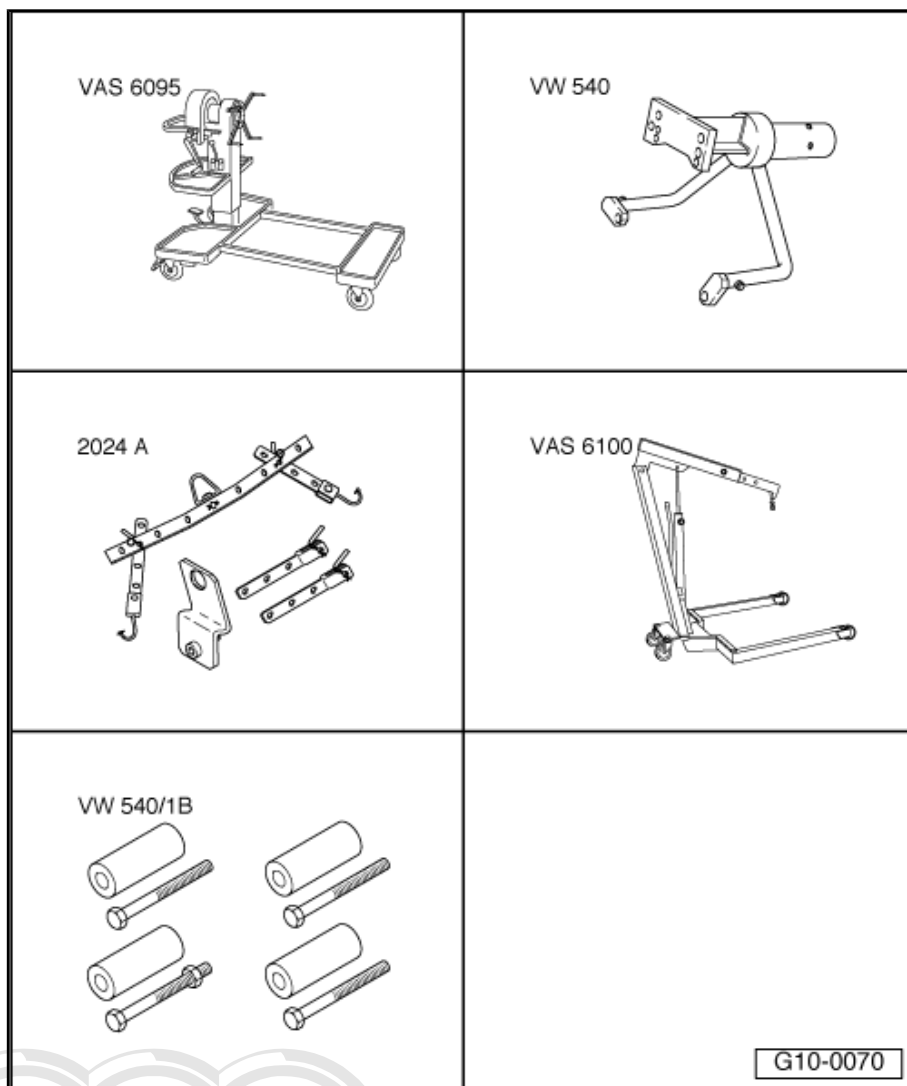
- Remove bolts -arrows- for gearbox mountings.
- Pull out engine/gearbox assembly from the front.
- Separate gearbox from engine if necessary.



1.3 Securing engine to assembly stand

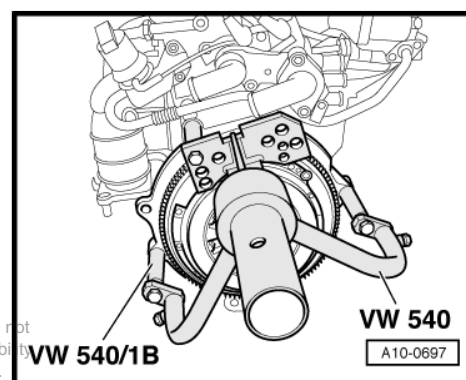
Special tools and workshop equipment required

- ◆ Engine and gearbox support -VAS 6095-
- ◆ Engine and gearbox support -VW 540-
- ◆ Lifting tackle -2024 A-
- ◆ Workshop hoist -VAS 6100-
- ◆ Engine and gearbox support supplement -VW 540/1B-



Procedure

- For performing assembly work, attach engine to repair stand with engine and gearbox support -VW 540- and engine and gearbox support settlement -VW 540/1B-.



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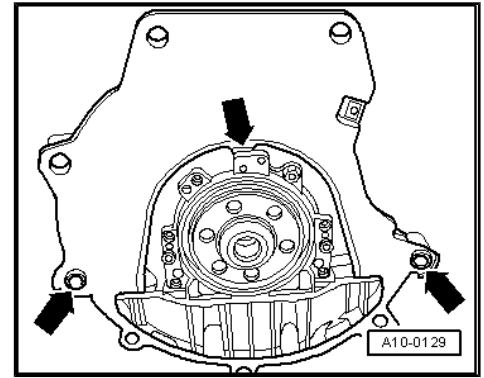
1.4 Installing engine

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

**Note**

- ◆ *Renew self-locking nuts and bolts when performing assembly work.*
 - ◆ *Renew bolts which are tightened to a specified angle as well as oil seals and gaskets.*
 - ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly. Do NOT use lubricant.*
 - ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
 - ◆ *Fit all cable ties in the original positions when installing.*
 - Clean input shaft splines and (in the case of used clutch plates) the hub splines. Remove corrosion and apply only a very thin coating of grease for clutch plate splines -G 000 100- to the splines. Do not lubricate guide sleeve.
 - Check that the clutch plate is properly centralised (only necessary if you have carried out other work on the clutch).
 - Check clutch release bearing for wear; renew if necessary.
 - Check whether dowel sleeves for centring the engine/gearbox assembly are fitted in the cylinder block; install dowel sleeves if necessary.
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- Fit intermediate plate onto dowel sleeves -arrows-.
- When swivelling engine/gearbox assembly in place, ensure sufficient clearance from gear actuator and starter catalytic converter.
- Install support arm with engine mounting ⇒ [page 27](#) .
- Install gearbox mounting ⇒ Rep. gr. 34 .
- Install motor/pump unit ⇒ Rep. gr. 48 .
- Install pendulum support ⇒ [page 31](#) .
- Install starter catalytic converter together with main catalytic converter ⇒ [page 174](#) .
- Install clutch slave cylinder ⇒ Rep. gr. 30 .
- Install gear actuator ⇒ Rep. gr. 34 .
- Install drive shafts ⇒ Rep. gr. 40 .
- Install coupling rod for anti-roll bar ⇒ Rep. gr. 40 .
- Install swivel joints ⇒ Rep. gr. 40 .
- Fit bumper ⇒ Rep. gr. 63 .
- Install wheel housing liners ⇒ Rep. gr. 66 .
- Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Observe notes on procedures required after connecting battery ⇒ Rep. gr. 27 .



Caution

Do not use a battery charger to boost starting. There is danger of damaging the vehicle's control units.

- Install and adjust wiper arms ⇒ Rep. gr. 92 .
- Check oil level ⇒ [page 132](#) .
- Fill cooling system ⇒ [page 136](#) .
- Perform basic setting of manual gearbox ⇒ Rep. gr. 01 .

Tightening torques



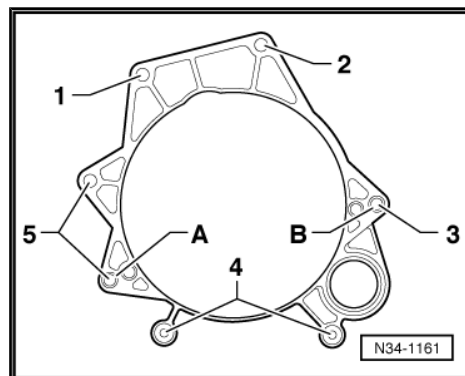
Note

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

Securing engine to gearbox

Item	Bolt	Nm
1, 2	M12x60	80
3	M12x80	80
4	M10x50	45
5	M12x180	80
A, B	Dowel sleeves for centralising	

Component	Nm	
Bolts/nuts	M6	9
	M8	20
	M10	40
	M12	65
Except for the following:		
Drive shaft heat shield to gearbox		23
Air pipe		8



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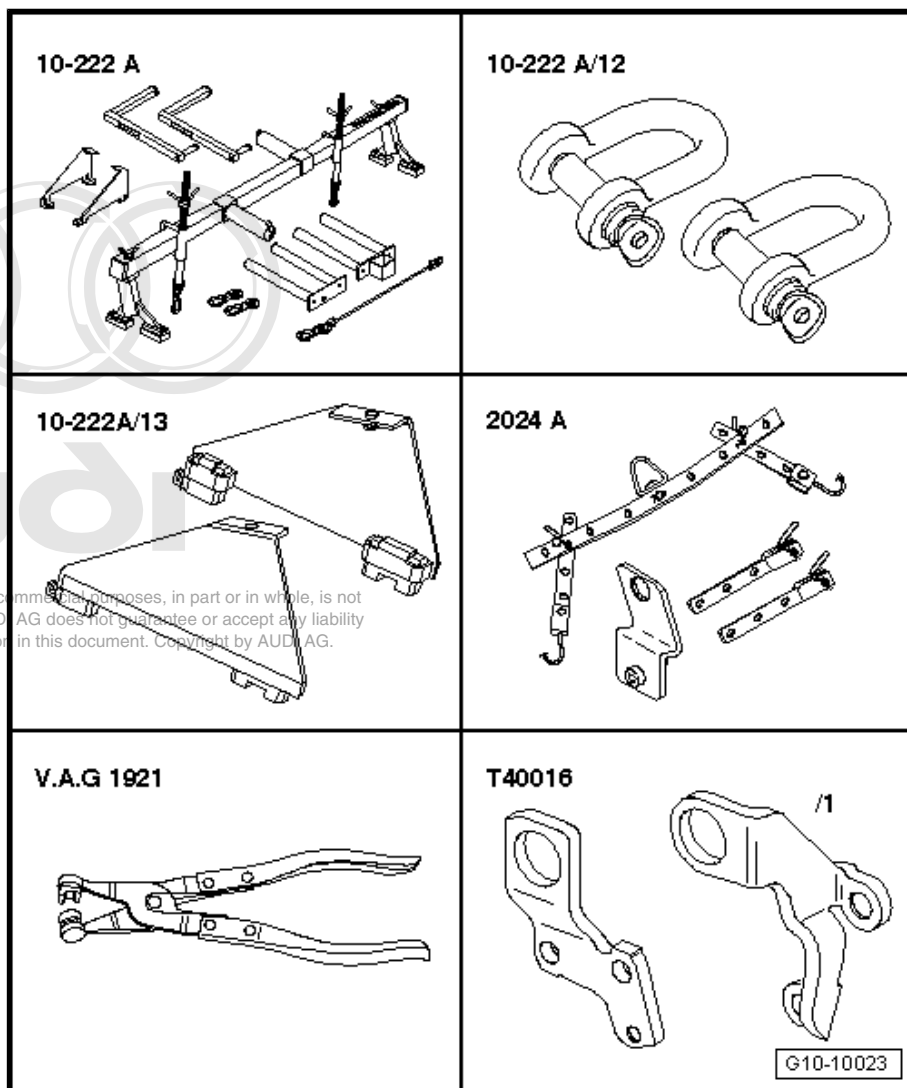
2 Assembly mountings

2.1 Removing and installing engine mountings

Special tools and workshop equipment required

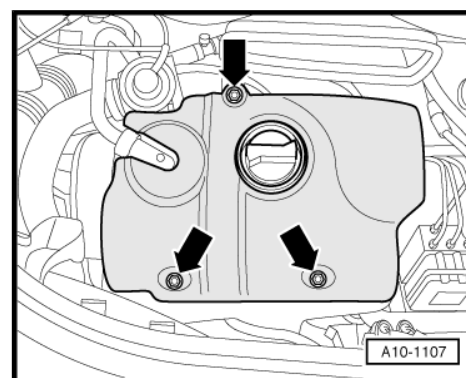
- ◆ Support bracket -10-222 A-
- ◆ Shackle -10-222 A/12-
- ◆ Adapters -10-222 A /13-
- ◆ Lifting tackle -2024 A-
- ◆ Hose clip pliers - V.A.G 1921-
- ◆ Transportation shackle - T40016- with -T40016/1-

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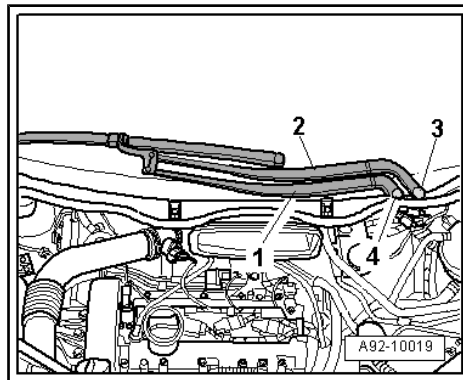


Removing

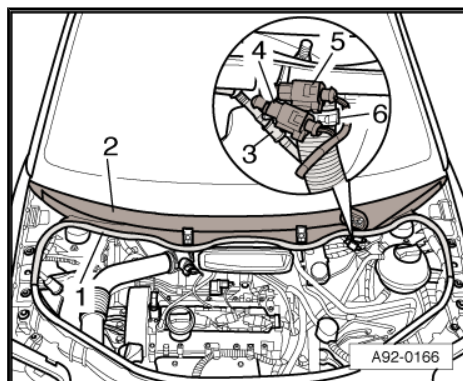
- Remove bonnet ⇒ [page 4](#) .
- Take off engine cover panel -arrows-.
- Remove noise insulation underneath (detach crankcase breather hose).



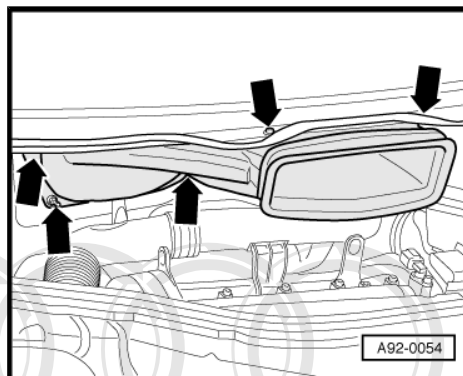
- Use screwdriver to lever off cover caps -3- and -4- from wiper arms.
- Slacken nuts on both wiper arms a few turns.
- Loosen wiper arms -1- and -2- from wiper shafts by tilting slightly.
- Completely remove nuts and take off wiper arms.



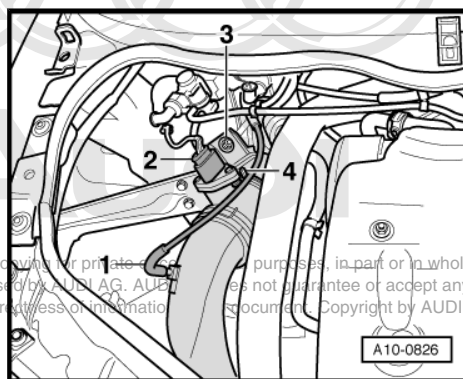
- Disconnect washer fluid hose -3-.
- If fitted, unplug electrical connectors -4- and -5- for heated washer jets.
- Open hose clip -6- using hose clip pliers -V.A.G 1921- and detach water drain hose from cowl panel grille.
- Pull off rubber seal -1- on cowl panel grille.
- Disconnect cowl panel grille -2-.
- Move washer fluid hose clear.



- Unscrew nuts and bolts -arrows-.
- Pull air duct forwards, move it to right side of vehicle and remove.



- Unplug electrical connector -2- at air mass meter -G70-.
- Detach vacuum hose -1-.
- Release hose clip -4- and remove air pipe with air mass meter -G70-.


Note

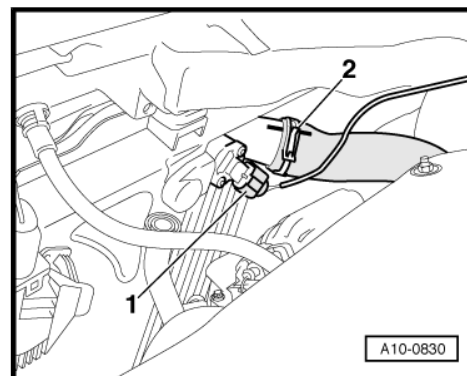
Disregard -item 3-.

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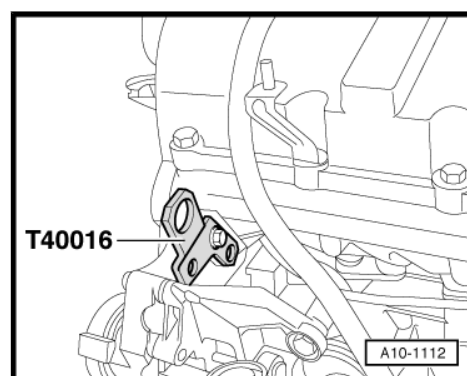
- Remove air intake hose -2- between charge air cooler and intake manifold.

**Note**

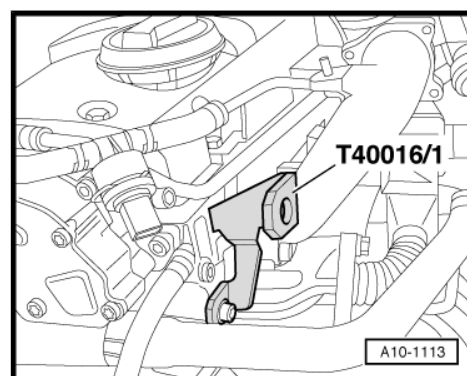
Disregard -item 1-.



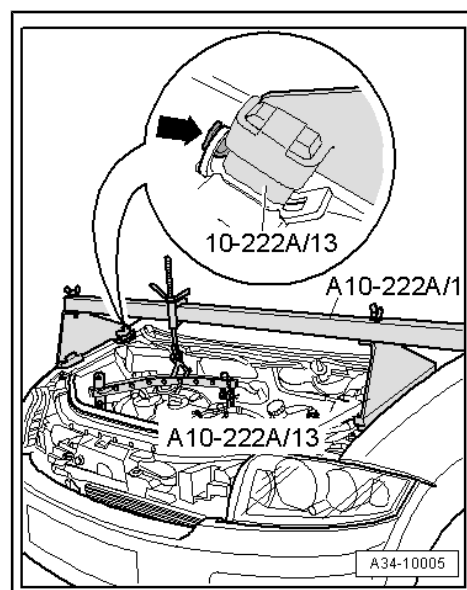
- Screw transportation shackle -T40016- onto front right on cylinder head.



- Screw transportation shackle -T40016/1- onto rear left of cylinder head.



Set up support bracket -10-222 A- with adapter -10-222 A/13- on wing panel flanges. Spindle of support bracket is located at front.



- Screw both shackles -10-222 A/12- onto transportation shackle -T40016- on rear left of cylinder head.
- Attach the lifting tackle -2024 A- to engine and support bracket -10-222 A- as shown in the illustration.



Note

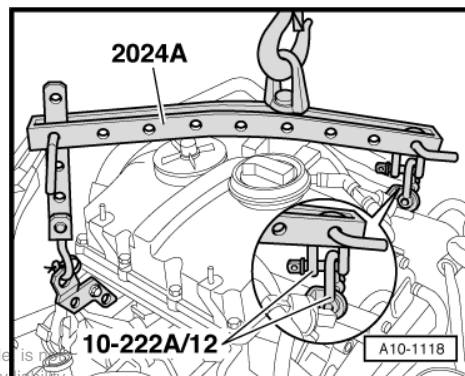
To adjust to the centre of gravity of the assembly, the perforated rails of the support hooks must be positioned as shown.



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The hook attachments and locating pins on the lifting tackle must be secured with locking pins.



- Take up weight of engine using spindle (do not raise).



Note

Do not loosen nut -3- unless renewing engine mounting.

- Remove bolts -1- and -2- and detach support arm with engine mounting.

Installing

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



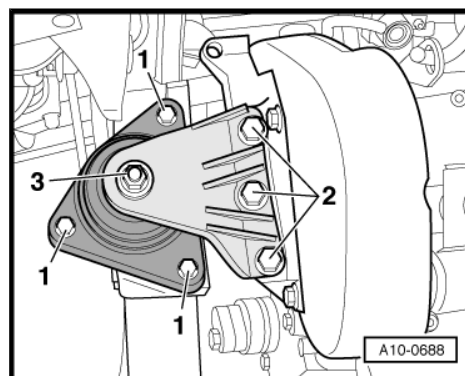
Note

- ◆ Renew self-locking nuts and bolts when performing assembly work.
- ◆ Renew the bolts tightened with specified tightening angle.
- ◆ Hose connections and hoses for charge air system must be free of oil and grease before assembly. Do NOT use lubricant.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.
- ◆ Fit all cable ties in the original positions when installing.

- Install and adjust wiper arms ⇒ Rep. gr. 92 .

Tightening torques

Component	Nm
Engine mounting to body	23 + 90° 1)2)
Support arm to:	
Engine support	60 + 90° 1)2)
Engine mounting	40 + 90° 1)2)
• 1) Renew bolt. • 2) 90° = one quarter turn.	

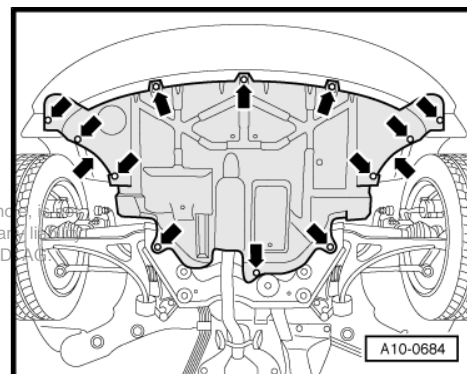


2.2 Removing and installing pendulum support

Removing

- Remove noise insulation -arrows-.

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- Remove bolts -B- and -C- and detach pendulum support.

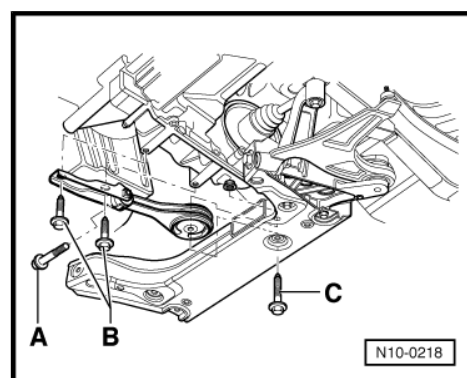
Installing

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



Note

- ◆ *Renew self-locking nuts and bolts when performing assembly work.*
- ◆ *Renew the bolts tightened with specified tightening angle.*



Tightening torques

Component	Nm
Pendulum support to:	
Subframe -item C-	40 + 90° 1)2)
Subframe -item B-	50
Rear section of pendulum support to front section -item A-	40 + 90° 1)2)
• 1) Renew bolt. • 2) 90° = one quarter turn.	

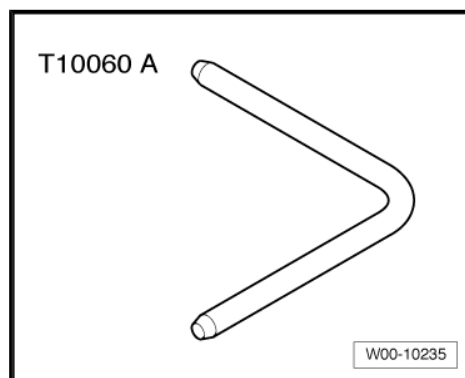
13 – Crankshaft group

1 Servicing work on pulley end

1.1 Removing and installing poly V-belt

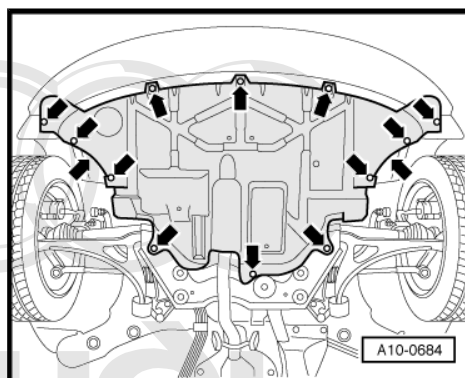
Special tools and workshop equipment required

- ♦ Locking pin -T10060 A- or -T10060-



Removing

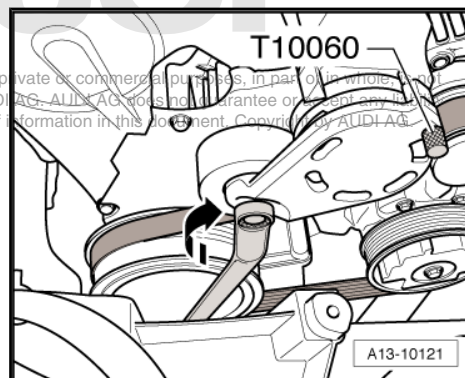
- Remove noise insulation -arrows-.



Note

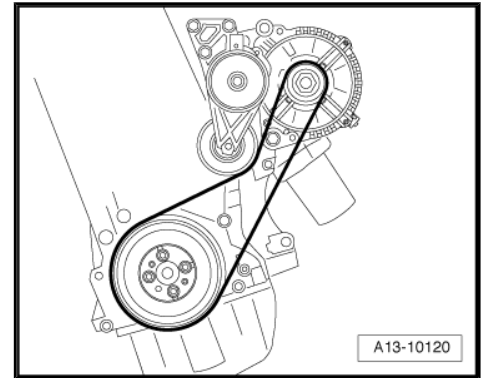
Mark rotation direction of poly V-belt with chalk or a felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

- Turn the tensioner in the direction of the -arrow- using a spanner to slacken the poly V-belt.
- Lock tensioner in position by inserting locking pin -T10060 A- or -T10060- in locating holes.
- Remove poly V-belt.



Installing

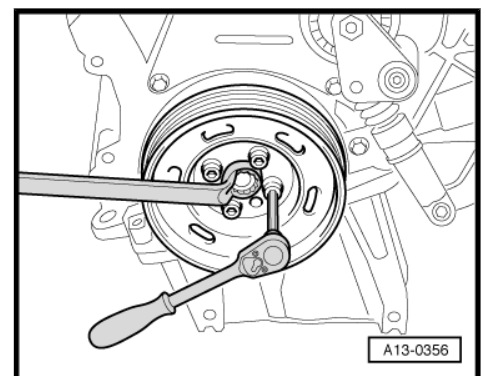
- Make sure poly V-belt is properly positioned and correctly routed.
- Fit poly V-belt onto crankshaft pulley and alternator pulley.
- Release tensioner and remove locking pin from locating holes.
- Check poly V-belt for proper seating.
- Start engine and check that belt runs properly.



1.2 Removing and installing vibration damper

Removing

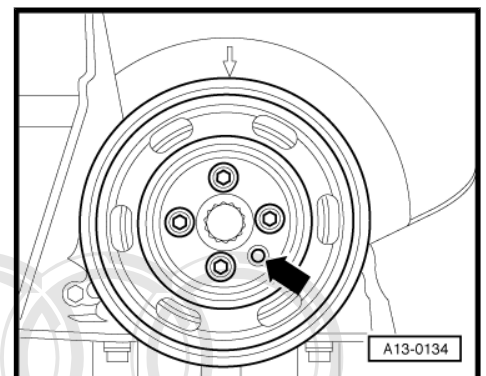
- Remove poly V-belt ⇒ [page 32](#) .
- Unbolt vibration damper; counterhold on centre bolt with ring spanner.



Installing

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

- Use new securing bolts.
- When installing the vibration damper, use only genuine bolts (same as original equipment): ⇒ Parts catalogue .
- The vibration damper can only be installed in one position. The hole in the vibration damper must be located over the projection on the toothed belt sprocket -arrow-.
- Install poly V-belt ⇒ [page 32](#) .



Tightening torque

Component	Nm
Vibration damper to crankshaft sprocket	10 + 90° 1)2)
• 1) Renew bolts. • 2) 90° = one quarter turn.	

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1.3 Removing and installing bracket for alternator

Removing

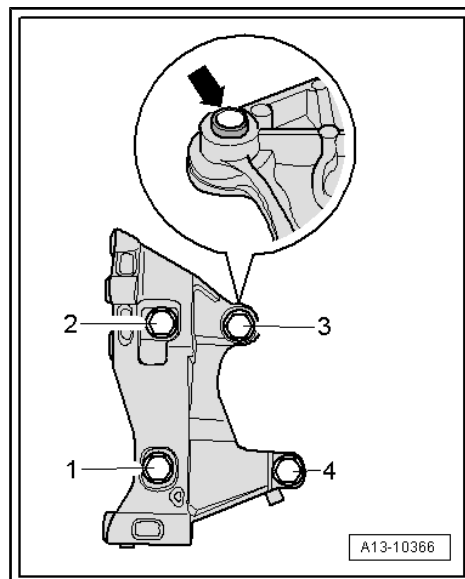
- Remove alternator ⇒ Rep. gr. 27 .
- Unscrew bolts -1 ... 4- and remove bracket for alternator.

Installing

- Check that dowel sleeves -arrow- for bracket for alternator are inserted.
- Fit bolts -1 ... 4- hand-tight and tighten in diagonal sequence.

Tightening torque

Component	Nm
Bracket for alternator to cylinder block	45



1.4 Toothed belt drive for camshaft - exploded view of components

1 - Toothed belt cover (top)

2 - Toothed belt

- ☐ Before removing, mark direction of rotation with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage

- ☐ Check for wear
- ☐ Removing ⇒ [page 36](#)
- ☐ Installing (adjusting valve timing) ⇒ [page 44](#)

3 - 20 Nm + 45° (1/8 turn) further

4 - Tensioning roller

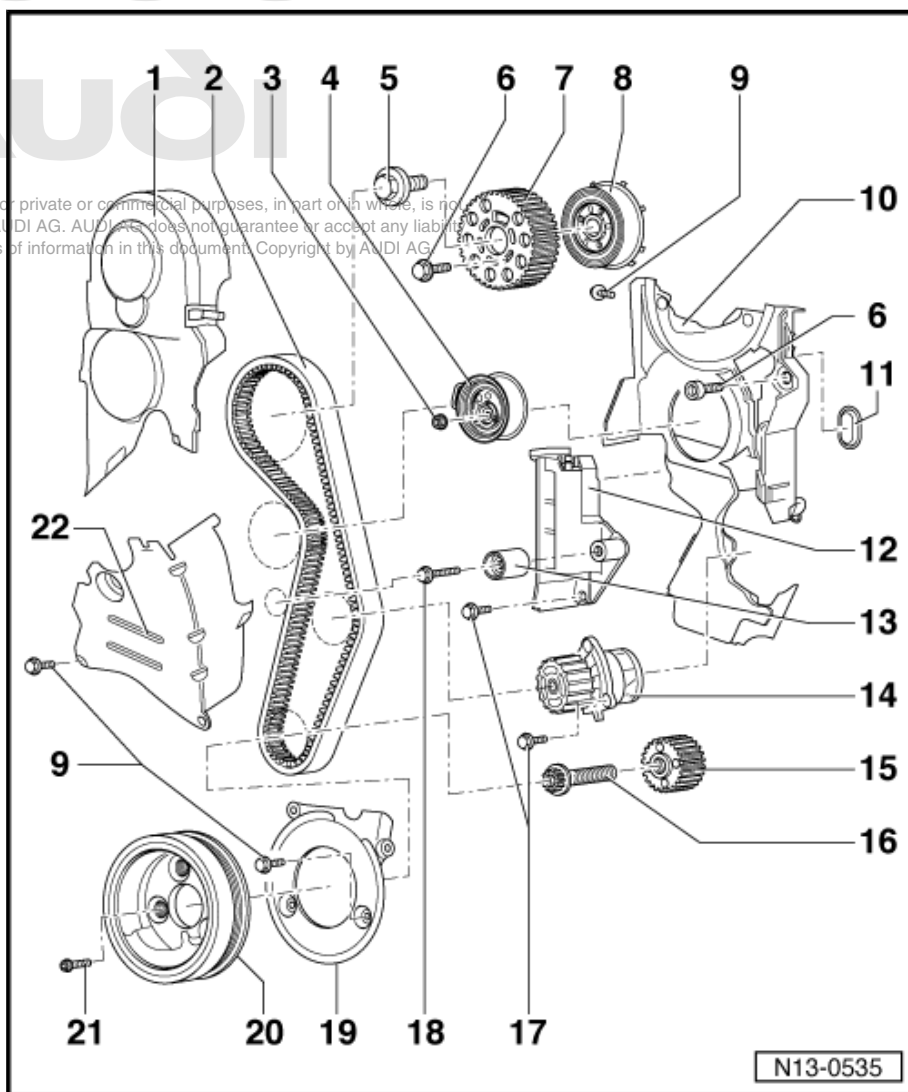
5 - 100 Nm

6 - 25 Nm

7 - Camshaft sprocket

8 - Hub

- ☐ With sender wheel
- ☐ Use counterhold tool - T10051- when loosening and tightening
- ☐ To remove, use puller - T10052-
- ☐ Removing and installing ⇒ „2.4 Removing and installing camshaft“, [page 105](#)



9 - 10 Nm

10 - Toothed belt cover (rear)

11 - Sealing grommet

- ☐ Renew if damaged

12 - Tensioner for toothed belt

13 - Idler roller

14 - Coolant pump

- ☐ Removing and installing ⇒ [page 141](#)

15 - Crankshaft sprocket

16 - 120 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ Use counterhold tool -3415- when loosening and tightening
- ☐ Do not additionally oil or grease the threads and shoulder

17 - 15 Nm

18 - 20 Nm

19 - Toothed belt cover (bottom)

20 - Vibration damper

- ☐ Installation position: hole in vibration damper must be positioned over raised section of toothed belt sprocket

21 - 10 Nm + 90° (1/4 turn) further

22 - Toothed belt cover (centre)

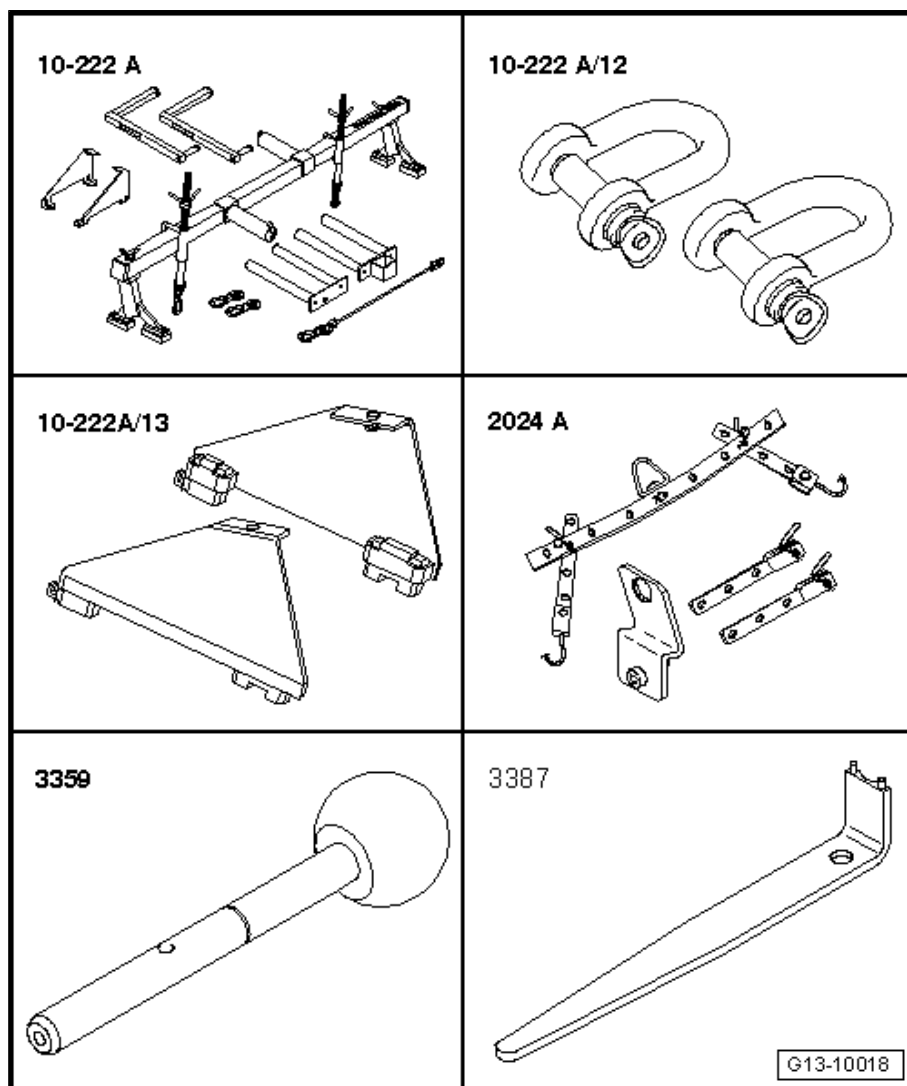


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1.5 Removing and installing toothed belt

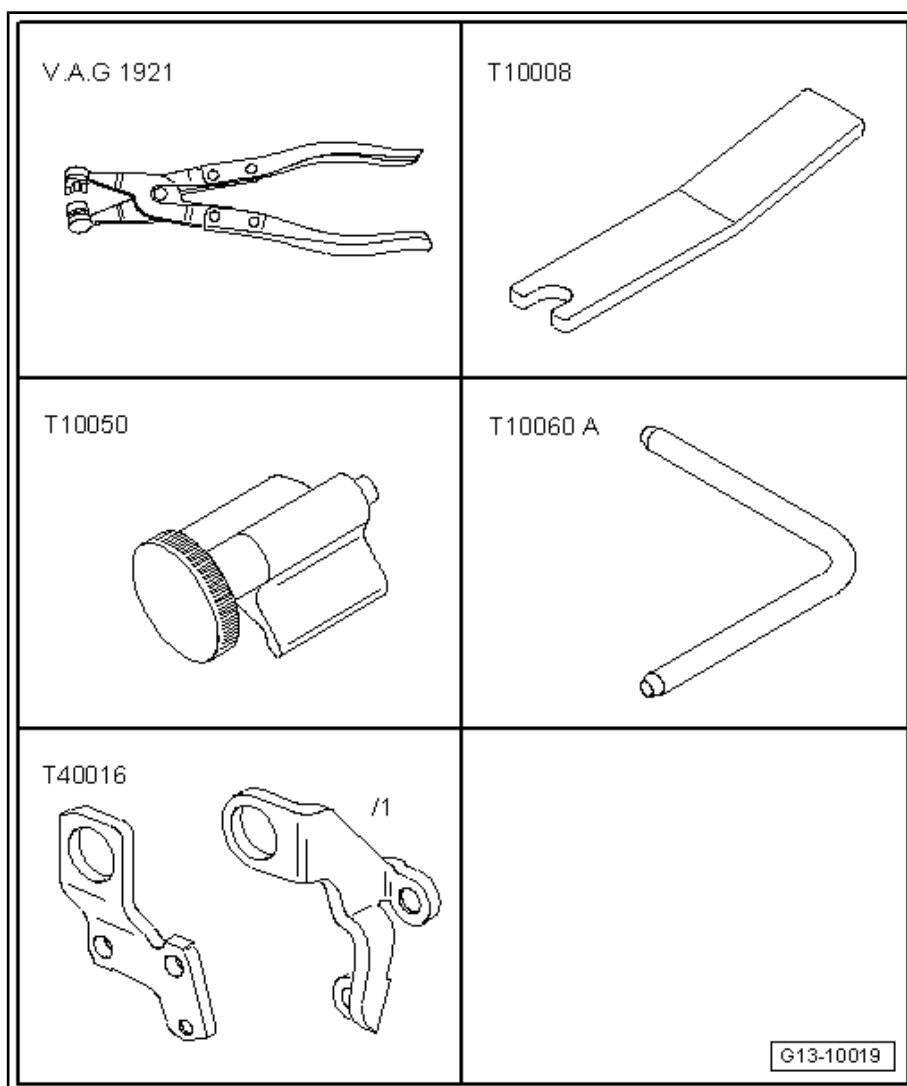
Special tools and workshop equipment required

- ◆ Support bracket -10-222 A-
- ◆ Shackle -10-222 A/12-
- ◆ Adapters -10-222 A/13-
- ◆ Lifting tackle -2024 A-
- ◆ Diesel injection pump locking pin -3359-
- ◆ Pin wrench -3387-



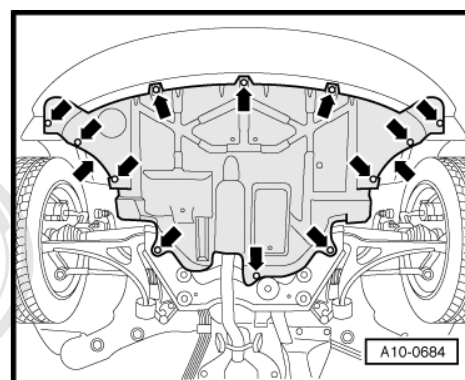
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- ◆ Hose clip pliers - V.A.G 1921-
- ◆ Locking plate -T10008-
- ◆ Crankshaft stop -T10050-
- ◆ Locking pin -T10060 A- or -T10060-
- ◆ Transport plate -T40016-
- ◆ Drill bit, $\varnothing$ 7 mm



Removing

- Remove front right wheel.
- Remove noise insulation -arrows-.



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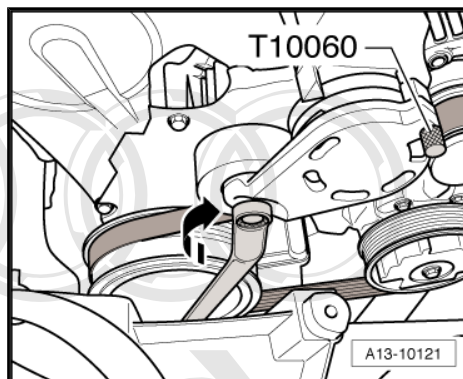
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Note

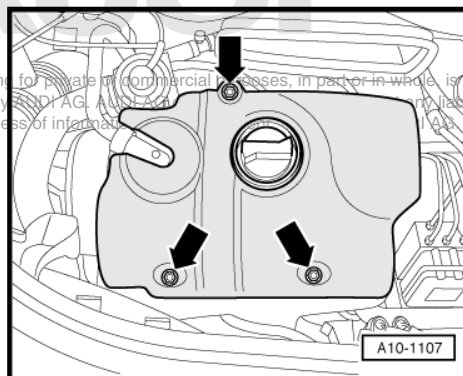
Mark rotation direction of poly V-belt with chalk or a felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

- Turn the tensioner in the direction of the -arrow- using a spanner to slacken the poly V-belt.
- Lock tensioner in position by inserting locking pin -T10060 A- or -T10060- in locating holes.
- Remove poly V-belt.

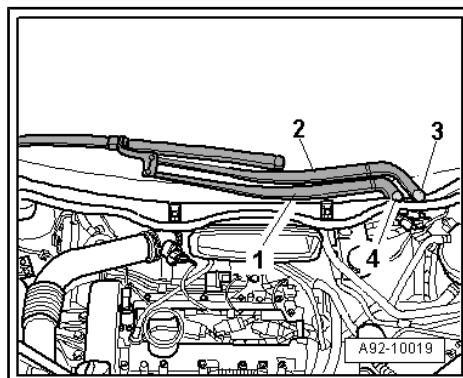


- Remove bonnet ⇒ [page 4](#).
- Take off engine cover panel -arrows-.
- Remove noise insulation underneath (detach crankcase breather hose).

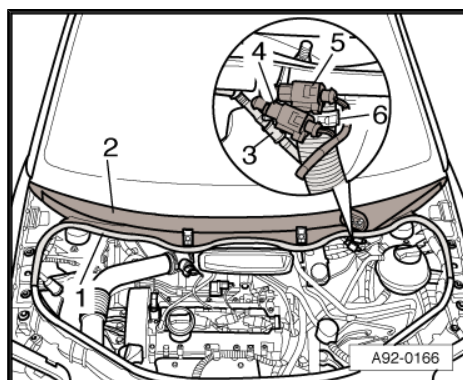
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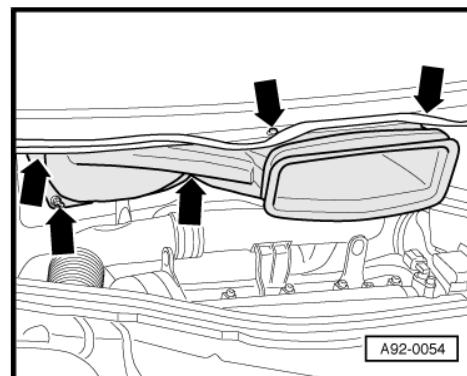
- Use screwdriver to lever off cover caps -3- and -4- from wiper arms.
- Slacken nuts on both wiper arms a few turns.
- Loosen wiper arms -1- and -2- from wiper shafts by tilting slightly.
- Completely remove nuts and take off wiper arms.



- Disconnect washer fluid hose -3-.
- If fitted, unplug electrical connectors -4- and -5- for heated washer jets.
- Open hose clip -6- using hose clip pliers -V.A.G 1921- and detach water drain hose from cowl panel grille.
- Pull off rubber seal -1- on cowl panel grille.
- Disconnect cowl panel grille -2-.
- Move washer fluid hose clear.



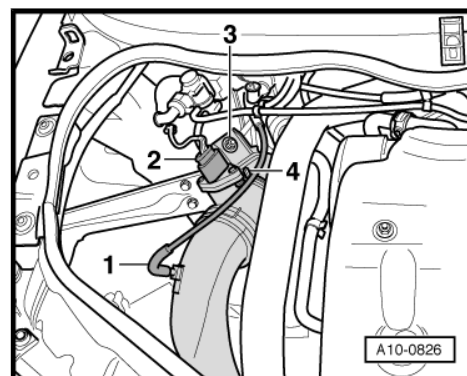
- Unscrew nuts and bolts -arrows-.
- Pull air duct forwards, move it to right side of vehicle and remove.



- Unplug electrical connector -2- at air mass meter -G70- .
- Detach vacuum hose -1-.
- Release hose clip -4- and remove air pipe with air mass meter -G70- .

**Note**

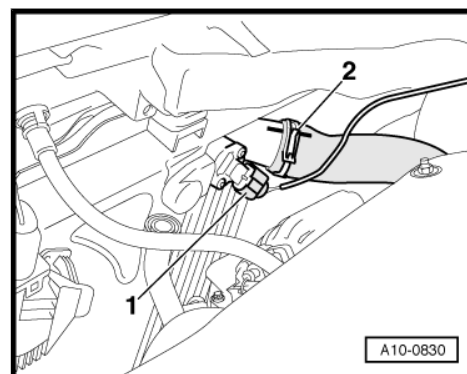
Disregard -item 3-.



- Remove air intake hose -2- between charge air cooler and intake manifold.

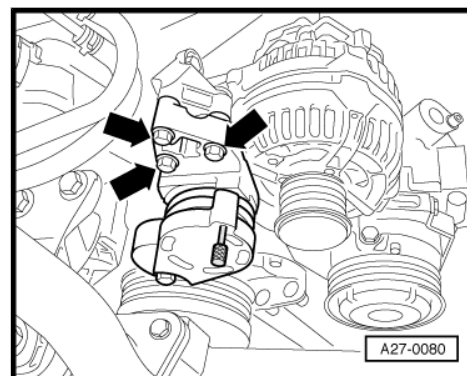
**Note**

Disregard -item 1-.

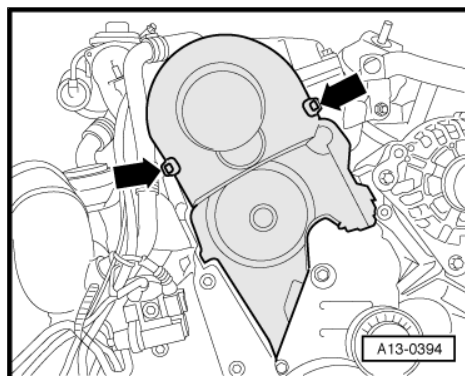


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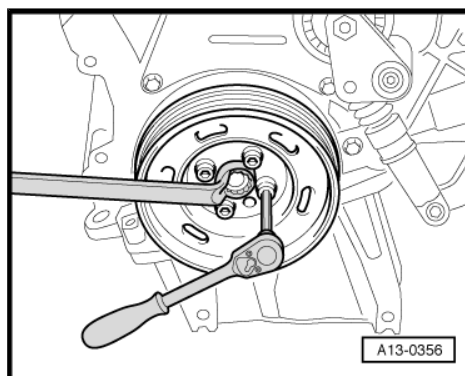
- Unscrew poly V-belt tensioner -arrows-.



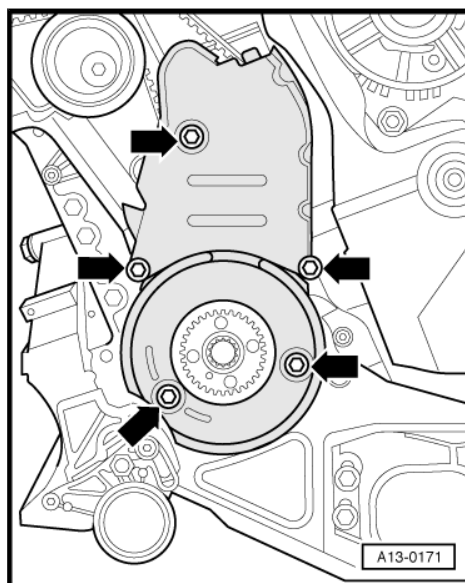
- Remove top toothed belt cover by releasing retaining clips -arrows-.



- Unbolt vibration damper; counterhold on centre bolt with ring spanner.



- Unbolt toothed belt cover (centre and bottom) -arrows-.



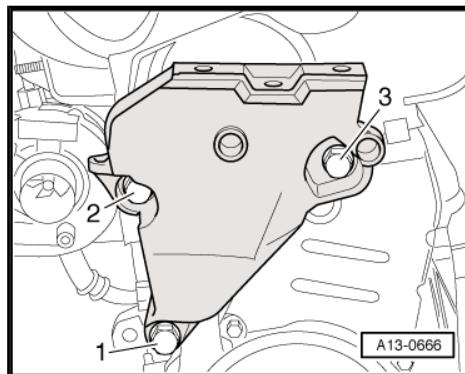
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- Remove bottom bolt -1- for engine support.

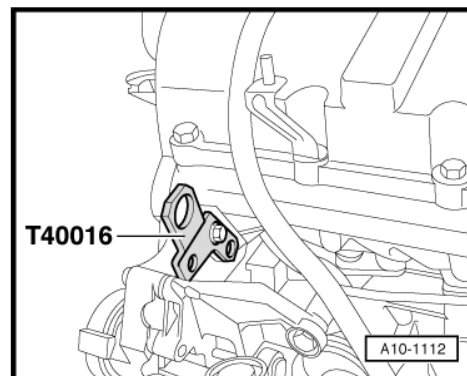


Note

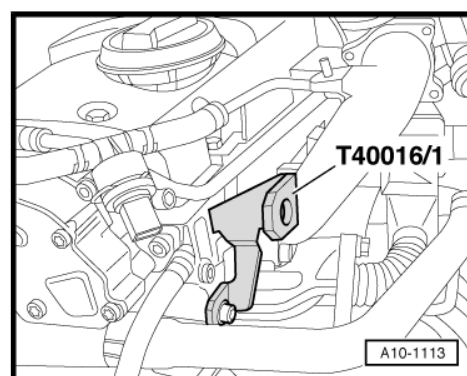
Bolts -2- and -3- do not have to be loosened at this stage.



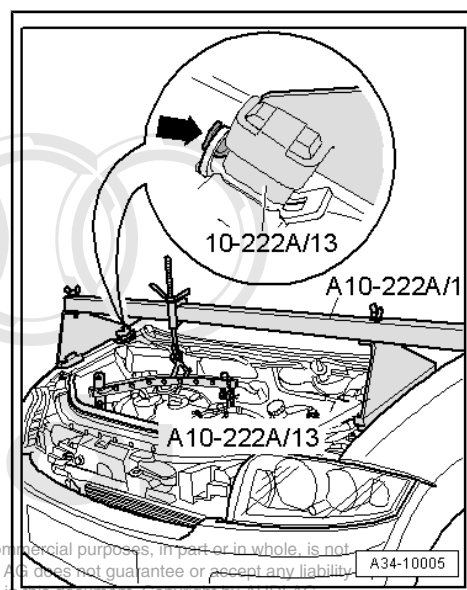
- Screw transportation shackle -T40016- onto front right on cylinder head.



- Screw transportation shackle -T40016/1- onto rear left of cylinder head.



- Set up support bracket -10-222 A- with adapter -10-222 A/13- on wing panel flanges. Spindle of support bracket is located at front.



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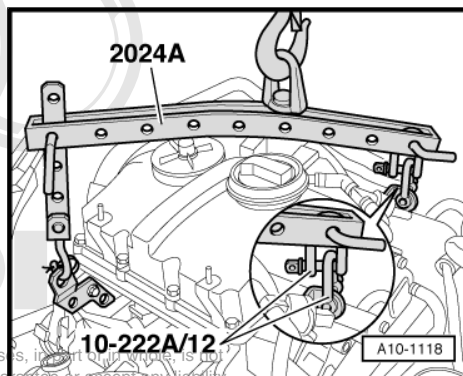
A34-10005

- Screw both shackles -10-222 A/12- onto transportation shackle -T40016- on rear left of cylinder head.
- Attach the lifting tackle -2024 A- to engine and support bracket -10-222 A- as shown in the illustration.



Note

To adjust to the centre of gravity of the assembly, the perforated rails of the support hooks must be positioned as shown.



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The hook attachments and locating pins on the lifting tackle must be secured with locking pins.

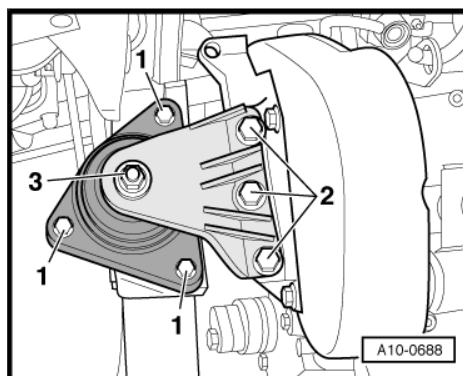
- Take up weight of engine using spindle (do not raise).



Note

Do not loosen nut -3- unless renewing engine mounting.

- Remove bolts -1- and -2- and detach support arm with engine mounting.



- Remove top bolts -2- and -3- and detach engine support.



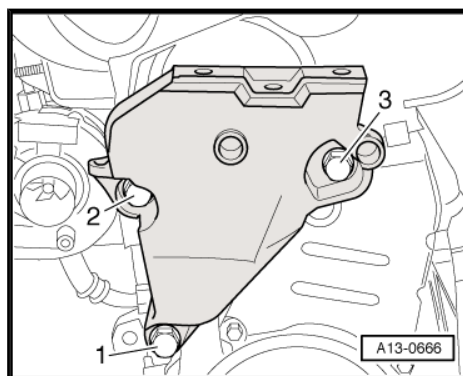
Caution

The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).



Note

Turn over the engine at the central bolt on the crankshaft.

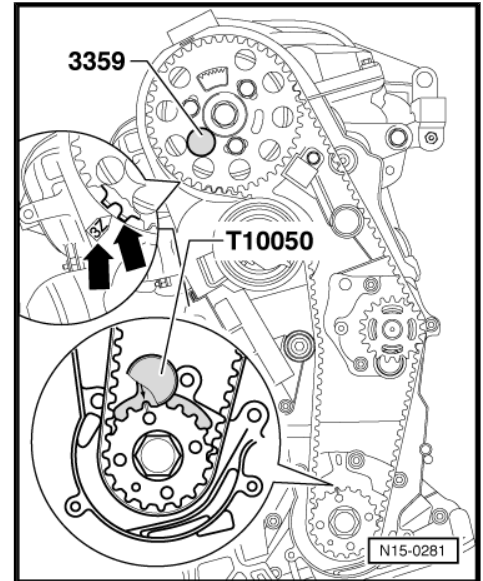


- Turn crankshaft to TDC of No. 1 cylinder.
- Arrow „3Z“ at rear toothed belt cover should face lugs on sender wheel of hub -arrows-.
- Lock hub on camshaft with locking pin -3359- .
- Lock crankshaft sprocket with crankshaft stop -T10050- .

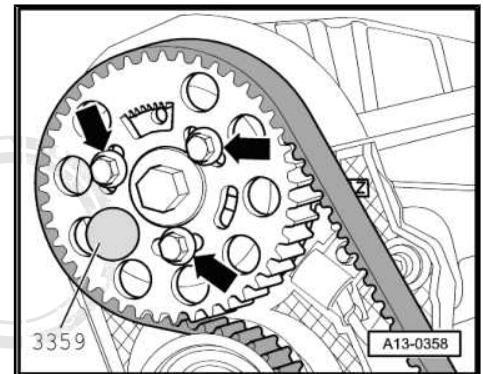
**Note**

The crankshaft stop can only be pushed onto the sprocket from the front face of the teeth.

- The markings on the toothed belt sprocket and the crankshaft stop -T10050- must align. The pin of the crankshaft stop -T10050- must engage in the aperture in the sealing flange.



- Mark direction of rotation of toothed belt with chalk or felt-tip pen.
- Loosen securing bolts for camshaft sprocket -arrows-.

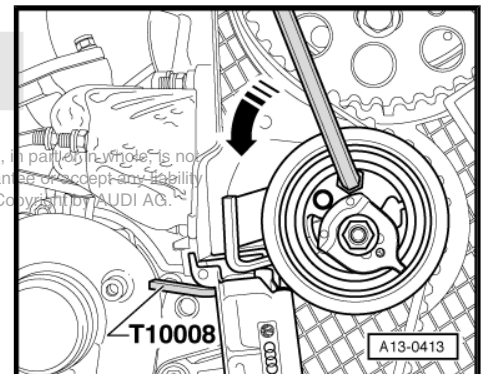


- Insert a hexagon key into the hexagon socket as far as the stop and use it to push the tensioning roller anti-clockwise -arrow- until you can lock the toothed belt tensioner with locking plate -T10008- .

**Note**

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- ◆ *Insert the hexagon key as far as stop, to prevent damage.*
- ◆ *The toothed belt tensioner is oil-damped and can therefore only be compressed slowly by applying constant pressure.*
- Loosen securing nut for tensioning roller.



- Unscrew bolts -arrows- and detach toothed belt tensioner.
- Remove toothed belt.

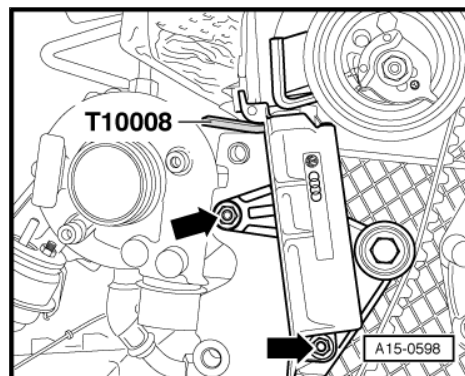
Installing (adjusting valve timing)

- Camshaft locked with locking pin -3359- .
- Crankshaft locked with crankshaft stop -T10050- .
- Tensioning roller locked with locking plate -T10008- .

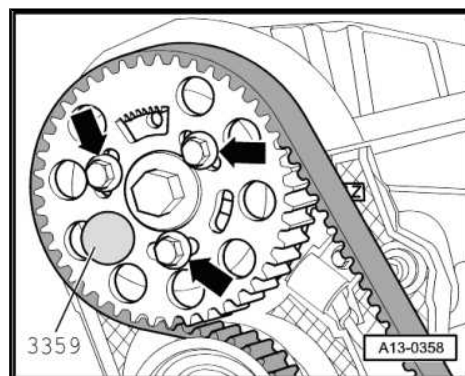


Note

- ◆ *Toothed belt adjustment must always be performed when the engine is cold.*
- ◆ *The crankshaft must not be at TDC at any cylinder when the camshaft is turned. Otherwise, there is a risk of damage to valves and piston crowns.*



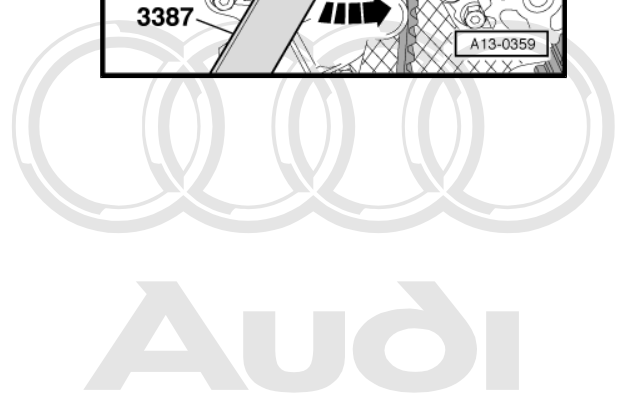
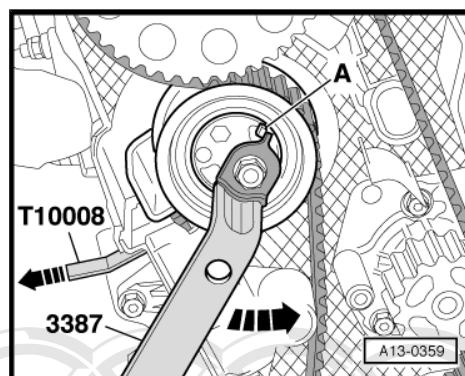
- Screw in bolts -arrows-, but do not tighten.
- The camshaft sprocket must just about still turn, and must not tilt.
- Turn the camshaft sprocket in its elongated hole clockwise until the stop.
- Fit toothed belt first onto camshaft sprocket, tensioning roller, crankshaft sprocket and then onto coolant pump sprocket.



- Install toothed belt tensioner.

Adjust toothed belt tension as follows:

- Turn eccentric adjuster anti-clockwise -arrow- onto stop -A- using 2-hole pin wrench -3387- .
- Remove locking plate -T10008- .



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- Wrap insulating tape around tip and shaft of 7 mm Ø drill bit to avoid cuts.
- Gradually relieve pressure on the tensioner and allow it to turn clockwise -arrow- until you can pull the shaft of a Ø 7.0 mm drill bit -item 2- through between the tensioning lever and the housing of the tensioner.
- Dimension -a- = 7.0 ± 1.0 mm.

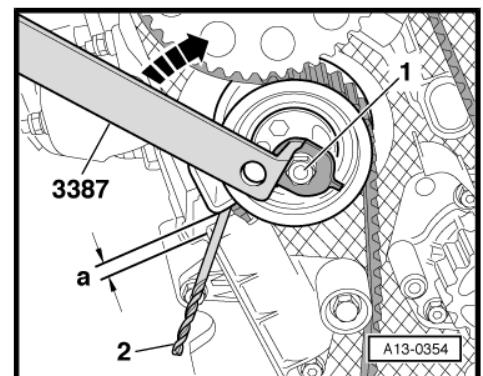
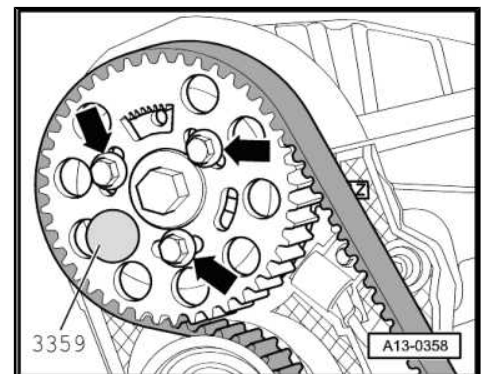
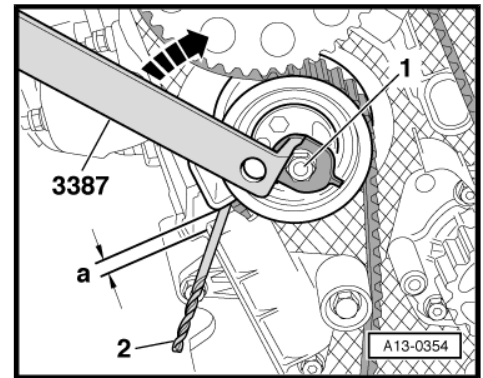
**Note**

- ◆ *Leave sufficient tolerance when adjusting, dimension -a- is reduced when tightening tensioning roller nut.*
- ◆ *Dimension -a- is reduced when the engine is at operating temperature.*
- Hold tensioning roller in this position and tighten securing nut to 20 Nm + 45° (1/8 turn).
- First tighten bolts -arrows- for camshaft sprocket to 25 Nm.
- Remove locking pin -3359- and crankshaft stop -T10050- .

**Caution**

The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).

- Turn crankshaft two rotations in normal direction of rotation until the crankshaft is just before TDC again.
 - Check again that dimension -a- is obtained between tensioning lever and housing of tensioner.
 - Dimension -a- = 7.0 ± 1.0 mm.
- If dimension -a- is not obtained, re-tension the tensioning roller as follows:
- Hold tensioning roller with 2-hole pin wrench -3387-, slacken nut -1- and relieve pressure on tensioner -arrow- until dimension -a- is obtained.
 - Dimension -a- = 7.0 ± 1.0 mm.
 - Hold tensioning roller in this position and tighten securing nut to 20 Nm + 45° (1/8 turn).



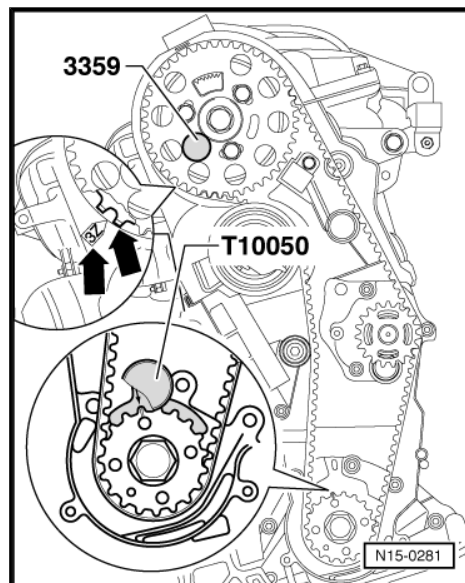
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Checking valve timing:

- Lock crankshaft sprocket with crankshaft stop -T10050- once again to check the setting.
- The markings on the toothed belt sprocket and the crankshaft stop -T10050- must align. The pin of the crankshaft stop -T10050- must engage in the aperture in the sealing flange.
- The pin on the crankshaft stop -T10050- must engage in the bore in the sealing flange as the crankshaft is turned.

**Note**

- ◆ *If the crankshaft has been rotated beyond TDC, turn it back 1/4 turn to then be able to reset it to TDC by turning in the direction of engine rotation.*
- ◆ *Do not insert the crankshaft stop -T10050- while turning the crankshaft against the normal direction of rotation.*
- Check whether it is possible to lock the camshaft hub using locking pin -3359- .



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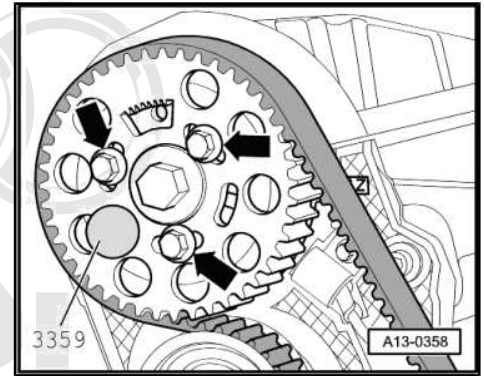
If the hub cannot be locked:

- Loosen securing bolts for camshaft sprocket -arrows-.
- Position a ring spanner at the camshaft centre bolt.
- Turn hub until locking pin -3359- can be inserted.
- Finally tighten bolts -arrows- for camshaft sprocket to 20 Nm + 45° (1/8 turn).
- Remove locking pin and crankshaft stop.



Caution

The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).



- Turn crankshaft two rotations in normal direction of rotation until the crankshaft is just before TDC again.
- Check valve timing once again ⇒ [page 46](#) .

Assembling:

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

- Install toothed belt cover (bottom and centre).
- Install vibration damper ⇒ [page 33](#) .
- Install support arm with engine mounting ⇒ [page 27](#) .
- Fit toothed belt cover (top section).
- Install poly V-belt ⇒ [page 32](#) .
- Install and adjust wiper arms ⇒ Rep. gr. 92 .



Note

Hose connections and hoses for charge air system must be free of oil and grease before assembly. Do NOT use lubricant.

Tightening torques

Component	Nm
Toothed belt tensioner to cylinder block	15
Camshaft sprocket to hub	25
Tensioning roller for toothed belt to cylinder head	20 + 45° ¹⁾
Toothed belt cover (bottom) to cylinder block	10 ²⁾
Toothed belt cover (centre) to cylinder block	10 ²⁾
Engine support to cylinder block	45
Tensioner for poly V-belt to bracket for alternator	22
• ¹⁾ 45° = one eighth turn. • ²⁾ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue .	

2 Removing and installing sealing flanges and flywheel

2.1 Sealing flanges and flywheel - exploded view



Note

Servicing clutch ⇒ Rep. gr. 30

1 - Seal

- ☐ Renewing ⇒ [page 49](#)
- ☐ Do not lubricate with oil

2 - Sealing flange (front)

- ☐ Removing and installing ⇒ [page 51](#)
- ☐ Must be positioned on dowel sleeves

3 - Cylinder block

- ☐ Can only be renewed together with crankshaft ⇒ [page 63](#)

4 - Flywheel

- ☐ Removing and installing ⇒ [page 53](#)
- ☐ To remove and install: counterhold with special tool -3386-

5 - 60 Nm + 90° (1/4 turn) further

- ☐ Renew

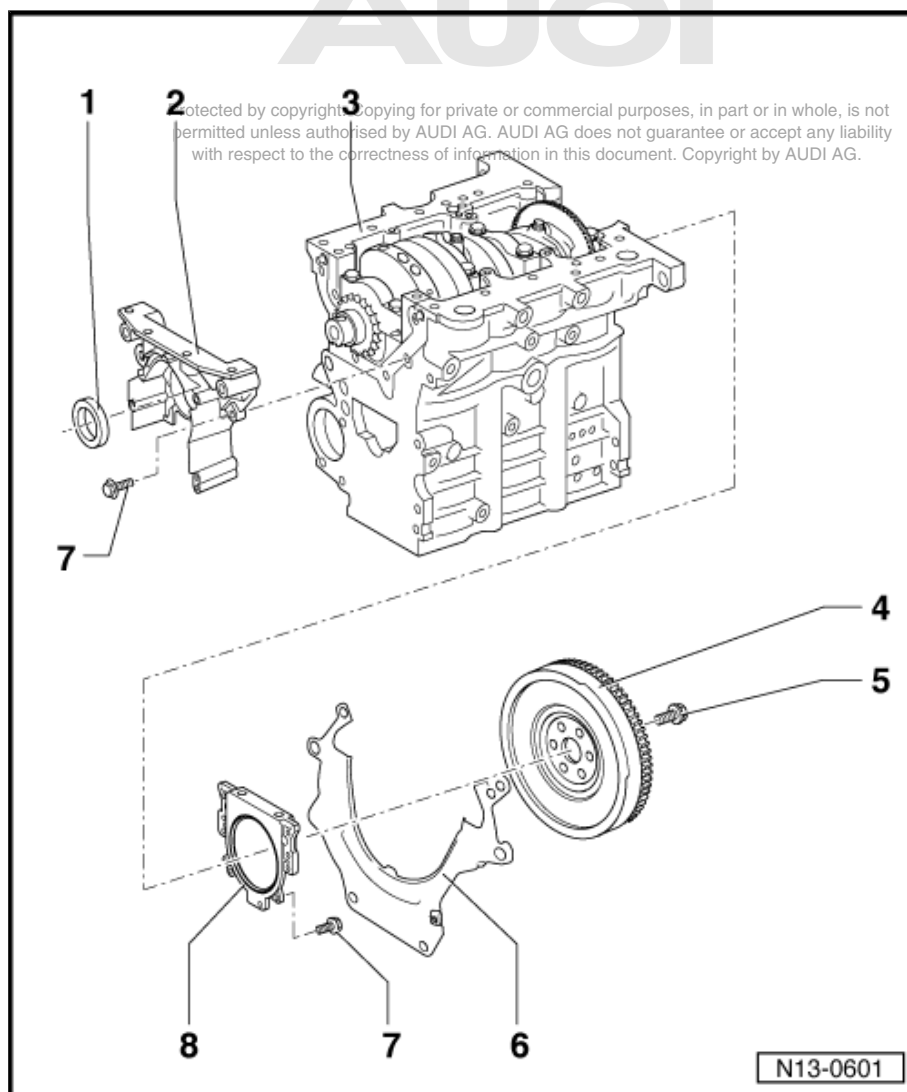
6 - Intermediate plate

- ☐ Do not damage/bend when assembling
- ☐ Must be positioned on dowel sleeves

7 - 15 Nm

8 - Sealing flange (rear) with oil seal

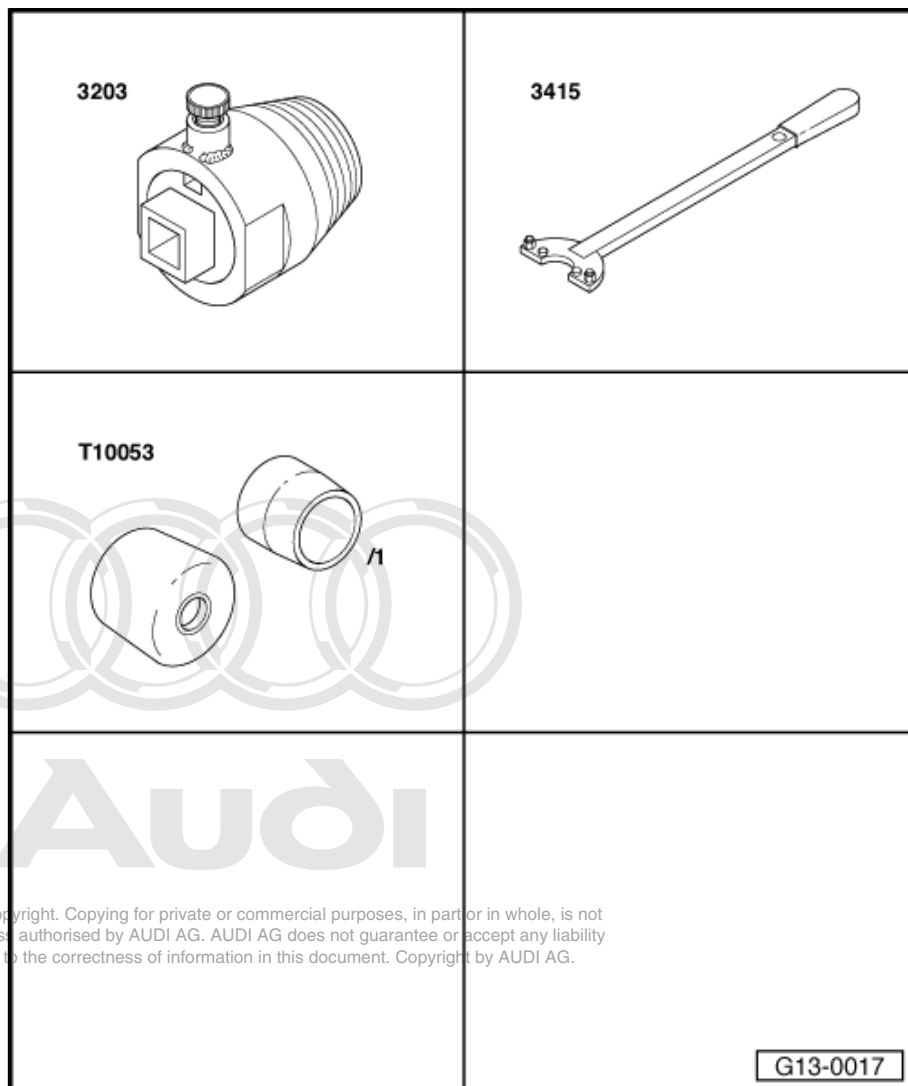
- ☐ With gasket for cylinder block
- ☐ Removing and installing ⇒ [page 54](#)
- ☐ Install using sealant; sealant ⇒ Parts catalogue
- ☐ To install, push guide sleeve from installation kit onto crankshaft



2.2 Renewing crankshaft oil seal (pulley end)

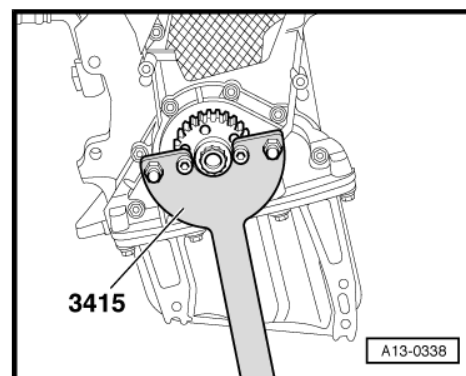
Special tools and workshop equipment required

- ◆ Oil seal extractor -3203-
- ◆ Counterhold tool -3415-
- ◆ Assembly tool -T10053-

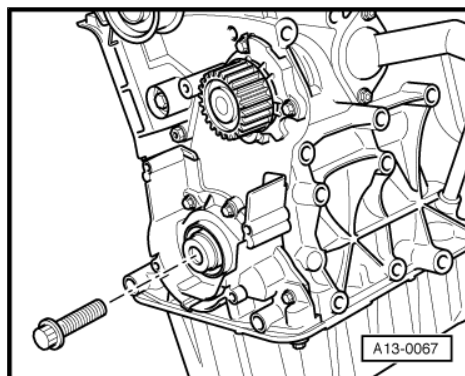


Procedure

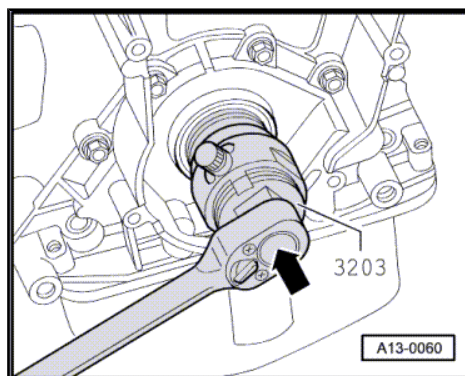
- Engine in vehicle.
- Remove toothed belt ⇒ [page 36](#) .
- Remove crankshaft sprocket using counterhold tool -3415- .



- Before fitting oil seal extractor, fully screw in centre bolt for sprocket into crankshaft.



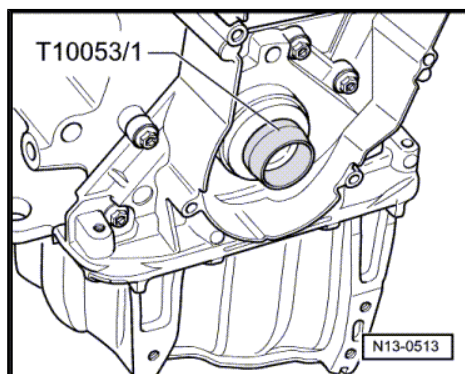
- Unscrew inner section of oil seal extractor -3203- 8 turns out of outer section and lock with knurled screw.
- Lubricate threaded head of oil seal extractor, place it in position and, exerting firm pressure -arrow-, screw it into oil seal as far as possible.
- Loosen knurled screw and turn inner part against crankshaft until the oil seal is pulled out.
- Clamp flats of oil seal extractor in vice.
- Remove oil seal with pliers.
- Clean running surface and sealing surface.



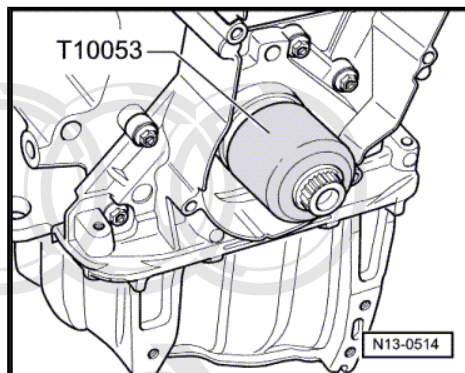
Note

Do not apply oil to sealing lip or outer circumference of seal.

- Place guide sleeve -T10053/1- onto crankshaft journal.
- Slide oil seal over guide sleeve.



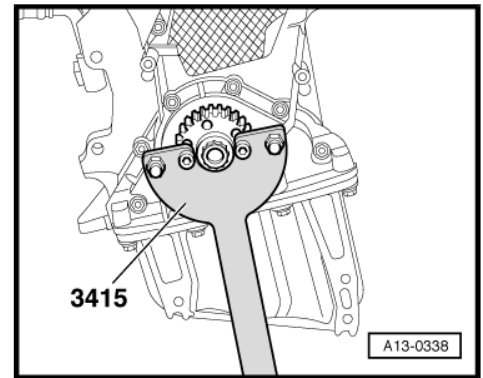
- Press in oil seal flush using the centre bolt of toothed belt sprocket and press sleeve from -T10053- .



- Renew centre bolt for toothed belt sprocket.

**Note**

- ◆ *Contact surface between toothed belt sprocket and crankshaft must be free of oil.*
- ◆ *Do not lubricate bolt for crankshaft sprocket.*
- Install crankshaft sprocket using counterhold tool -3415- .
- Install toothed belt (adjust valve timing) ⇒ [page 44](#) .
- Install poly V-belt ⇒ [page 32](#) .

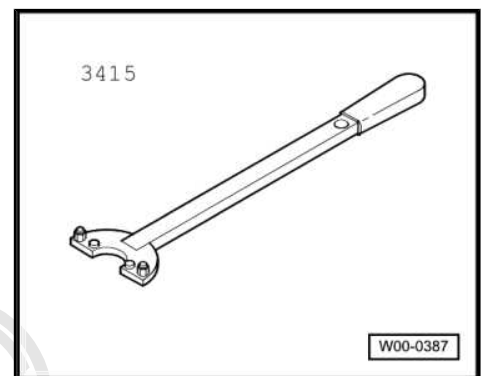
**Tightening torque**

Component	Nm
Toothed belt sprocket to crankshaft	120 + 90° 1)2)
• 1) Renew bolt. • 2) 90° = one quarter turn.	

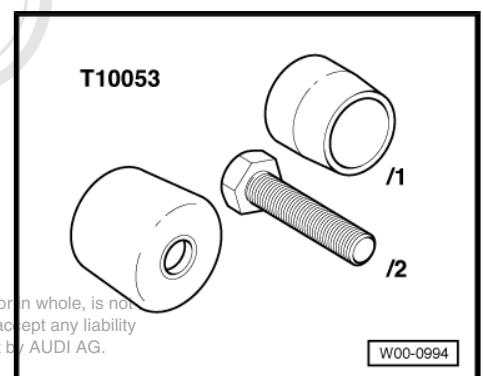
2.3 Removing and installing sealing flange (front)

Special tools and workshop equipment required

- ◆ Counterhold tool -3415-



- ◆ Assembly tool -T10053-

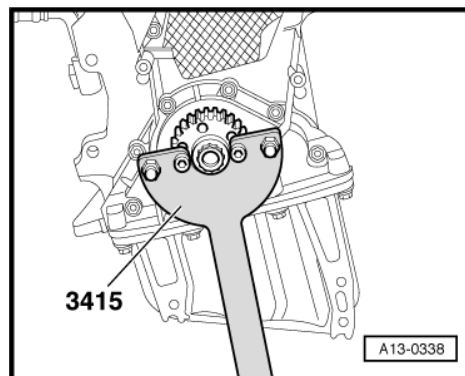


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- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles
- ◆ Sealant ⇒ Parts catalogue

Removing

- Engine in vehicle.
- Remove air pipe to turbocharger.
- Remove toothed belt ⇒ [page 36](#) .
- Remove crankshaft sprocket using counterhold tool -3415- .



- Remove bolts -1 ... 10-.
- Lever off front sealing flange and remove.
- Drive out oil seal with sealing flange removed.

Installing

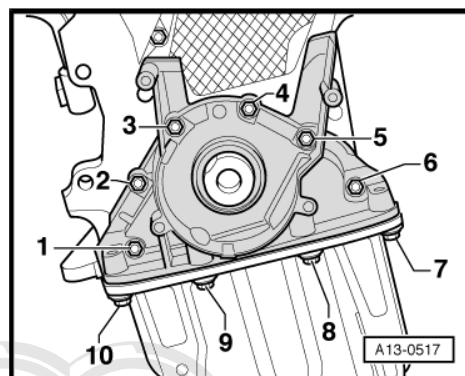
Installation is carried out in the reverse order; note the following:



Note

Place a cloth over the exposed section of the sump.

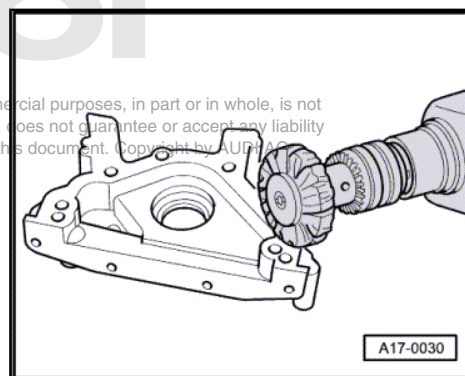
- Carefully remove any sealant residue on the cylinder block and sump.



WARNING

Wear safety goggles.

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

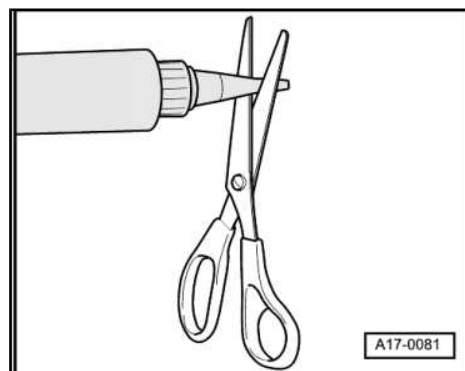


- Cut off tube nozzle at front marking (diameter of nozzle approx. 2 mm).

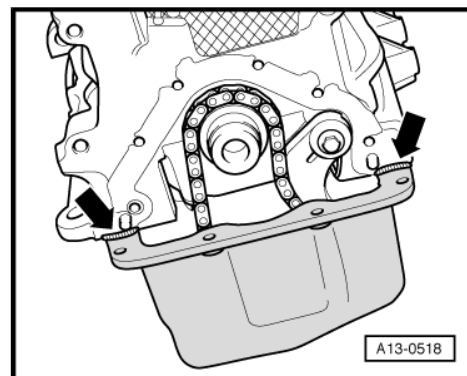


Note

The sealant must be applied at several points on the engine as described below.



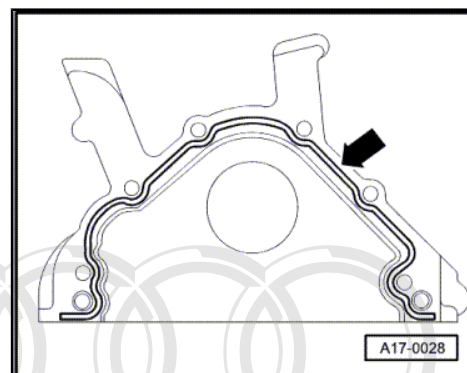
- Apply a thin bead of sealant at the edge of the joint between the cylinder block and the sump -arrows-.



- Apply the bead of sealant onto the clean sealing surface of the sealing flange as illustrated -arrow-.
- Width of sealant bead -arrow-: 2 ... 3 mm.

**Note**

Sealant bead must not be wider than 3 mm, otherwise excess sealant could ingress into sump and clog strainer in oil intake pipe.

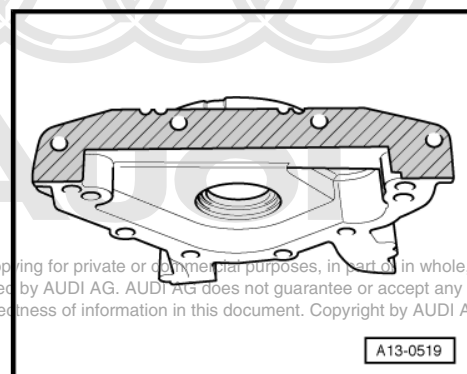


- Coat the lower sealing surface on the sealing flange lightly with sealant -hatched area-.

**Note**

The sealing flange must be installed within 5 minutes after applying sealant.

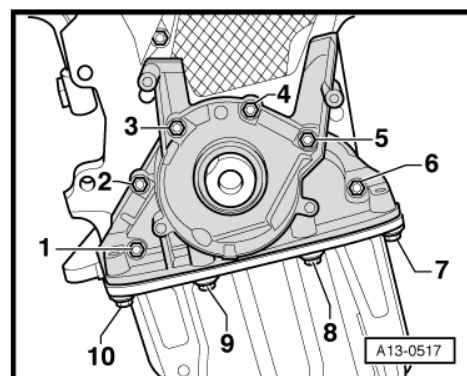
- Push the sealing flange carefully onto the dowel sleeves on the cylinder block.



- Tighten bolts in the specified sequence:
 1. Tighten bolts -1 ... 6-.
 2. Tighten bolts -7 ... 10-.
- Install crankshaft oil seal (pulley end) ⇒ [page 49](#) .
- Install toothed belt (adjust valve timing) ⇒ [page 44](#) .

**Note**

Hose connections and hoses for charge air system must be free of oil and grease before assembly. Do NOT use lubricant.

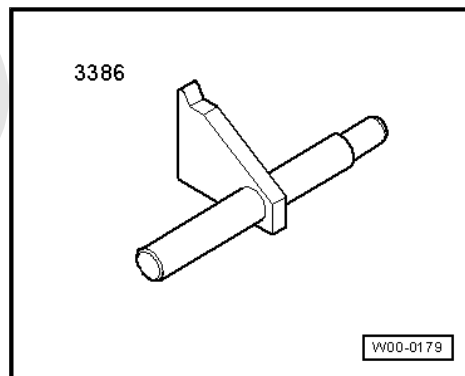
**Tightening torque**

Component	Nm
Sealing flange to cylinder block	15

2.4 Removing and installing flywheel

Special tools and workshop equipment required

◆ Counterhold tool -3386-



Removing

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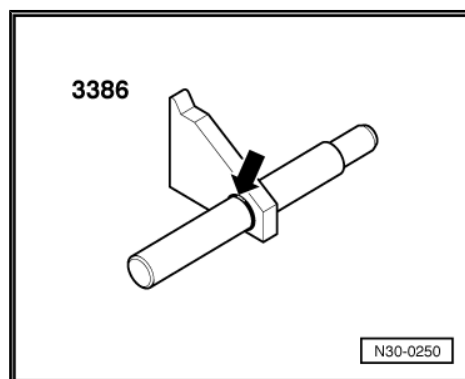
- Engine or gearbox removed.
- Remove clutch pressure plate ⇒ Rep. gr. 30 .
- Mark installation position of flywheel on crankshaft.



Note

It must be possible to move counterhold tool -3386- axially.

- Counterhold tool can be moved axially after removing circlip -arrow-.
- Attach counterhold tool -3386- in order to loosen bolts.
- Unbolt flywheel.



Installing

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

- Use new securing bolts.
- Reverse position of counterhold tool -3386- in order to tighten bolts.
- Install clutch pressure plate ⇒ Rep. gr. 30 .

Tightening torque

Component	Nm
Flywheel to crankshaft	
Bolt length 19.5 mm	60 + 90° 1)2)
• 1) Renew bolts. • 2) 90° = one quarter turn.	

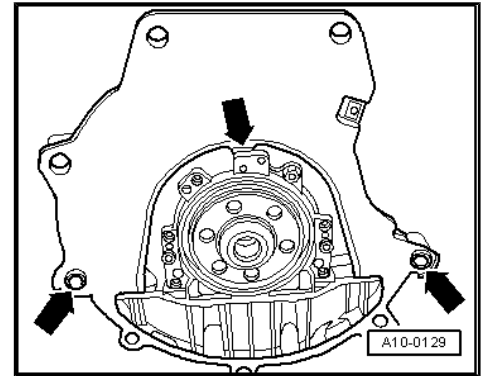
2.5 Removing and installing sealing flange (rear)

Special tools and workshop equipment required

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

Removing

- Gearbox removed.
- Remove flywheel ⇒ [page 53](#) .
- Detach intermediate plate at sealing flange and dowel sleeves -arrows-.

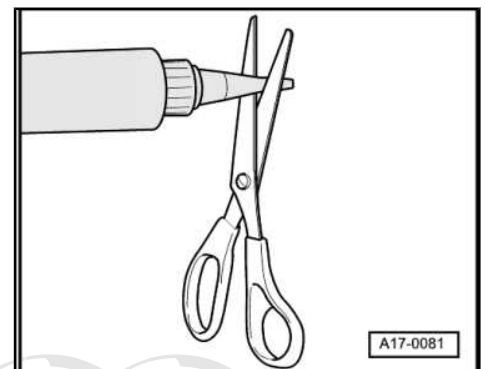
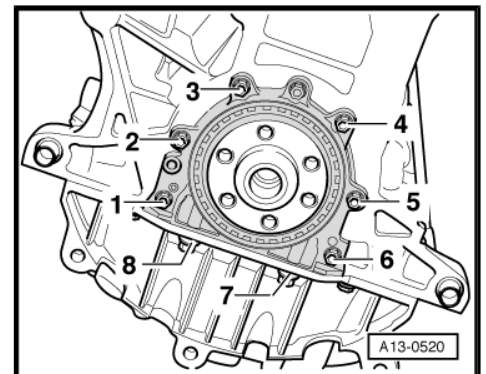


- Remove bolts -1 ... 8-.
- Pull off sealing flange (rear).

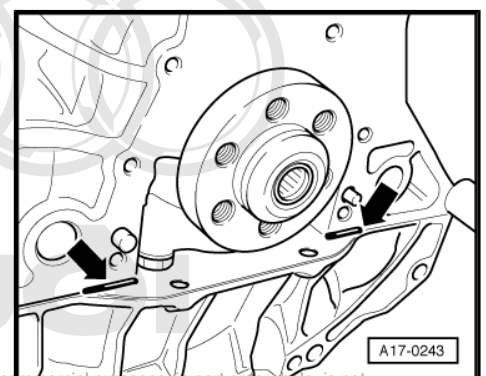
Installing**Note**

Place a cloth over the exposed section of the sump.

- Carefully remove any sealant residue on the cylinder block and sump.
- Clean sealing surfaces; they must be free of oil and grease.
- Cut off tube nozzle at front marking (diameter of nozzle approx. 2 mm).



- Apply a thin bead of sealant at the edge of the joint between the cylinder block and the sump -arrows-.



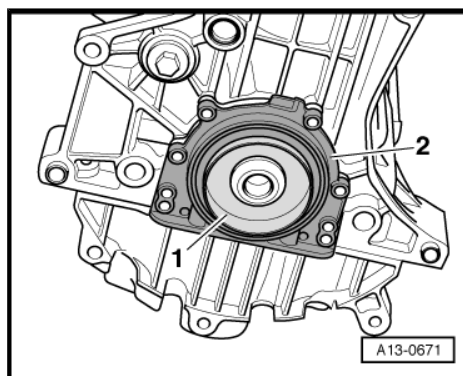
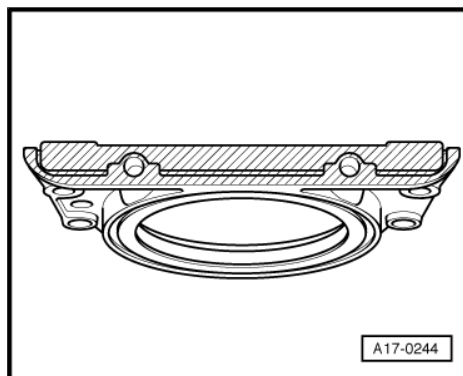
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- Coat the lower sealing surface on the sealing flange lightly with sealant -hatched area-.


Note

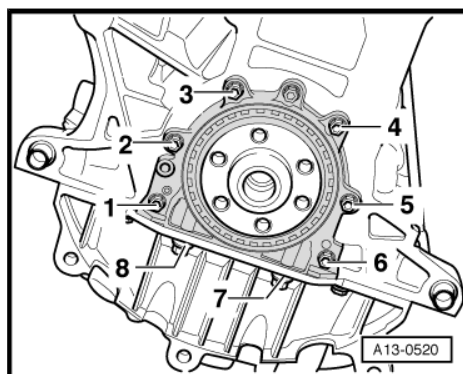
The sealing flange must be installed within 5 minutes after applying sealant.

- Carefully push sealing flange -2- together with guide sleeve -1- (fitted on replacement part) onto crankshaft.
- Then push the sealing flange carefully onto the dowel sleeves on the cylinder block.



- Tighten bolts in the specified sequence:

1. Tighten bolts -1 ... 6-.
2. Tighten bolts -7- and -8-.



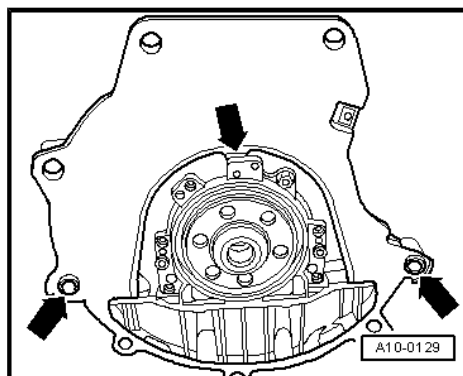
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The remaining installation steps are carried out in the reverse sequence.

- Fit intermediate plate on sealing flange and push onto dowel sleeves -arrows-.
- Install flywheel ⇒ [page 53](#) .

Tightening torque

Component	Nm
Sealing flange to cylinder block	15



3 Removing and installing balance shaft and retaining frame

3.1 Balance shaft and retaining frame - exploded view of components



Note

All bearing and running surfaces must be oiled before assembling.

1 - Chain

- ☐ Note installation position
⇒ „3.2 Removing and installing balance shaft and retaining frame“, page 58

2 - 100 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ Use socket -T10061- to loosen and tighten

3 - Balance weight

- ☐ Can only be installed in one position

4 - Chain sprocket for balance shaft

- ☐ Can only be installed in one position

5 - Dowel sleeve

6 - 20 Nm + 90° (1/4 turn) further

- ☐ Renew

7 - Chain sprocket for oil pump

- ☐ Can only be installed in one position

8 - Baffle plate

9 - 5 Nm

10 - O-ring

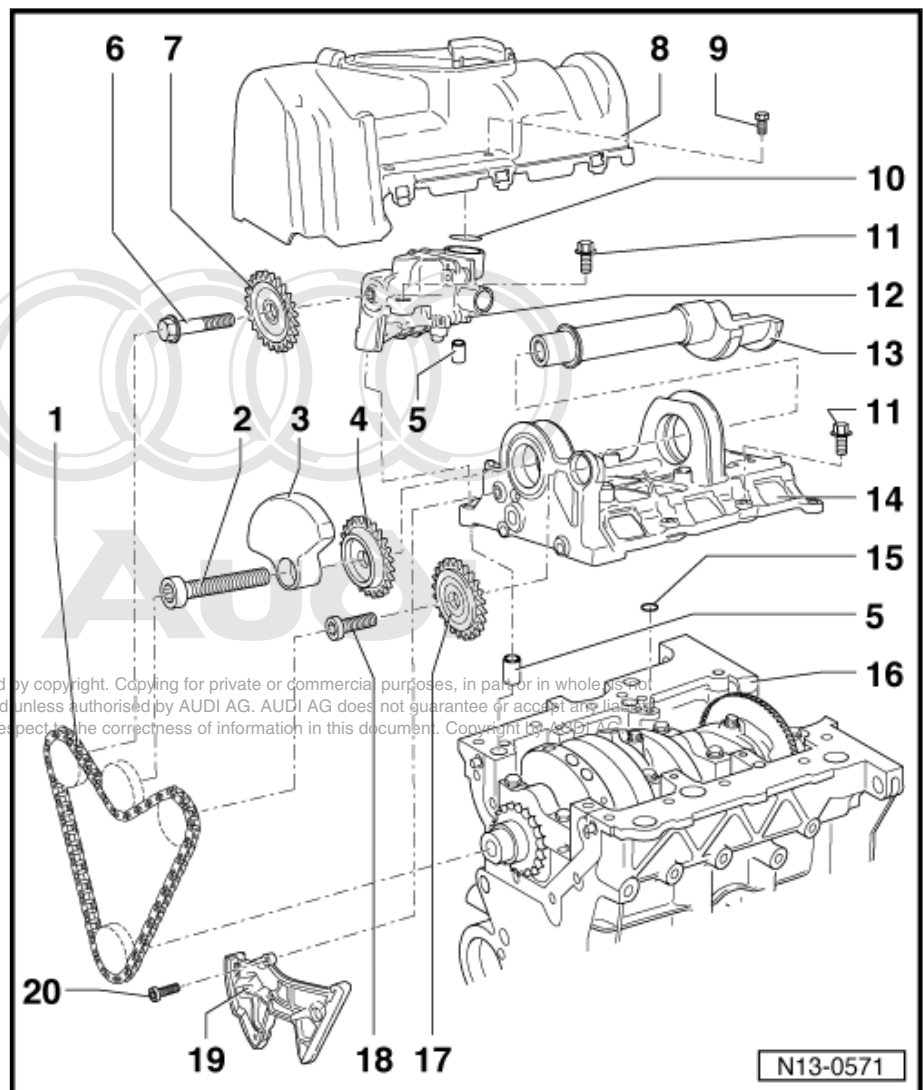
- ☐ Renew
- ☐ Check for firm attachment
- ☐ Oil lightly when fitting

11 - Bolt

- ☐ Oil pump to retaining frame, 20 Nm + 90° (1/4 turn) further; renew bolt
- ☐ Retaining frame to cylinder block: 14 Nm + 180° (1/2 turn) further; renew bolt

12 - Oil pump

- ☐ With pressure relief valve (11.5 bar)
- ☐ Before installing, check that the two dowel sleeves for centralising are fitted.



N13-0571

13 - Balance shaft

- ☐ Removing and installing ⇒ [page 58](#)

14 - Retaining frame

- ☐ Before installing, check that the fitting sleeve for centring on cylinder block is in place and that the O ring is inserted in the retaining frame.
- ☐ Removing and installing ⇒ „3.2 Removing and installing balance shaft and retaining frame“, page 58

15 - O-ring

- ☐ Renew
- ☐ Ensure secure seating in retaining frame

16 - Cylinder block

- ☐ Can only be renewed together with crankshaft ⇒ [page 63](#)

17 - Idler sprocket

18 - 20 Nm

19 - Chain tensioner with tensioning rail

- ☐ To remove, lock with locking pin -T10060 A- or -T10060-
- ☐ Removing and installing ⇒ „3.2 Removing and installing balance shaft and retaining frame“, page 58

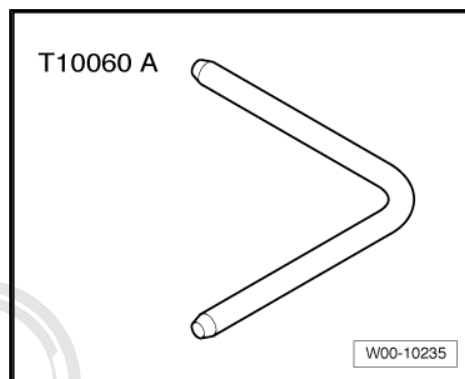
20 - 8 Nm + 90° (1/4 turn) further

- ☐ Renew

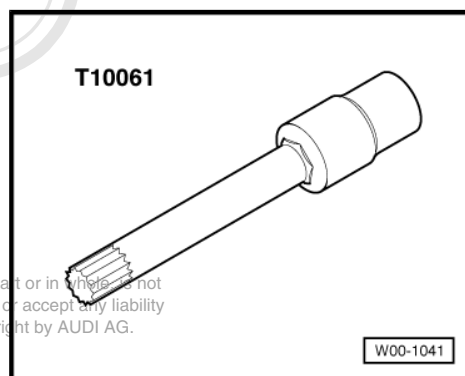
3.2 Removing and installing balance shaft and retaining frame

Special tools and workshop equipment required

- ◆ Locking pin -T10060 A- or -T10060-



- ◆ Socket, multi-point bit -T10061-

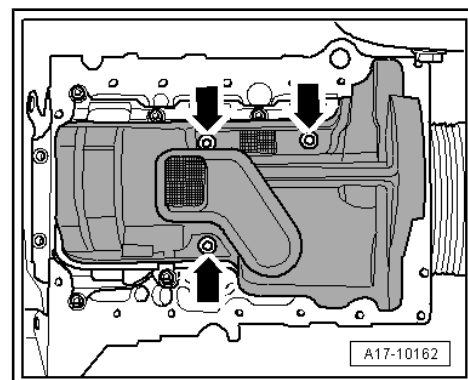


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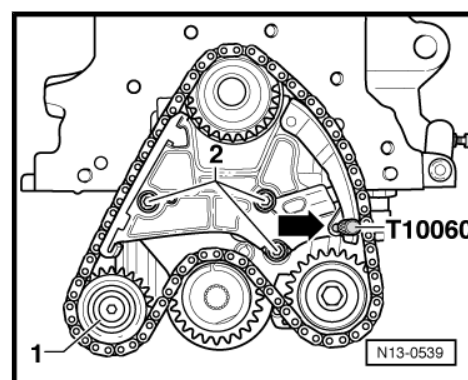
Removing

- Remove poly V-belt ⇒ [page 32](#) .

- Remove toothed belt ⇒ [page 36](#) .
- Remove sump ⇒ [page 118](#) .
- Remove front sealing flange ⇒ [page 51](#) .
- Remove bolts -arrows-.
- Release the 5 retaining tabs and remove baffle plate.



- Press down chain tensioner and lock with locking pin -T10060 A- or -T10060- -arrow-.
- Unbolt idler sprocket -1- from retaining frame.
- Unscrew bolts -2- on chain tensioner and remove chain tensioner.
- Remove chain from sprockets and lay it aside on a clean surface.



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- Block balance shaft as shown using a spanner (24/27 mm) -item 1-.
- When blocking the balance shaft, make sure that the spanner is centred on the balance weight and at right angles to balance shaft.
- Loosen bolt -2- at balance weight using socket -T10061- .



Note

Do not unscrew bolt all the way when loosening.

- Unbolt retaining frame -3- from cylinder block and remove retaining frame with balance shaft.
- Lay retaining frame aside on a clean surface.
- Unscrew bolt on balance weight and detach balance weight and chain sprocket.
- Turn balance shaft so that it can be removed from the bearings.

Installing

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



Note

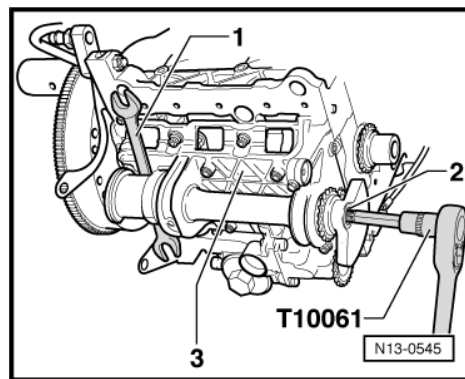
- ◆ *Renew O-ring.*
- ◆ *Renew the bolts tightened with specified tightening angle.*
- Lubricate contact surfaces of bearing and insert balance shaft.
- Fit sprocket and balance weight on balance shaft.



Note

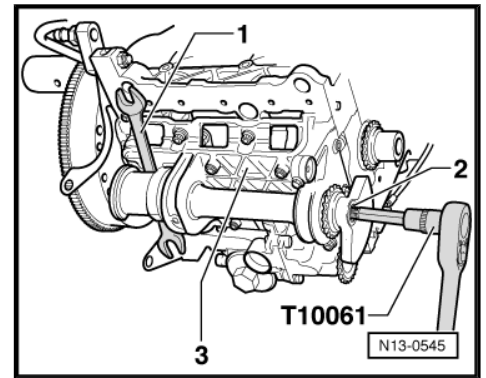
Chain sprocket and balance weight can only be fitted in one position.

- Tighten bolt for balance weight/chain sprocket hand-tight.
- Check that dowel sleeve in cylinder block and O-ring in retaining frame are in position before installing retaining frame.
- Tighten retaining frame to cylinder block hand-tight and align.
- Check that retaining frame aligns flush with outer edge of cylinder block on pulley end.
- Tighten retaining frame in stages and in diagonal sequence.

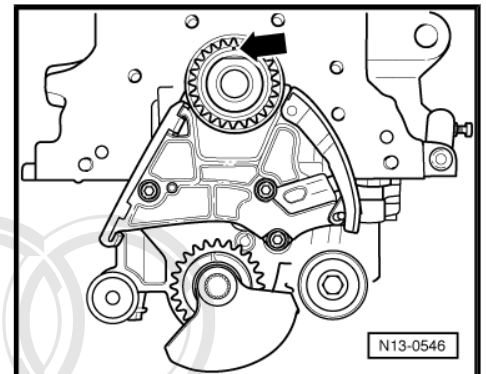


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- Block balance shaft as shown using a spanner (24/27 mm) -item 1-.
- When blocking the balance shaft, make sure that the spanner is centred on the balance weight and at right angles to balance shaft.
- Secure balance weight using new bolt -2-.
- Install chain tensioner.



- Clean chain with a lint-free cloth.
- Ensure that mark -arrow- on crankshaft sprocket is at top.

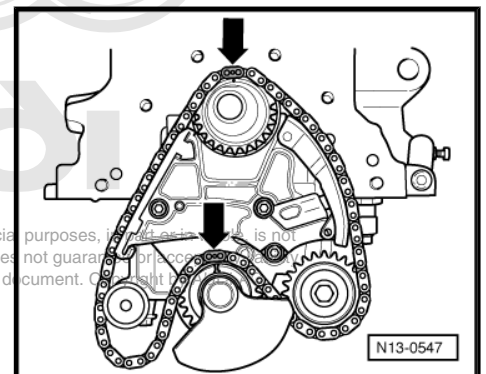


- Lay chain over crankshaft sprocket, oil pump sprocket and balance shaft sprocket.
- Ensure that marks on crankshaft sprocket and balance shaft sprocket align with the colour-coded chain links -arrows-.

Note

The colour-coded chain links are additionally marked with a notch.

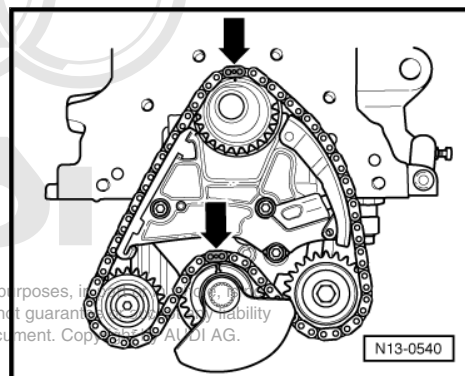
- Engage idler sprocket in chain and tighten idler sprocket to retaining frame.
- Remove locking pin from chain tensioner.



- Check that marks on crankshaft sprocket and balance shaft sprocket align with the colour-coded chain links -arrows-.
- Install front sealing flange ⇒ [page 51](#) .
- Fit baffle plate with new O-ring.
- Install sump ⇒ [page 118](#) .
- Install toothed belt (adjust valve timing) ⇒ [page 44](#) .
- Install poly V-belt ⇒ [page 32](#) .

Tightening torques

Component	Nm
Retaining frame with balance shaft to cylinder block	14 + 180° ¹⁾²⁾
Balance weight with chain sprocket to retaining frame	100 + 90° ¹⁾³⁾
Chain tensioner to retaining frame	8 + 90° ¹⁾³⁾
Idler sprocket to retaining frame	20
Baffle plate to retaining frame	5
• ¹⁾ Renew bolt(s). • ²⁾ 180° = one half turn. • ³⁾ 90° = one quarter turn.	



4 Crankshaft



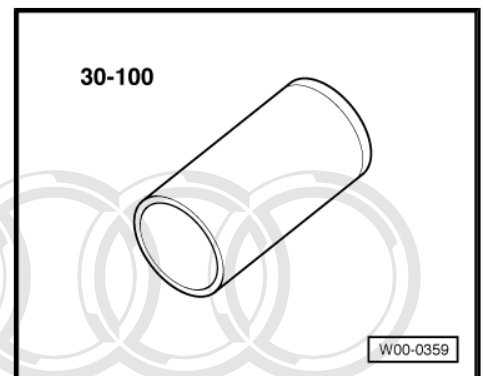
Caution

- ◆ *Crankshaft is not to be removed. Even loosening the main bearing cap nuts will cause deformation of the cylinder block bearing pedestals. This will result in reduced bearing clearance. Even if bearing shells are not renewed, a change in bearing clearance can cause bearing damage.*
- ◆ *If the main bearing cap nuts are loosened, the cylinder block must be renewed together with the crankshaft.*
- ◆ *Crankshaft bearing clearance cannot be measured using workshop equipment.*

4.1 Removing and installing chain sprocket

Special tools and workshop equipment required

- ◆ Drift sleeve -30-100-



- ◆ Two-arm puller, commercially available
- ◆ Protective gloves

Removing

- Remove sump ⇒ [page 118](#) .
- Remove front sealing flange ⇒ [page 51](#) .
- Remove the following components:
 - ◆ Chain sprocket for oil pump ⇒ [Item 12 \(page 124\)](#) .
 - ◆ Chain tensioner ⇒ [Item 22 \(page 125\)](#) .
 - ◆ Chain ⇒ [Item 11 \(page 124\)](#) .
- Pull chain sprocket with a puller -2-; use a suitable washer -1- to protect end of crankshaft.

Installing

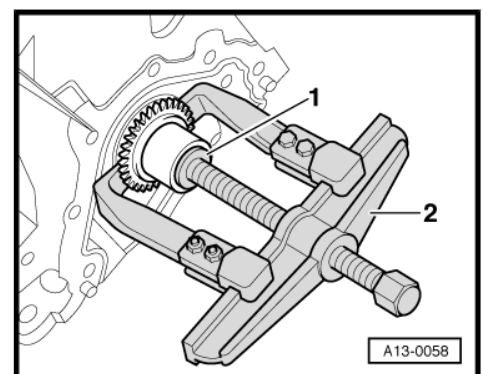
Installation is carried out in the reverse order; note the following:



WARNING

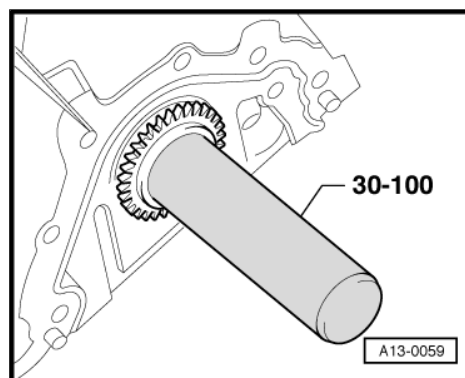
Wear protective gloves.

- Heat chain sprocket in an oven for approx. 15 minutes to 220 °C.



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- Fit chain sprocket on end of crankshaft using pliers, and press onto crankshaft as far as the stop using drift sleeve -30-100- .
- Installation position: wider collar on sprocket faces engine.
- Install front sealing flange ⇒ [page 51](#) .
- Install sump ⇒ [page 118](#) .



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5 Dismantling and assembling pistons and conrods

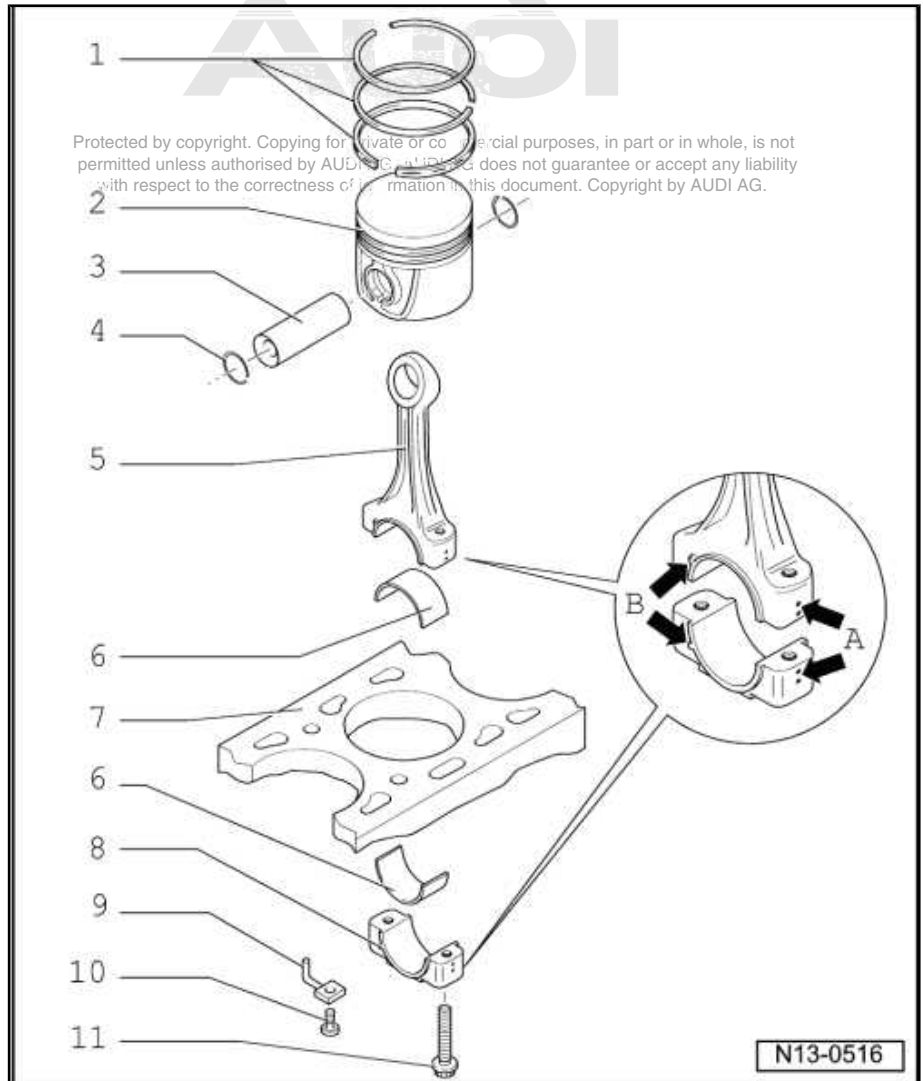
5.1 Pistons and conrods - exploded view

1 - Piston rings

- ☐ Offset gaps by 120°
- ☐ Use piston ring pliers to remove and install
- ☐ Marking „TOP“ or inscription must face piston crown.
- ☐ Checking ring gap
⇒ [page 66](#)
- ☐ Checking ring-to-groove clearance ⇒ [page 66](#)

2 - Piston

- ☐ With combustion chamber
- ☐ Mark installation position and cylinder number
- ☐ Installation position and allocation of piston/cylinder ⇒ [page 67](#)
- ☐ Arrow on piston crown points to pulley end
- ☐ If cracking is visible on piston skirt, renew piston
- ☐ Checking cylinder bore
⇒ [page 67](#)
- ☐ Piston and cylinder dimensions ⇒ [page 69](#)
- ☐ Install using piston ring clamp
- ☐ Checking piston projection at TDC
⇒ [page 67](#)



3 - Piston pin

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

4 - Circlip

5 - Conrod

- ☐ Only renew as a complete set
- ☐ Mark cylinder allocation -A-
- ☐ Installation position: Marking -B- faces towards pulley end

6 - Bearing shell

- ☐ Installation position ⇒ [page 67](#)
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Note type: upper bearing shell (closest to piston) is made of more wear-resistant material. Distinguishing feature on new bearing shells: black marking on bearing surface near joint

- ☐ Check that it is securely seated
- ☐ Axial clearance: wear limit: 0.37 mm
- ☐ Check radial clearance with Plastigage
- ☐ Do not rotate crankshaft when checking radial clearance
- ☐ Radial clearance: wear limit: 0.08 mm

7 - Cylinder block

- ☐ Checking cylinder bore ⇒ [page 67](#)
- ☐ Piston and cylinder dimensions ⇒ [page 69](#)

8 - Conrod bearing cap

- ☐ Note installation position

9 - Oil spray jet

- ☐ For piston cooling
- ☐ Note installation position: Turn oil spray jet anti-clockwise until it makes contact with cylinder block and secure in this position

10 - 27 Nm

- ☐ Insert without sealant

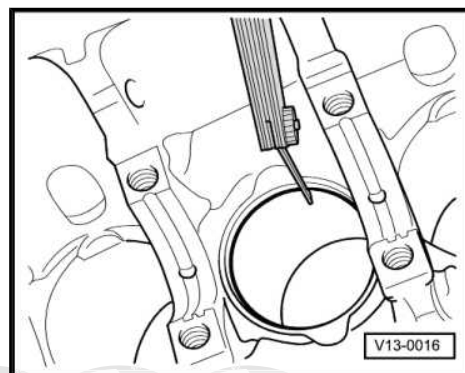
11 - Conrod bolt, 30 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ Lubricate threads and contact surface
- ☐ Use old bolts when measuring radial clearance

Checking 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.

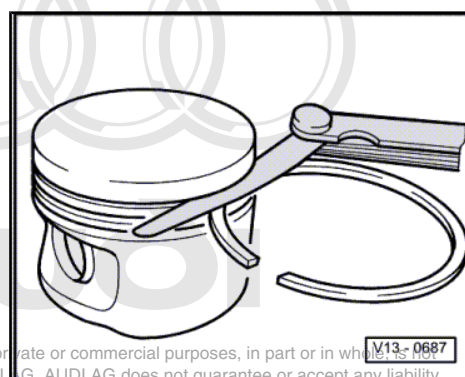
Piston ring Dimensions in mm	New	Wear limit ¹⁾
1st compression ring	0.20 ... 0.35	–
2nd compression ring	0.90 ... 1.15	–
Oil scraper ring	0.25 ... 0.50	–
• ¹⁾ No wear limit specified.		



Checking ring-to-groove clearance

- Clean groove in piston before checking clearance.

Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.06 ... 0.09	0.25
2nd compression ring	0.05 ... 0.08	0.25
Oil scraper ring	0.03 ... 0.06	0.15



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Piston installation position and piston/cylinder allocation

Pistons in cylinders 1 and 2:

- Larger inlet valve chamber towards flywheel -arrows-.

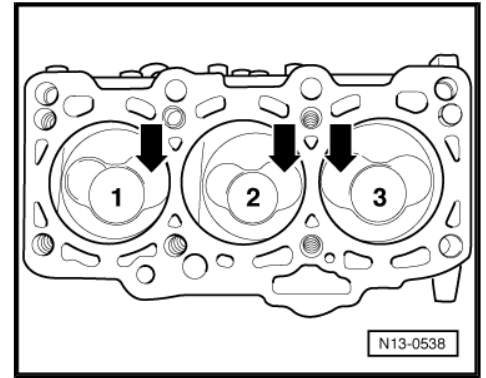
Piston in cylinder 3:

- Larger inlet valve chamber towards belt pulley side -arrow-.



Note

- ◆ *With new pistons, cylinder allocation is indicated by a coloured marking on piston crown.*
- ◆ *Piston for cylinder 1 and 2: marked 1/2.*
- ◆ *Piston for cylinder 3: marked 3.*



Checking cylinder bore

- Use 50 ... 100 mm internal dial gauge to take measurements at 3 points in transverse direction -A- and longitudinal direction -B-.
- Difference between measured value and nominal value: max. 0.10 mm.

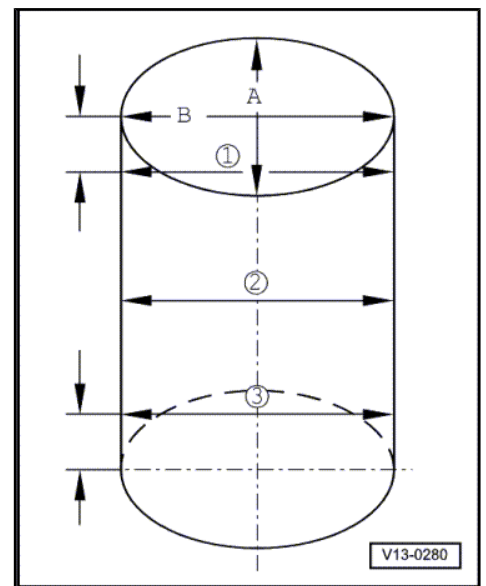
Nominal dimension

⇒ „5.3 Piston and cylinder dimensions“, page 69 .



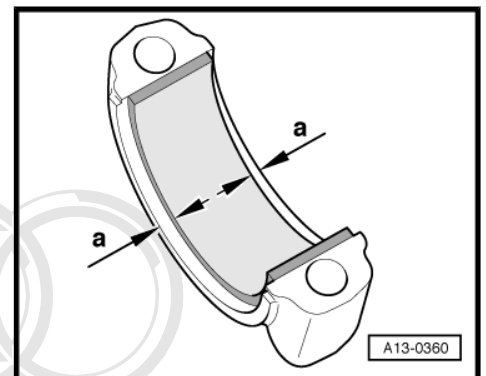
Note

Measuring the cylinder bores must not be done when the cylinder block is mounted on a repair stand with engine and gearbox support -VW 540- , as incorrect measurements may result.



Installation position of bearing shell

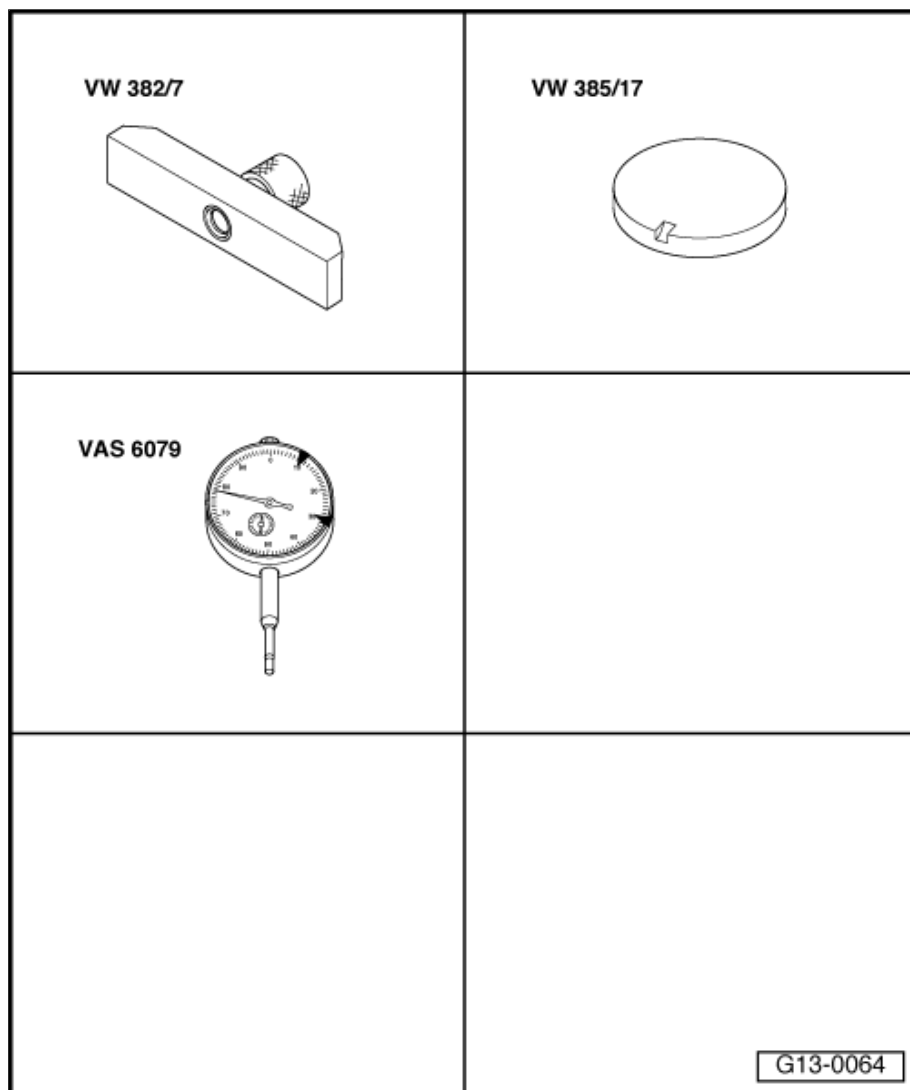
- Insert bearing shells centrally in conrod/conrod bearing cap.
- Distance -a- = 2.5 mm.



5.2 Checking piston projection at TDC

Special tools and workshop equipment required

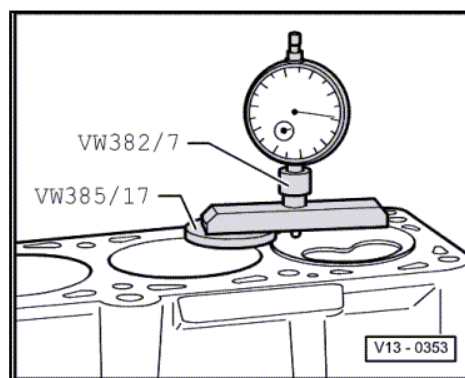
- ◆ -VW 382/7- from measuring tool -VW 382-
- ◆ -VW 385/17- from universal measuring tool -VW 385-
- ◆ Dial gauge -VAS 6079-



Procedure

- Check piston projection at TDC when installing new pistons or short engine.
- Install cylinder head gasket corresponding to piston projection according to table below:

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



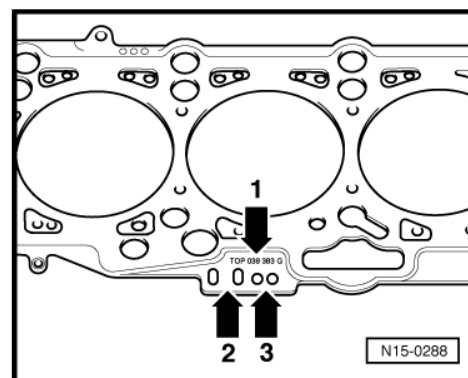
Identification of cylinder head gasket

- 1 - Part No.
- 2 - Production code (can be disregarded)
- 3 - Holes



Note

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



5.3 Piston and cylinder dimensions

Honing dimension (in mm)	Piston Ø	Cylinder bore Ø
Basic dimension	76.76	76.51



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15 – Cylinder head, valve gear

1 Cylinder head

1.1 Cylinder head - exploded view



Note

- ◆ *When installing an exchange cylinder head with fitted camshaft, the contact surfaces between the bucket tappets and the cams must be oiled before installing the cylinder head cover.*
- ◆ *All bearing and running surfaces must be oiled before assembling.*
- ◆ *The plastic protectors fitted to protect the open valves must not be removed until immediately before fitting the cylinder head.*
- ◆ *If the cylinder head is replaced, all the coolant in the system must also be renewed.*

1 - Toothed belt cover (top section)

2 - Toothed belt

- ☐ Mark direction of rotation before removing
- ☐ Check for wear
- ☐ Do not kink
- ☐ Removing, installing and tensioning
⇒ [page 36](#)

3 - 10 Nm

4 - 25 Nm

5 - 100 Nm

6 - Camshaft sprocket

7 - Hub

- ☐ With sender wheel
- ☐ Use counterhold tool - T10051- to loosen and tighten
- ☐ To remove, use puller - T10052-
- ☐ Removing and installing
⇒ [page 105](#), Removing and installing camshaft

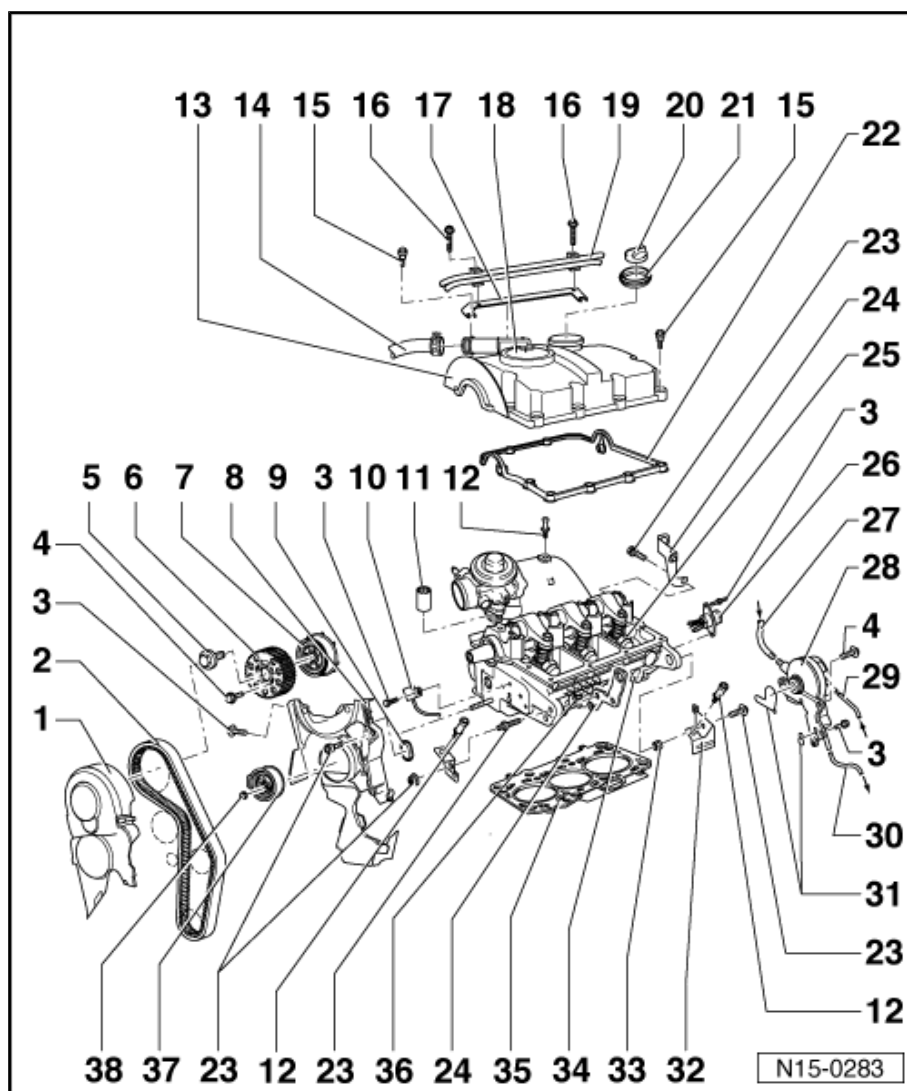
8 - Toothed belt cover (rear)

9 - Sealing grommet

- ☐ Renew if damaged

10 - Hall sender -G40-

- ☐ For camshaft position
- ☐ To remove, remove



sealing grommet ([⇒ Item 9 \(page 70\)](#)) from toothed belt cover (rear)

- ☐ Checking ⇒ Rep. gr. 23

11 - Cylinder head nut

- ☐ Note sequence when loosening and tightening [⇒ page 74](#) , Removing and installing cylinder head
- ☐ Use socket -T10061- to loosen and tighten
- ☐ Before installing, set washers in cylinder head [⇒ Item 4 \(page 100\)](#) , Servicing valve gear

12 - Pin, 10 Nm

- ☐ For engine cover

13 - Cylinder head cover

- ☐ Before fitting, use clean cloth to thoroughly clean sealing surface of cylinder head

14 - To turbocharger

15 - 10 Nm

- ☐ First hand-tighten all bolts
- ☐ Then tighten first both top bolts and then the remaining bolts to the specified torque, working diagonally and from inside to outside

16 - 10 Nm

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17 - Bracket

- ☐ For fuel lines

18 - Pressure control valve

- ☐ For crankcase breather

19 - Fuel line

20 - Filler cap

- ☐ Renew seal if damaged

21 - Sealing collar

- ☐ Renew if damaged

22 - Gasket for cylinder head cover

- ☐ Renew if damaged

23 - 20 Nm

24 - Lifting eye

25 - Unit injector

- ☐ Removing and installing ⇒ Rep. gr. 23

26 - Main connector

- ☐ For unit injector

27 - From brake servo

28 - Tandem pump

- ☐ For fuel and vacuum supply
- ☐ Removing and installing ⇒ Rep. gr. 20
- ☐ Must not be dismantled

29 - Supply hose

- ☐ White or with white marking
- ☐ Check that it is securely seated
- ☐ Secure with spring-type clips

30 - Return hose

- ☐ Blue or with blue marking
- ☐ Check that it is securely seated
- ☐ Secure with spring-type clips

31 - Gasket

- ☐ Renew

32 - Bracket

33 - Tapered hexagon nut

34 - Cylinder head

- ☐ Removing and installing ⇒ [page 74](#)
- ☐ If renewed, change coolant in entire system

35 - Cylinder head gasket

- ☐ Renew
- ☐ Note marking ⇒ [page 72](#)
- ☐ If renewed, change coolant in entire system

36 - Glow plug

- ☐ 15 Nm
- ☐ Removing and installing ⇒ Rep. gr. 28

37 - Tensioning roller

38 - Turn 20 Nm + 45° further

Checking cylinder head for distortion

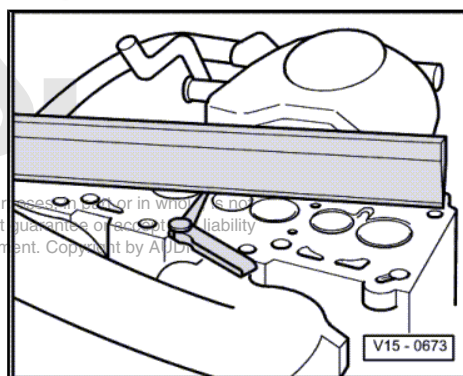
Max. permissible distortion: 0.1 mm



Note

The cylinder heads of diesel engines must not be machined.

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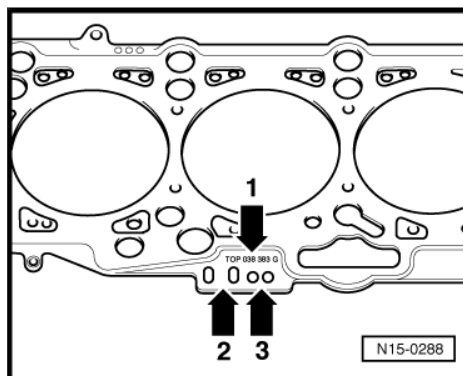
Cylinder head gasket identification

- ◆ Part number = arrow 1
- ◆ Production code = arrow 2 (can be disregarded)
- ◆ Holes = arrow 3



Note

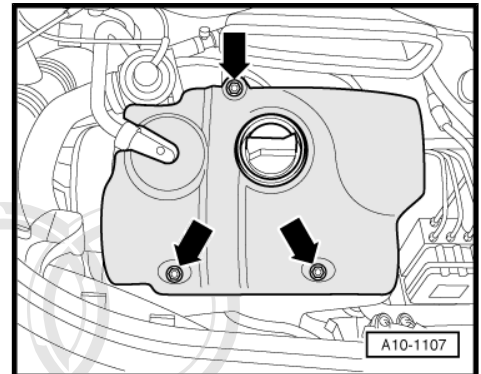
Cylinder head gaskets of different thicknesses are fitted depending on piston projection. When replacing the cylinder head gasket, install a new gasket with the same identification.



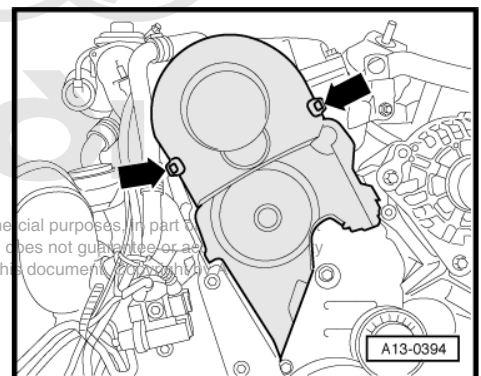
1.2 Removing and installing cylinder head cover

Removing

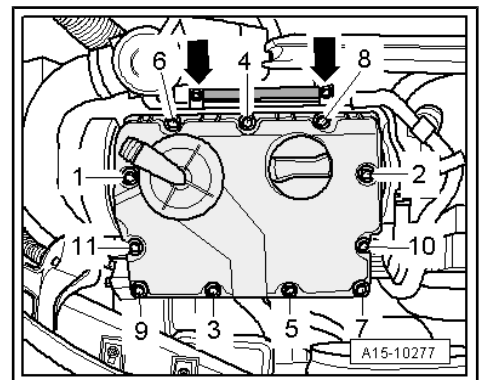
- Remove bonnet ⇒ [page 4](#) .
- Take off engine cover panel -arrows-.
- Remove noise insulation underneath (detach crankcase breather hose).



- Unclip water collector.
- Remove top toothed belt cover by releasing retaining clips -arrows-.



- Unscrew bolts -arrows- from bracket for fuel pipes on cylinder head cover.
- Remove cylinder head cover bolts in the sequence -11 ... 1-.
- Detach bracket with fuel pipes.
- Remove cylinder head cover.



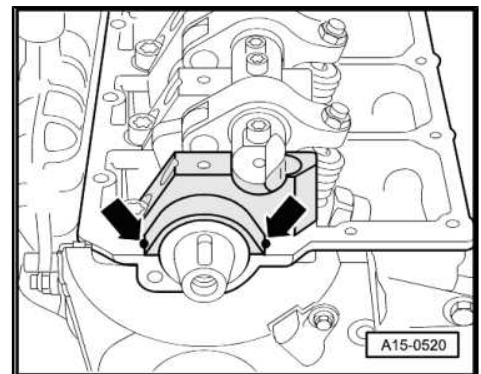
Installing

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

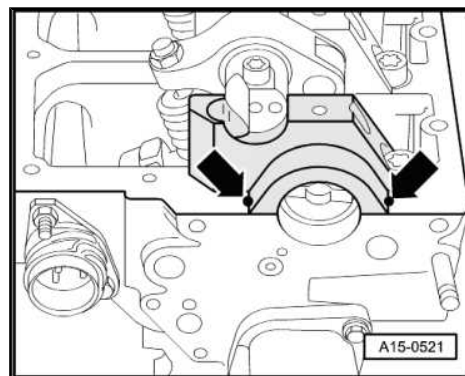


Note

- ◆ *Renew gasket for cylinder head cover if damaged.*
- ◆ *Renew cylinder head cover bolts if gasket is damaged.*
- Apply one drop of sealant (Ø approx. 5 mm) to each sealing point at front bearing cap/cylinder head -arrows-; for sealant refer to ⇒ Parts catalogue .



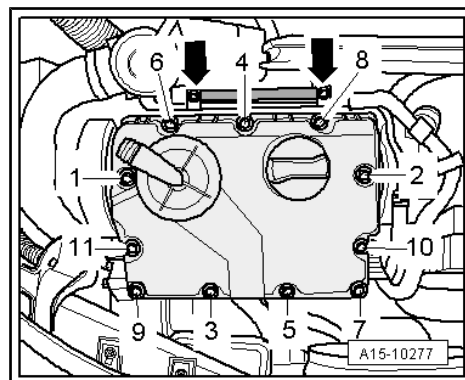
- Apply one drop of sealant ($\varnothing$ approx. 5 mm) to each sealing point at rear bearing cap/cylinder head -arrows-; for sealant refer to $\Rightarrow$ Parts catalogue .



- Tighten bolts for cylinder head cover to final setting in the sequence -1 ... 11-.

Tightening torques

Component	Nm
Cylinder head cover to cylinder head	10
Fuel pipe to bracket for pipe	10



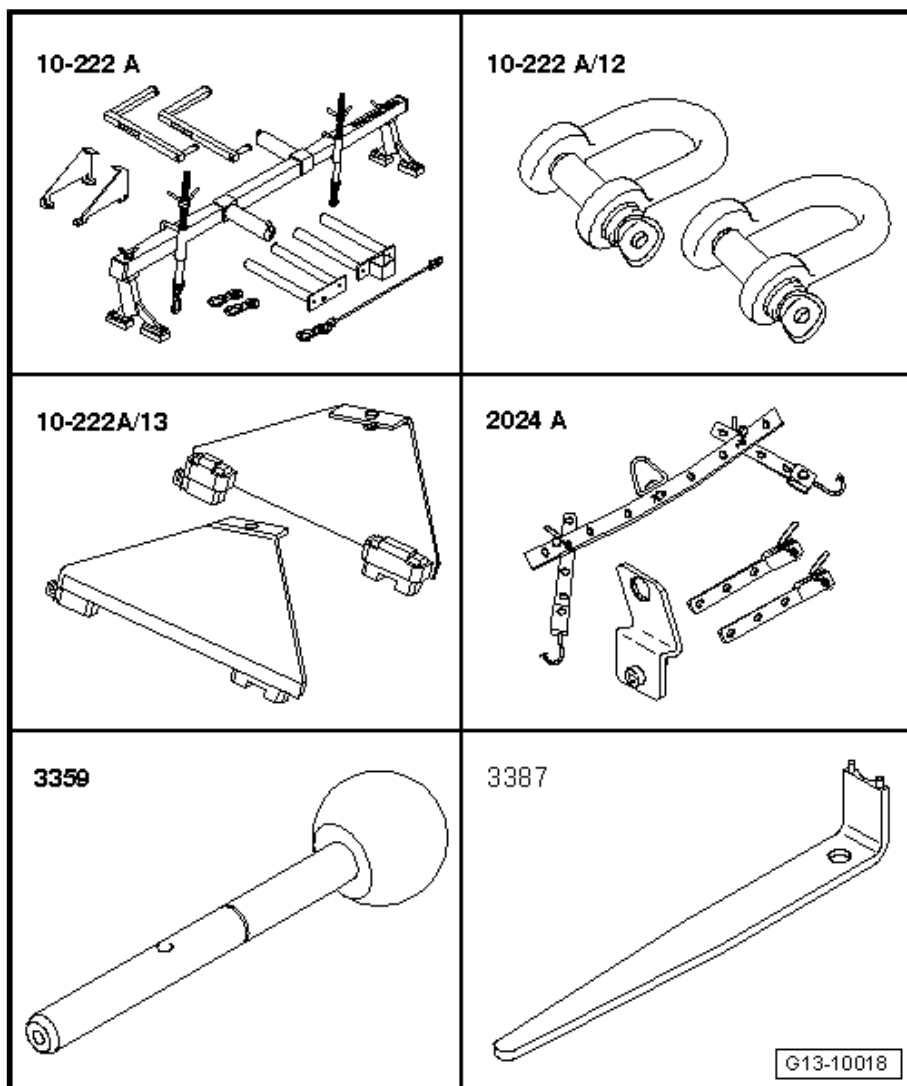
1.3 Removing and installing cylinder head



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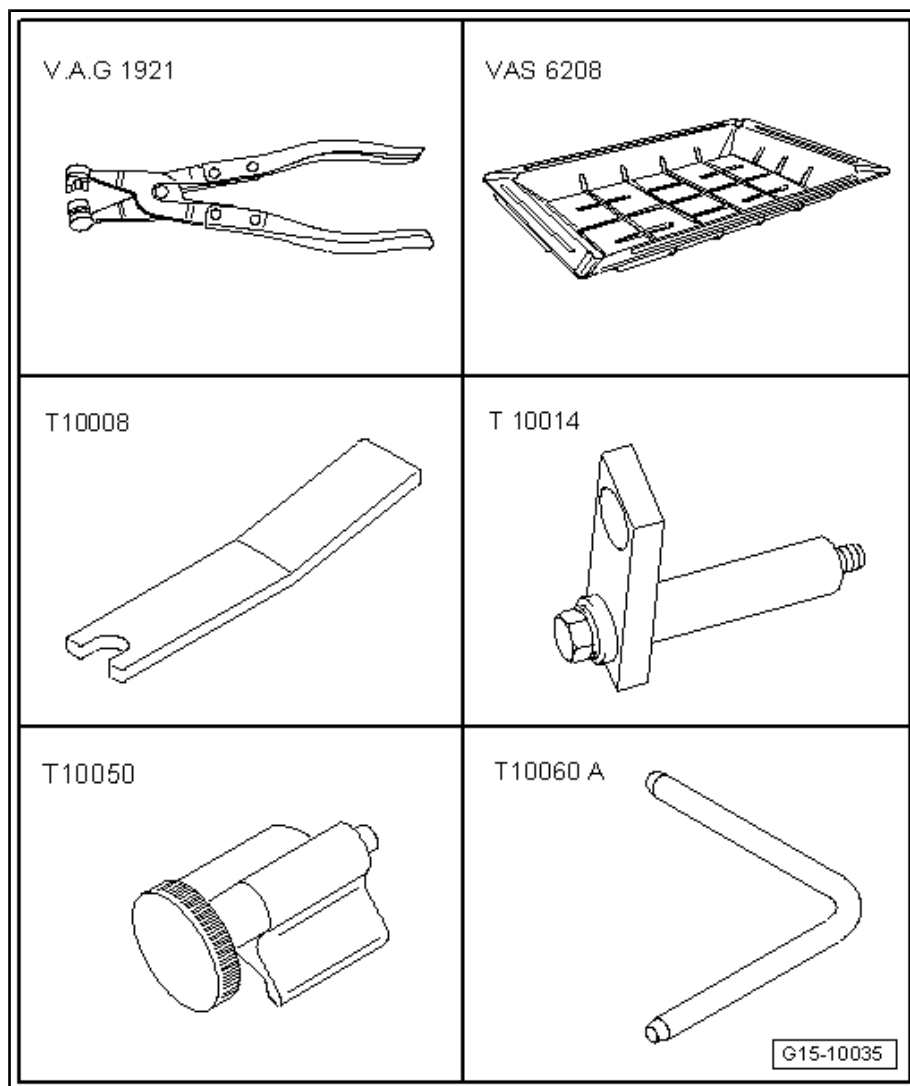
Special tools and workshop equipment required

- ◆ Support bracket -10-222 A-
- ◆ Shackle -10-222 A /12-
- ◆ Adapters -10-222 A /13-
- ◆ Lifting tackle -2024 A-
- ◆ Diesel injection pump locking pin -3359-
- ◆ Pin wrench -3387-

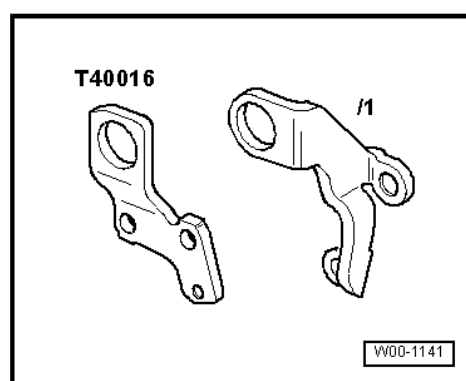


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- ◆ Hose clip pliers -V.A.G 1921-
- ◆ Drip tray for workshop hoist -VAS 6208-
- ◆ Locking plate -T10008-
- ◆ Retainer -T10014-
- ◆ Crankshaft stop -T10050-
- ◆ Locking pin -T10060 A- or -T10060-

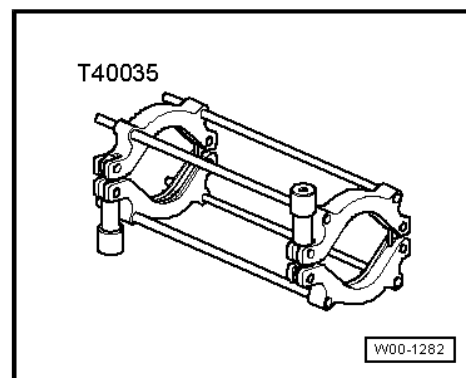


- ◆ Transportation shackle -T40016- with -T40016/1-



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◆ Setting tool -T40035-



Removing



Caution

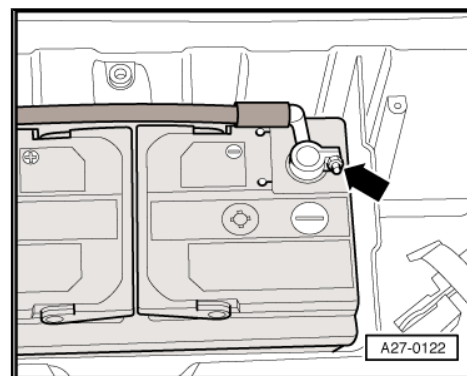
Observe notes on procedure for disconnecting the battery → Rep. gr. 27.



Note

The battery is located in the luggage compartment panel.

- Switch off ignition and remove ignition key.
- Disconnect earth cable -arrow- at battery.
- Remove bonnet → [page 4](#).



Note

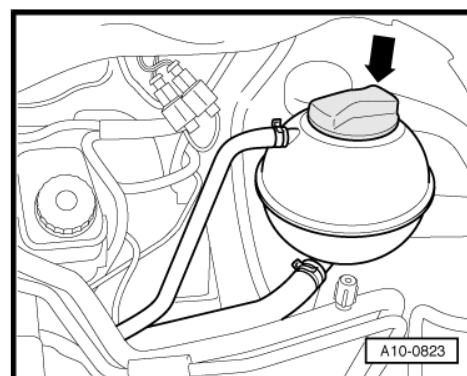
Collect drained coolant in a clean container for re-use or disposal.



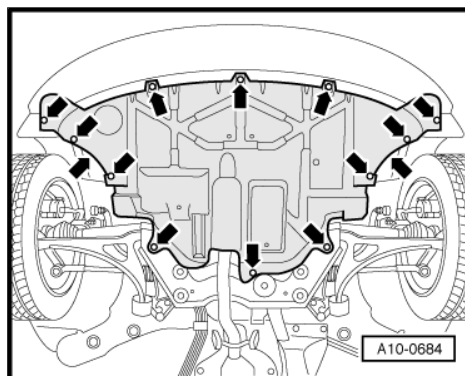
WARNING

Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.

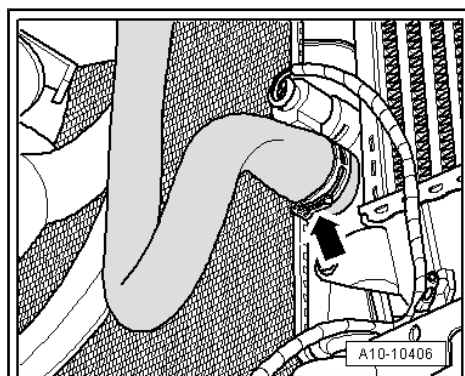
- Open filler cap -arrow- on coolant expansion tank.



- Remove noise insulation -arrows-.



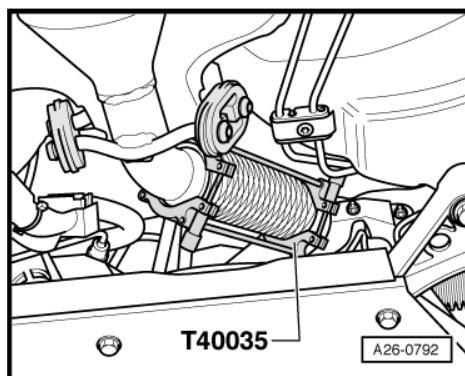
- Place drip tray for workshop hoist -VAS 6208- under engine.
- Disconnect coolant hose (bottom) at radiator -arrow- and drain off coolant.



Note

Do not bend the flexible joint (de-coupling element) between starter catalytic converter and main catalytic converter more than 10°, otherwise it could be damaged.

- Support flexible joint (decoupling element) with fixing tool -T40035-.

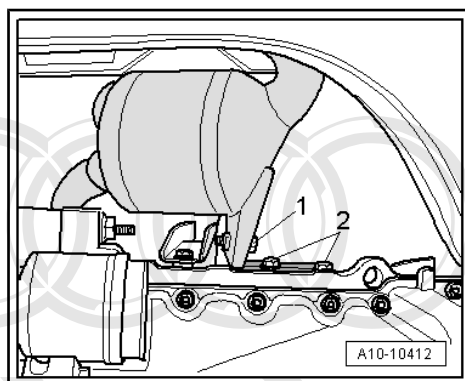


- Remove bolts -2- on bracket for starter catalytic converter.



Note

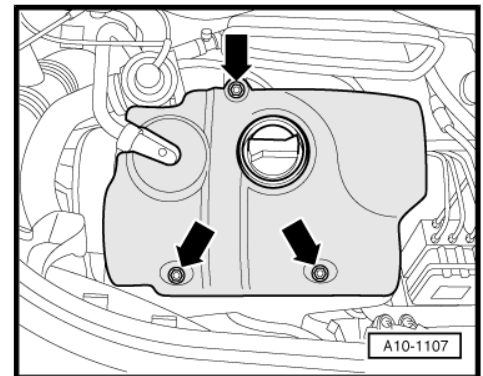
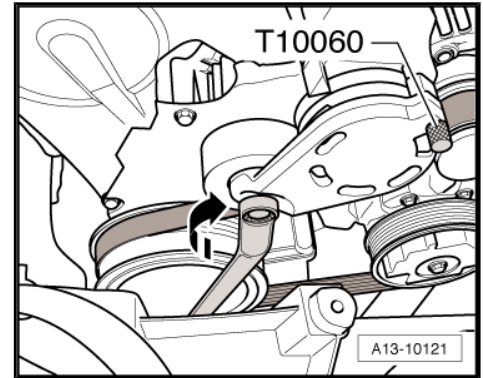
Disregard -item 1-.



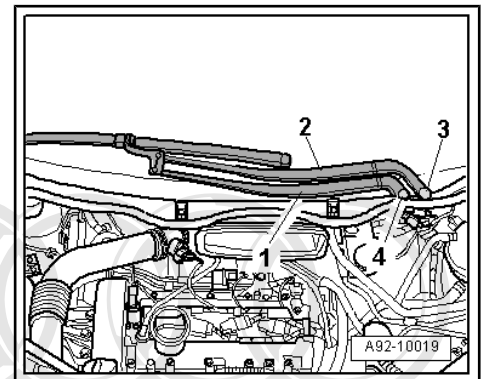
**Note**

Mark rotation direction of poly V-belt with chalk or a felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

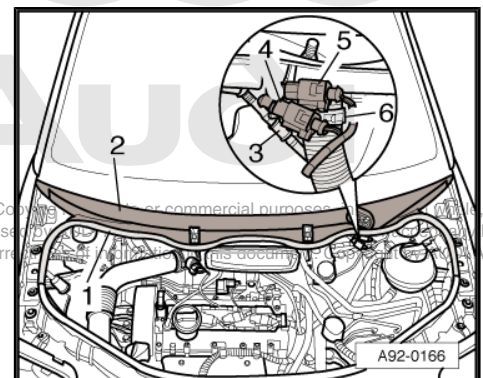
- Turn the tensioner in the direction of the -arrow- using a spanner to slacken the poly V-belt.
- Lock tensioner in position by inserting locking pin -T10060 A- or -T10060- in locating holes.
- Remove poly V-belt.
- Take off engine cover panel -arrows-.
- Remove noise insulation underneath (detach crankcase breather hose).



- Use screwdriver to lever off cover caps -3- and -4- from wiper arms.
- Slacken nuts on both wiper arms a few turns.
- Loosen wiper arms -1- and -2- from wiper shafts by tilting slightly.
- Completely remove nuts and take off wiper arms.

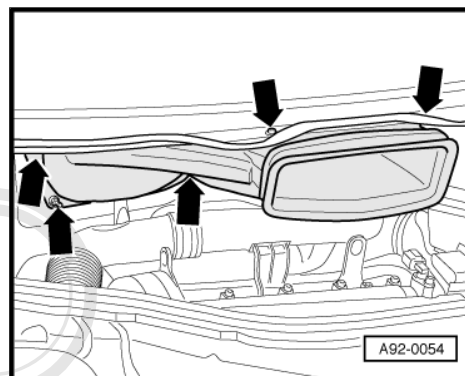


- Disconnect washer fluid hose -3-.
- If fitted, unplug electrical connectors -4- and -5- for heated washer jets.
- Open hose clip -6- using hose clip pliers -V.A.G 1921- and detach water drain hose from cowl panel grille.
- Pull off rubber seal -1- on cowl panel grille.
- Disconnect cowl panel grille -2-.



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- Unscrew nuts and bolts -arrows-.
- Pull air duct forwards, move it to right side of vehicle and remove.

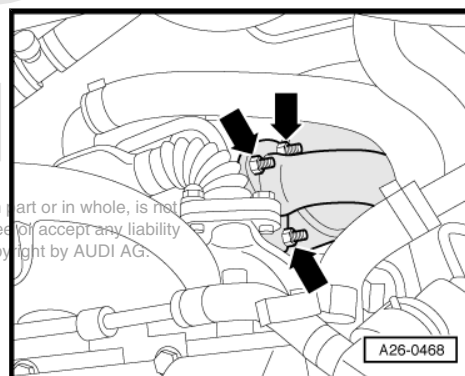


- Unscrew nuts -arrows- at turbocharger/starter catalytic converter.

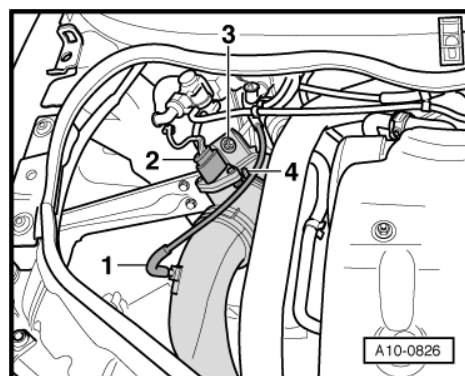


Note

Do not bend the flexible joint (de-coupling element) between starter catalytic converter and main catalytic converter more than 10°, otherwise it could be damaged.



- Disconnect starter catalytic converter from turbocharger.
- Tie up starter catalytic converter to body.
- Unplug electrical connector -2- at air mass meter -G70- .
- Detach vacuum hose -1-.
- Release hose clip -4- and remove air pipe with air mass meter -G70- .
- Remove nut -3-.

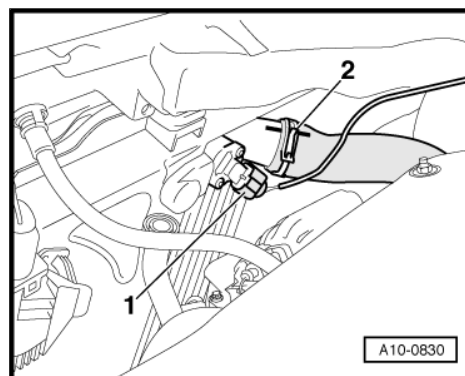


- Remove air intake hose -2- between charge air cooler and intake manifold.



Note

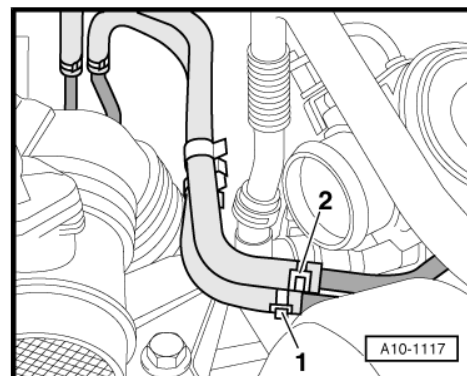
Disregard -item 1-.



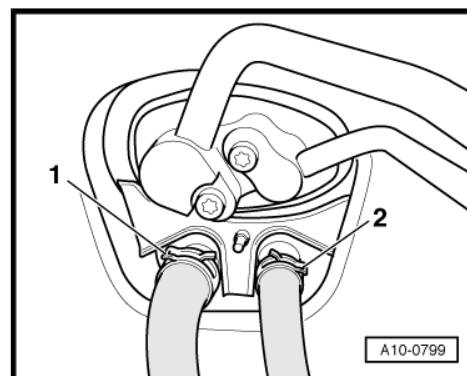
WARNING

- ◆ *In extreme cases the fuel lines and the fuel can reach a temperature of 100 °C on vehicles with unit injector engine. Allow the fuel to cool down before disconnecting the lines - danger of scalding.*
- ◆ *Wear protective gloves.*
- ◆ *Wear safety goggles.*

- Mark fuel supply line -2- and fuel return line -1-.

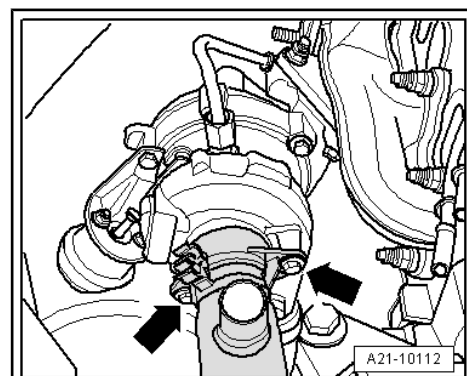


- Mark fuel supply line -1- and fuel return line -2- going to heat exchanger and remove hoses from bulkhead.



- Unscrew bolts -arrows- and detach air pipe from turbocharger.

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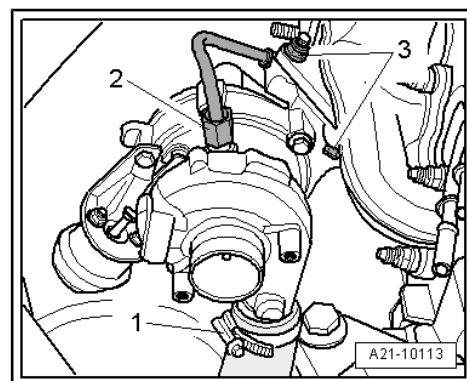


- Detach air hose -1- from turbocharger.
- Unscrew oil supply line -2- from turbocharger.

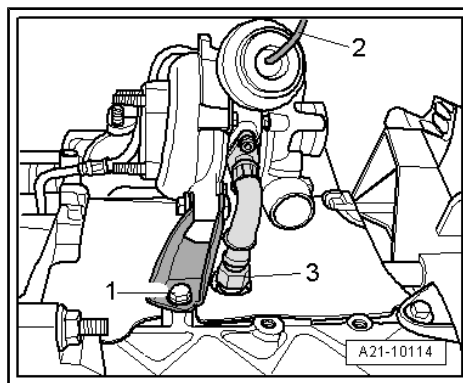


Note

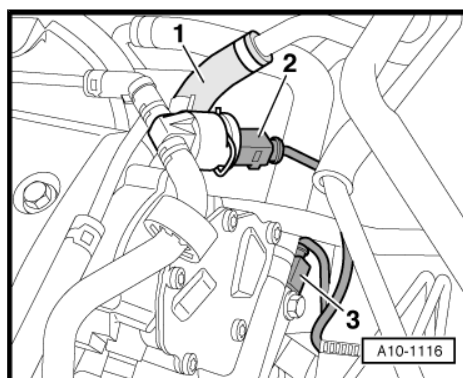
Disregard -item 3-.



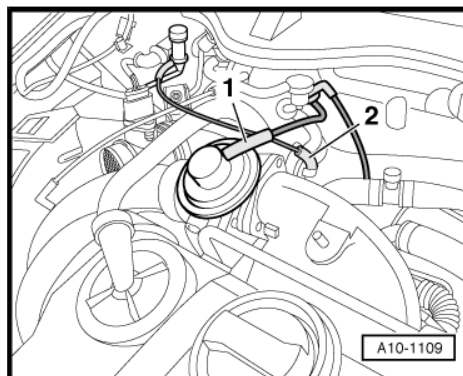
- Detach vacuum hose -2- leading to vacuum unit for charge pressure control and move it clear.
- Unbolt oil return line -3- at cylinder block.
- Unbolt support -1- for turbocharger from cylinder block.



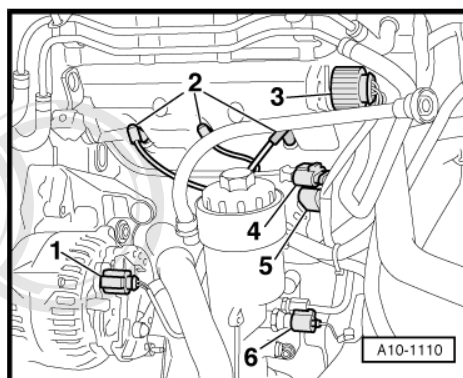
- Detach vacuum hose -1- from brake servo.
- Unplug electrical connector -2- at fuel temperature sender - G81- and move wiring clear.
- Unplug electrical connector -3- at coolant temperature display sender -G2- / coolant temperature sender -G62- .



- Disconnect vacuum hose -1- from mechanical exhaust gas recirculation valve.
- Disconnect vacuum hose -2- from throttle butterfly valve - N211- .



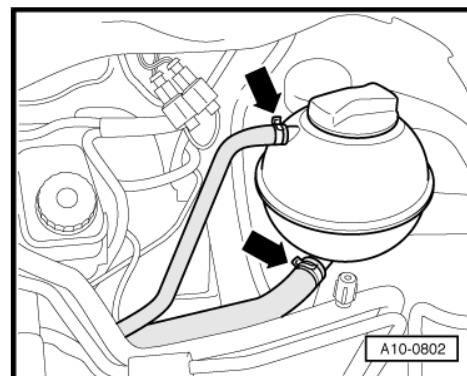
- Unplug electrical connectors -2- on glow plugs.
- Pull retaining tab and loosen knurled nut -3- at main connector for unit injectors.
- Unplug electrical connector -4- at Hall sender -G40- and remove electrical connector from retainer.



Note

Disregard -items 1, 5, 6-.

- Unbolt top coolant hose from coolant expansion tank -top arrow-.



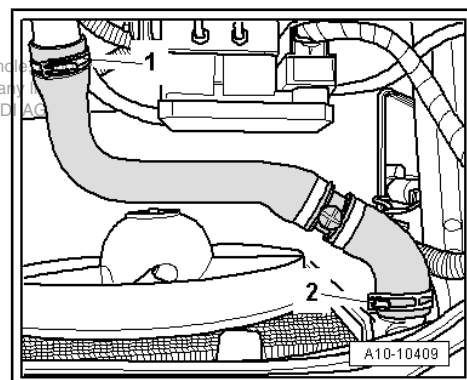
- Detach coolant hose (top left) from coolant hose/pipe connection at the location indicated -1-.

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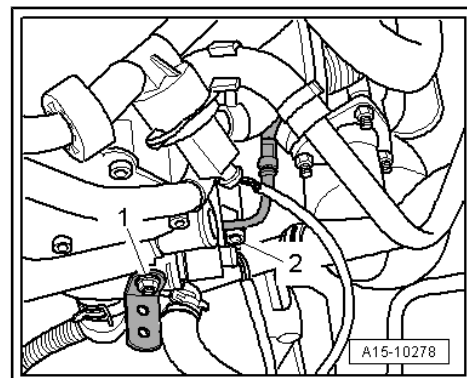


Note

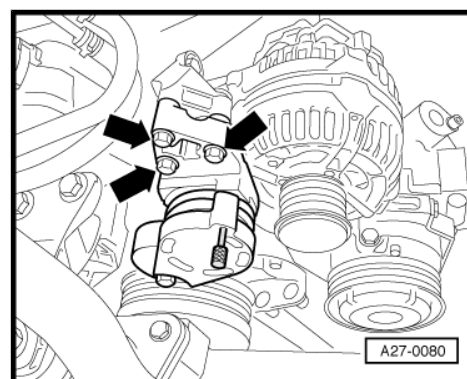
Disregard -item 2-.



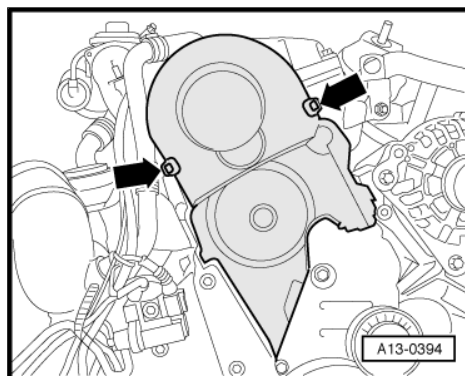
- Unbolt bracket -1- for wiring harness from top of coolant hose/pipe connection.
- Unscrew bracket -2- for oil supply line at bottom of coolant hose/pipe connection from turbocharger.



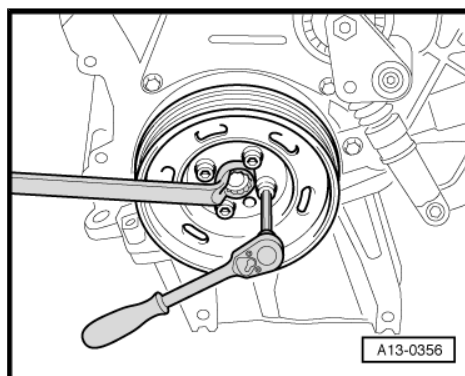
- Unscrew poly V-belt tensioner -arrows-.



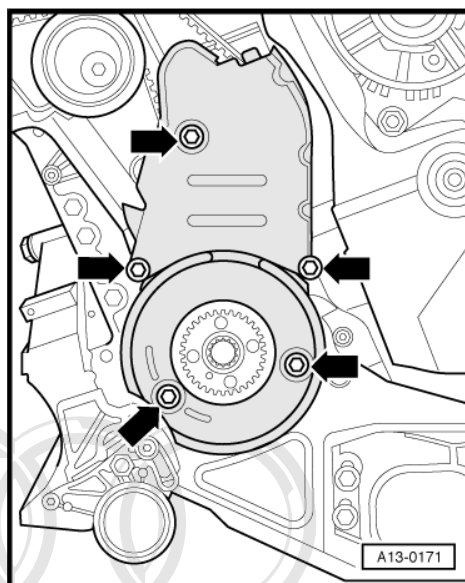
- Remove top toothed belt cover by releasing retaining clips -arrows-.



- Unbolt vibration damper; counterhold on centre bolt with ring spanner.



- Unbolt toothed belt cover (centre and bottom) -arrows-.



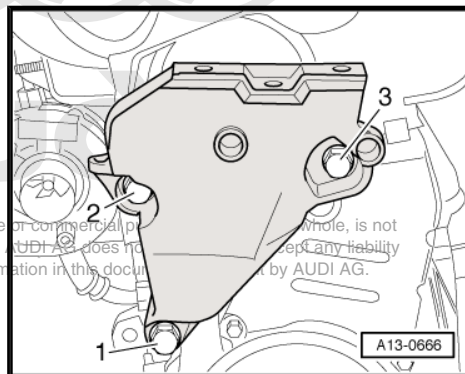
- Remove bottom bolt -1- for engine support.



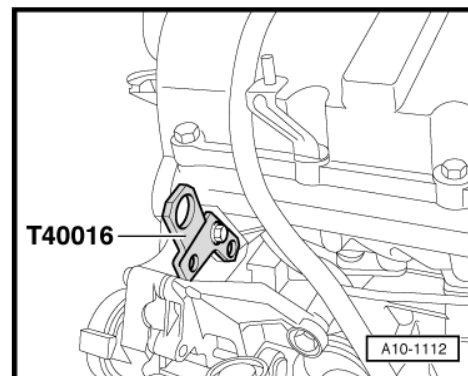
Note

Bolts -2- and -3- do not have to be loosened at this stage.

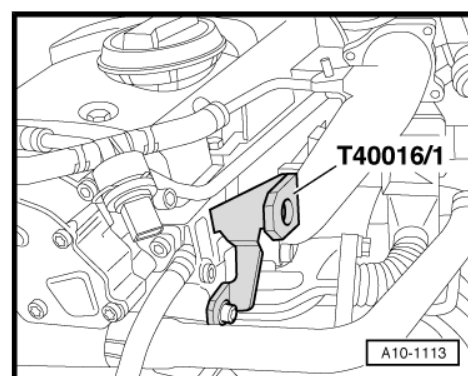
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- Screw transportation shackle -T40016- onto front right on cylinder head.



- Screw transportation shackle -T40016/1- onto rear left of cylinder head.

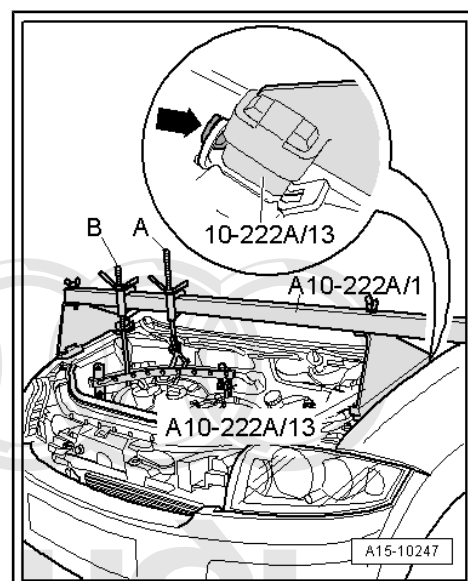


- Set up support bracket -10-222 A- with adapter -10-222 A/13- and 2 spindles -A- and -B- on wing panel flanges.
- The spindles of support bracket are located at front.



Note

The second spindle -B- (right-side) is not used at this stage.



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- Screw both shackles -10-222 A/12- onto transportation shackle -T40016- on rear left of cylinder head.
- Attach the lifting tackle -2024 A- to engine and spindle -A- of support bracket -10-222 A- as shown in the illustration.



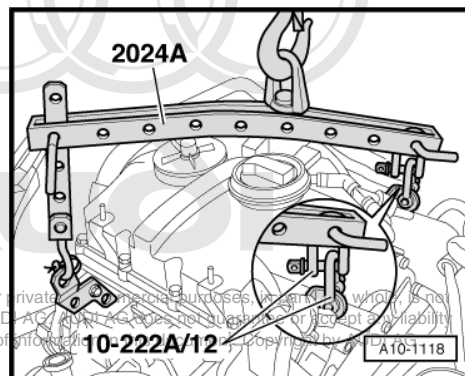
Note

To adjust to the centre of gravity of the assembly, the perforated rails of the support hooks must be positioned **as shown**.



WARNING

The hook attachments and locating pins on the lifting tackle must be secured with locking pins.



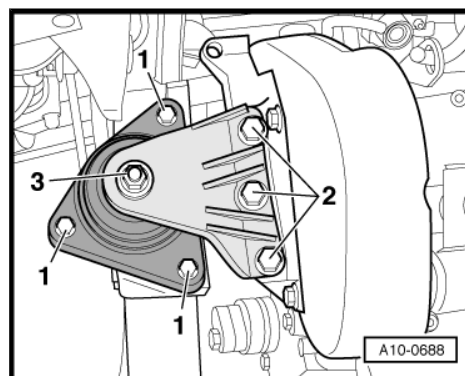
- Take up weight of engine using spindle (do not raise).



Note

Do not loosen nut -3- unless renewing engine mounting.

- Remove bolts -1- and -2- and detach support arm with engine mounting.



- Remove top bolts -2- and -3- and detach engine support.



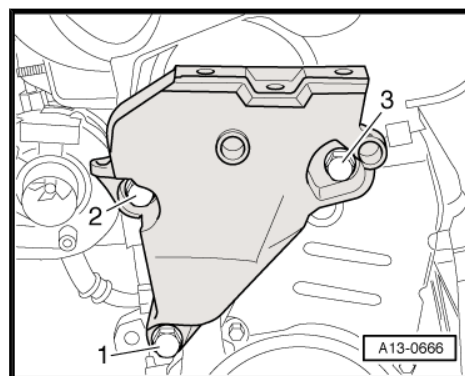
Caution

The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).



Note

Turn over the engine at the central bolt on the crankshaft.

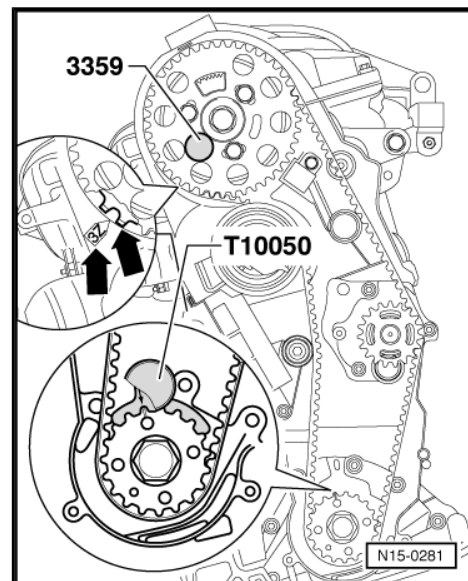


- Turn crankshaft to TDC of No. 1 cylinder.
- Arrow at rear toothed belt cover should face lugs on sender wheel of hub -arrows-.
- Lock hub on camshaft with locking pin -3359- .
- Lock crankshaft sprocket with crankshaft stop -T10050- .

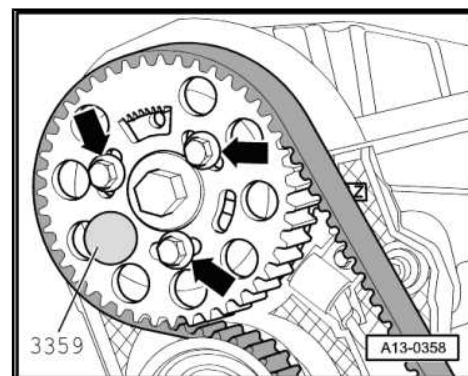
**Note**

ected by copyright. 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
The crankshaft stop can only be pushed onto the sprocket from the front face of the teeth.

- The markings on the toothed belt sprocket and the crankshaft stop -T10050- must align. The pin of the crankshaft stop -T10050- must engage in the aperture in the sealing flange.



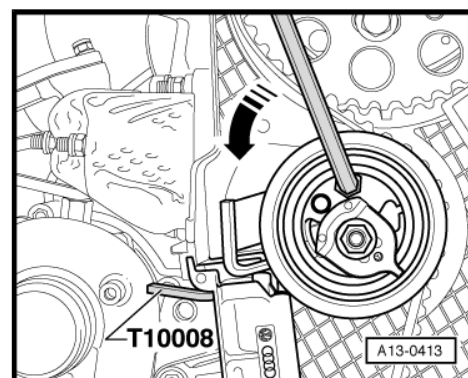
- Mark direction of rotation of toothed belt with chalk or felt-tip pen.
- Loosen securing bolts for camshaft sprocket -arrows-.



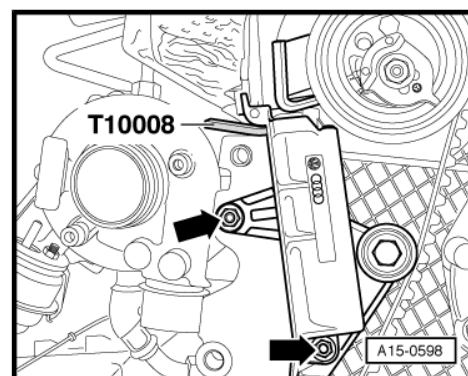
- Insert a hexagon key into the hexagon socket as far as the stop and use it to push the tensioning roller anti-clockwise -arrow- until you can lock the toothed belt tensioner with locking plate -T10008- .

**Note**

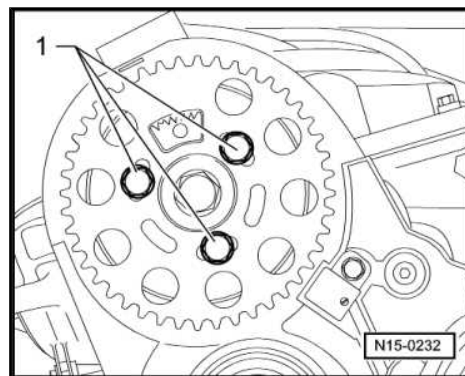
- ◆ Insert the hexagon key as far as stop, to prevent damage.
- ◆ The toothed belt tensioner is oil-damped and can therefore only be compressed slowly by applying constant pressure.



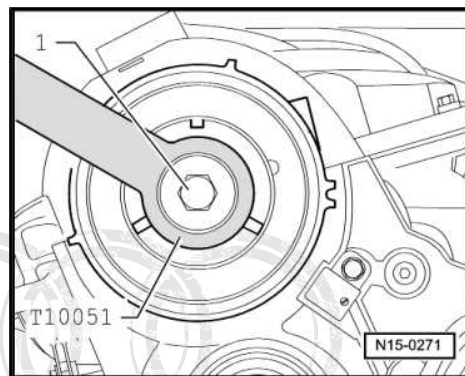
- Loosen securing nut for tensioning roller.
- Unscrew bolts -arrows- and detach toothed belt tensioner.
- Remove toothed belt.
- Remove locking pin -3359- .



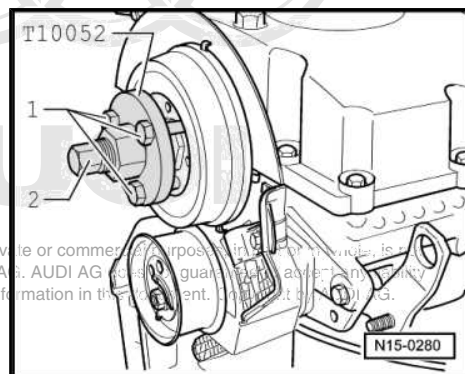
- Unscrew bolts -arrows- and detach camshaft sprocket from hub.



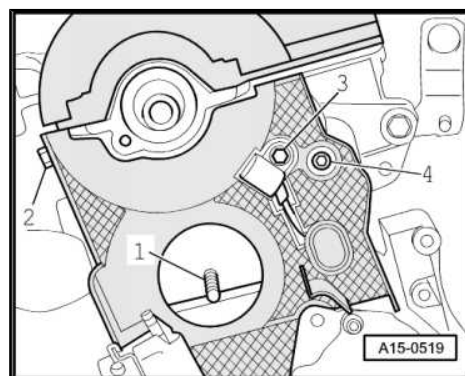
- Loosen bolt -1- for hub; use counterhold tool -T10051- .
- Then unscrew bolt approx. 2 turns.



- Fit puller -T10052- on hub and fit bolts -1-.
- Remove hub from camshaft by screwing in bolt -2- while counterholding at hexagon flats (30 mm) of puller.
- Detach hub from taper of camshaft.

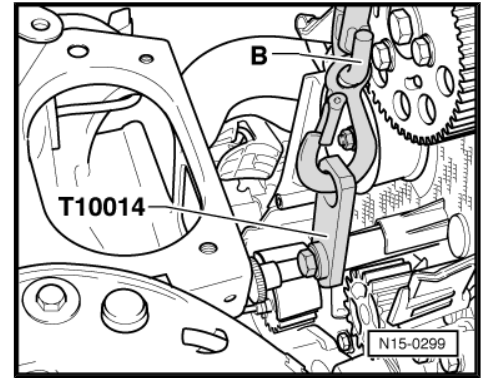


- Remove toothed belt tensioning roller.
- Remove bolts -2 ... 4-.
- Unscrew stud -1- using two M8 lock nuts.

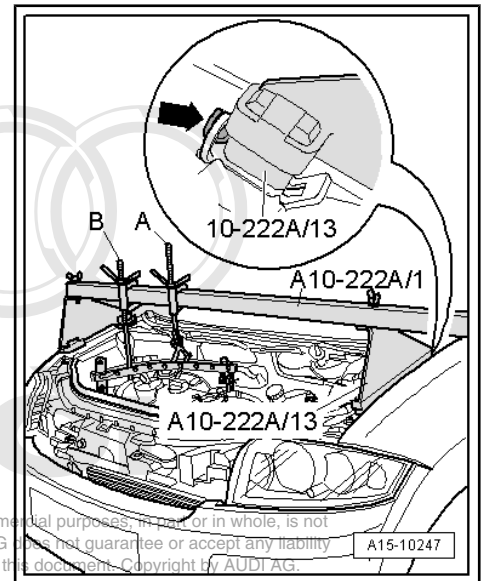


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- Screw in bracket -T10014- into threaded hole above coolant pump.

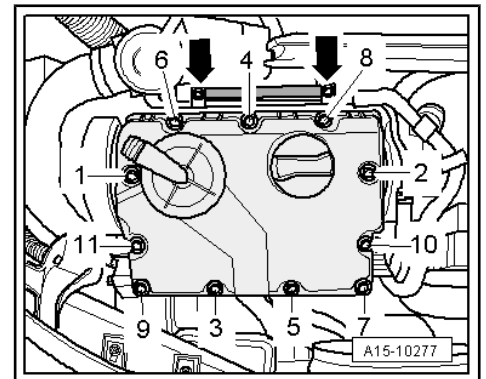


- Attach spindle -B- of support bracket -10-222 A- to retainer -T10014-.
- Lift engine via spindle -B- until spindle -A- has no more load.
- Detach lifting tackle -2024 A- at engine.
- Move lifting tackle -2024 A- and spindle -A- to side.



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- Unscrew bolts -arrows- from bracket for fuel pipes on cylinder head cover.
- Remove cylinder head cover bolts in the sequence -11 ... 1-.
- Detach bracket with fuel pipes.
- Remove cylinder head cover.



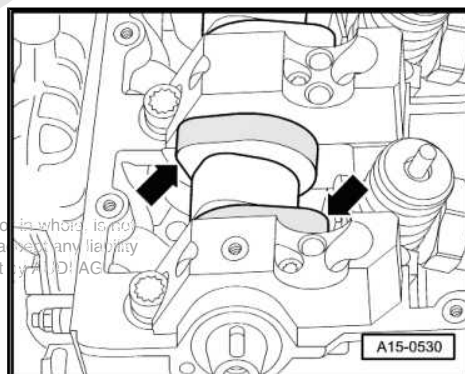
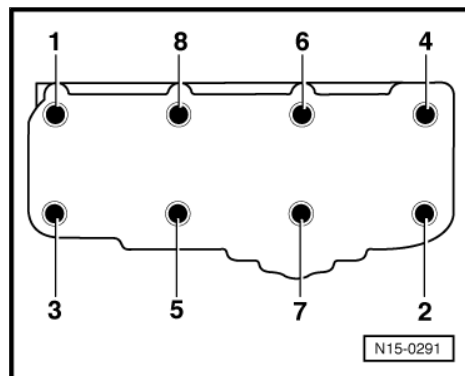
- Loosen cylinder head nuts in the sequence -1 ... 8-.
- Carefully lift off the cylinder head with the assistance of a 2nd mechanic.
- Lay cylinder head aside on a clean surface with the combustion chamber side facing upwards.

Installing



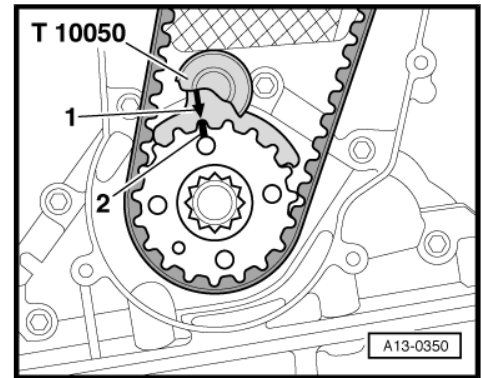
Note

- ◆ *Renew cylinder head nuts.*
 - ◆ *Renew self-locking nuts and bolts when performing assembly work.*
 - ◆ *Renew bolts which are tightened to a specified angle as well as oil seals and gaskets.*
 - ◆ *If repairing, carefully remove any remaining gasket material from the cylinder head and cylinder block. Ensure that no long scores or scratches are made on the surfaces.*
 - ◆ *Carefully remove any remaining emery and abrasive material.*
 - ◆ *Do not remove new cylinder head gasket from packaging until it is ready to be fitted.*
 - ◆ *Handle gasket very carefully. Damage to the silicone coating or the indented area will lead to leaks.*
 - ◆ *Cylinder heads with cracks between the valve seats may be used without reducing engine life, provided the cracks are small and not more than 0.5 mm wide.*
 - ◆ *The cylinder heads of diesel engines must not be machined.*
 - ◆ *When installing a replacement cylinder head with fitted camshaft, the contact surfaces between hydraulic tappets and cam running surfaces must be oiled after installing the cylinder head.*
 - ◆ *The plastic protectors fitted to protect the open valves should not be removed until the cylinder head is ready to be fitted.*
 - ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
 - ◆ *If engine oil is contaminated, perform oil change.*
 - ◆ *When fitting a new cylinder head or cylinder head gasket, drain off all the old coolant and refill with new coolant.*
 - ◆ *After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*
- Check whether the camshaft and the crankshaft are positioned at TDC:
 - The cams for cylinder 1 must point upwards evenly on camshaft -arrows-.



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- The crankshaft sprocket must be locked with the crankshaft stop -T10050- .
- The markings on the toothed belt sprocket and the crankshaft stop -arrow- must align. The lug of the crankshaft stop must engage in the bore in the sealing flange.



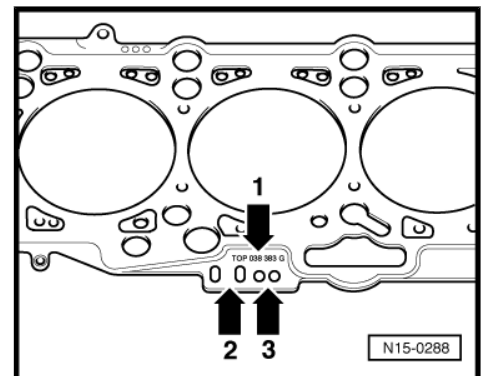
– Note identification markings on cylinder head gasket.

- 1 - Part No.
- 2 - Production code (can be disregarded)
- 3 - Holes



Note

- ◆ If the cylinder head gasket or cylinder head is renewed, be sure to install a gasket with the same identification.
- ◆ 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 67](#) .



- Fit cylinder head gasket.
- Note position of centring sleeves in cylinder block.
- Check installation position of cylinder head gasket: the word „oben“ (top) or the Part No. should face towards the cylinder head.
- Fit cylinder head.
- Check that all washers for cylinder head nuts are fitted in cylinder head.
- Fit new cylinder head nuts and tighten hand-tight.

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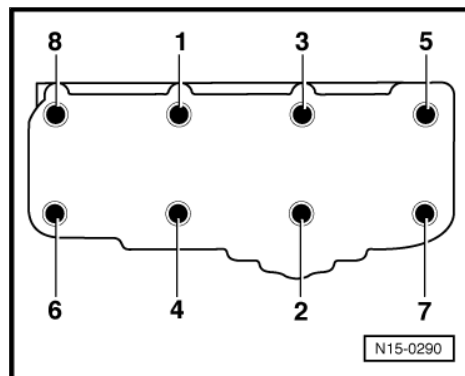
- Tighten cylinder head nuts in 7 stages in the sequence indicated:



Caution

To reduce the torsional stress in the tie bolts that occurs when the cylinder head nuts are tightened, the cylinder head nuts must be turned back in the last work step.

1. Tighten with torque wrench to 40 Nm.
2. Tighten with torque wrench to 60 Nm.
3. Turn 90° (1/4 turn) further using a rigid wrench.
4. Turn 90° (1/4 turn) further using a rigid wrench.
5. Turn 90° (1/4 turn) further using a rigid wrench.
6. Turn 90° (1/4 turn) further using a rigid wrench.
7. Turn back 90° (1/4 turn) using a rigid wrench.

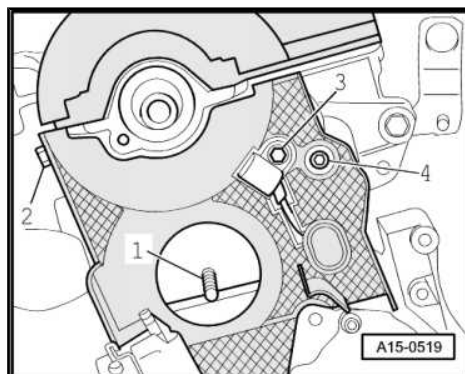


Note

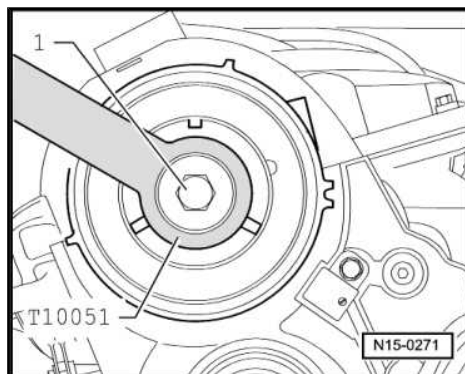
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Cylinder head nuts do not have to be torqued down again later after repair work.

- Apply locking fluid to bolts -2 ... 4- and tighten; for locking fluid refer to ⇒ Parts catalogue .
- Tighten stud -1- using two M8 lock nuts.



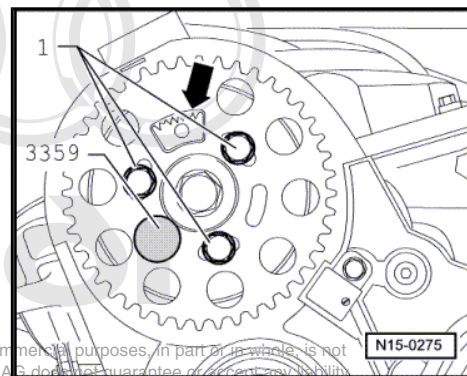
- Attach hub to camshaft.
- Tighten securing bolt -1- (use counterhold -T10051-).



- Push camshaft sprocket onto hub.
- Toothed segment -arrow- of camshaft sprocket must be at top.
- Screw in bolts -1- finger-tight.
- Lock hub on camshaft with locking pin -3359- .

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

- Install cylinder head cover ⇒ [page 73](#) .
- Install toothed belt (adjust valve timing) ⇒ [page 44](#) .



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Note

- ◆ *Follow all instructions for removing and installing toothed belt.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly. Do NOT use lubricant.*

- Install vibration damper ⇒ [page 33](#) .
- Install poly V-belt ⇒ [page 32](#) .
- Install engine mounting with support arm ⇒ [page 27](#) .
- Install starter catalytic converter together with main catalytic converter ⇒ [page 174](#) .
- Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Observe notes on procedures required after connecting battery ⇒ Rep. gr. 27 .
- Install and adjust wiper arms ⇒ Rep. gr. 92 .
- Check oil level ⇒ [page 132](#) .



Note

If engine oil is contaminated, perform oil change ⇒ Maintenance ; Booklet 809 .

- Fill cooling system with fresh coolant ⇒ [page 136](#) .

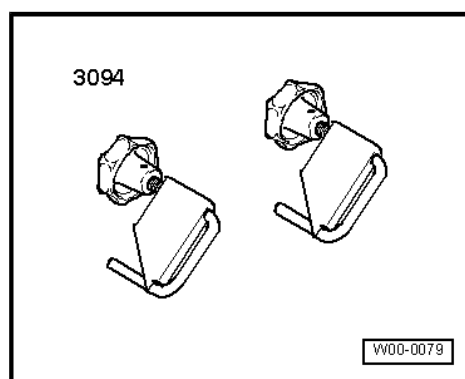
Tightening torques

Component	Nm
Hall sender -G40- to cylinder head	10 ¹⁾
Rear toothed belt cover to cylinder head	M6 10 ¹⁾
	M8 20 ¹⁾
Stud to cylinder head	15
Hub to camshaft	100
Engine support to cylinder block	45
Oil supply line to oil filter bracket	22
Oil return line to turbocharger	15
Top coolant pipe to lifting eye	20
Bracket for turbocharger to:	Turbocharger 20
	Cylinder block 20
Oil return line to cylinder block	30
Bracket for wiring harness to coolant hose/pipe connection	10
Bracket for oil supply line to coolant hose/pipe connection	10
Guide tube for oil dipstick to:	Oil filter bracket 10
	Lifting eye 10
Air pipe to turbocharger	8
¹⁾ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue .	

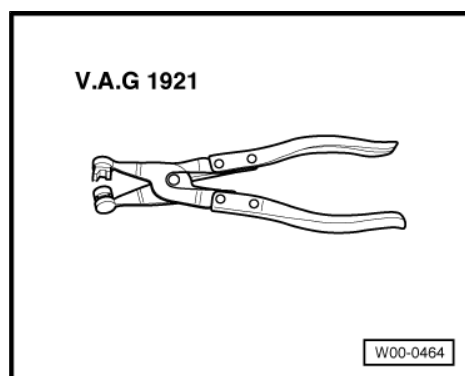
1.4 Removing and installing intake manifold

Special tools and workshop equipment required

- ◆ Hose clamps up to Ø 25 mm -3094-

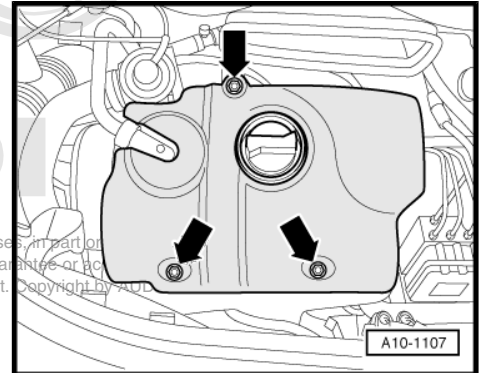


- ◆ Hose clip pliers -V.A.G 1921-

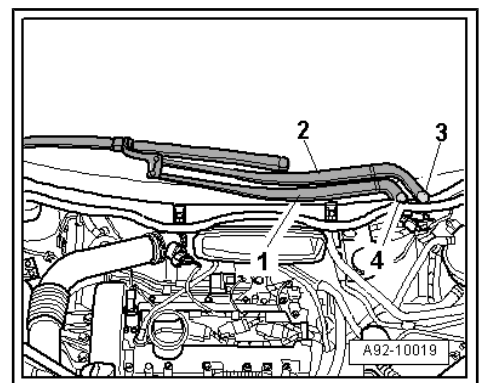


Removing

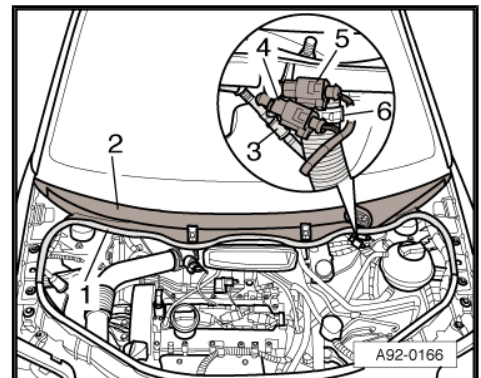
- Remove bonnet ⇒ [page 4](#) .
- Take off engine cover panel -arrows-.
- Remove noise insulation underneath (detach crankcase breather hose).



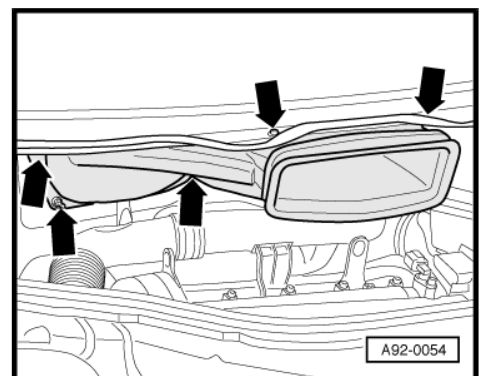
- Use screwdriver to lever off cover caps -3- and -4- from wiper arms.
- Slacken nuts on both wiper arms a few turns.
- Loosen wiper arms -1- and -2- from wiper shafts by tilting slightly.
- Completely remove nuts and take off wiper arms.



- Disconnect washer fluid hose -3-.
- If fitted, unplug electrical connectors -4- and -5- for heated washer jets.
- Open hose clip -6- using hose clip pliers -V.A.G 1921- and detach water drain hose from cowl panel grille.
- Pull off rubber seal -1- on cowl panel grille.
- Disconnect cowl panel grille -2-.



- Unscrew nuts and bolts -arrows-.
- Pull air duct forwards, move it to right side of vehicle and remove.

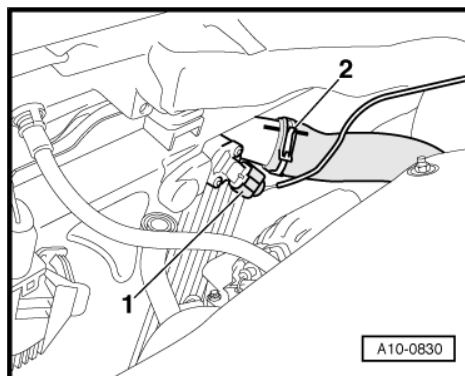


- Remove air intake hose -2- between charge air cooler and intake manifold.

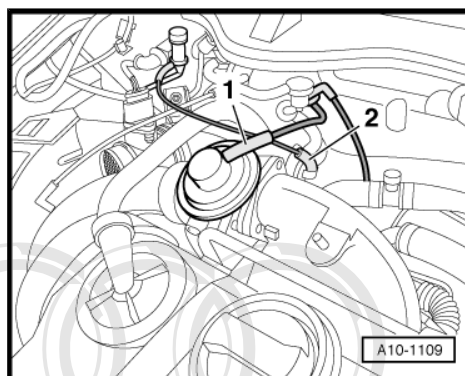


Note

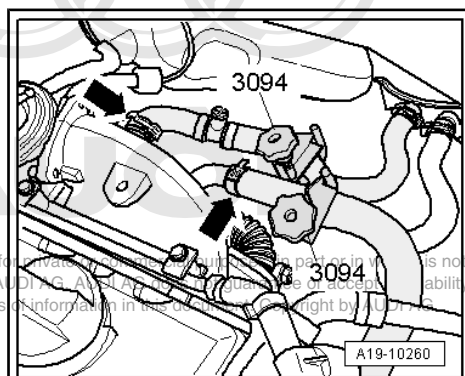
Disregard -item 1-.



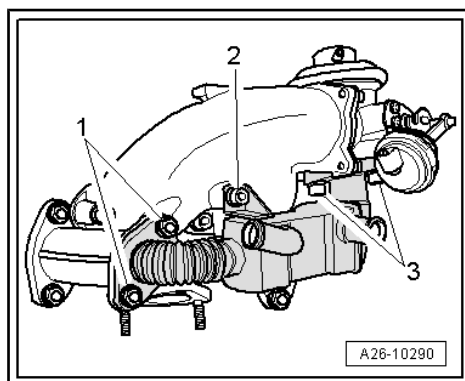
- Disconnect vacuum hose -1- from mechanical exhaust gas recirculation valve.
- Disconnect vacuum hose -2- from throttle butterfly valve - N211- .



- Clamp off coolant hoses going to exhaust gas recirculation cooler using hose clamps -3094- .
- Detach coolant hoses -arrow- at exhaust gas recirculation cooler.



- Remove bolts -2- and -3- and also nuts -1- and take off exhaust gas recirculation cooler.



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- Unscrew bolts -arrows- and remove intake manifold.

Installing

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

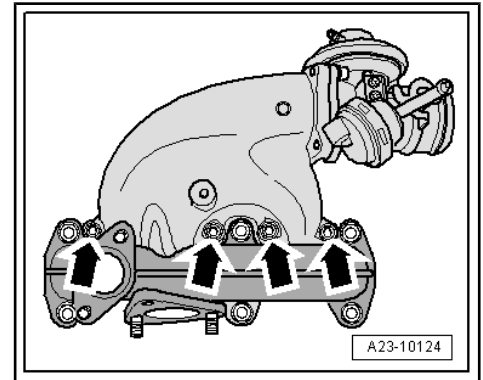
Note

- ◆ *Renew gaskets, seals and self-locking nuts.*
- ◆ *Charge air system must be free of leaks.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*

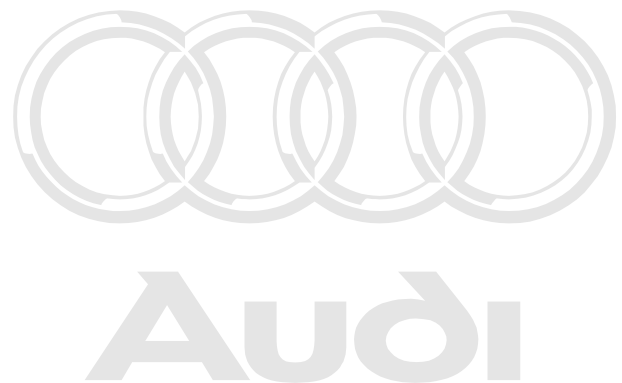
- Install and adjust wiper arms ⇒ Rep. gr. 92 .

Tightening torques

Component	Nm
Intake manifold to cylinder head	25
Exhaust gas recirculation cooler to:	Mechanical exhaust gas recirculation valve
	Intake manifold
	Exhaust manifold
• ¹⁾ Renew nuts.	



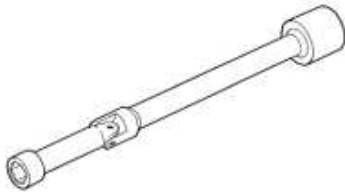
1.5 Checking compression



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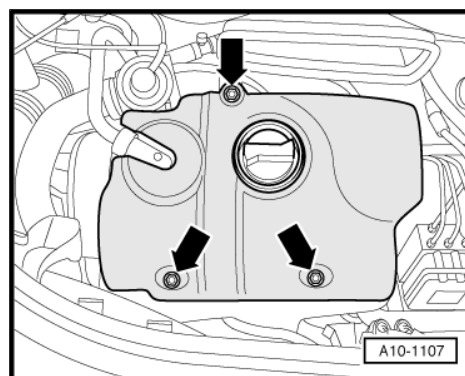
Special tools and workshop equipment required

- ◆ U/J extension and socket, 10 mm -3220-
- ◆ Torque wrench -V.A.G 1331-
- ◆ Adapter -V.A.G 1381/12-
- ◆ Compression tester -V.A.G 1763-

3220 	V.A.G 1331 
V.A.G 1381/12 	V.A.G 1763 
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Procedure

- Engine oil temperature at least 30 °C
- Battery voltage at least 12.5 V.
- Take off engine cover panel -arrows-.
- Remove noise insulation underneath (detach crankcase breather hose).



- Unplug electrical connectors -2- on glow plugs.
- Pull retaining tab and loosen knurled nut -3- at main connector for unit injectors.

**Note**

Ignore other items.

- Unscrew all glow plugs using jointed spanner -3220- .
- Screw in adapter -V.A.G 1381/12- in place of the glow plug in each cylinder.
- Test the compression pressure with the compression tester - V.A.G 1763- .

**Note**

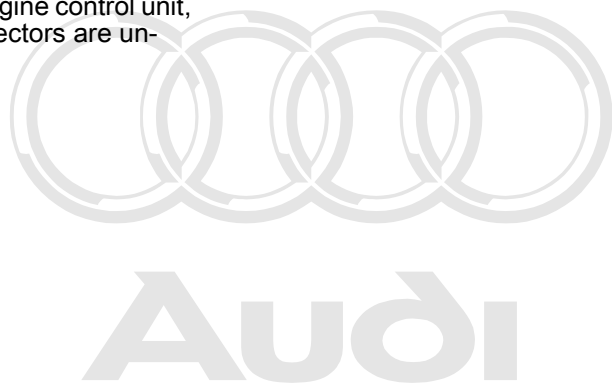
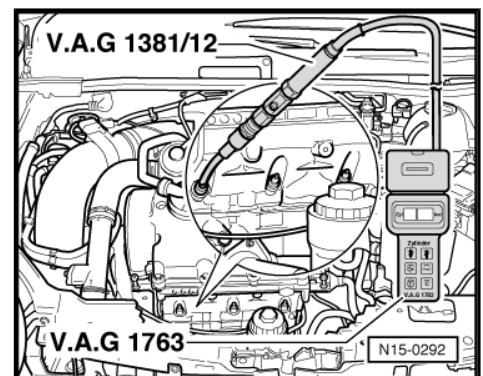
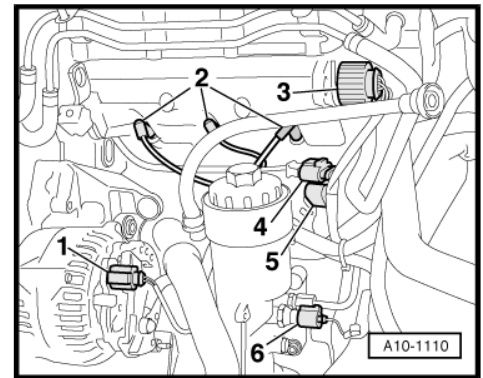
Using the compression tester ⇒ Operating instructions .

- Have a 2nd mechanic operate starter until tester shows no further pressure increase.

Compression pressure	bar
When new	25.0 ... 31.0
Wear limit	19.0
Difference between cylinders	5.0 (maximum)

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

- Install glow plugs ⇒ Rep. gr. 28 .
- Interrogate and erase the fault memory for engine control unit, as faults are stored when the electrical connectors are unplugged ⇒ Vehicle diagnostic tester.



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2 Servicing valve gear



Note

- ◆ After installing the camshaft, the engine must NOT be started for about 30 minutes. The hydraulic tappets have to settle (otherwise valves will strike pistons).
- ◆ After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.
- ◆ Renew seals and gaskets.
- ◆ All bearing and running surfaces must be oiled before assembling.
- ◆ Removing and installing tandem pump ⇒ Rep. gr. 20 .

2.1 Valve gear - exploded view

1 - 20 Nm + 1/4 turn (90°) further

- ☐ Renew
- ☐ Note correct sequence for loosening and tightening
⇒ „2.4 Removing and installing camshaft“, page 105

2 - Rocker arm shaft

- ☐ Note correct sequence for loosening and tightening
⇒ „2.4 Removing and installing camshaft“, page 105

3 - Cylinder head nut

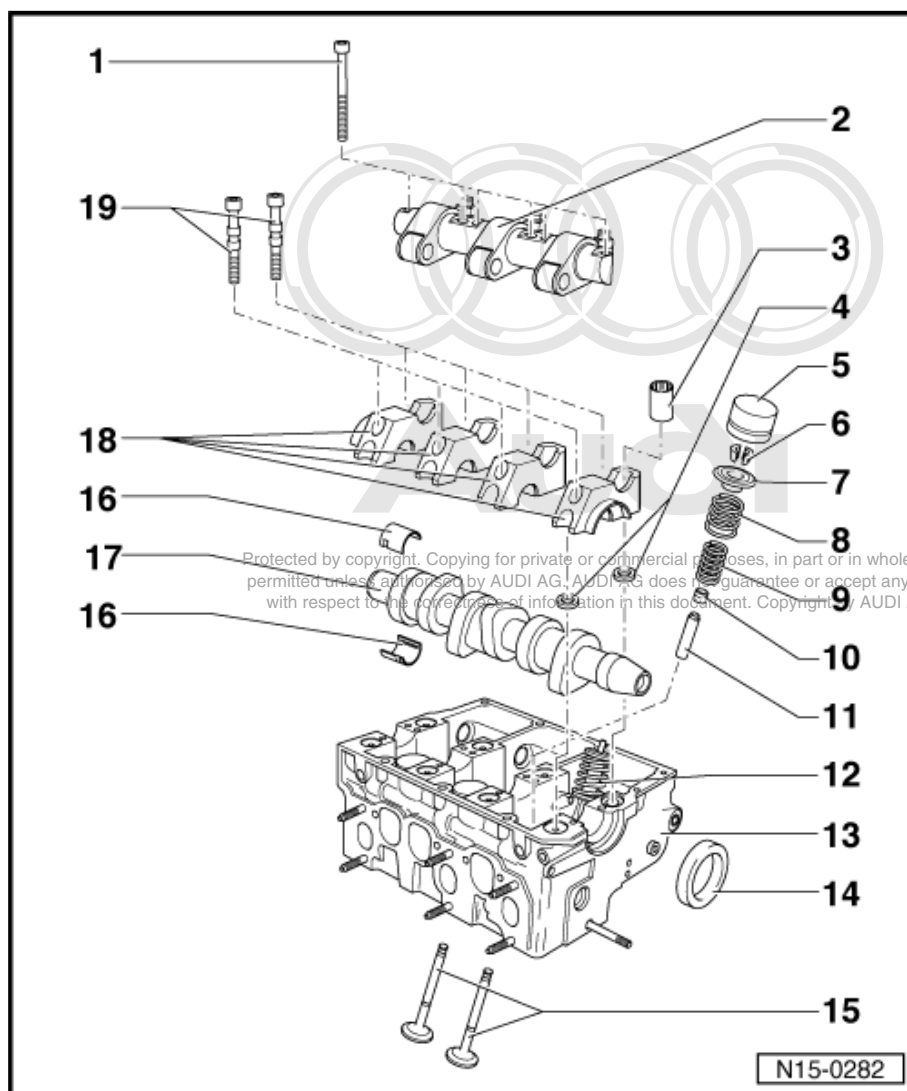
- ☐ Renew
- ☐ Note correct sequence for loosening and tightening
⇒ „1.3 Removing and installing cylinder head“, page 74
- ☐ Before installing, insert washers in cylinder head
⇒ Item 4 (page 100) .

4 - Washer

- ☐ For cylinder head nuts

5 - Hydraulic bucket tappet

- ☐ Checking ⇒ page 108
- ☐ Removing and installing
⇒ „2.4 Removing and installing camshaft“, page 105
- ☐ Do not interchange (mark allocation)
- ☐ Place down with contact surface facing downwards



- ☐ Check axial clearance of camshaft before installing ⇒ [page 102](#)
- ☐ Lubricate contact surface

6 - Valve cotters

7 - Valve spring plate

8 - Valve spring (outer)

- ☐ Removing and installing with cylinder head installed ⇒ „2.6 Renewing valve stem oil seals“, [page 109](#)
- ☐ Remove and install with cylinder head removed using valve spring compressor -2037-

9 - Valve spring (inner)

- ☐ Removing and installing with cylinder head installed ⇒ „2.6 Renewing valve stem oil seals“, [page 109](#)
- ☐ Remove and install with cylinder head removed using valve spring compressor -2037-

10 - Valve stem oil seal

- ☐ Renewing ⇒ [page 109](#)

11 - Valve guide

- ☐ Checking ⇒ [page 113](#)

12 - Unit injector

- ☐ Removing and installing ⇒ Rep. gr. 23
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13 - Cylinder head

- ☐ Machining valve seats ⇒ [page 114](#)

14 - Seal

- ☐ Renewing ⇒ [page 102](#)

15 - Valves

- ☐ Checking ⇒ [page 116](#)
- ☐ Valve dimensions ⇒ [page 113](#)
- ☐ Do not machine; only grinding in is permitted

16 - Bearing shell

- ☐ Note installation position
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Make sure that the retaining lugs are correctly seated in the bearing caps and the cylinder head

17 - Camshaft

- ☐ Check radial clearance with Plastigage
- ☐ Radial clearance: wear limit: 0.11 mm
- ☐ Runout: max. 0.01 mm
- ☐ Checking axial clearance ⇒ [page 102](#)
- ☐ Removing and installing ⇒ [page 105](#)

18 - Bearing cap

- ☐ Installation sequence ⇒ „2.4 Removing and installing camshaft“, [page 105](#)
- ☐ Bearing cap 4 is marked as bearing cap „5“.
- ☐ Apply sealant to bearing caps 1 and 4 ⇒ [page 102](#)

19 - 8 Nm + 1/4 turn (90°) further

- ☐ Renew

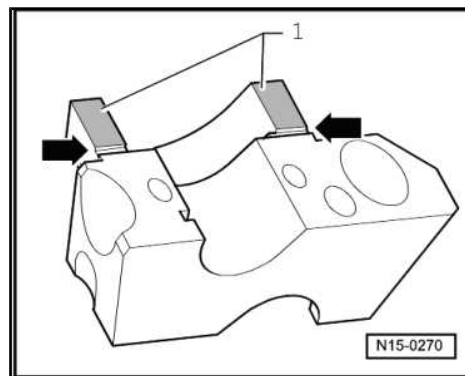
Applying sealant to bearing caps 1 and 4

- Apply a thin and even coat of sealant to surfaces -1-; sealant
⇒ Parts catalogue .



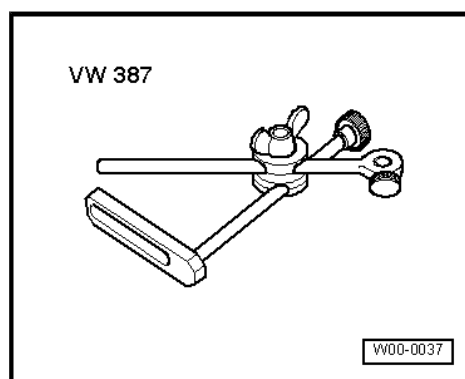
Note

- ◆ Make sure no sealant gets into the grooves -arrows-.
- ◆ Bearing cap 4 is marked as bearing cap „5“.

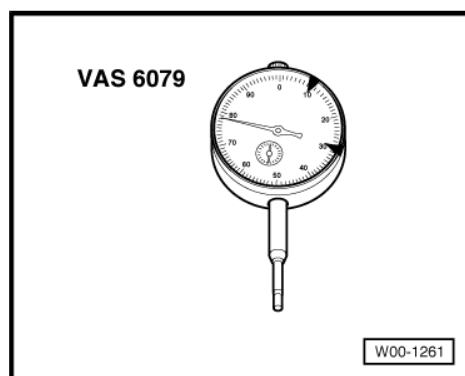


2.2 Checking axial clearance of camshaft

- ◆ Universal dial gauge bracket -VW 387-



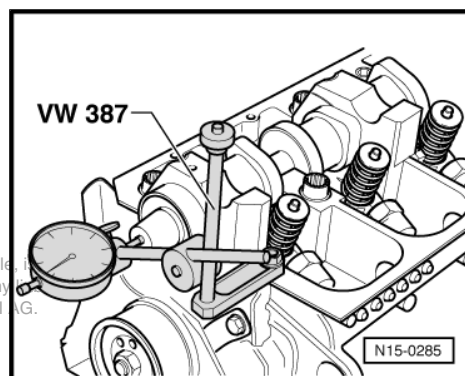
- ◆ Dial gauge -VAS 6079-



Procedure

- Measure with bucket tappets removed and bearing caps fitted.
- Secure universal dial gauge bracket -VW 387- with dial gauge -VAS 6079- to cylinder head.
- Determine axial clearance.
- Wear limit: 0.15 mm.

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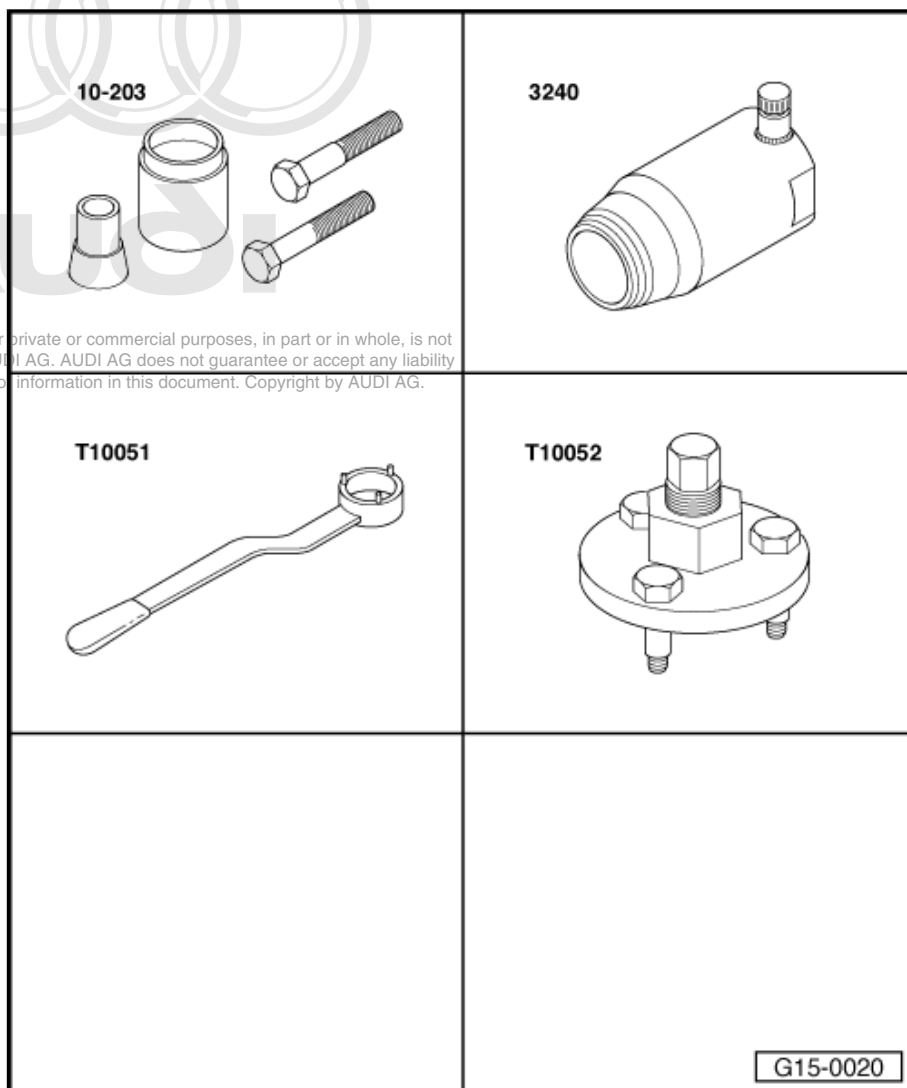


2.3 Renewing camshaft oil seal

Special tools and workshop equipment required

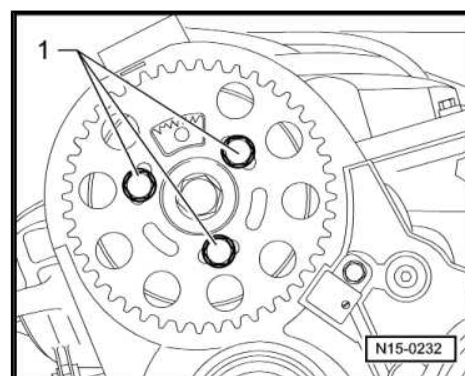
- ◆ Fitting tool -10-203-
- ◆ Oil seal extractor -3240-
- ◆ Counterhold tool -T10051-
- ◆ Puller -T10052-
- ◆ Bolt M12x65

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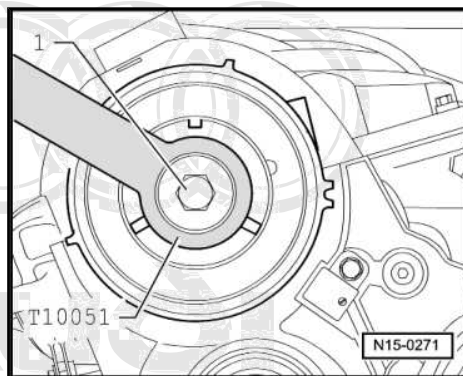


Procedure

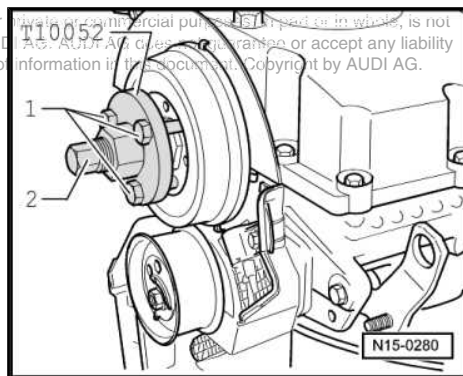
- Cylinder head installed.
- Remove toothed belt ⇒ [page 36](#) .
- Remove locking pin -3359- .
- Unscrew bolts -1- and detach camshaft sprocket from hub.



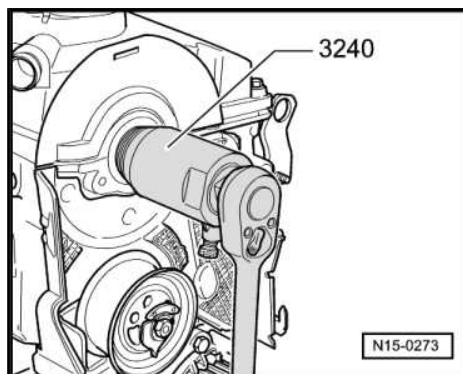
- Loosen bolt -1- for hub; use counterhold tool -T10051- .
- Then unscrew bolt approx. 2 turns.



- Fit puller -T10052- on hub and fit bolts -1-.
- Remove hub from camshaft by screwing in bolt -2- while counterholding at hexagon flats (30 mm) of puller.



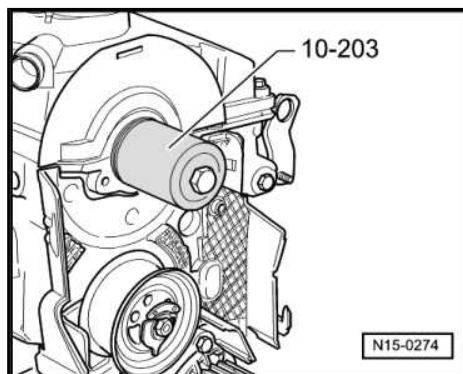
- Adjust inner part of oil seal extractor -3240- so that it is level with the outer part and lock in position with knurled screw.
- Lubricate threaded head of oil seal extractor, place it in position and, exerting firm pressure, screw it into camshaft oil seal as far as possible.
- Loosen knurled screw and turn inner section against camshaft until oil seal is pulled out.
- Clamp flats of oil seal extractor in vice.
- Remove oil seal with pliers.
- Clean running surface and sealing surface.



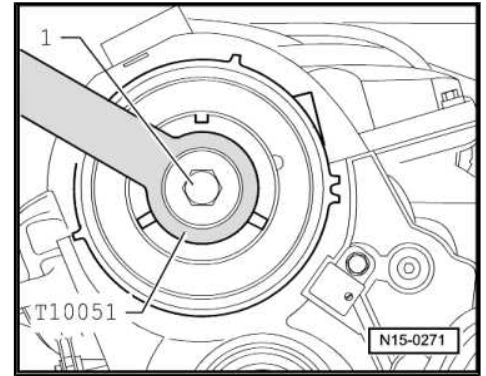
Note

The sealing lip of the oil seal must not be additionally oiled or greased.

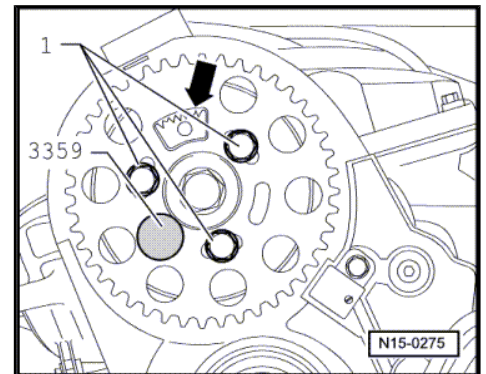
- Remove oil residue on camshaft journal with a clean cloth.
- Tape off groove on taper of camshaft with adhesive tape.
- Carefully position oil seal on camshaft.
- Press in oil seal with press piece of fitting tool -10-203- and bolt M12×65 as far as the stop.



- Attach hub to camshaft.
- Tighten securing bolt -1- (use counterhold -T10051-).



- Push camshaft sprocket onto hub.
- Toothed segment -arrow- in camshaft sprocket must face upwards.
- Screw in bolts -1- finger-tight.
- Lock hub on camshaft with locking pin -3359- .
- Install toothed belt (adjust valve timing) ⇒ [page 44](#) .



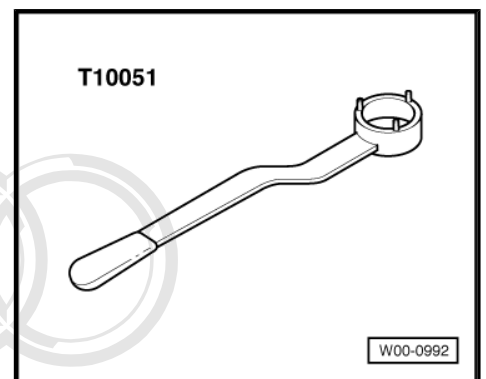
Tightening torque

Component	Nm
Hub to camshaft	100

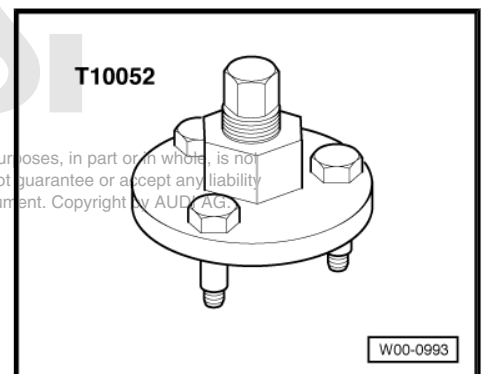
2.4 Removing and installing camshaft

Special tools and workshop equipment required

- ◆ Counterhold tool -T10051-



- ◆ Puller -T10052-

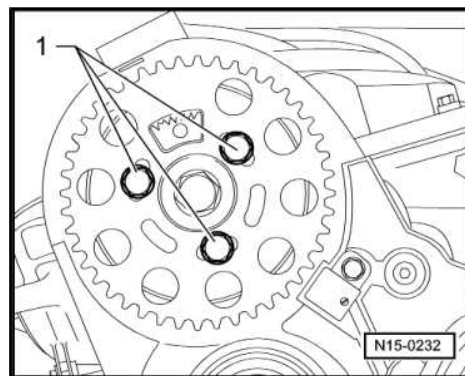


- ◆ Sealant ⇒ Parts catalogue

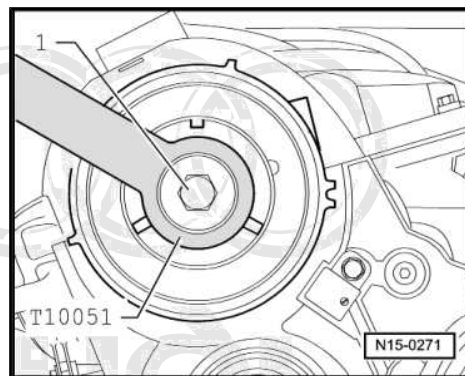
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Removing

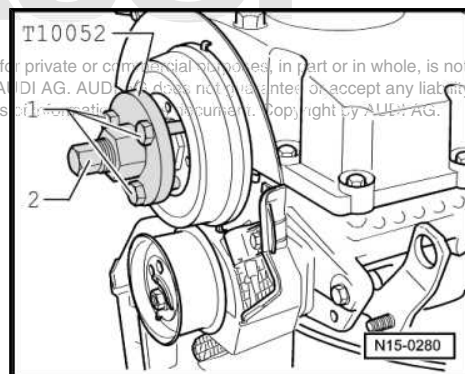
- Cylinder head installed.
- Remove toothed belt ⇒ [page 36](#) .
- Remove locking pin -3359- .
- Unscrew bolts -1- and detach camshaft sprocket from hub.



- Loosen bolt -1- for hub; use counterhold tool -T10051- .
- Then unscrew bolt approx. 2 turns.



- Fit puller -T10052- on hub and fit bolts -1-.
- Remove hub from camshaft by screwing in bolt -2- while counterholding at hexagon flats (30 mm) of puller.
- Remove cylinder head cover ⇒ [page 73](#) .
- First loosen outer bolts on rocker arm shaft, then inner bolts and remove rocker arm shaft.
- Remove tandem pump ⇒ Rep. gr. 20 .
- First remove bearing caps „2“ and „3“.
- Then loosen bearing caps „1“ and „4“ alternately in diagonal sequence.



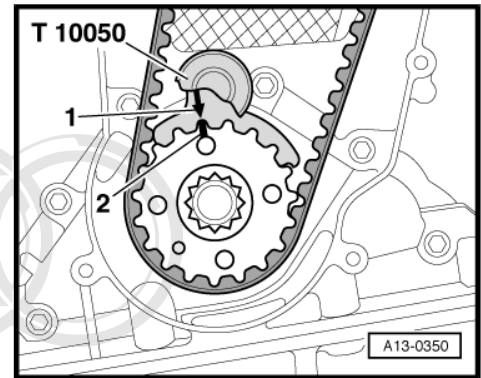
Note

- ◆ *Bearing cap „4“ is marked as bearing cap „5“.*
- ◆ *Make sure that the camshaft bearing shells are not interchanged.*
- ◆ *Mark allocation of camshaft bearing shells on rear with a waterproof felt-tip pen.*
- Remove camshaft.

Installing

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

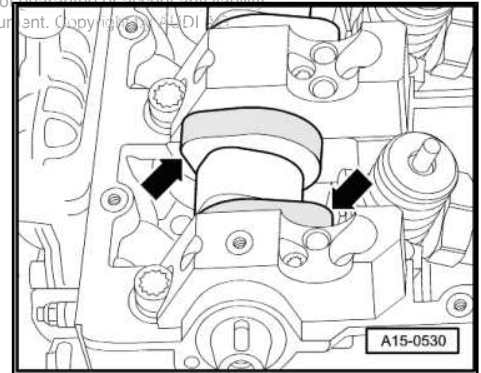
- The crankshaft sprocket must be locked with the crankshaft stop -T10050- .
- The markings on the toothed belt sprocket and the crankshaft stop -arrow- must align. The lug of the crankshaft stop must engage in the bore in the sealing flange.



Note

- ◆ *Make sure that the used camshaft bearing shells are not interchanged (note marking).*
- ◆ *When installing the camshaft, make sure that the retaining lugs on the bearing shells are correctly seated in the bearing caps and the cylinder head.*

- Lubricate contact surfaces of camshaft.
- Install camshaft in TDC position for cylinder 1:
- The cams for cylinder 1 must point upwards on camshaft -arrows-.
- Tighten bearing caps „2“ and „3“ alternately in diagonal sequence.

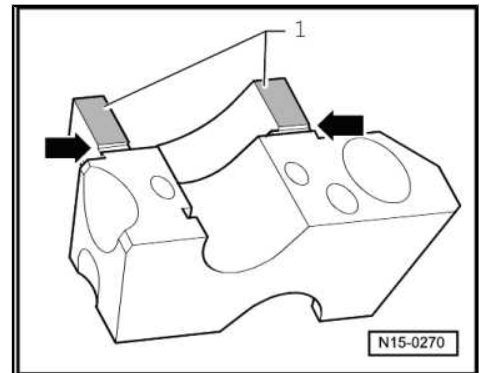


- Apply a thin and even coat of sealant to surfaces -1- on bearing caps „1“ and „4“; for sealant refer to ⇒ Parts catalogue .

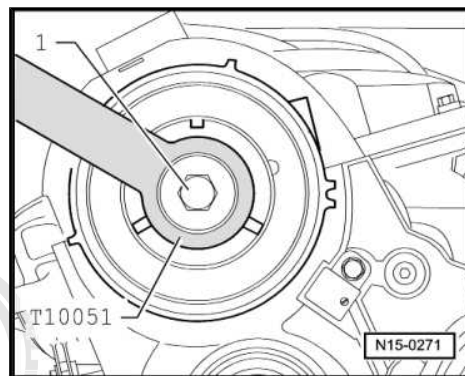


Note

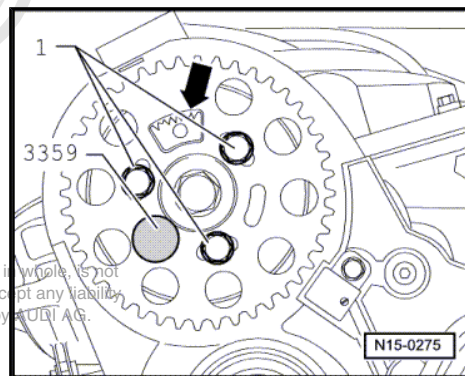
- ◆ *Bearing cap „4“ is marked as bearing cap „5“.*
- ◆ *Make sure no sealant gets into the grooves -arrows- or onto the other surfaces.*
- Install bearing caps „1“ and „4“ and tighten.
- Bearing cap „4“ must be flush with the outer edge of the cylinder head, otherwise the tandem pump may leak.
- Install camshaft oil seal ⇒ [page 104](#) .
- Fit rocker arm shaft, then first tighten inner bolts then outer bolts in several stages.



- Attach hub to camshaft.
- Tighten securing bolt -1- (use counterhold -T10051-).



- Push camshaft sprocket onto hub.
- Toothed segment -arrow- in camshaft sprocket must face upwards.
- Screw in bolts -1- finger-tight.
- Lock hub on camshaft with locking pin -3359- .
- Install toothed belt (adjust valve timing) ⇒ [page 44](#) .
- Install tandem pump ⇒ Rep. gr. 20 .
- If the rocker arm shaft or ball studs and adjuster screws were renewed, the unit injectors must be adjusted ⇒ Rep. gr. 23 .
- Install cylinder head cover ⇒ [page 73](#) .



Note

- ◆ After installing the camshaft, the engine must NOT be started for about 30 minutes. The hydraulic tappets have to settle (otherwise valves will strike pistons).
- ◆ After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.

Tightening torques

Component	Nm
Bearing cap to cylinder head	8 + 90° 1)2)
Rocker arm shaft to cylinder head	20 + 90° 1)2)
Hub to camshaft	100
• 1) Renew bolts. • 2) 90° = one quarter turn.	

2.5 Checking hydraulic bucket tappets

Special tools and workshop equipment required

- ◆ Feeler gauge
- ◆ Wooden/plastic wedge

Procedure



Note

- ◆ *Hydraulic bucket tappets cannot be serviced.*
- ◆ *Irregular valve noises when starting engine are normal.*
- Start engine and allow to run until radiator fan switches on.
- Increase engine speed to about 2500 rpm for approx. 2 minutes; perform test drive if necessary.



Note

If the irregular valve noise stops but repeatedly re-occurs when driving short distances, then the oil retention valve is defective. Fitting location: in oil filter bracket ⇒ [Item 3 \(page 117\)](#). The oil retention valve cannot be renewed separately.

If the hydraulic tappets are still noisy, locate defective tappet as follows:

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- **Remove cylinder head cover ⇒ [page 73](#).**
- Turn crankshaft until cam of the bucket tappet to be checked faces upwards; to do so, push vehicle forwards with 4th gear engaged and ignition switched off.
- Determine clearance between cam and bucket tappet by pressing down bucket tappet with a suitable wood or plastic wedge.

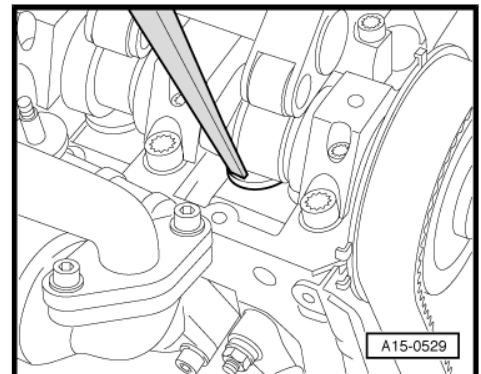
If it is possible to insert a feeler gauge of 0.20 mm between camshaft and bucket tappet:

- Renew hydraulic bucket tappet
⇒ [„2.4 Removing and installing camshaft“, page 105](#).



Note

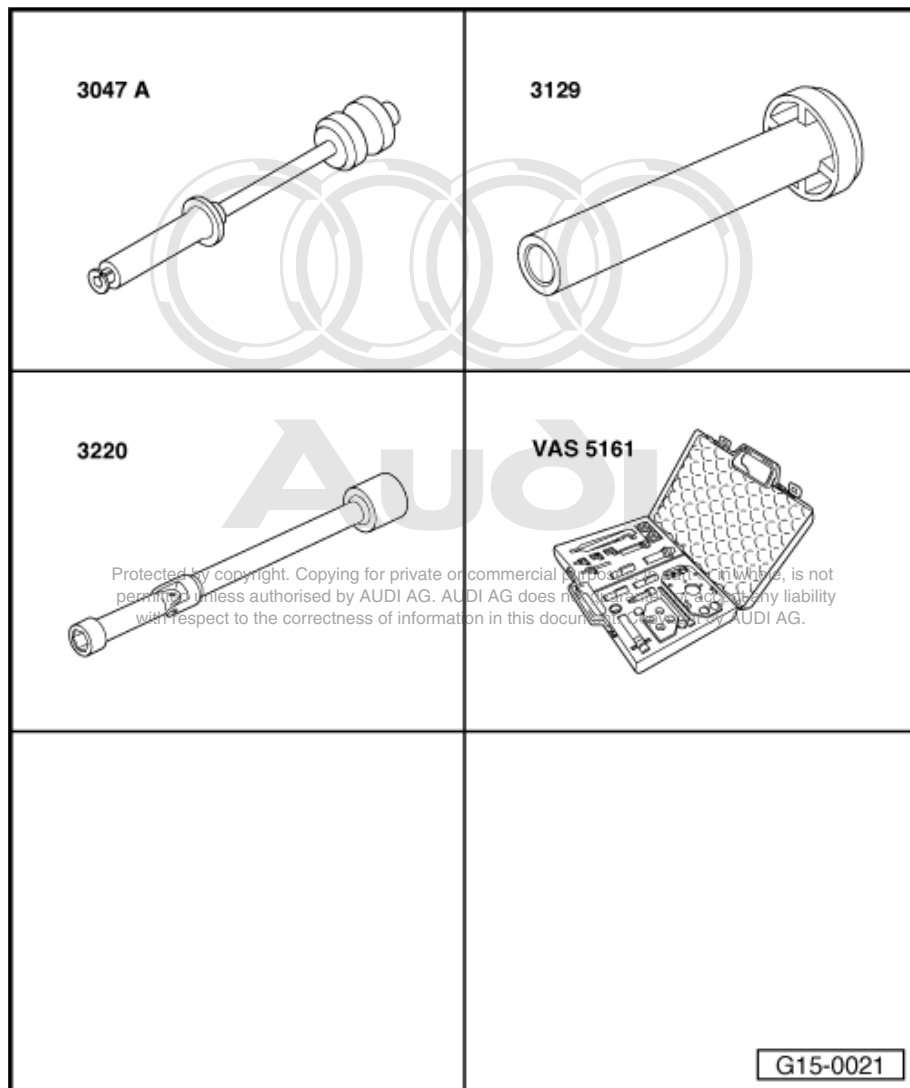
- ◆ *After installing the camshaft, the engine must NOT be started for about 30 minutes. The hydraulic tappets have to settle (otherwise valves will strike pistons).*
- ◆ *After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*



2.6 Renewing valve stem oil seals

Special tools and workshop equipment required

- ◆ Puller -3047 A-
- ◆ Fitting tool -3129-
- ◆ U/J extension and socket, 10 mm -3220-
- ◆ Removal and installation device -VAS 5161-



Procedure

- Cylinder head installed.



Note

If cylinder head is removed, the valve stem oil seals can be renewed using valve spring compressor -2037-.

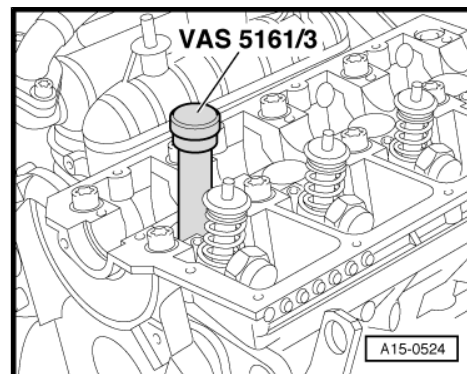
- Remove the camshaft ⇒ [page 105](#).
- Remove camshaft bearing shells from cylinder head.



Note

- ◆ *Make sure that the used camshaft bearing shells are not interchanged (note marking).*
- ◆ *Make sure that the hydraulic bucket tappets are not interchanged; mark allocation on rear with a waterproof felt-tip pen.*
- Remove bucket tappets out of guides.

- Place bucket tappets down on a clean surface with contact surface facing downwards in the order in which they were removed.
- Insert punch -VAS 5161/3- into bucket tappet guide.
- Knock valve cotters loose on all valves using a plastic hammer.

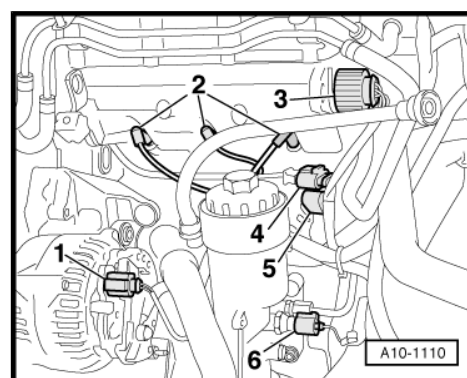


- Unplug electrical connectors -2- on glow plugs.

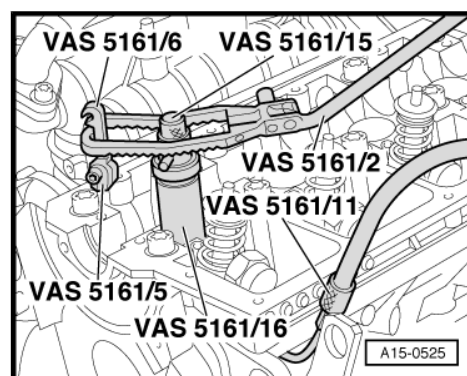
**Note**

Ignore other items.

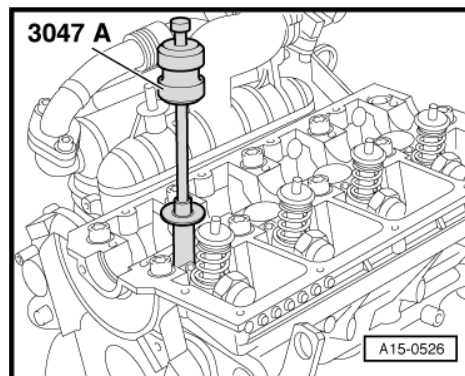
- Unscrew all glow plugs using jointed spanner -3220-.
- Set piston of the respective cylinder to „bottom dead centre“.



- Screw adapter -VAS 5161/11- finger-tight into the glow plug hole of the relevant cylinder.
- Screw snap-in device -VAS 5161/6- with interlocking fork (M6) -VAS 5161/5- into threaded hole on cylinder head.
- Push guide bush -VAS 5161/16- as far as it will go into bucket tappet guide for valve to be removed.
- Installation position of guide bush: hatched areas are perpendicular to driving direction.
- Insert assembly cartridge -VAS 5161/15- into guide bush.
- Connect adapter -VAS 5161/11- to compressed air supply using a commercially available connection piece.
- Minimum pressure: 6 bar
- Attach pressure fork -VAS 5161/2- to snap-in device -VAS 5161/6- 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 cartridge.
- Release pressure fork.
- Remove assembly cartridge.
- Remove guide bush, valve spring plate and valve springs.



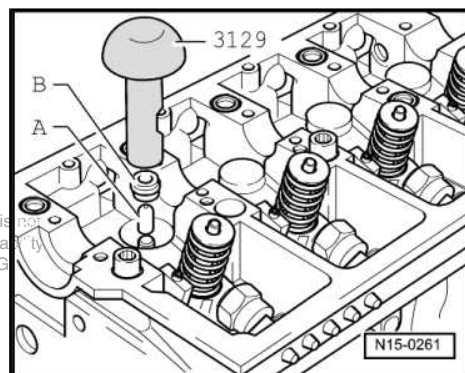
- Detach valve stem oil seals using puller -3047 A- .



Note

A plastic sleeve -A- is included with the new valve stem oil seals.

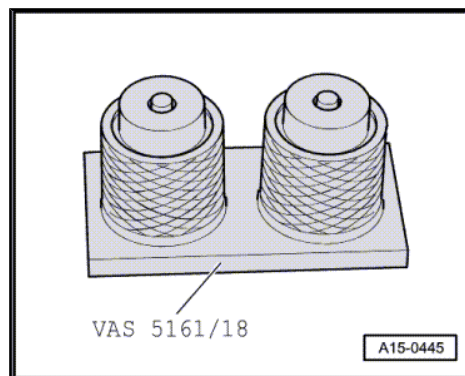
- Insert plastic sleeve -A- onto the valve stem to prevent damage to the new valve stem oil seal -B-.
- Lightly lubricate sealing lip of valve stem oil seal.
- Slip valve stem oil seal over plastic sleeve.
- Carefully press valve stem oil seal down onto valve guide using fitting tool -3129- .
- Remove plastic sleeve.
- If valve cotters have been removed from assembly cartridge, they need to be put into insertion device -VAS 5161/18- first.



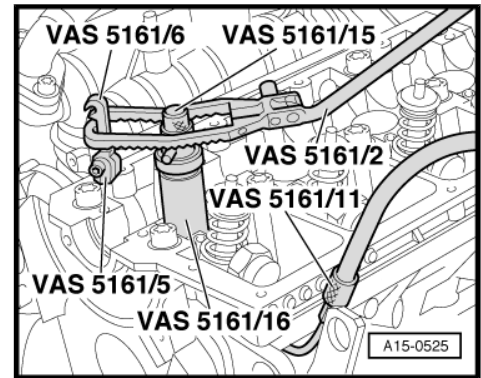
Note

Larger diameter of valve cotters faces upwards.

- Insert valve springs, valve spring plate and guide bush -VAS 5161/16- .
- Press assembly cartridge -VAS 5161/15- onto insertion device from above and pick up valve cotters.



- Reinstall the assembly cartridge -VAS 5161/15- into guide bush -VAS 5161/16- .
- Push pressure fork down and pull knurled screw upwards, while turning screw in both directions – this will insert the valve cotter.
- Release pressure fork with knurled screw still in pulled position.
- Insert bucket tappets.
- Install camshaft ⇒ [page 105](#) .
- Install glow plugs ⇒ Rep. gr. 28 .

**Note**

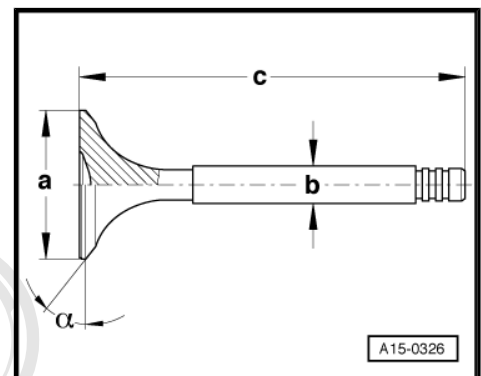
- ◆ *After installing the camshaft, the engine must NOT be started for about 30 minutes. The hydraulic tappets have to settle (otherwise valves will strike pistons).*
- ◆ *After working on the valve gear, turn the engine carefully at least 2 rotations to ensure that none of the valves make contact when the starter is operated.*

2.7 Valve dimensions

Dimension		Inlet valve	Exhaust valve
Ø a	mm	35.95	31.45
Ø b	mm	6.980	6.956
c	mm	89.95	89.95
α	∠°	45	45

**Note**

Valves are not to be machined. Only grinding is permitted.

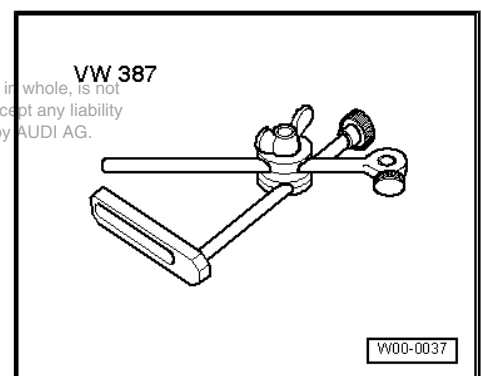


2.8 Checking valve guides

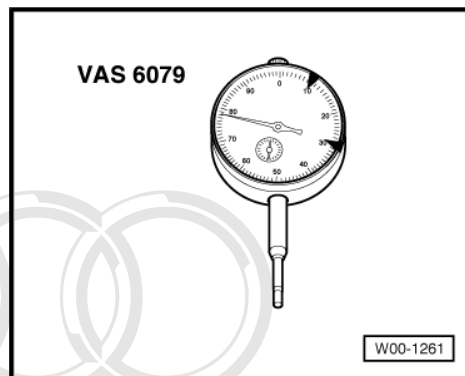
Special tools and workshop equipment required

- ◆ Universal dial gauge bracket -VW 387-

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◆ Dial gauge -VAS 6079-

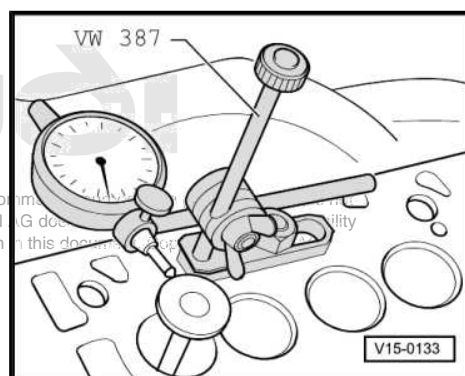


Procedure

- Insert valve into valve guide.
- End of valve stem must be flush with valve guide.
- Determine amount of sideways play.
- Wear limit: 1.3 mm.

i Note

- ◆ *If the wear limit is exceeded, repeat the measurement with new valves. Renew cylinder head if wear limit is still exceeded. Valve guides cannot be renewed.*
- ◆ *If the valve has to be renewed as part of a repair, use a new valve for the measurement.*



2.9 Machining valve seats

Special tools and workshop equipment required

- ◆ Depth gauge
- ◆ Valve seat machining tool

If a good seating pattern cannot be obtained by grinding the valve seats (lapping), they must be refaced (machined):

i Note

- ◆ *When servicing engines with leaking valves, it is not sufficient to machine (reface) the valve seats and renew the valves. The valve guides must also be checked for wear. This is particularly important on high-mileage engines ⇒ [page 113](#).*
- ◆ *Valve seats should only be machined to the extent required to give a proper seating pattern.*
- ◆ *The maximum permissible machining dimension must be calculated before starting work.*
- ◆ *If the machining dimension is exceeded, the function of the hydraulic valve clearance compensation can no longer be ensured and the cylinder head must be renewed.*

Calculating maximum permissible machining dimension

- Insert valve and press firmly against valve seat.

 Note

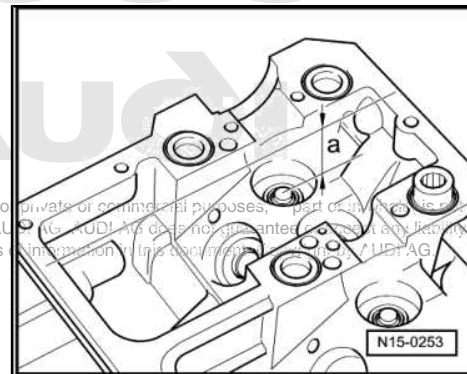
If the valve has to be renewed as part of a repair, use a new valve for the measurement.

- Measure distance -a- between end of valve stem and upper cylinder head surface with a depth gauge.
- Calculate the maximum permissible machining dimension using the measured distance and the minimum dimension.
- Minimum dimension for inlet valve: 43.4 mm.
- Minimum dimension for exhaust valve: 43.2 mm

Measured distance minus minimum dimension = max. permissible machining dimension.

Example for inlet valve:

Measured distance	44.1 mm
Minimum dimension	– 43.4 mm
Maximum permissible machining dimension	= 0.7 mm



 Note

If the maximum permissible machining dimension is 0 mm or less than 0 mm, repeat the measurement with a new valve. If the result is again 0 mm or less than 0 mm, renew the cylinder head.

Machining inlet valve seat

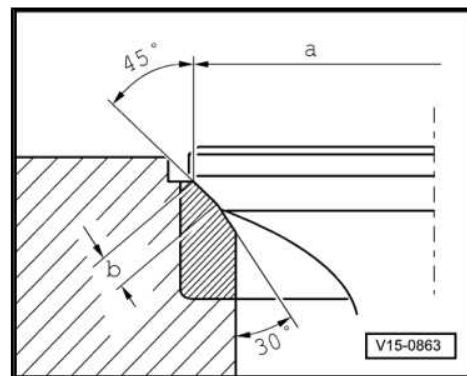
a - Ø 35.7 mm

b - 1.6 mm

45° - Valve seat angle

 Note

- ◆ Calculating maximum permissible machining dimension
⇒ [page 114](#).
- ◆ The 30° lower valve seat chamfer is necessary to ensure that the inlet channel flow characteristics are maintained.



Machining exhaust valve seat

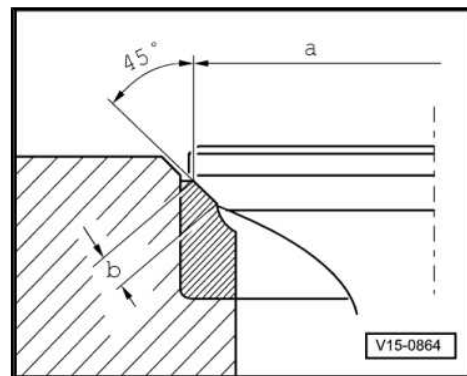
a - Ø 31.4 mm

b - 2.7 mm

45° - Valve seat angle

 Note

Calculating maximum permissible machining dimension
⇒ [page 114](#).





2.10 Checking valves

- Visually inspect for scoring on valve stem and on seating surface.

If scoring is clearly visible:

- Renew the relevant valve.



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17 – Lubrication

1 Removing and installing parts of lubrication system



Note

- ◆ If large quantities of metal shavings or particles are found in the engine oil when repairing the engine, the oil passages must be cleaned carefully in order to prevent further damage occurring later.
- ◆ The oil level must not be above max. mark on dipstick – danger of damage to catalytic converter.

Viscosity grades and oil specifications ⇒ Maintenance ; Booklet 809 .

Oil capacities ⇒ Maintenance tables .

1.1 Lubrication system - exploded view

1 - Cylinder block

2 - Gasket

- ☐ Renew

3 - Oil filter bracket

- ☐ Exploded view of components ⇒ [page 126](#)

4 - 14 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ First fit bolt on top left and bolt on bottom right, then tighten the four bolts diagonally

5 - Seal

- ☐ Renew

6 - Quick release coupling

7 - Clip

8 - Oil filler reservoir

9 - Oil filler cap

10 - Seal

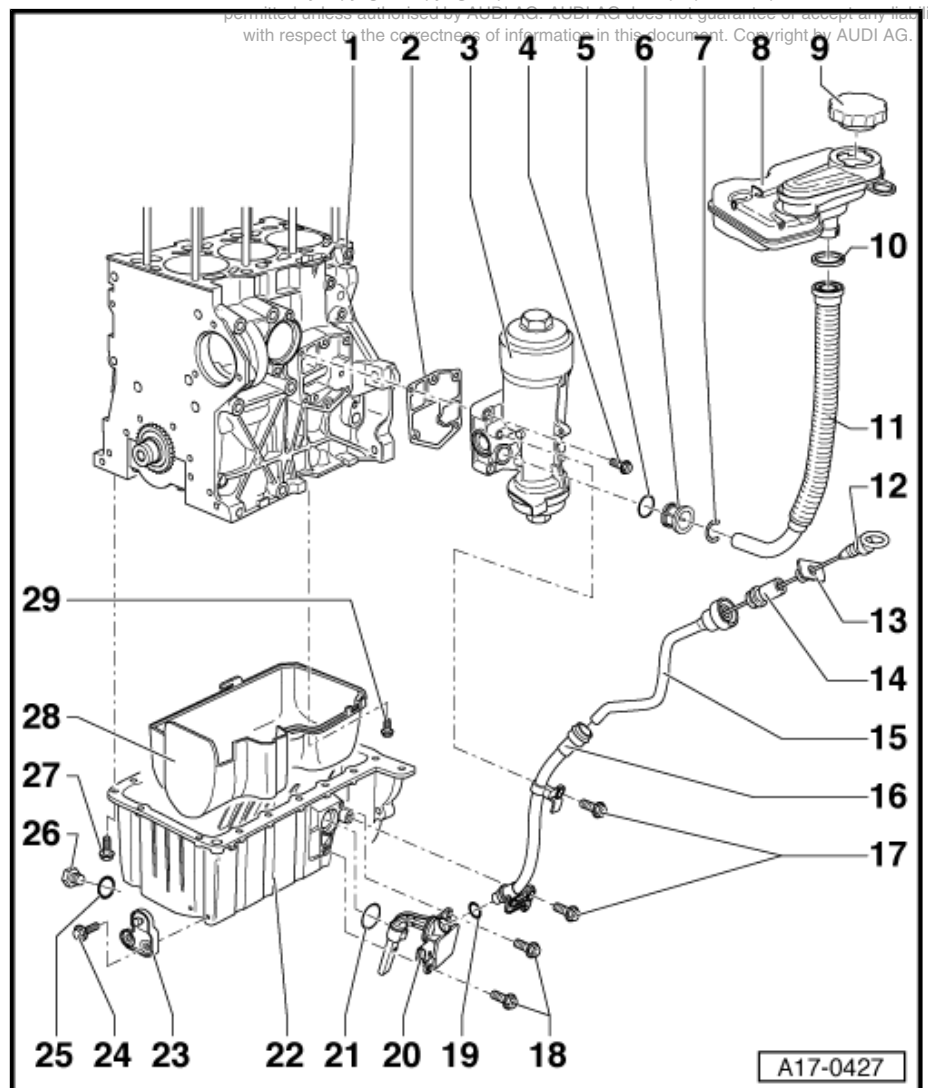
- ☐ Renew

11 - Oil filler pipe

- ☐ To remove press oil filler pipe toward oil filler bracket and remove clip ⇒ [Item 7 \(page 117\)](#) .

12 - Oil dipstick

- ☐ The oil level must not be above max. mark on dipstick





- ☐ Markings ⇒ [page 133](#)

13 - Connecting piece

14 - Guide

- ☐ Pull off to extract oil

15 - Guide tube for oil dipstick

16 - Oil pipe

17 - 10 Nm

18 - 10 Nm

19 - O-ring

- ☐ Renew
- ☐ Oil lightly when fitting

20 - Oil level and oil temperature sender -G266-

21 - O-ring

- ☐ Renew
- ☐ Oil lightly when fitting

22 - Sump

- ☐ Removing and installing ⇒ [page 118](#)
- ☐ Clean sealing surface before installing

23 - Bracket

- ☐ For air pipe

24 - 10 Nm

25 - Seal

- ☐ Renew

26 - Oil drain plug, 30 Nm

27 - 15 Nm

28 - Baffle plate

29 - 5 Nm

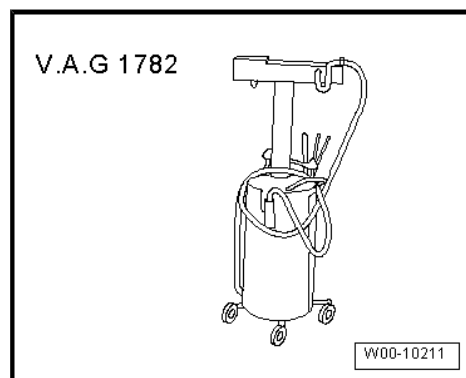


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1.2 Removing and installing sump

Special tools and workshop equipment required

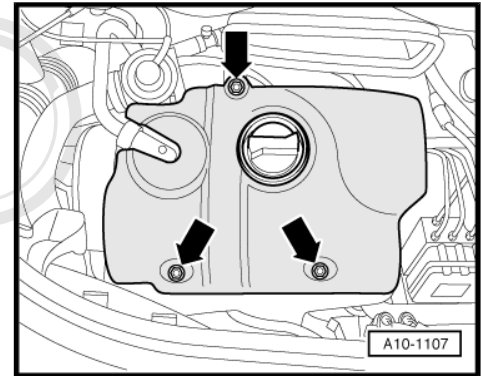
- ◆ Used oil collection and extraction unit -V.A.G 1782-



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

Removing

- Remove bonnet ⇒ [page 4](#) .
- Take off engine cover panel -arrows-.
- Remove noise insulation underneath (detach crankcase breather hose).



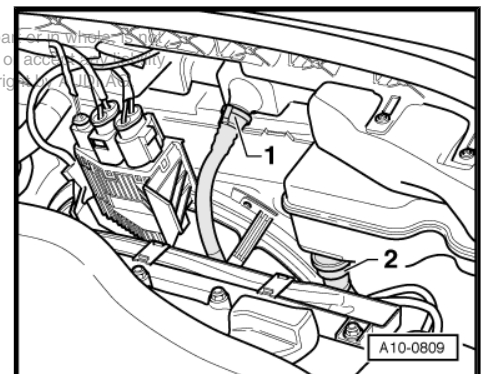
- Pull oil dipstick out of guide tube.
- Remove guide tube for oil dipstick -1-.

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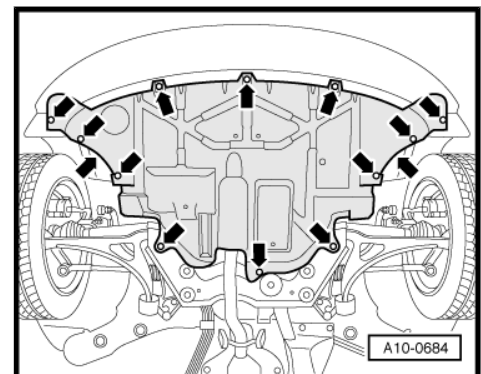


Note

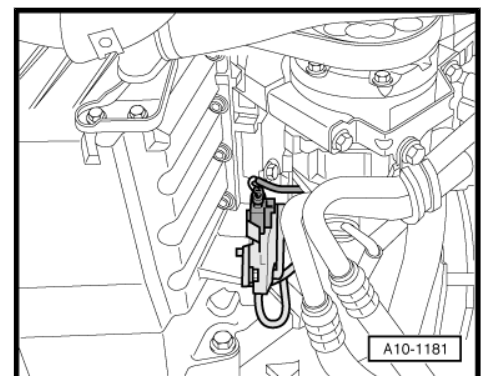
Disregard -item 2-.



- Remove front right wheel.
- Remove noise insulation -arrows-.
- Place used oil collection and extraction unit -V.A.G 1782- under engine.
- Drain off engine oil.
- Drain gear oil ⇒ Rep. gr. 34 .



- Unplug electrical connector at oil level and oil temperature sender -G266- .
- Move wiring going to oil level and oil temperature sender -G266- and to engine speed sender -G28- clear from oil filter bracket.

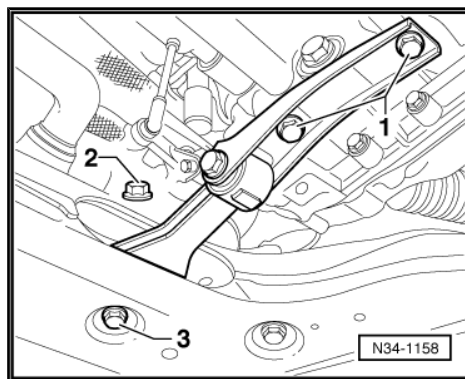


- Remove bolts -1- and -3- and detach pendulum support.

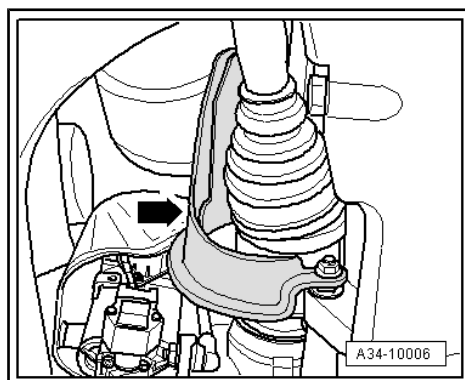


Note

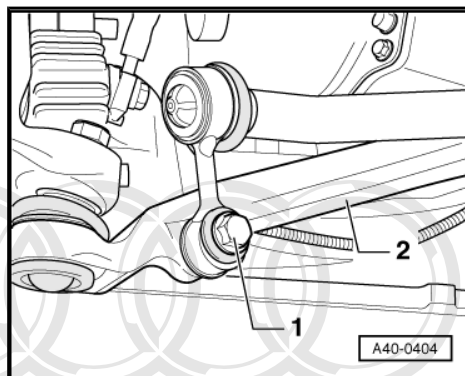
Disregard -item 2-.



- Unbolt heat shield -arrow- for drive shaft (right-side).



- Remove bolt -1- for coupling rod at suspension link -2-.

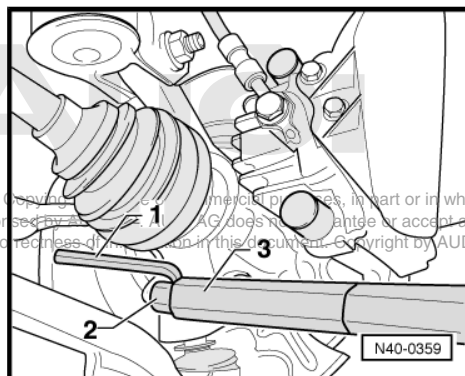


- Unscrew nut at right swivel joint (counterhold with Allen key 5 mm if necessary).

1 - Allen key 5 mm (shortened by approx. 10 mm).

2 - Ring insert

3 - Torque wrench -V.A.G 1331-

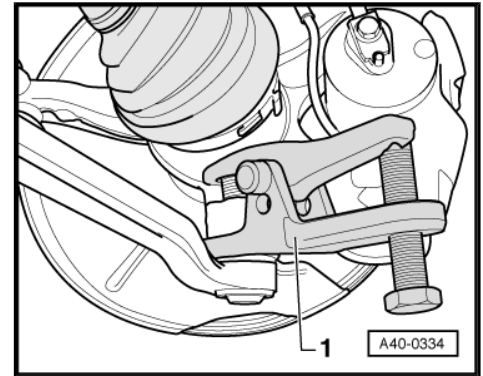


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- Apply ball joint puller -item 1- as shown in illustration and press off right swivel joint.

**Note**

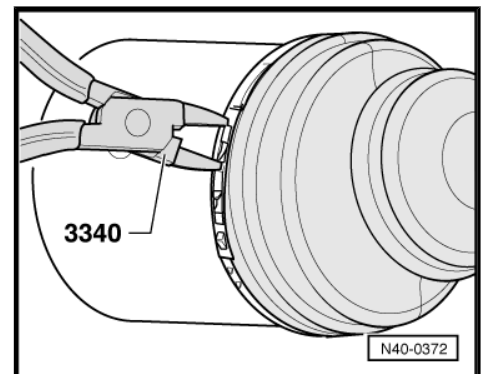
Take care not to damage the boot of the drive shaft when applying ball joint puller.



- Mark installation position of drive shaft relative to flange shaft at gearbox for re-installation.
- Cut through cable tie at gearbox side of drive shaft boot using pliers -3340- .

**Caution**

- ◆ *Make sure triple rollers do not drop to the ground when pulling drive shaft apart from flange shaft.*
- ◆ *Hold triple rollers in place and secure with adhesive tape.*

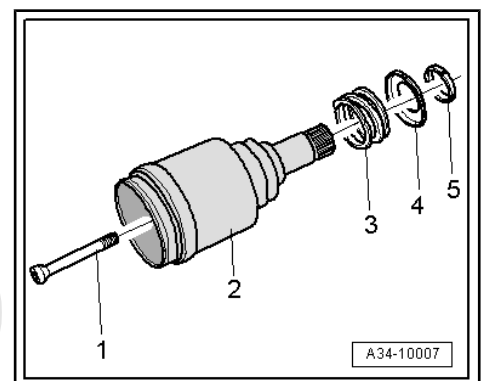


- Swivel suspension strut outwards and pull drive shaft apart from flange shaft.
- Tie drive shaft to front onto longitudinal member.

**Note**

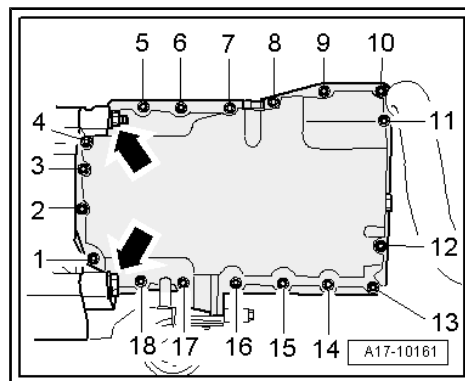
Take care not to damage the surface coating of the drive shaft.

- Unscrew bolt -1- and detach flange shaft -2- with spring -3-, washer -4- and taper -5- from gearbox.



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- Remove top bolt of guide tube for oil dipstick on oil filter bracket.
- Unclip retaining tab for air pipe (right-side) on sump.
- Unscrew sump/gearbox bolts -arrows-.
- Slacken bolts -1 ... 18- in diagonal sequence and remove.
- Take off sump; if necessary loosen it by striking lightly with a rubber hammer.



Installing

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

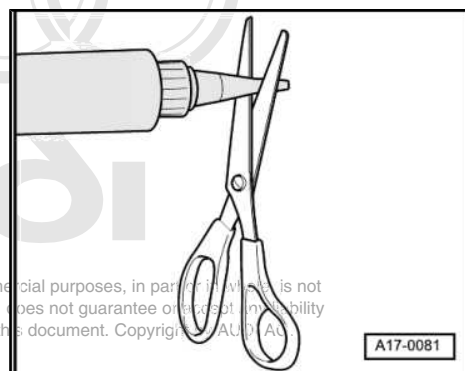
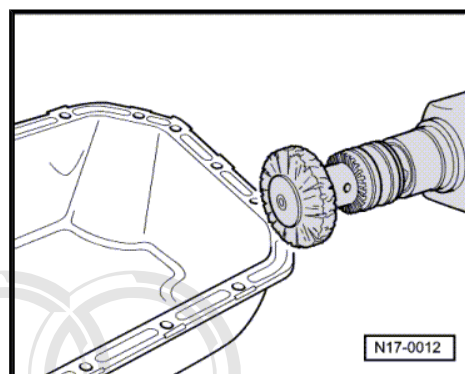
- Remove sealant residue from sump and cylinder block using a rotating plastic brush or similar.



WARNING

Wear safety goggles.

- Clean sealing surfaces; they must be free of oil and grease.
- Cut off tube nozzle at front marking (diameter of nozzle approx. 2 mm).

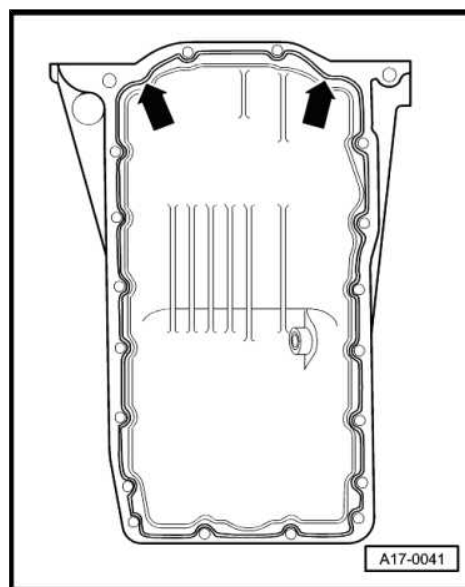


- Apply bead of sealant onto clean sealing surface of sump as shown in illustration.
- Thickness of sealant bead: 2 ... 3 mm



Note

- ◆ *Sealant bead must not be wider than 3 mm, otherwise excess sealant could ingress into sump and clog strainer in oil intake pipe.*
- ◆ *Take particular care when applying sealant bead in area of rear sealing flange -arrows-.*
- ◆ *The sump must be installed within 5 minutes after applying sealant.*

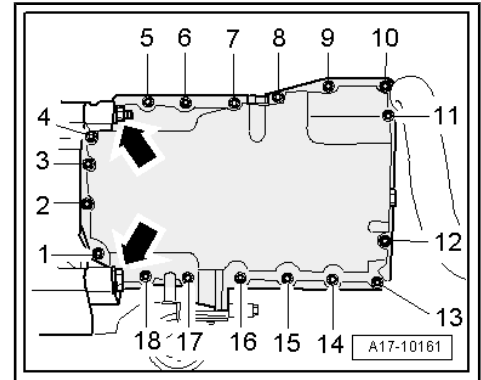


- Immediately install sump and tighten bolts in the sequence indicated:

 1. Tighten bolts -1 ... 18- securing sump to cylinder block in diagonal sequence initially to 5 Nm.
 2. Tighten bolts securing sump to gearbox -arrows-.
 3. Tighten bolts -1 ... 18- in diagonal sequence.

 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 assembly, the sealant must dry for approx. 30 minutes. Then (and only then) fill the engine with engine oil.*



- Install drive shaft ⇒ Rep. gr. 40 .
- Install swivel joint ⇒ Rep. gr. 40 .
- Install pendulum support ⇒ [page 31](#) .
- Fill up with engine oil and check oil level ⇒ [page 132](#) .
- Fill up with gear oil ⇒ Rep. gr. 34 .

Tightening torques

Component		Nm
Sump to:	Cylinder block	15
	Gearbox	45
Oil drain plug		30
Guide tube for oil dipstick to oil filter bracket		10

1.3 Oil pump and retaining frame - exploded view of components



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1 - Cylinder block

2 - Oil spray jet

- ☐ For piston cooling
- ☐ Note installation position: Turn oil spray jet anti-clockwise until it makes contact with cylinder block and secure in this position

3 - 27 Nm

- ☐ Insert without sealant

4 - O-ring

- ☐ Renew

5 - Retaining frame

- ☐ Before installing, check that the fitting sleeve for centring on cylinder block is in place and that the O ring is inserted in the retaining frame.
- ☐ Removing and installing ⇒ [page 58](#)

6 - Dowel sleeve

7 - Bolt

- ☐ Oil pump to retaining frame, 20 Nm + 90° (1/4 turn) further; renew bolt
- ☐ Retaining frame to cylinder block: 14 Nm + 180° (1/2 turn) further; renew bolt

8 - O-ring

- ☐ Renew
- ☐ Check for firm attachment
- ☐ Oil lightly when fitting

9 - Oil pump

- ☐ With pressure relief valve (11.5 bar)
- ☐ Removing and installing ⇒ [page 125](#)
- ☐ Before installing, check that the two dowel sleeves for centralising are fitted.

10 - Dowel sleeve

11 - Chain

- ☐ Note installation position ⇒ „3.2 Removing and installing balance shaft and retaining frame“, [page 58](#)

12 - Chain sprocket for oil pump

13 - 20 Nm + 90° (1/4 turn) further

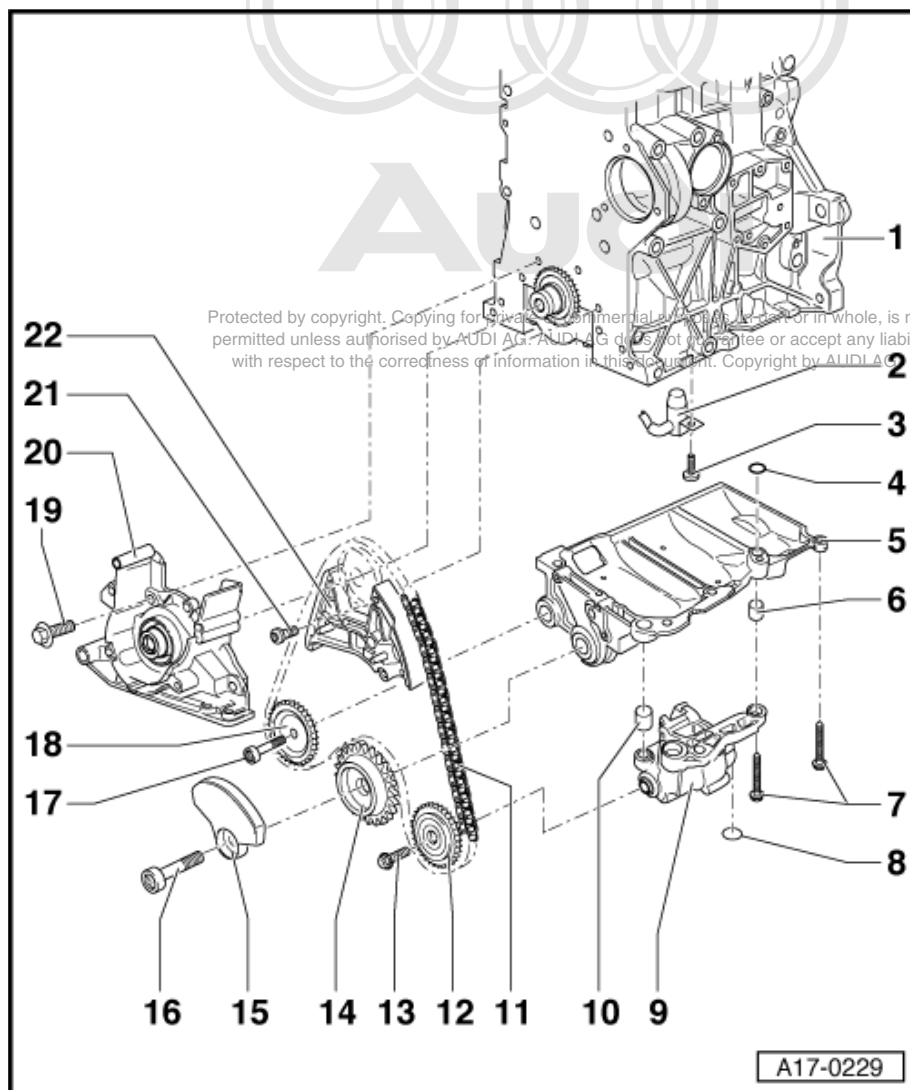
- ☐ Renew

14 - Chain sprocket for balance shaft

- ☐ Can only be installed in one position

15 - Balance weight

- ☐ Can only be installed in one position



16 - 100 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ Use socket -T10061- to loosen and tighten

17 - 20 Nm

18 - Idler sprocket

19 - 15 Nm

20 - Sealing flange (front)

- ☐ Must be positioned on dowel sleeves
- ☐ Removing and installing ⇒ [page 51](#)
- ☐ Renewing crankshaft oil seal on pulley end ⇒ [page 49](#)

21 - 8 Nm + 90° (1/4 turn) further

- ☐ Renew

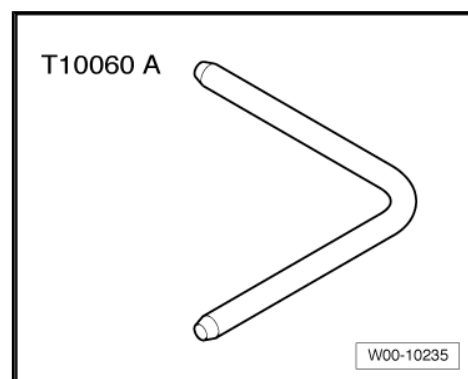
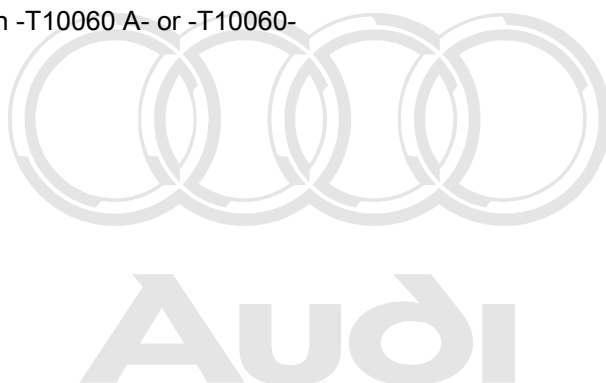
22 - Chain tensioner with tensioning rail

- ☐ To remove, lock with locking pin -T10060 A- or -T10060-
- ☐ Removing and installing ⇒ „3.2 Removing and installing balance shaft and retaining frame“, [page 58](#)

1.4 Removing and installing oil pump

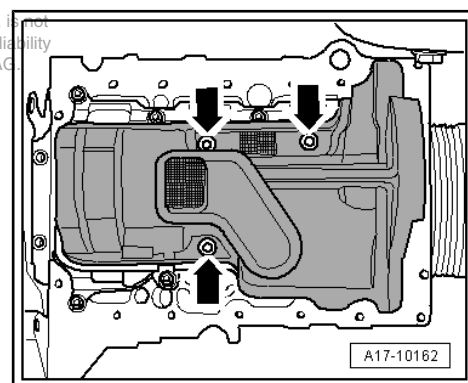
Special tools and workshop equipment required

- ◆ Locking pin -T10060 A- or -T10060-



Removing

- Remove sump ⇒ [page 118](#).
- Remove bolts -arrows-.
- Release the 5 retaining tabs and remove baffle plate.

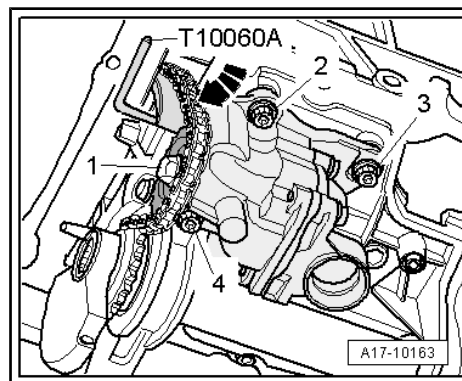


- Press down chain tensioner -arrow- and lock with locking pin -T10060 A- or -T10060- .



Caution

- ◆ **Do not remove oil pump sprocket from chain when detaching oil pump.**
- ◆ **Make sure that the chain remains in position on the chain sprocket. Otherwise the position of the balance shaft in relation to the crankshaft must be re-adjusted**
⇒ **page 60** .



- Remove bolt -1-.
- Detach chain sprocket from oil pump and position it to rest in chain.
- Unscrew bolts -2 ... 4- and remove oil pump.

Installing

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



Note

Renew O-ring.

- Insert dowel sleeves ⇒ **Item 6 (page 124)** and ⇒ **Item 10 (page 124)** at top of oil pump.
- Chain sprocket can only be fitted in one position on oil pump shaft.
- Fit baffle plate with new O-ring.
- Install sump ⇒ **page 118** .

Tightening torques

Component	Nm
Chain sprocket to oil pump shaft	20 + 90° 1)2)
Oil pump to retaining frame	20 + 90° 1)2)
Baffle plate to retaining frame	5
• 1) Renew bolt. • 2) 90° = one quarter turn.	

1.5 Oil filter bracket - exploded view of components

1 - Filler cap

- ☐ Tighten to 25 Nm

2 - O-ring

- ☐ Renew

3 - Oil filter element

- ☐ Detach from sealing cap
⇒ [Item 1 \(page 127\)](#)
- ☐ When changing filter,
renew O-rings
⇒ [Item 2 \(page 127\)](#) and
⇒ [Item 4 \(page 127\)](#)
- ☐ Note installation position
- ☐ Observe change intervals ⇒ Maintenance ;
Booklet 809

4 - O-ring

- ☐ Renew

5 - Seal

- ☐ Renew

6 - Connection

- ☐ For oil supply line to turbocharger
- ☐ Tighten to 25 Nm

7 - Oil supply line

- ☐ To turbocharger
- ☐ Tighten to 22 Nm

8 - Oil pressure switch -F1-

- ☐ 0.7 bar - brown
- ☐ Checking ⇒ [page 130](#)
- ☐ Tighten to 20 Nm

9 - 14 Nm + 1/4 turn (90°) further

- ☐ Renew
- ☐ First fit bolt on top left and bolt on bottom right, then tighten the four bolts diagonally

10 - Seal

- ☐ Renew

11 - Screw plug, 25 Nm**12 - Seal**

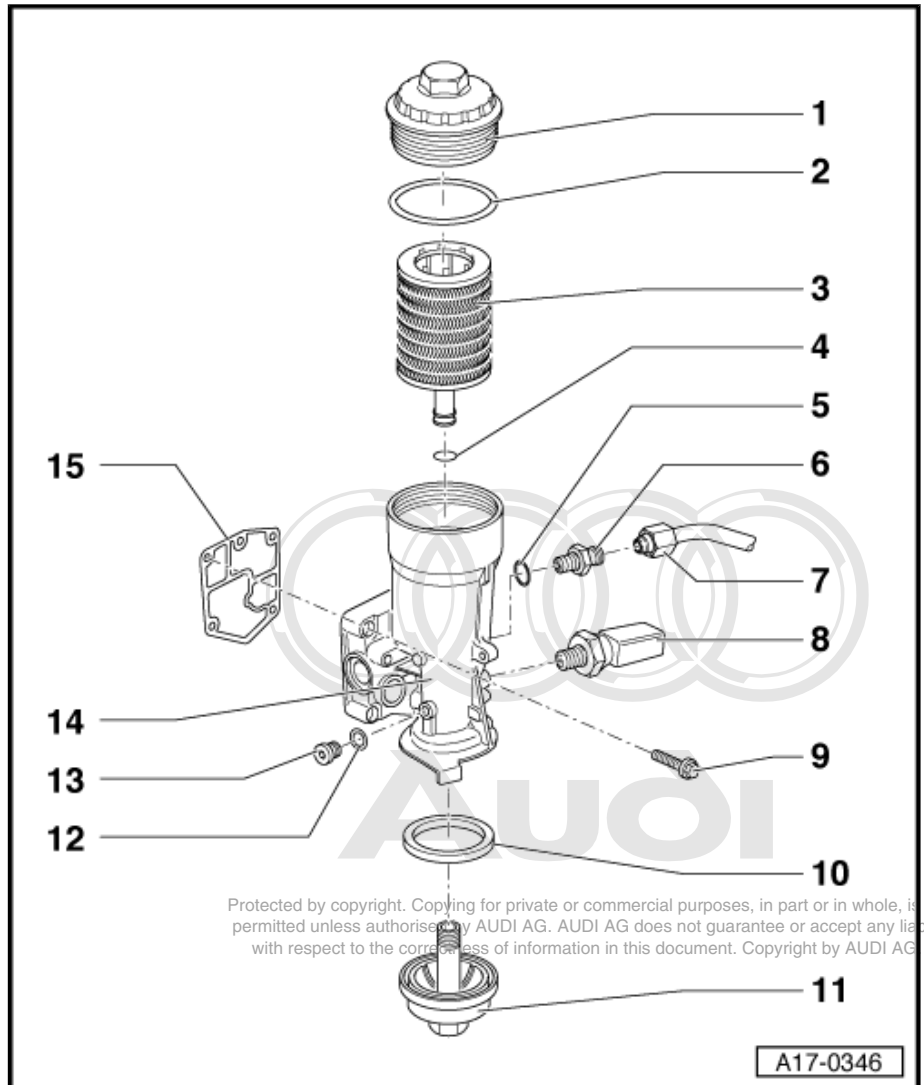
- ☐ Renew

13 - Screw plug, 15 Nm**14 - Oil filter bracket**

- ☐ Removing and installing ⇒ [page 127](#)

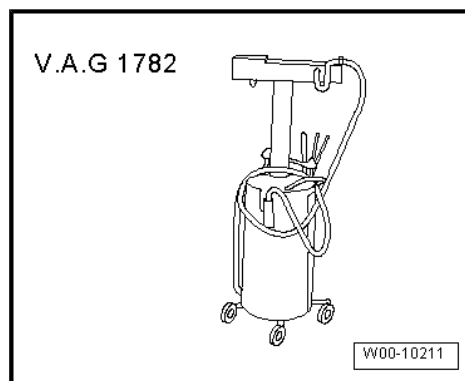
15 - Gasket

- ☐ Renew

**1.5.1 Removing and installing oil filter bracket**

Special tools and workshop equipment required

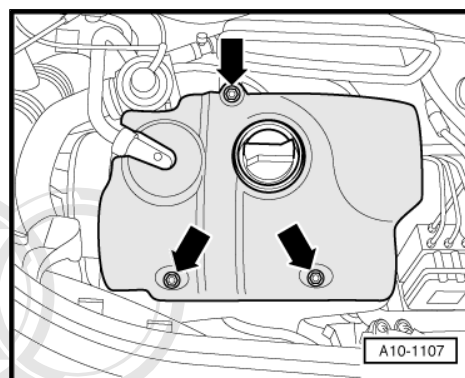
♦ Used oil collection and extraction unit -V.A.G 1782-



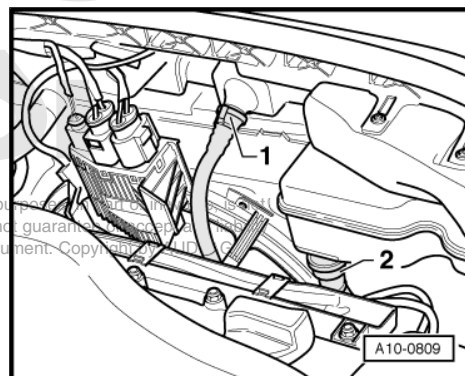
- ♦ Electric drill with plastic brush attachment
- ♦ Sealant ⇒ Parts catalogue
- ♦ Safety goggles

Removing

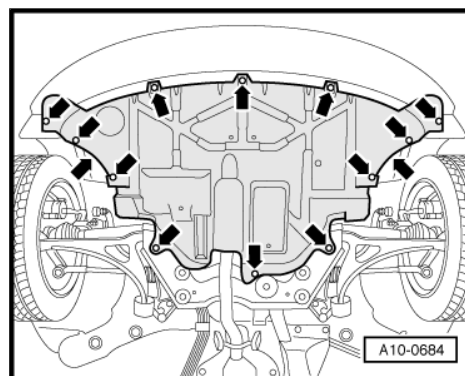
- Remove bonnet ⇒ [page 4](#) .
- Take off engine cover panel -arrows-.
- Remove noise insulation underneath (detach crankcase breather hose).



- Pull oil dipstick out of guide tube.
- Remove guide tube -1- for oil dipstick.
- Pull oil filler pipe -2- off oil filler reservoir.
- Move wiring going to oil level and oil temperature sender - G266- and to engine speed sender -G28- clear from oil filter bracket.



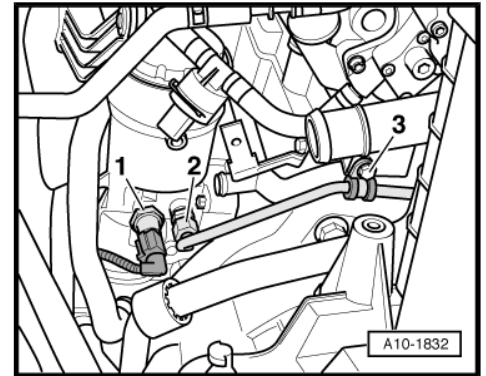
- Remove noise insulation -arrows-.



- Unplug electrical connector at oil pressure switch -F1- -item 1-.
- Place used oil collection and extraction unit -V.A.G 1782- under engine.
- Unscrew oil pressure switch.
- Detach oil supply line going to turbocharger at oil filter bracket -2-.

**Note**

Disregard -item 3-.



- Unscrew bolts -arrows- and remove oil filter bracket.

Installing

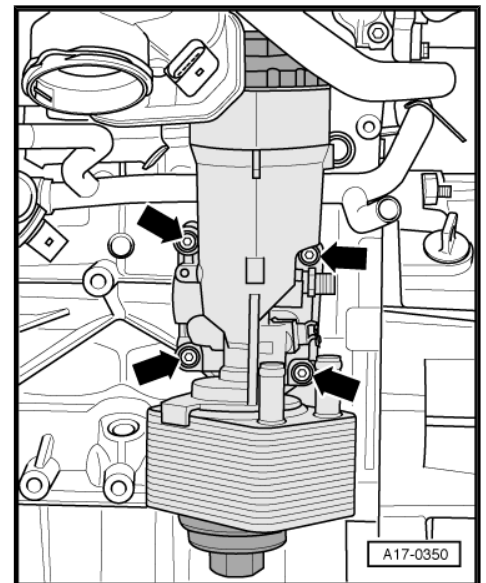
Installation is carried out in the reverse order; note the following:

**Note**

- ◆ *Renew gaskets, seals and O-rings.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) → Parts catalogue.*
- Fill up with engine oil and check oil level ⇒ [page 132](#) .

Tightening torques

Component	Nm
Oil filter bracket to cylinder block	14 + 90° ¹⁾²⁾
Guide tube for oil dipstick to oil filter bracket	10
Oil supply line to oil filter bracket	22
Oil pressure switch to oil filter bracket	20
• ¹⁾ Renew bolts. • ²⁾ 90° = one quarter turn.	



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1.6 Removing and installing oil pressure switch -F1-

Removing

- Remove bonnet ⇒ [page 4](#) .
- Unplug electrical connector -arrow- at oil pressure switch -F1- .



Note

Place a cloth below the oil filter housing to catch escaping oil.

- Unscrew oil pressure switch.

Installing

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



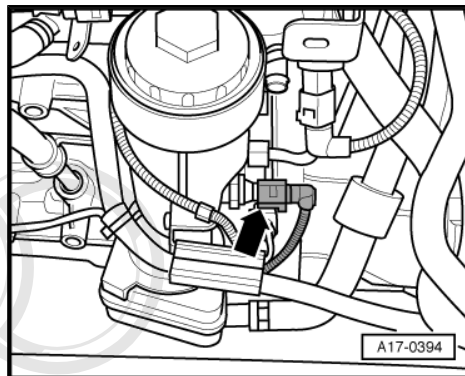
Note

Renew seal.

- Check oil level ⇒ [page 132](#) with respect to the correctness of information in this document. Copyright by AUDI AG.

Tightening torque

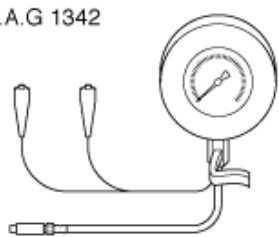
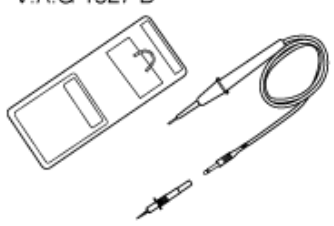
Component	Nm
Oil pressure switch to oil filter bracket	20



1.7 Checking oil pressure and oil pressure switch

Special tools and workshop equipment required

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

V.A.G 1342 	V.A.G 1527 B 
V.A.G 1594 C 	
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G17-0023

Procedure

- Oil level OK
- Engine oil temperature approx. 80 °C
- Remove oil pressure switch ⇒ [page 130](#) .

- Connect oil pressure tester -V.A.G 1342- to threaded hole for oil pressure switch.
- Screw oil pressure switch -2- into oil pressure tester -V.A.G 1342- .

Checking oil pressure switch

- Connect brown wire -1- of oil pressure tester to earth (-).
- Connect voltage tester -V.A.G 1527 B- with test leads from auxiliary measuring set -V.A.G 1594 C- to oil pressure switch and battery positive (+).
- LED should not light up.

If LED lights up now:

- Renew oil pressure switch.
- Start engine.



Note

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

- LED should light up at 0.55 ... 0.85 bar.

If LED does not light up:

- Renew oil pressure switch.

Checking oil pressure

- Start engine.
- Minimum oil pressure at 2000 rpm: 2.0 bar
- Maximum oil pressure at higher engine speeds: 5.8 bar

The pressure relief valve or oil pump is defective if the specifications are not attained.

- Renew oil pump ⇒ [page 125](#) .

Assembling

- Install oil pressure switch ⇒ [page 130](#) .

1.8 Engine oil

Viscosity grades and oil specifications ⇒ Maintenance ; Booklet 809 .

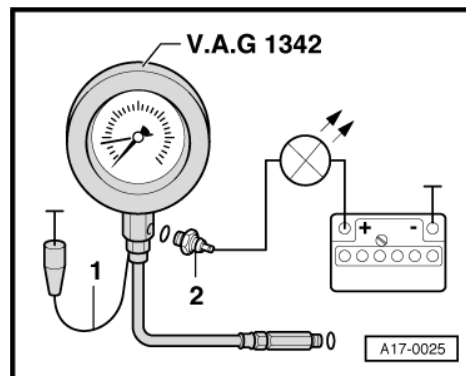
1.9 Checking oil level

Test conditions

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

Test sequence

- Pull out the dipstick, wipe off with a clean cloth and insert it again as far as it will go.
- Pull out the dipstick again and read off the oil level.



Markings on oil dipstick:

a - Do not top up oil.

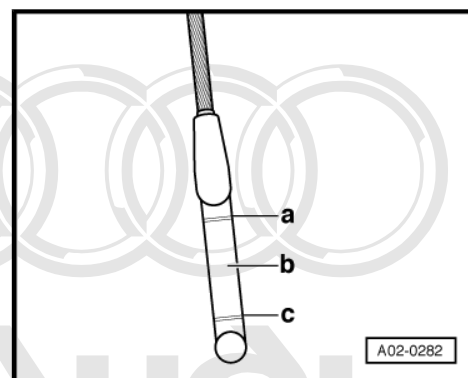
b - Oil may be topped up.

c - Oil must be topped up. It is sufficient if the oil level is somewhere in area -b- after topping up.



Note

The oil level must not be above the MAX marking -a- and not below the MIN marking -c-.



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19 – Cooling

1 Removing and installing parts of cooling system



WARNING

Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.



Note

- ◆ *The cooling system is under pressure when the engine is hot. If necessary, relieve pressure before commencing repair work.*
- ◆ *Renew gaskets and seals.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- ◆ *The arrow markings on coolant pipes and on ends of coolant hoses must align.*

1.1 Diagram of coolant hose connections



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1 - Radiator

- ☐ Removing and installing
⇒ [page 144](#)
- ☐ If renewed, refill system
with fresh coolant

2 - Thermostat

- ☐ Removing and installing
⇒ [page 141](#)
- ☐ Checking ⇒ [page 144](#)

3 - Coolant pump

- ☐ Removing and installing
⇒ [page 141](#)

4 - Exhaust gas recirculation cooler**5 - Bleeder hole**

- ☐ In coolant hose to heat
exchanger

6 - Heat exchanger

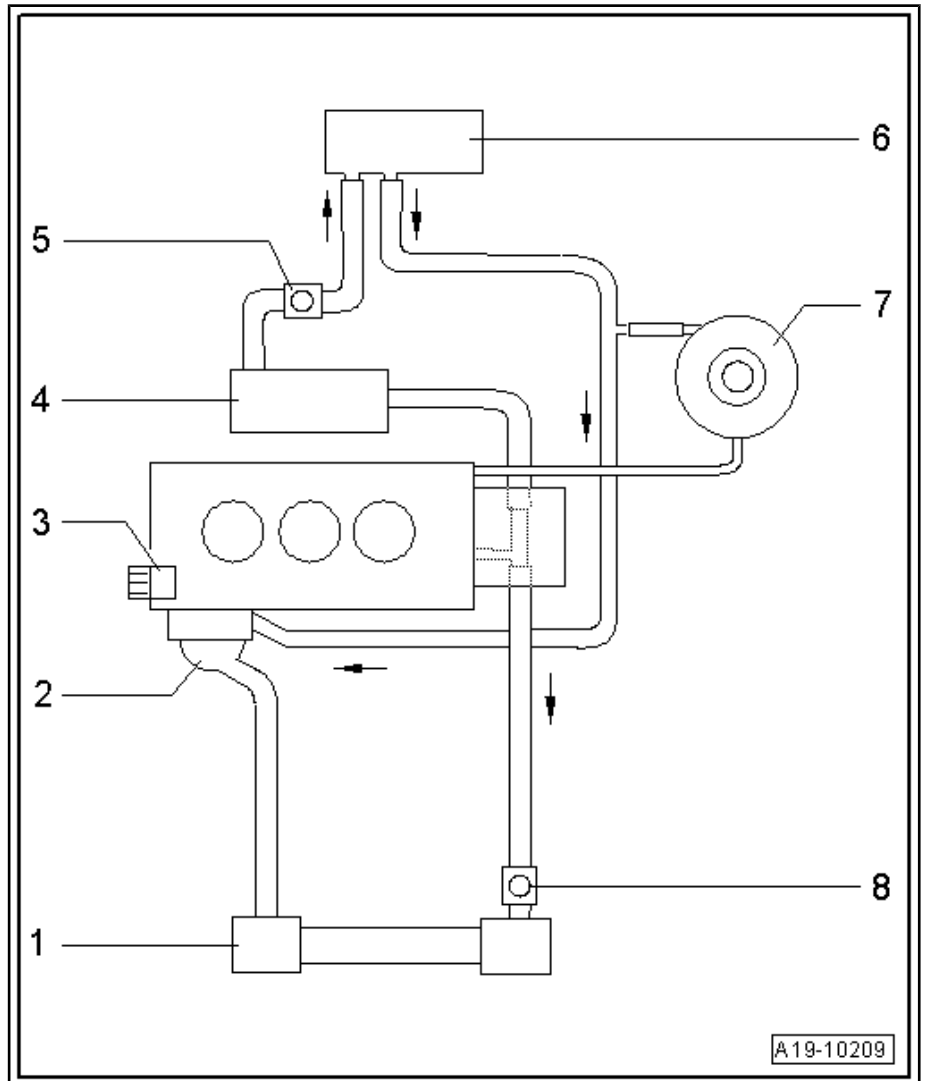
- ☐ If renewed, refill system
with fresh coolant

7 - Expansion tank

- ☐ With filler cap
- ☐ Checking pressure re-
lief valve in filler cap
⇒ [page 150](#)

8 - Bleeder hole

- ☐ In coolant hose going to
radiator

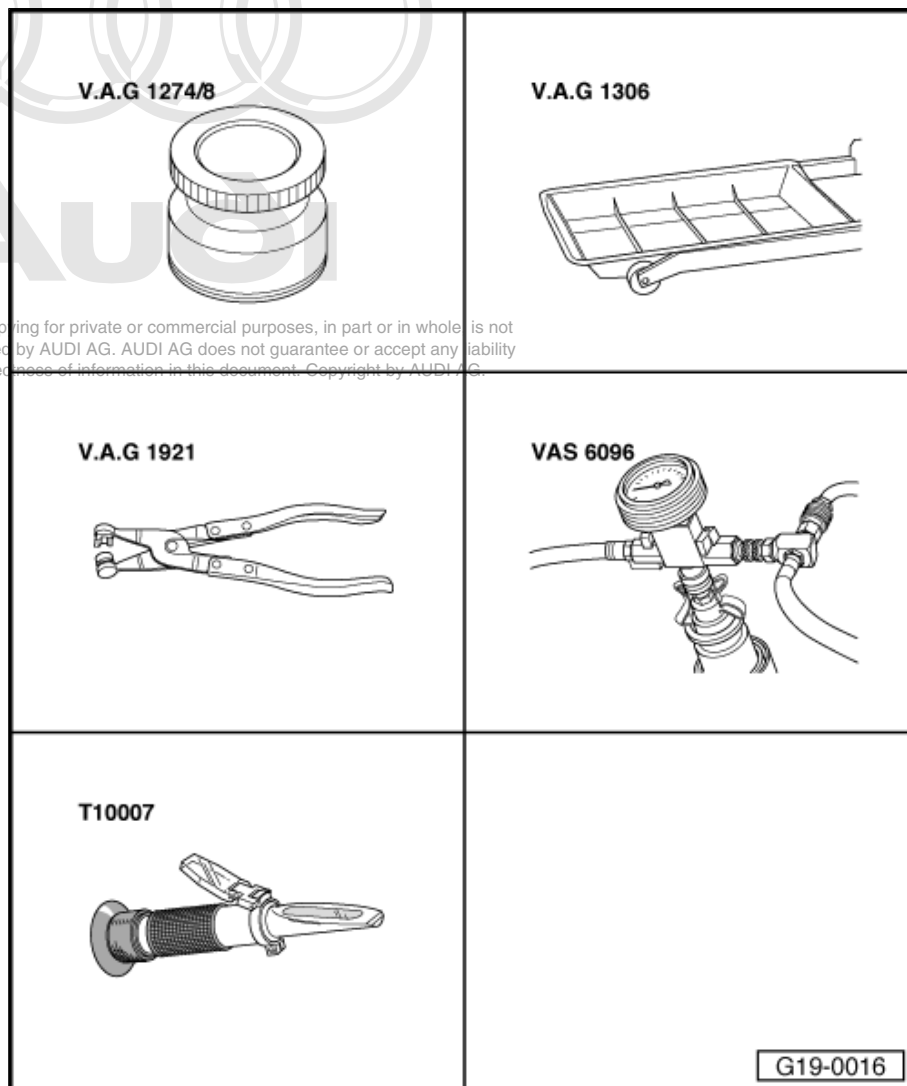


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1.2 Draining and filling cooling system

Special tools and workshop equipment required

- ◆ Adapter for cooling system tester -V.A.G 1274/8-
- ◆ Drip tray for workshop hoist -VAS 6208- or -V.A.G 1306-
- ◆ Hose clip pliers - V.A.G 1921-
- ◆ Cooling system charge unit -VAS 6096- with -VAS 6096/1-
- ◆ Refractometer -T10007-



Draining

- Remove bonnet ⇒ [page 4](#) .



Note

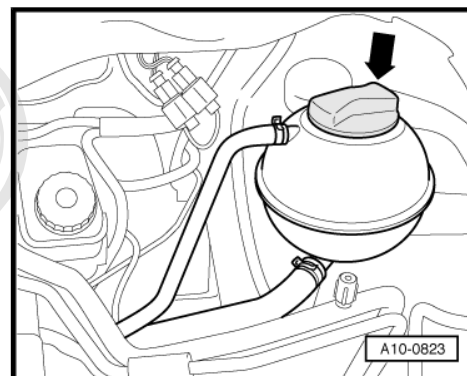
Collect drained coolant in a clean container for re-use or disposal.



WARNING

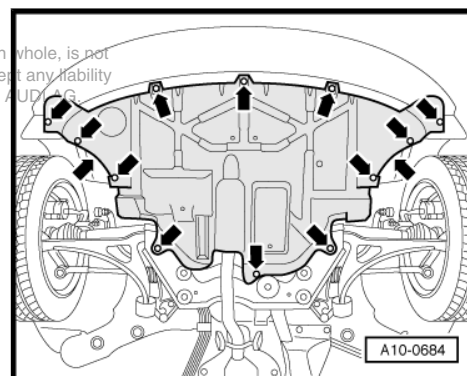
Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.

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



- Remove noise insulation -arrows-.

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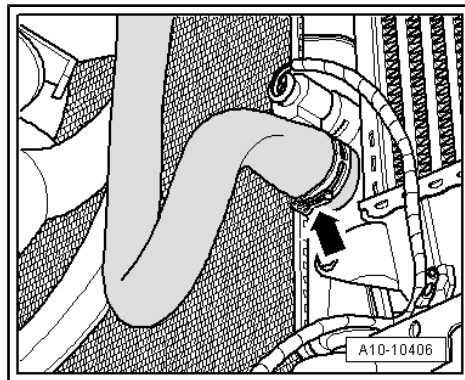
- Place drip tray for workshop hoist -VAS 6208- under engine.
- Disconnect coolant hose (bottom) at radiator -arrow- and drain off coolant.

Filling

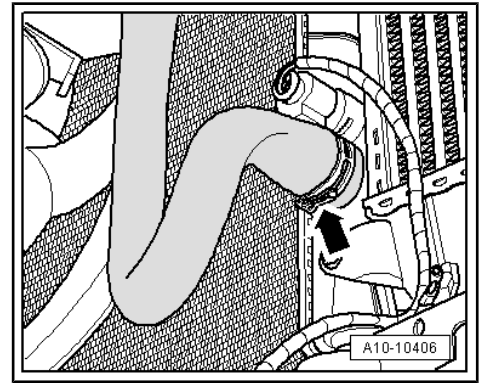


Note

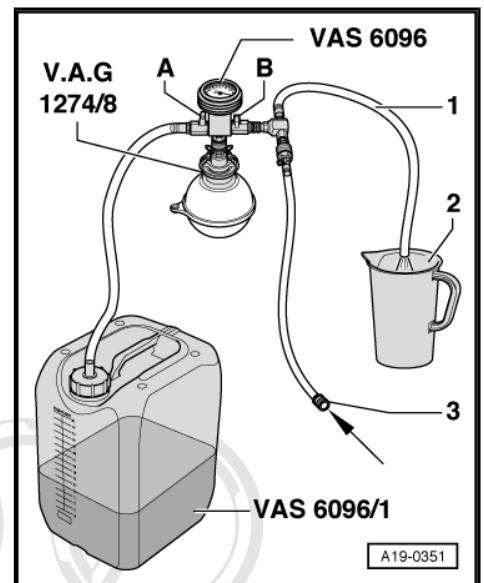
- ◆ *The cooling system is filled all year round with a mixture of water and radiator antifreeze/anti-corrosion agent.*
- ◆ *It is important to use only coolant additive Plus -G 012 A8F A1- (also designated as »G12+«) „meeting specification TL VW 774 F“. Other coolant additives could seriously impair in particular the anti-corrosion properties. The resulting damage could lead to loss of coolant and consequently to serious engine damage.*
- ◆ *Coolant additive »G12+« may be mixed with additives »G11« and »G12«.*
- ◆ *»G12+« and coolant additives marked „Conforming with specification TL VW 774 F“ prevent frost and corrosion damage and stop scale from forming. Such additives also raise the boiling point of the coolant. For these reasons the cooling system must be filled all year round with the correct antifreeze and anticorrosion additive.*
- ◆ *Because of its high boiling point, the coolant improves engine reliability under heavy loads, particularly in countries with tropical climates.*
- ◆ *Frost protection is required down to about –25 °C (in countries with arctic climate: down to about –35 °C).*
- ◆ *The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The antifreeze concentration must be at least 40 %.*
- ◆ *If greater frost protection is required in very cold climates, the amount of »G12+« can be increased, but only up to 60% (this gives frost protection to about –40 °C). If antifreeze concentration exceeds 60%, frost protection decreases again and cooling efficiency is also impaired.*
- ◆ *Use only clean tap water for mixing coolant.*
- ◆ *If radiator, heat exchanger, cylinder head, cylinder head gasket or cylinder block have been renewed, do not re-use old coolant.*
- ◆ *Contaminated or dirty coolant must not be used again.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- ◆ *To check frost protection level of coolant additive »G12+« you must use a refractometer -T10007- .*



- Push coolant hose onto bottom connection on radiator
-arrow-.



- Fill reservoir of cooling system charge unit -VAS 6096- with at least 6 litres of premixed coolant (based on recommended ratio):
 - »G12+« (40 %) and water (60 %) for frost protection to -25 ° C.
 - »G12+« (50 %) and water (50 %) for frost protection to -35 ° C
 - »G12+« (60 %) and water (40 %) for frost protection to -40 ° C.
- Screw adapter -V.A.G 1274/8- onto coolant expansion tank.
- Attach cooling system charge unit -VAS 6096- onto adapter -V.A.G 1274/8- .
- Run vent hose -1- into a small container -2-. (The vented air draws along a small amount of coolant, which should be collected.)
- Close the two valves -A- and -B- by setting lever at right angle to direction of flow.
- Connect hose -3- to compressed air.
- Pressure: 6 ... 10 bar.



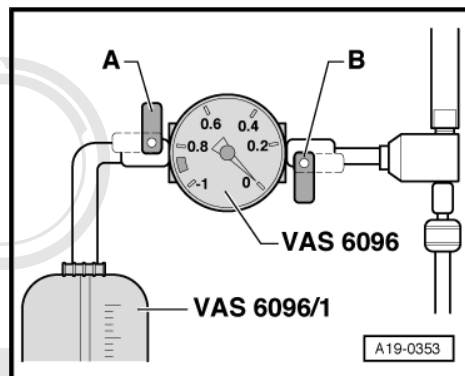
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- Open valve -B- by setting lever in direction of flow.

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 for cooling system charge unit -VAS 6096- can fill with coolant.
- Close valve -A- again.
- Leave valve -B- open for another 2 minutes.
- The suction jet pump will continue generating a 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.

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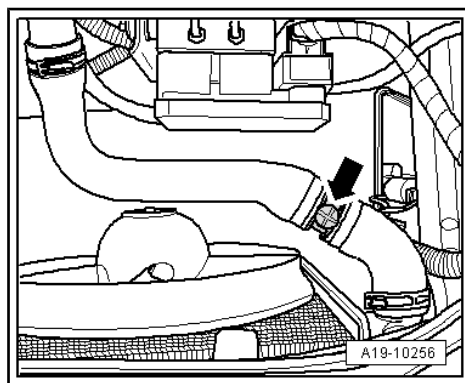
If the needle does not reach the green zone, repeat the process.

If the vacuum level drops, there is a leak in the cooling system.

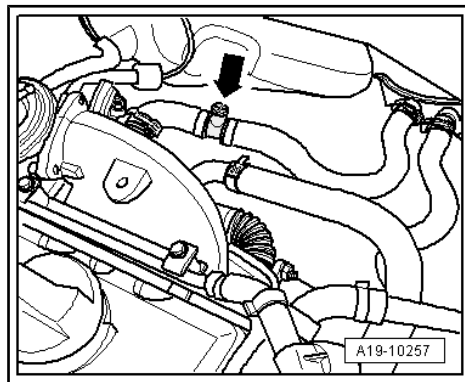
- Detach compressed air hose.
- Open valve -A-.

The partial vacuum in the cooling system causes the coolant to be drawn up out of the reservoir -VAS 6096/1- ; the cooling system is then filled.

- Detach cooling system charge unit -VAS 6096- from adapter -V.A.G 1274/8- on expansion tank.
- Open bleeder screw -arrow- in coolant hose at top left of radiator.
- Fill up with coolant until it flows out at bleeder hole.
- Close bleeder screw.



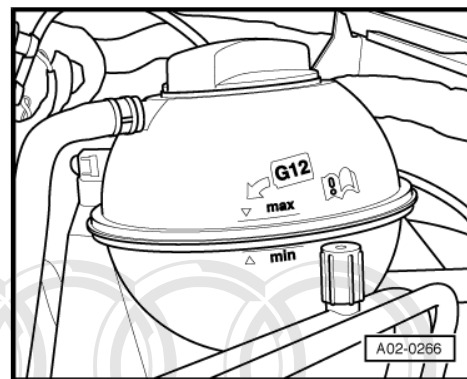
- Open bleeder screw -arrow- in coolant hose at heat exchanger for heater.
- Fill up with coolant until it flows out at bleeder hole.
- Close bleeder screw.



- Check the coolant level and top up coolant as far as the max mark.
- On vehicles with auxiliary heater, switch heater on (for about 30 seconds) ⇒ Owner's Manual .
- Start engine, run for 2 minutes (maximum) at approx. 2000 rpm and top up coolant to max. mark on expansion tank with engine running.
- Tighten filler cap on expansion tank.
- Run engine until radiator fan cuts in.

**WARNING**

Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.



- Check coolant level and top up if necessary.
- When the engine is at normal operating temperature, coolant level must be at MAX mark, when engine is cold it must be between MIN and MAX marks.
- Switch engine off.

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1.3 Removing and installing coolant pump

Removing

- Drain off coolant ⇒ [page 136](#) .
- Remove toothed belt ⇒ [page 36](#) .
- Remove bolts -1- and detach coolant pump -2-.
- Remove O-ring -3-.

Installing

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

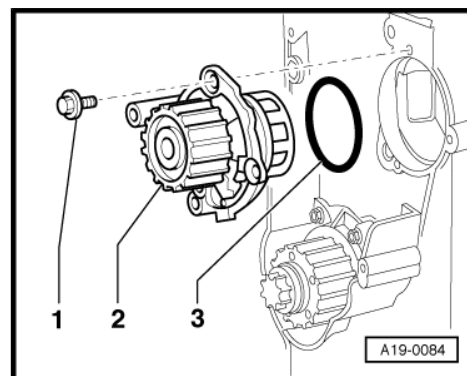
**Note**

Renew O-ring.

- Clean and smoothen sealing surface for O-ring as required.
- Lubricate new O-ring -3- with coolant additive »G12+«.
- Fit coolant pump -2-.
- Installation position: Sealing plug in housing faces downwards.
- Install toothed belt (adjust valve timing) ⇒ [page 44](#) .
- Fill cooling system ⇒ [page 138](#) .

Tightening torque

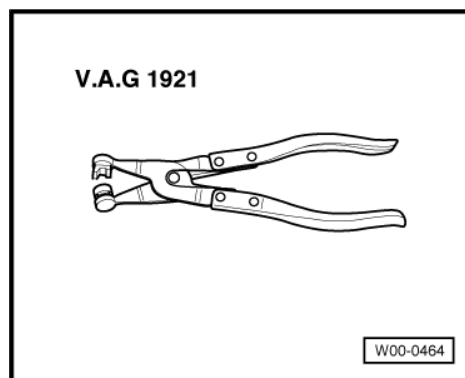
Component	Nm
Coolant pump to cylinder block	15



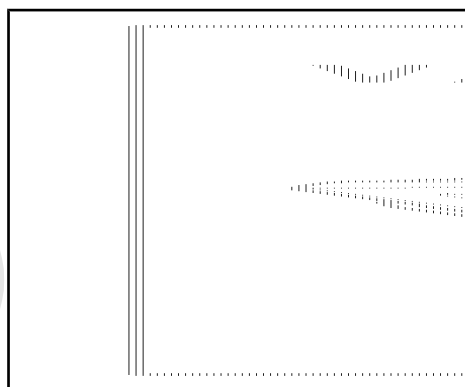
1.4 Removing and installing thermostat

Special tools and workshop equipment required

- ◆ Hose clip pliers -V.A.G 1921-

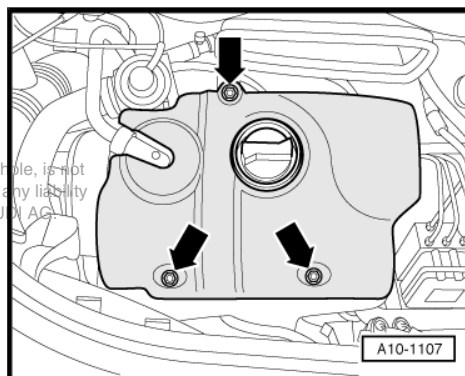


- ◆ Drip tray for workshop hoist -VAS 6208-



Removing

- Remove bonnet ⇒ [page 4](#).
- Take off engine cover panel -arrows-.
- Remove noise insulation underneath (detach crankcase breather hose).



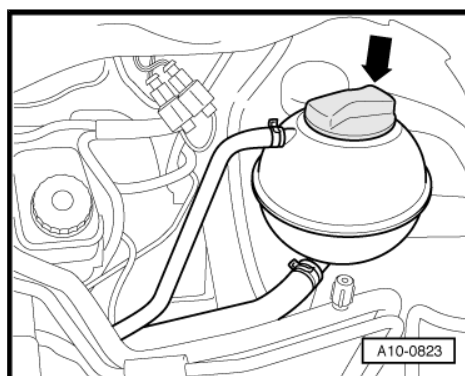
Note

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



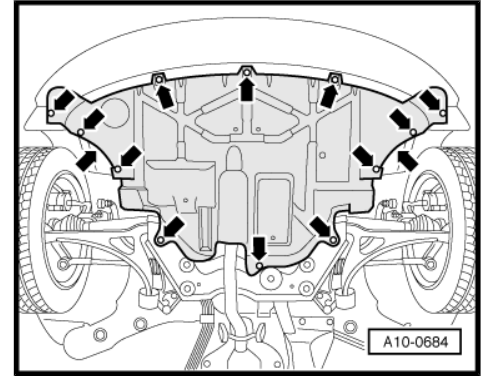
WARNING

Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.

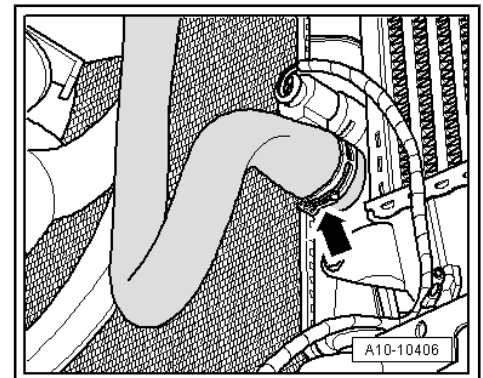


- Open filler cap -arrow- on coolant expansion tank.

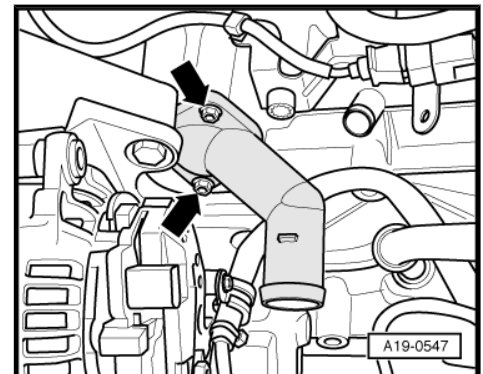
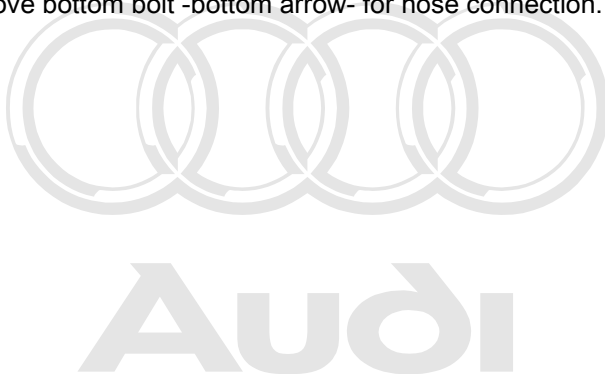
- Remove noise insulation -arrows-.



- Place drip tray for workshop hoist -VAS 6208- under engine.
- Disconnect coolant hose (bottom) at radiator -arrow- and drain off coolant.

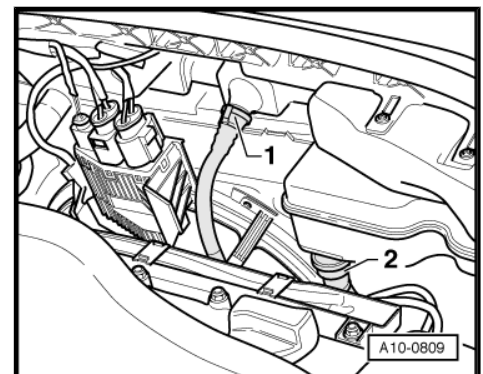


- Remove bottom bolt -bottom arrow- for hose connection.

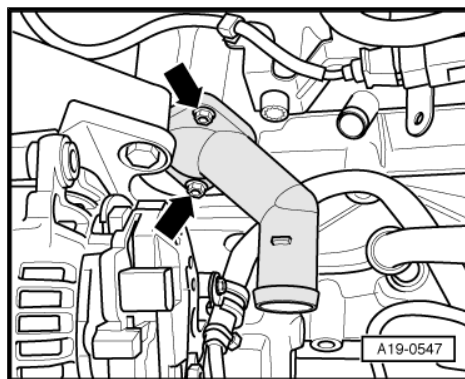


- Pull oil dipstick out of guide tube.
- Remove guide tube -1- for oil dipstick.
- Pull oil filler pipe -2- off oil filler reservoir.

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- Remove top bolt -top arrow- for hose connection.
- Turn thermostat clockwise through approx. 90° (1/4 turn) and remove thermostat from hose connection.
- Remove O-ring.



Installing

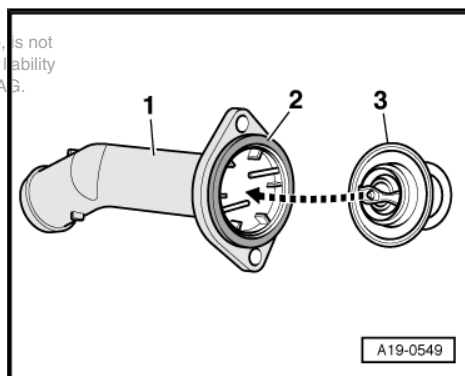
Installation is carried out in the reverse order; note the following:

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Note

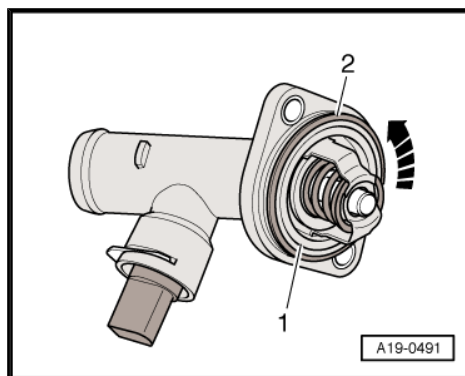
Renew O-ring.

- Clean and smoothen sealing surface for O-ring as required.
- Insert thermostat -3- with new O-ring -2- into hose connection -1-.
- When inserting, the cross-piece on the thermostat should be horizontal as shown in the illustration.
- Lubricate O-ring -2- with coolant additive »G12+«.
- Turn thermostat anti-clockwise -arrow- through approx. 90° (1/4 turn).
- Fill cooling system ⇒ [page 138](#).



Tightening torques

Component	Nm
Connection to cylinder block	15
Guide tube for oil dipstick to oil filter bracket	10



1.5 Checking thermostat

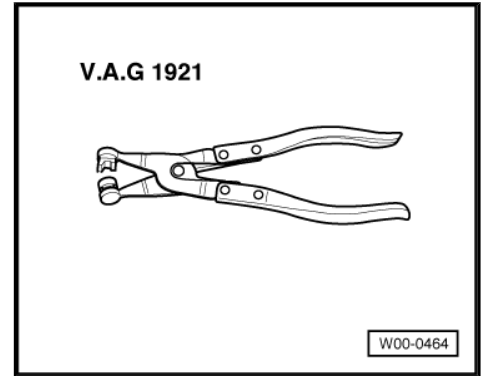
- Heat removed thermostat in water bath.

Starts to open	Fully open	Opening travel
approx. 87 °C	approx. 102 °C ¹⁾	at least 8 mm
• ¹⁾ Cannot be tested.		

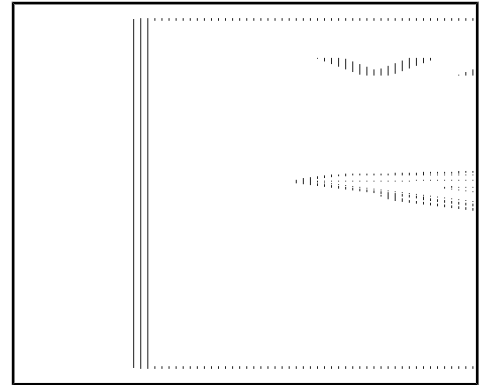
1.6 Removing and installing radiator

Special tools and workshop equipment required

- ◆ Hose clip pliers -V.A.G 1921-



- ◆ Drip tray for workshop hoist -VAS 6208-



Removing

- Remove bonnet ⇒ [page 4](#) .



Note

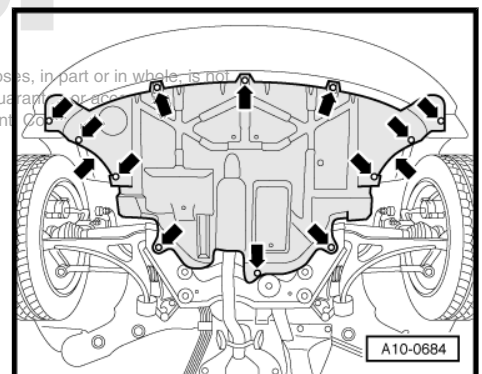
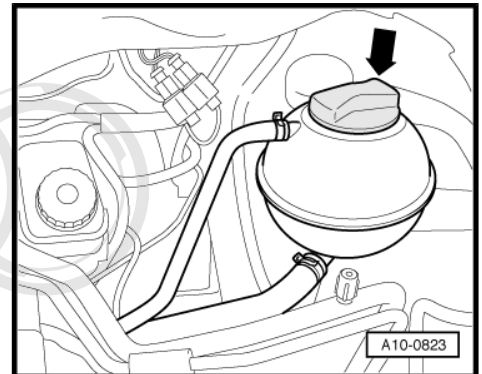
Collect drained coolant in a clean container for re-use or disposal.



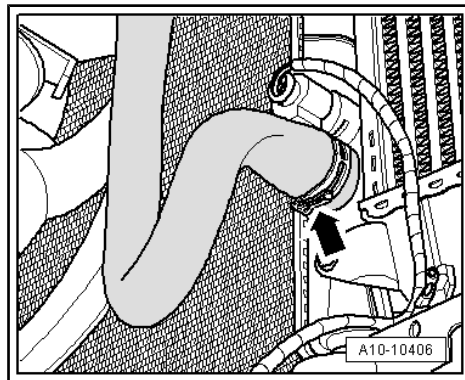
WARNING

Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.

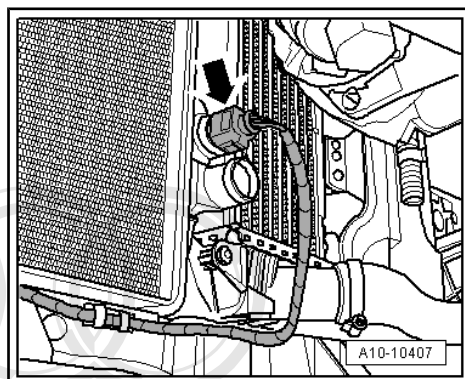
- Open filler cap -arrow- on coolant expansion tank.
- Remove noise insulation -arrows-.
- Remove bumper cover ⇒ [Rep. gr. 63](#)



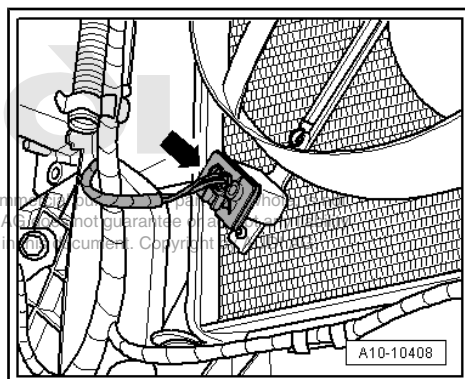
- Place drip tray for workshop hoist -VAS 6208- under engine.
- Disconnect coolant hose (bottom) at radiator -arrow- and drain off coolant.



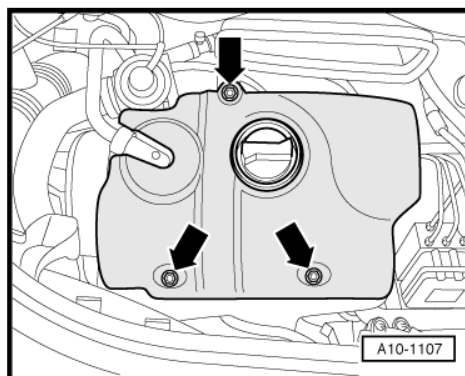
- Unplug electrical connector -arrow- at radiator fan thermostat -F18- .



- Unplug electrical connector -arrow- at radiator fan -V7- .



- Take off engine cover panel -arrows-.
- Remove noise insulation underneath (detach crankcase breather hose).

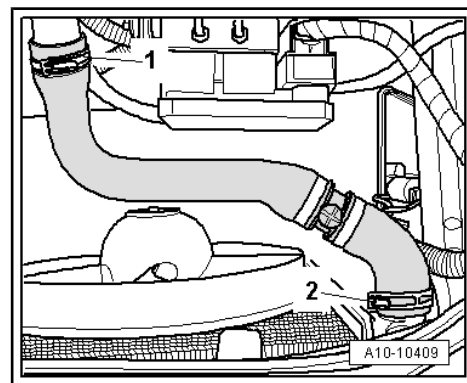


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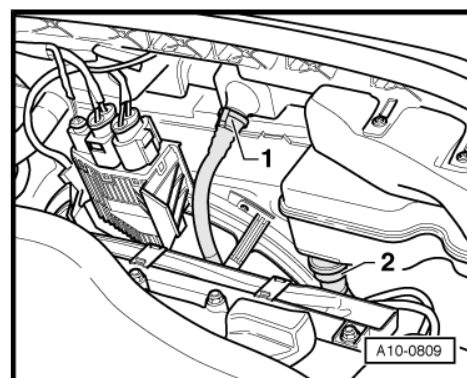
- Detach coolant hose (top left) from radiator at the location indicated -2-.

**Note**

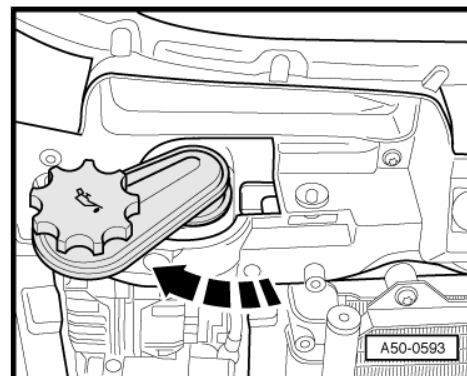
Disregard -item 1-.



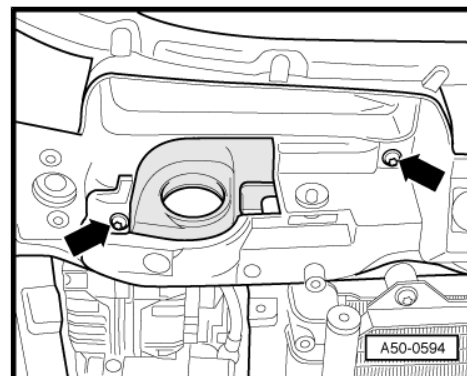
- Pull oil dipstick out of guide tube.
- Remove guide tube -1- for oil dipstick.
- Pull oil filler pipe -2- off oil filler reservoir.



- Move oil filler neck past stop to right side of vehicle -arrow-.
- Lift off oil filler neck.

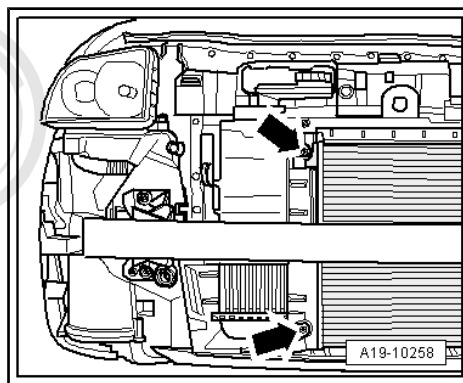


- Remove bolts -arrows-.
- Remove oil filler reservoir from lock carrier.



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- Unscrew bolts -arrows- at front of lock carrier.



- Remove bolts -1-, 2-, 4- and -6- on reverse side of lock carrier.

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Note

Disregard items -3- and -5-.

- Slightly lift radiator and remove from below together with radiator fan.

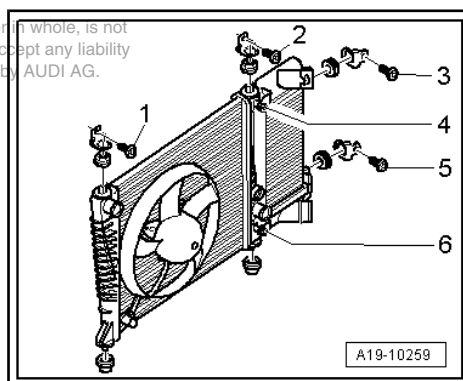
Installing

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

- Install bumper cover ⇒ Rep. gr. 63 .
- Fill cooling system ⇒ [page 138](#) .

Tightening torques

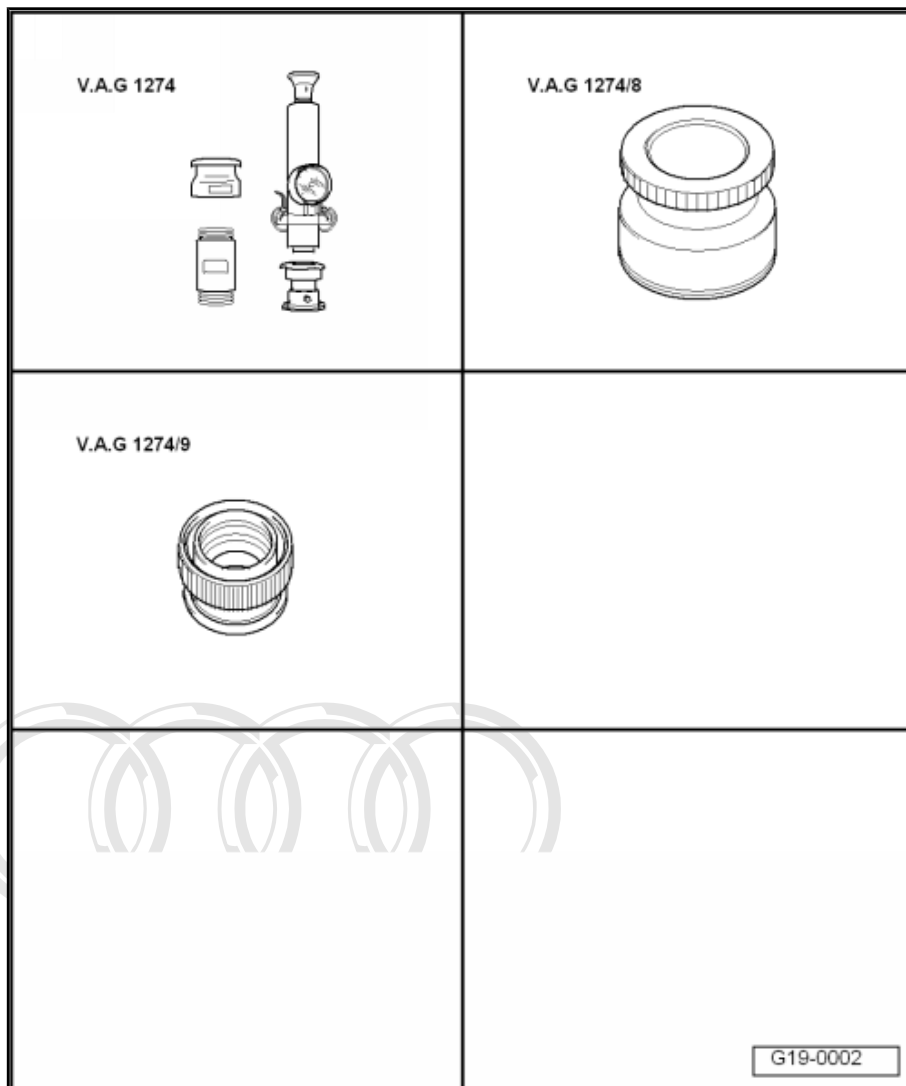
Component	Nm
Charge air cooler to radiator	6
Radiator to lock carrier	6
Guide tube for oil dipstick to oil filter bracket	10



1.7 Checking cooling system for leaks

Special tools and workshop equipment required

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



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Procedure

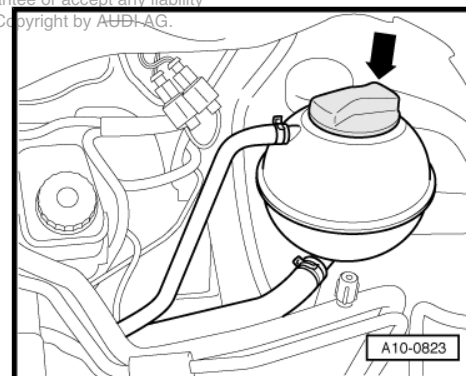
- Engine must be warm.



WARNING

Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.

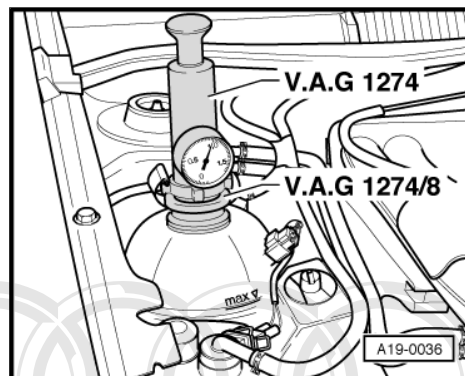
- Open filler cap -arrow- on coolant expansion tank.



- Attach cooling system tester -V.A.G 1274- with adapter - V.A.G 1274/8- to expansion tank.
- Use hand pump on cooling system tester to create a pressure of approx. 1.0 bar.

If the pressure drops:

- Trace leak and repair.

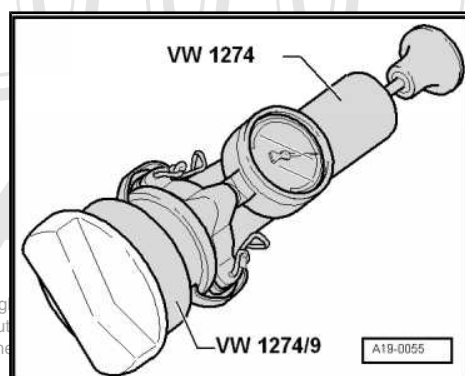


Checking pressure relief valve in filler cap

- Attach cooling system tester -V.A.G 1274- with adapter - V.A.G 1274/9- to filler cap.
- Use hand pump on cooling system tester to create pressure.
- The pressure relief valve should open at a pressure of 1.4 ... 1.6 bar.

If the pressure relief valve does not open as described:

- Renew filler cap.



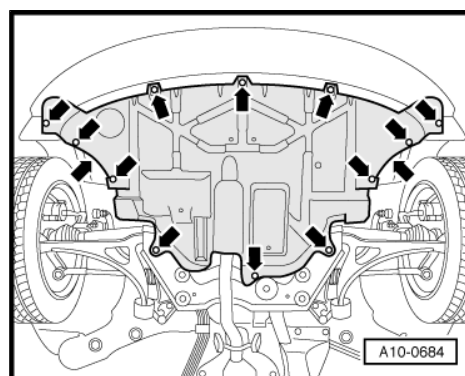
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1.8 Removing and installing radiator fan - V7-

Removing

- Remove noise insulation -arrows-.
- Remove bumper cover ⇒ Rep. gr. 63 .



- Unplug electrical connector -arrow- at radiator fan -V7- .
- Unscrew radiator fan securing bolts on front of radiator and remove radiator fan.

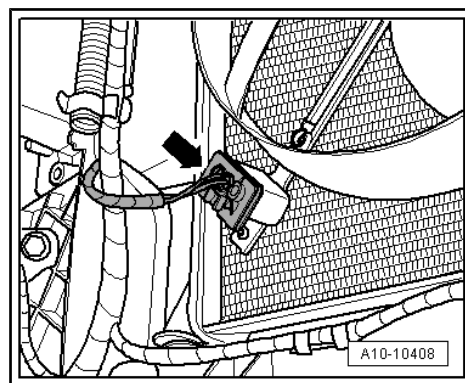
Installing

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

- Install bumper cover ⇒ Rep. gr. 63 .

Tightening torque

Component	Nm
Radiator fan -V7- to radiator	5



21 – Turbocharging/supercharging

1 Checking charge air system with turbocharger

Note

- ◆ *Observe rules for cleanliness ⇒ [page 159](#).*
- ◆ *Renew gaskets, seals and self-locking nuts.*
- ◆ *Charge air system must be free of leaks.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly. Do NOT use lubricant.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ [Parts catalogue](#).*

1.1 Safety precautions

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



WARNING

- ◆ *Test equipment must always be secured on the rear seat and operated from that position by a second person.*
- ◆ *If test and measuring instruments are operated from front passenger's seat and the vehicle is involved in an accident, the person sitting in this seat could be seriously injured when the airbag is triggered.*

1.2 Test requirements for checking turbocharging system

- Coolant temperature at least 80 °C.
- Fault memory of engine control unit interrogated.
- Exhaust gas recirculation system OK, checking ⇒ [page 181](#).

Note

Reliable values cannot be obtained when checking turbocharger system if the exhaust gas recirculation system is defective.

- No leaks in the intake and exhaust systems. Effects of leaks ⇒ [page 151](#).
- Vacuum pipe to charge pressure regulating valve not obstructed, loose or leaking.
- No faults on engine or injection system (e.g. compression pressure or unit injectors).

1.3 Effects of leaks in charge air system

A - Leaks after air mass meter -G70-

Possible causes of trouble:

- 1 - Connecting hose between air mass meter -G70- and turbo-charger
- 2 - Connecting hose to crankcase breather

Effect: Loss of power

B - Leaks downstream of turbocharger (intake side)

Possible causes of trouble:

- 1 - Air intake hoses and pipes between turbocharger and charge air cooler
- 2 - Air intake hoses and pipes between charge air cooler and intake manifold
- 3 - Charge air cooler
- 4 - Seal below intake manifold pressure sender -G71-
- 5 - Seal between intake connecting pipe, mechanical exhaust gas recirculation valve and intake manifold
- 6 - Gasket between intake manifold and cylinder head

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Effect: inadequate charge pressure

C - Leaks downstream of turbocharger (exhaust side)

Possible causes of trouble:

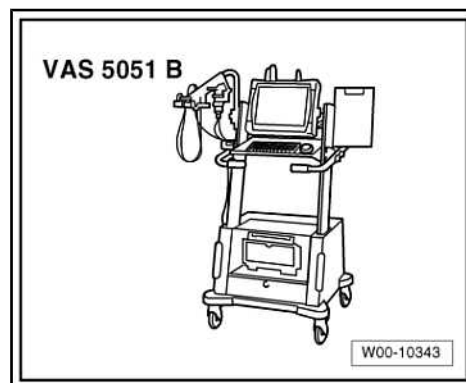
- 1 - Components of exhaust gas recirculation system
- 2 - Connection between exhaust manifold and cylinder head

Effect: inadequate charge pressure; possible smell of exhaust gas, traces of soot in engine compartment

1.4 Checking charge pressure

Special tools and workshop equipment required

- ◆ Vehicle diagnosis, testing and information system -VAS 5051-



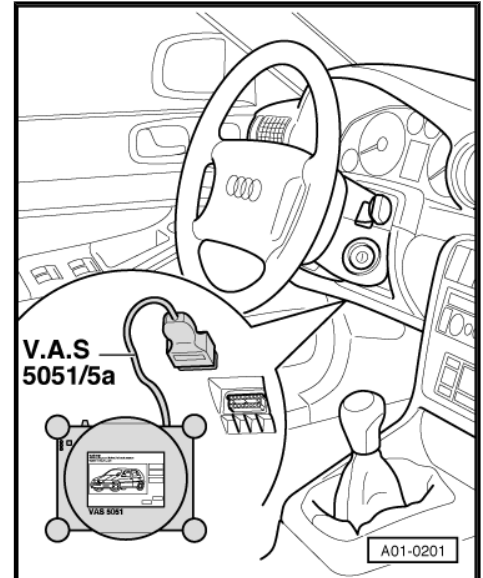
Procedure

- All hoses, pipes and wiring are checked for tight fit and leak-ages.
- No leaks in the intake and exhaust systems.
- No faults on engine or injection system (e.g. compression pressure or injector units).
- Coolant temperature at least 80 °C.
- Fault memory interrogated.

**WARNING**

*To avoid accident risks when road testing the vehicle with test equipment, always observe the relevant safety precautions
⇒ [page 151](#).*

- Connect up vehicle diagnostic, testing and information system -VAS 5051- with diagnosis lead -VAS 5051/5A- and select vehicle self-diagnosis and vehicle system „01 - Engine electronics“. Engine must be idling.



Display on -VAS 5051-

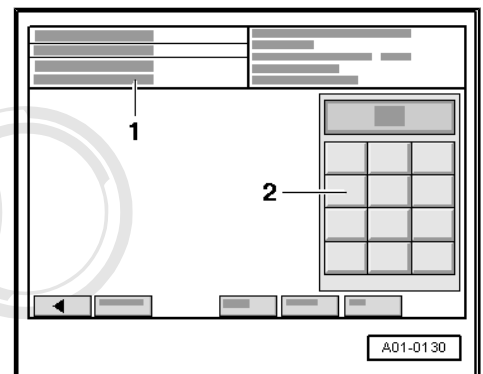
- From list -1- select diagnostic function „08 - Read measured value block“.



Display on -VAS 5051-

- Enter „011“ via keypad -2- to select „Display group 011“ and confirm entry with the  key.

1 - Enter display group



Display on -VAS 5051-

- Accelerate vehicle in 3rd gear from 2000 rpm at full throttle and observe rev counter.
- Press „Print - Save result“ on -VAS 5051- at approx. 3000 rpm.

Display zone	Display shows	Specification
-1-	Engine speed	2800 ... 3200 rpm
-2-	Specification (charge pressure)	1650 ... 2200 mbar
-3-	Actual (charge pressure)	1650 ... 2100 mbar
-4-	Signal ratio of charge pressure control solenoid valve -N75-	40 ... 95 %

- Exit function „08 - Read measured value block“ by pressing the key.
- Press „06 - End output“.
- Switch off ignition.

If charge pressure in display zone -3- is not within the specified range:

- Check charge air system for leaks.
- Test vacuum actuation at turbocharger ⇒ [page 155](#) .
- Check charge pressure control solenoid valve -N75- ⇒ Vehicle diagnostic tester.

If all the above items are OK, but the charge pressure is too low:

- Renew turbocharger ⇒ [page 161](#) .

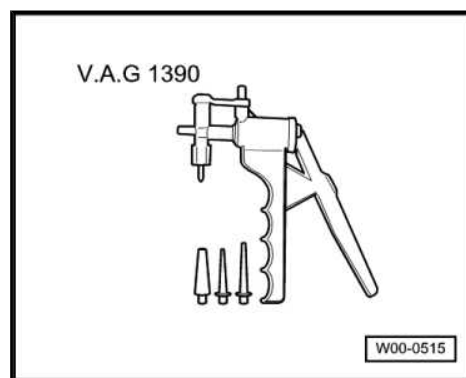
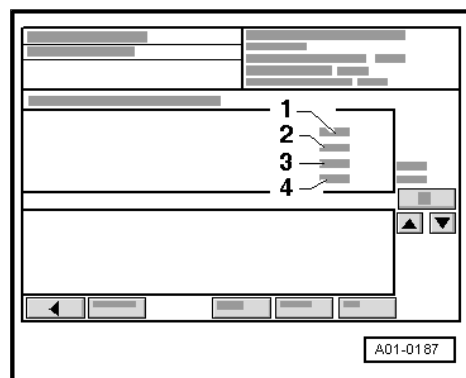
1.5 Checking linkage and vacuum unit for charge pressure control

Problems with linkage/vacuum unit for charge pressure control result in the following faults:

- ◆ Not achieving the specified charge pressure values.
- ◆ Loss of power.
- ◆ Uneven power delivery at part throttle
- ◆ Jolts when throttle is opened or closed.

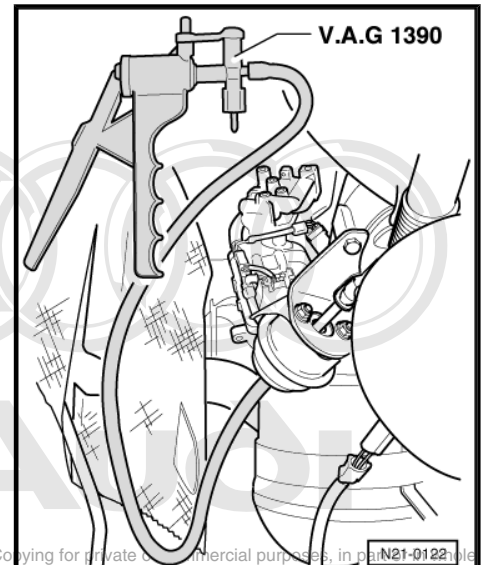
Special tools and workshop equipment required

- ◆ Hand vacuum pump with accessories -V.A.G 1390-



Procedure

- Disconnect hose going to vacuum unit for charge pressure control at separating point.
- Connect hand vacuum pump -V.A.G 1390- to vacuum hose.



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- Use hand vacuum pump to generate a vacuum and watch the movements of the turbocharger linkage:
 - Linkage should move towards vacuum unit.
- Vent hand vacuum pump.
 - Linkage should move away from vacuum unit.

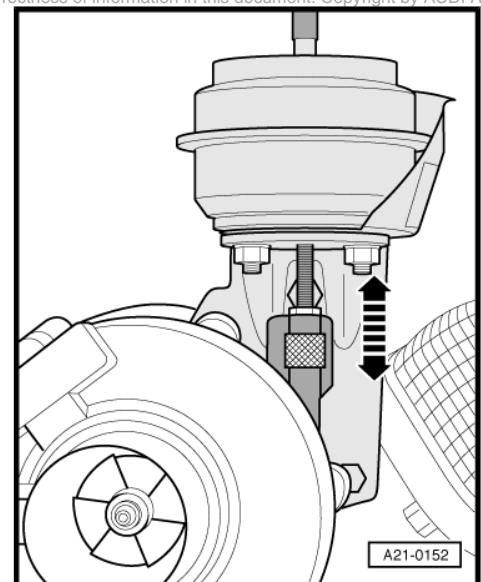


Note

Observe the movement of the linkage over the complete range of travel. It should move steadily and smoothly.

If the linkage does not move or moves jerkily:

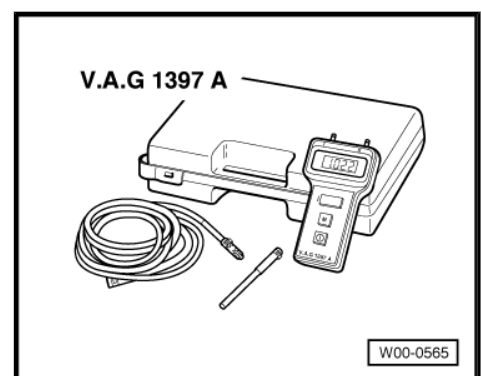
- Renew turbocharger ⇒ [page 161](#) .



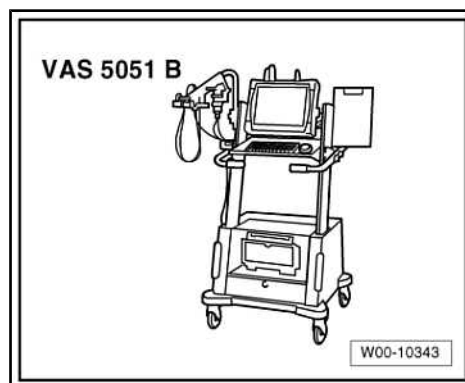
1.6 Checking vacuum actuation at turbocharger

Special tools and workshop equipment required

- ◆ Turbocharger tester -V.A.G 1397 A-

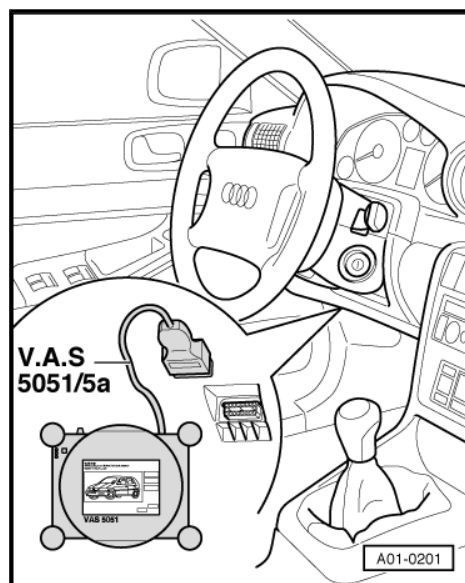
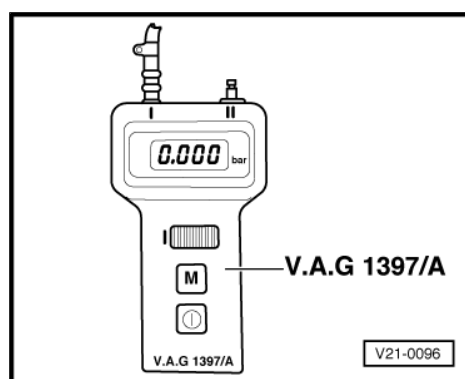


◆ Vehicle diagnosis, testing and information system -VAS 5051-



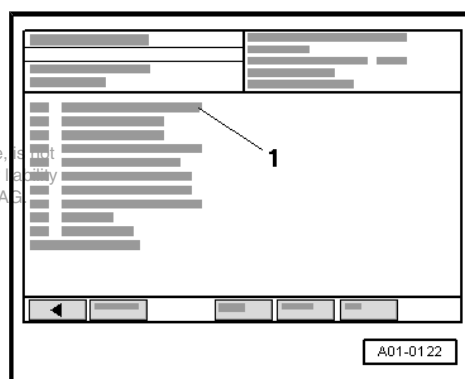
Procedure

- Disconnect hose going to vacuum unit for charge pressure control at separating point.
- Switch on turbocharger tester and set measuring range selector switch to position -I- (absolute pressure).
- Attach test hose to connection -I-.
- Connect test hose to detached vacuum hose.
- Connect up vehicle diagnostic, testing and information system -VAS 5051- with diagnosis lead -VAS 5051/5A- and select vehicle self-diagnosis and vehicle system „01 - Engine electronics“. Engine must be idling.



Display on -VAS 5051-

- From list -1- select diagnostic function „04 - Basic setting“.

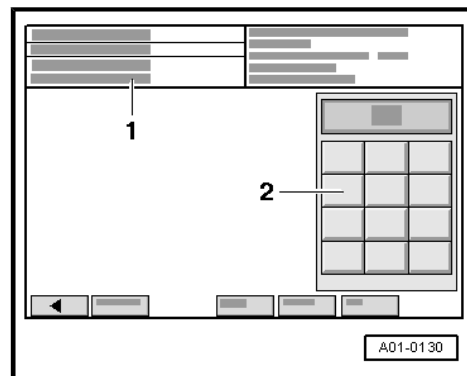


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Display on -VAS 5051-

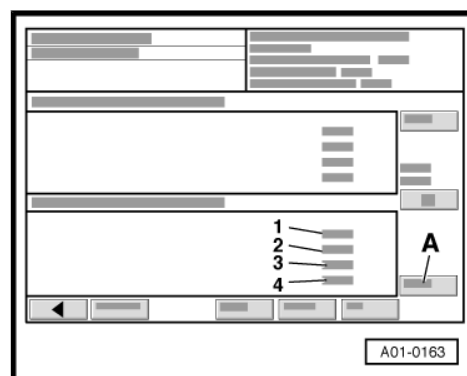
- Enter „011“ via keypad -2- to select „Display group 011“ and confirm entry with the **[Q]** key.

1 - Enter display group



Display on -VAS 5051-

- Activate basic setting by touching key **[A]**.

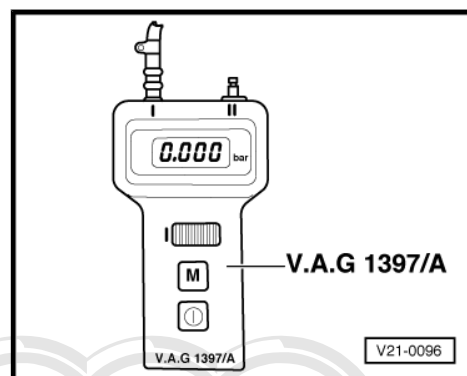


- The idling speed is increased to 1350 rpm ... 1450 rpm.
- The vacuum unit for charge pressure control is actuated in intervals.
- Specification on turbocharger tester -V.A.G 1397 A- : above 650 mbar vacuum when vacuum unit is actuated.



Note

The absolute pressure displayed on the turbocharger tester -V.A.G 1397 A- must decrease by the specified value given.



If specification is not obtained:

- Check whether hoses for charge pressure control have become disconnected or are obstructed ⇒ [page 157](#) .
- Check charge pressure control solenoid valve -N75- ⇒ Vehicle diagnostic tester.

If vacuum does not drop when actuation stops:

- Check the vent hoses ⇒ [page 157](#) .
- Exit function „04 - Basic setting“ by pressing the **[←]** key.
- Press „06 - End output“.

1.7 Hose connection diagram for charge pressure control

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1 - Vacuum reservoir
2 - Throttle butterfly valve - N211-
3 - Exhaust gas recirculation valve -N18-
4 - Non-return valve

- ☐ White connection to charge pressure control solenoid valve -N75-

5 - Charge pressure control solenoid valve -N75-

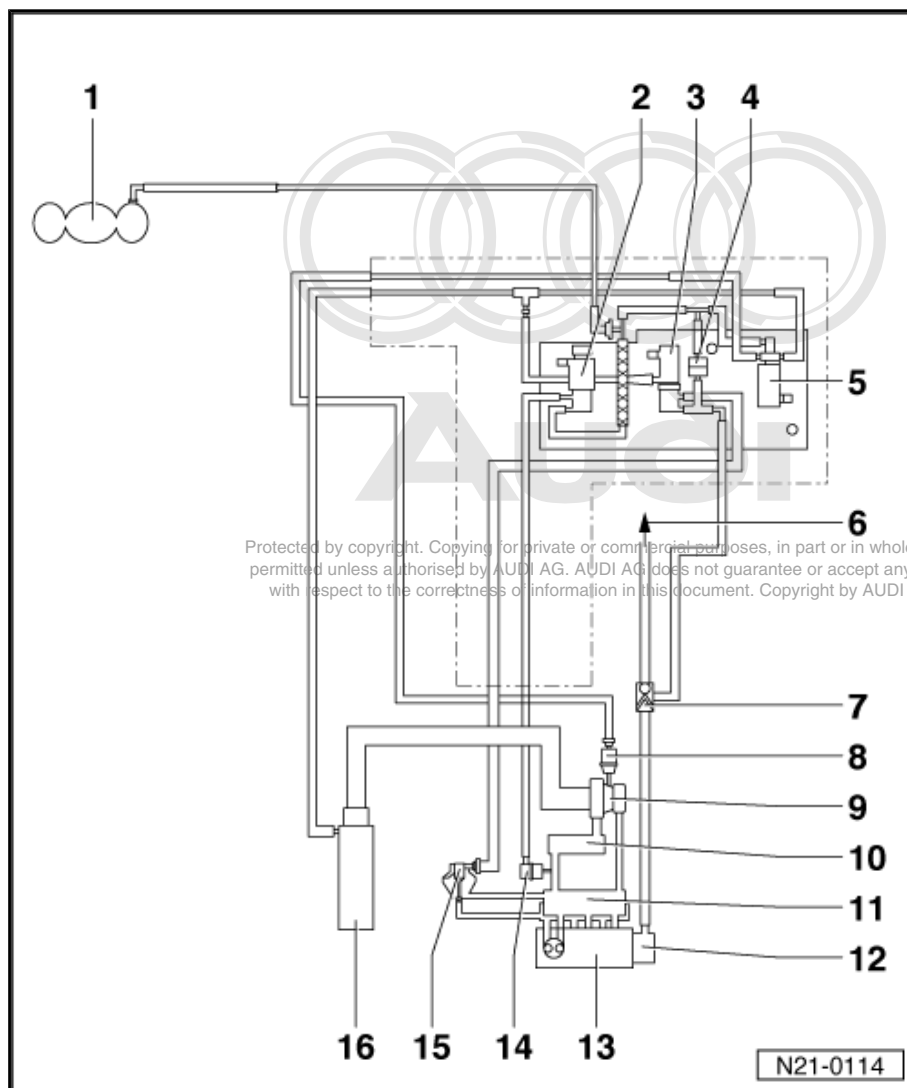
- ☐ Checking vacuum actuation at turbocharger
⇒ [page 155](#)

6 - To brake servo
7 - Non-return valve
8 - Vacuum unit for charge pressure control
9 - Turbocharger
10 - Charge air cooler
11 - Intake manifold
12 - Tandem pump

- ☐ For fuel and vacuum supply

13 - Cylinder head
14 - Vacuum unit for intake manifold flap
15 - Mechanical exhaust gas recirculation valve

- ☐ Part of intake connecting pipe
- ☐ Can only be renewed together with intake connecting pipe

16 - Air cleaner


2 Servicing charge air system with turbocharger

2.1 Rules for cleanliness

When working on the turbocharger, pay careful attention to the following „5 rules“:

- ◆ Thoroughly clean all unions and surrounding areas before disconnecting.
- ◆ Place parts that have been removed on a clean surface and cover them over. Do not use fluffy 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 been previously unpacked and stored away loose (e.g. in toolboxes, etc.).
- ◆ When the system is open: Do not work with compressed air if this can be avoided. Do not move the vehicle unless absolutely necessary.

2.2 Turbocharger - exploded view



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1 - Exhaust manifold

- ☐ Removing and installing
⇒ [page 179](#)

2 - 25 Nm

- ☐ Renew
- ☐ Coat thread and contact surface of bolt head with high-temperature paste; ⇒ Parts catalogue

3 - Intake manifold

- ☐ Removing and installing
⇒ [page 94](#)

4 - From charge air cooler

5 - Gasket

- ☐ Renew
- ☐ Coating (bead) faces intake manifold

6 - 25 Nm

7 - Gasket

- ☐ Renew
- ☐ Note installation position

8 - Turbocharger

- ☐ Checking charge pressure ⇒ [page 152](#)
- ☐ Removing and installing
⇒ [page 161](#)

9 - Vacuum unit for charge pressure regulating valve

- ☐ Checking ⇒ [page 154](#)
- ☐ Cannot be renewed separately

10 - 8 Nm

11 - From air cleaner

12 - Gasket

- ☐ Renew

13 - Oil return line

- ☐ To cylinder block
- ☐ Tighten to 30 Nm

14 - 15 Nm

15 - 20 Nm

16 - Support for turbocharger

17 - 20 Nm

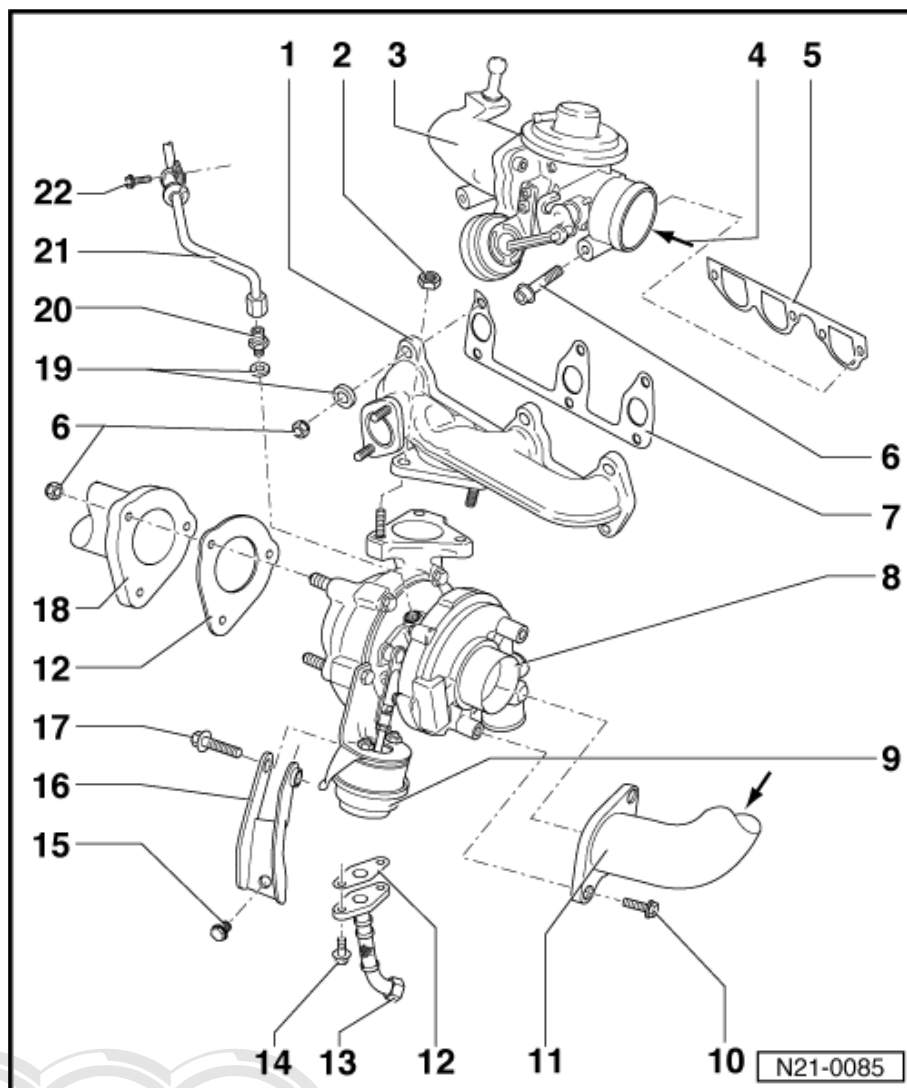
18 - Starter catalytic converter

19 - Washer or seal

20 - Connection

21 - Oil supply line

- ☐ From oil filter bracket ⇒ [Item 7 \(page 127\)](#)
- ☐ Tighten to 22 Nm

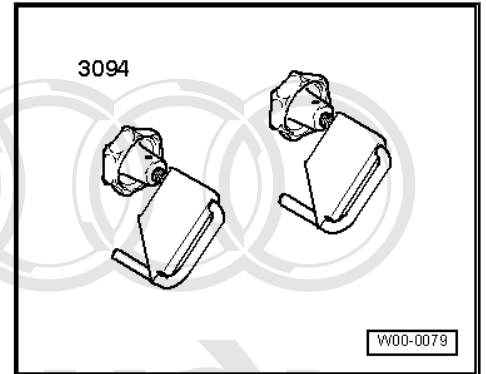


22 - 10 Nm

2.3 Removing and installing turbocharger

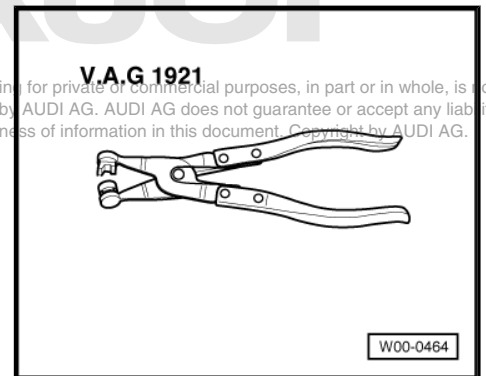
Special tools and workshop equipment required

- ◆ Hose clamps up to Ø 25 mm -3094-



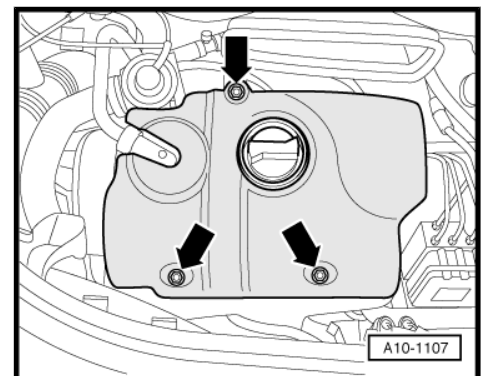
- ◆ Hose clip pliers -V.A.G 1921-

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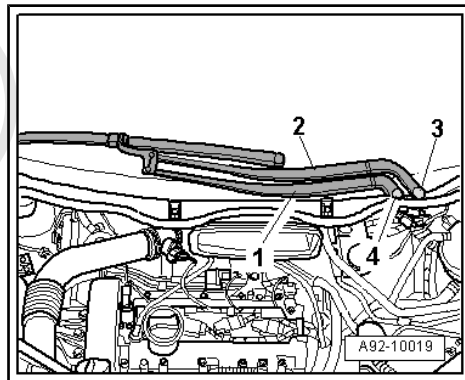


Removing

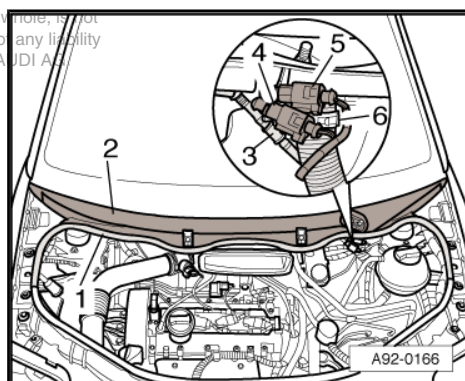
- Remove bonnet → [page 4](#) .
- Take off engine cover panel -arrows-.
- Remove noise insulation underneath (detach crankcase breather hose).



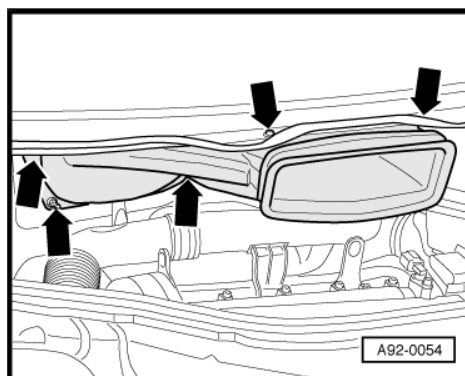
- Use screwdriver to lever off cover caps -3- and -4- from wiper arms.
- Slacken nuts on both wiper arms a few turns.
- Loosen wiper arms -1- and -2- from wiper shafts by tilting slightly.
- Completely remove nuts and take off wiper arms.



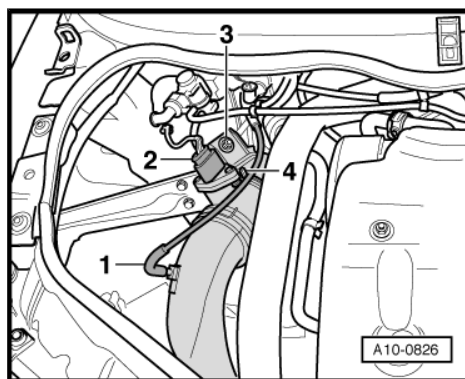
- Disconnect washer fluid hose -3-.
- If fitted, unplug electrical connectors -4- and -5- for heated washer jets.
- Open hose clip -6- using hose clip pliers -V.A.G 1921- and detach water drain hose from cowl panel grille.
- Pull off rubber seal -1- on cowl panel grille.
- Disconnect cowl panel grille -2-.



- Unscrew nuts and bolts -arrows-.
- Pull air duct forwards, move it to right side of vehicle and remove.



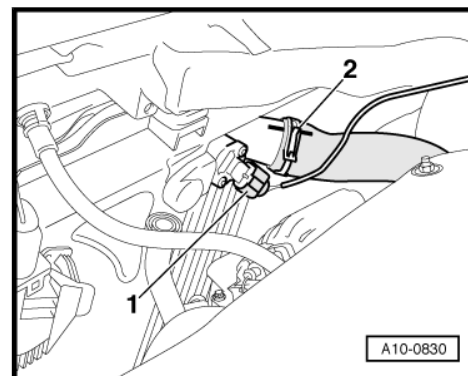
- Unplug electrical connector -2- at air mass meter -G70- .
- Detach vacuum hose -1-.
- Release hose clip -4- and remove air pipe with air mass meter -G70- .
- Remove nut -3-.



- Remove air intake hose -2- between charge air cooler and intake manifold.

**Note**

Disregard -item 1-.



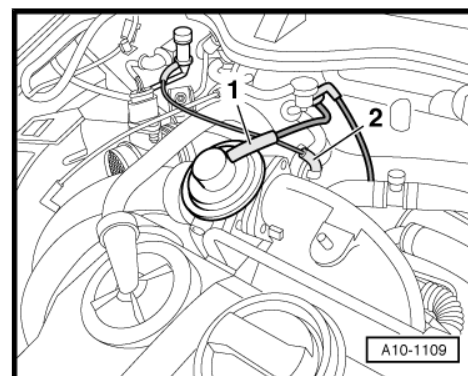
- Disconnect vacuum hose -1- from mechanical exhaust gas recirculation valve.
- Disconnect vacuum hose -2- from throttle butterfly valve - N211- .

**WARNING**

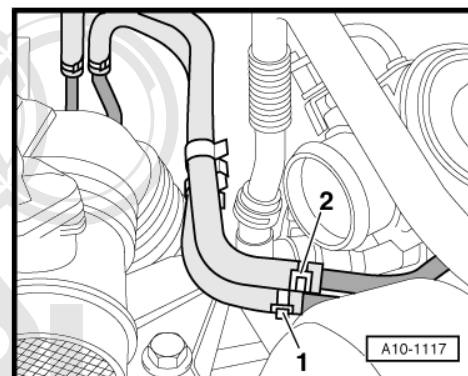
◆ *In extreme cases the fuel lines and the fuel can reach a temperature of 100 °C on vehicles with unit injector engine. Allow the fuel to cool down before disconnecting the lines - danger of scalding.*

◆ *Wear protective gloves.*

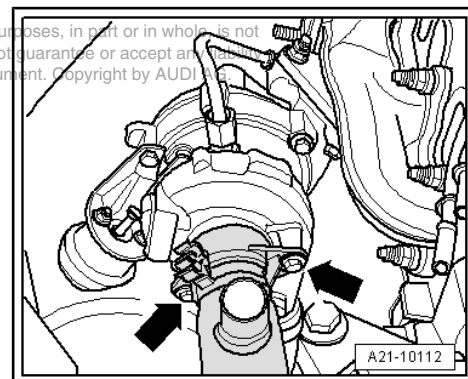
◆ *Wear safety goggles.*



- Mark fuel supply line -2- and fuel return line -1-.



- Unscrew bolts -arrows- and detach air pipe from turbocharger.

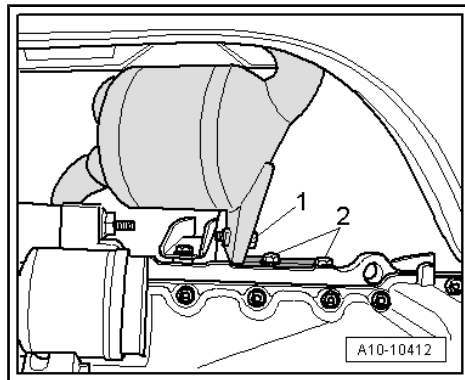


- Remove bolts -2- on bracket for starter catalytic converter.



Note

Disregard -item 1-.

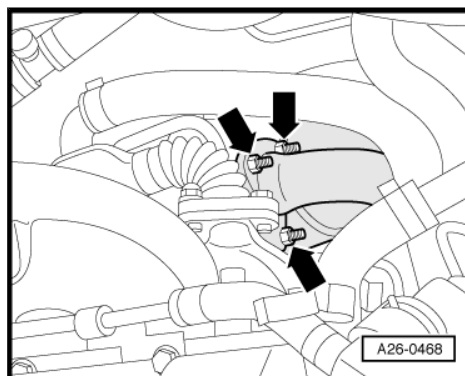


- Unscrew nuts -arrows- at turbocharger/starter catalytic converter.

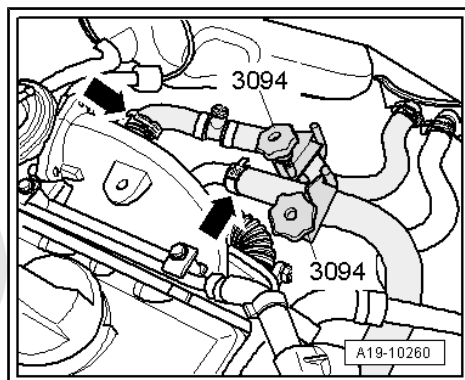


Note

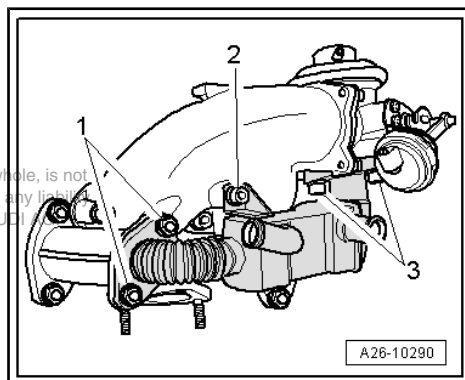
Do not bend the flexible joint (de-coupling element) between starter catalytic converter and main catalytic converter more than 10°, otherwise it could be damaged.



- Disconnect starter catalytic converter from turbocharger.
- Tie up starter catalytic converter to body.
- Clamp off coolant hoses going to exhaust gas recirculation cooler using hose clamps -3094- .
- Detach coolant hoses -arrow- at exhaust gas recirculation cooler.

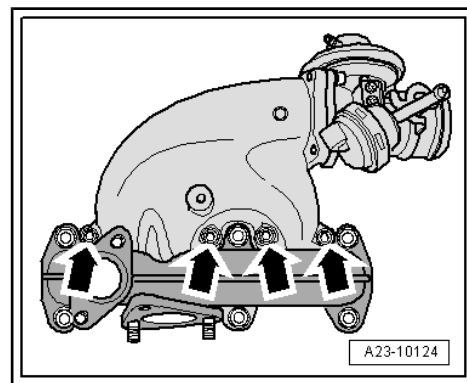


- Remove bolts -2- and -3- and also nuts -1- and take off exhaust gas recirculation cooler.

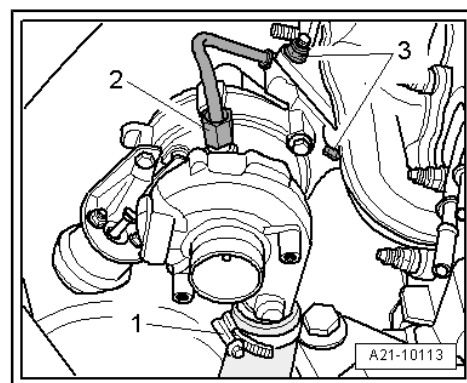


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- Unscrew bolts -arrows- and remove intake manifold.



- Detach air hose -1- from turbocharger.
- Unscrew oil supply line -2- from turbocharger.
- Unscrew the 3 turbocharger nuts -3-.



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- Detach vacuum hose -2- leading to vacuum unit for charge pressure control and move it clear.
- Remove oil return line -3- at cylinder block.
- Unbolt support -1- for turbocharger from cylinder block.
- Lift out turbocharger.

Installing

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



Note

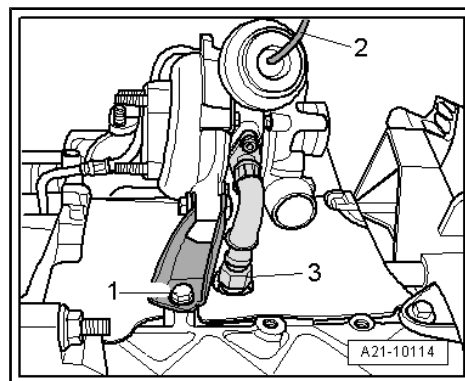
- ◆ *Renew gaskets, seals and self-locking nuts.*
- ◆ *Fill turbocharger with engine oil at connection for oil supply line.*
- ◆ *Charge air system must be free of leaks.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*

- Install intake manifold.
- Install starter catalytic converter together with main catalytic converter ⇒ [page 174](#) .
- Install and adjust wiper arms ⇒ Rep. gr. 92 .
- Check oil level ⇒ [page 132](#) .



Note

After installing turbocharger, allow engine to idle for approx. 1 minute and do not rev up immediately to ensure turbocharger is supplied with oil.



Tightening torques

Component		Nm
Turbocharger to exhaust manifold		25 ¹⁾
Support for turbocharger to cylinder block		20
Oil return line to cylinder block		30
Oil supply line to turbocharger		22
Intake manifold to cylinder head		25
Exhaust gas recirculation cooler to:	Mechanical exhaust gas recirculation valve	25
	Intake manifold	25
	Exhaust manifold	25 ¹⁾
Air pipe to turbocharger		8
• ¹⁾ Renew nuts.		

2.4 Removing and installing charge air cooler

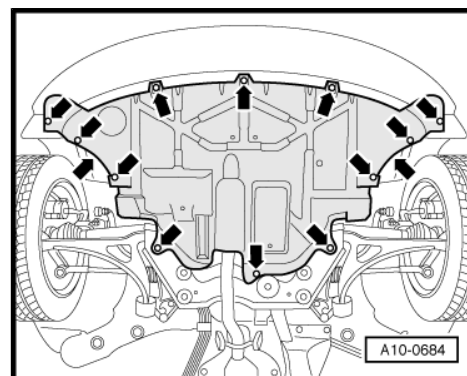
Removing



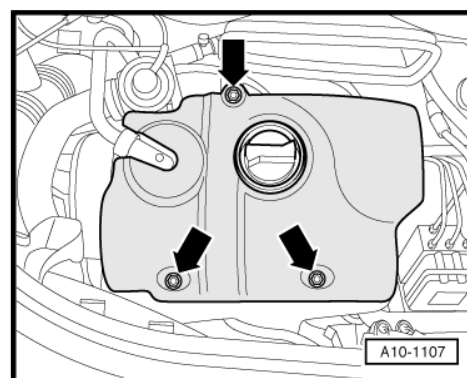
Note

Check all hoses and pipes for correct fitting and leakage before carrying out tests or repairs.

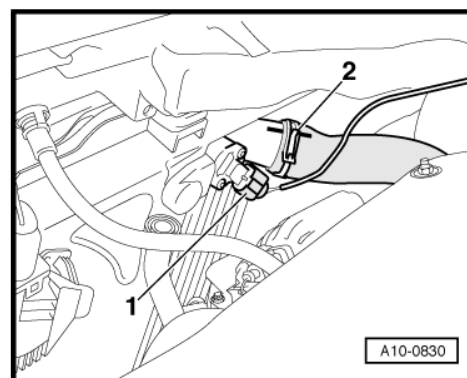
- Remove noise insulation -arrows-.
- Remove bumper cover ⇒ Rep. gr. 63 .
- Remove bonnet ⇒ [page 4](#) .



- Take off engine cover panel -arrows-.
- Remove noise insulation underneath (detach crankcase breather hose).

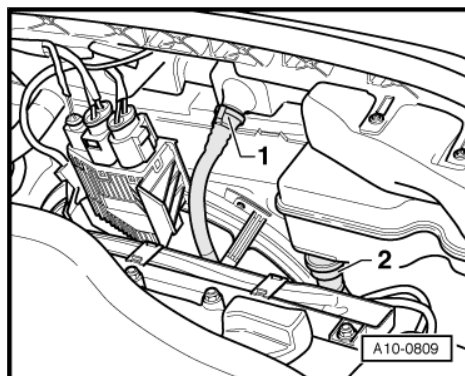


- Unplug electrical connector -1- at intake manifold pressure sender -G71- and move wiring clear.
- Remove air intake hose -2- between charge air cooler and intake manifold.

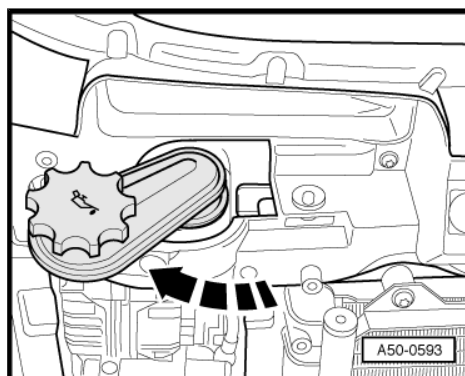


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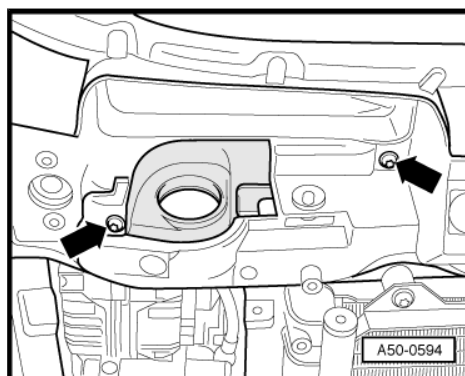
- Pull oil dipstick out of guide tube.
- Remove guide tube -1- for oil dipstick.
- Pull oil filler pipe -2- off oil filler reservoir.



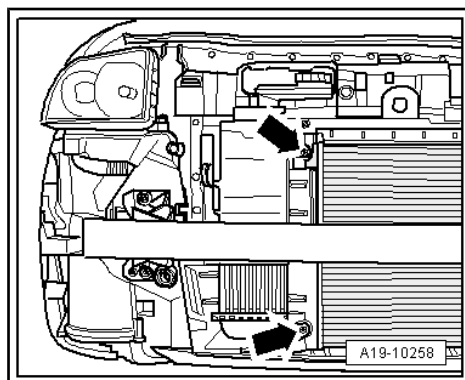
- Move oil filler neck past stop to right side of vehicle -arrow-.
- Lift off oil filler neck.



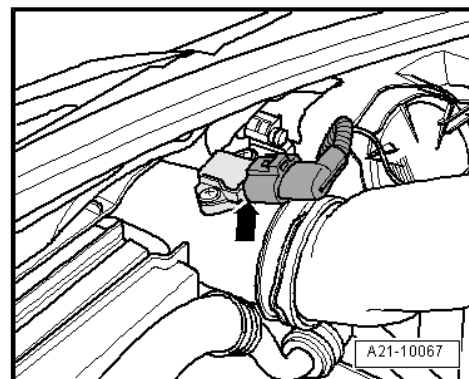
- Remove bolts -arrows-.
- Remove oil filler reservoir from lock carrier.



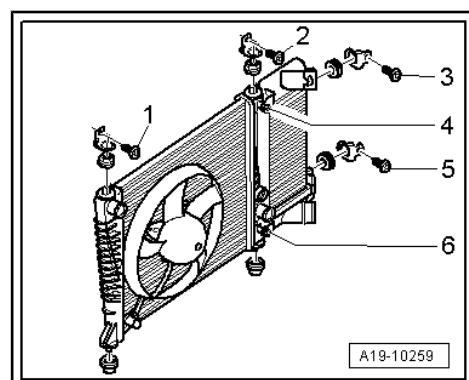
- Unscrew bolts -arrows- at front of lock carrier.



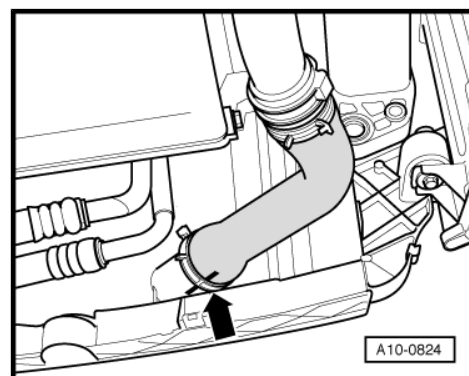
- Remove intake manifold pressure sender -G71- -arrow- from charge air cooler.



- Remove bolts -3- and -4- working from reverse side of lock carrier.



- Remove air intake hose from charge air cooler -arrow-.



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- Remove bolts -5- and -6- working from reverse side of lock carrier and remove charge air cooler.

Installing

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



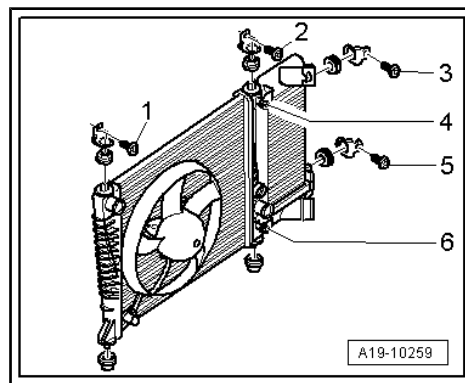
Note

- ◆ *Charge air system must be free of leaks.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*

- Install bumper cover ⇒ Rep. gr. 63 .

Tightening torques

Component	Nm
Charge air cooler to lock carrier	6
Charge air cooler to radiator	6
Guide tube for oil dipstick to oil filter bracket	10



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26 – Exhaust system

1 Removing and installing parts of exhaust system



Note

- ◆ *Renew gaskets and self-locking nuts.*
- ◆ *After working on the exhaust system, ensure that the system is not under stress and that it has sufficient clearance from the body. If necessary, loosen clamp and align silencers and exhaust pipe so that sufficient clearance is maintained to the body at all points and the mountings are evenly loaded.*
- ◆ *Do not bend the flexible joint (de-coupling element) between starter catalytic converter and main catalytic converter more than 10°, otherwise it could be damaged.*

1.1 Exhaust system - exploded view of components

1 - 23 Nm

- ☐ Renew

2 - Gasket

- ☐ Renew

3 - Turbocharger

4 - Rubber mounting

- ☐ Renew if damaged

5 - Clamp

- ☐ For separate replacement of starter and main catalytic converter or rear silencer
- ☐ Installation position
⇒ [page 172](#)
- ☐ Tighten bolt connections evenly

6 - 23 Nm

- ☐ Renew

7 - 23 Nm

8 - Mounting

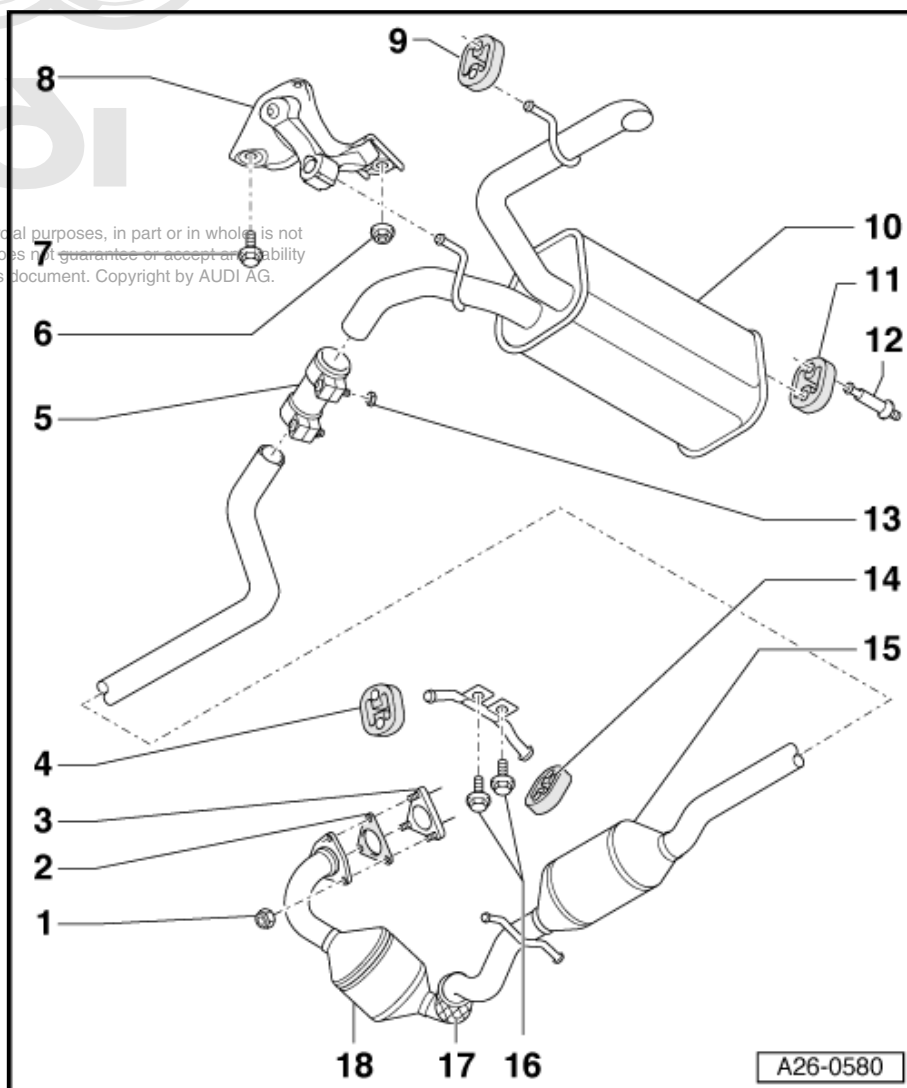
- ☐ Renew if damaged

9 - Rubber mounting

- ☐ Renew if damaged

10 - Rear silencer

- ☐ Combined in one unit with starter and main catalytic converter as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point
⇒ [page 173](#)



11 - Rubber mounting

- ☐ Renew if damaged

12 - Retainer**13 - 23 Nm****14 - Rubber mounting**

- ☐ Renew if damaged

15 - Main catalytic converter

- ☐ Protect against knocks and impact
- ☐ Combined in one unit with rear silencer as original equipment. Can only be renewed together with starter catalytic converter for repair purposes
- ☐ Cutting point ⇒ [page 173](#)
- ☐ Removing and installing ⇒ [page 174](#)

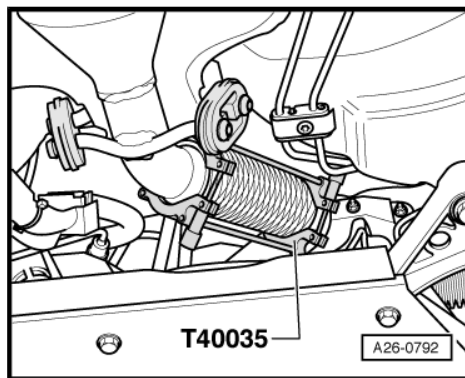
16 - 40 Nm**17 - Flexible joint (decoupling element)**

- ☐ Do not bend flexible joint more than 10° – otherwise it can be damaged
- ☐ Support with fixing tool -T40035- ⇒ [page 172](#).

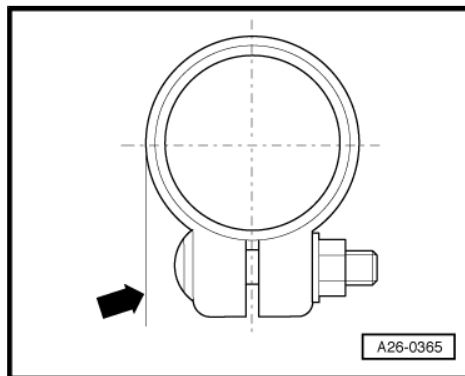
18 - Starter catalytic converter

- ☐ Protect against knocks and impact
- ☐ With bracket ⇒ [page 173](#)
- ☐ Combined in one unit with rear silencer as original equipment. Can only be renewed together with main catalytic converter for repair purposes
- ☐ Cutting point ⇒ [page 173](#)
- ☐ Removing and installing ⇒ [page 174](#)

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Supporting flexible joint (decoupling element) with fixing tool - T40035-**Installation position of rear clamp**

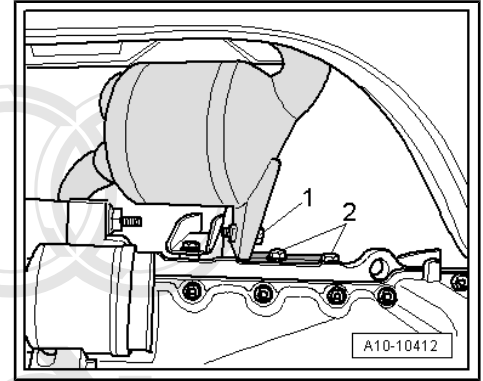
- Install clamp so that bolts are positioned horizontally -arrow-.
- Bolt connection faces downwards.



Bracket for starter catalytic converter

Tightening sequence:

1. Screw in bolt -1- finger-tight.
2. Screw in bolt -2- finger-tight.
3. Tighten bolt -1- to 23 Nm with torque wrench.
4. Tighten bolt -2- to 23 Nm with torque wrench.

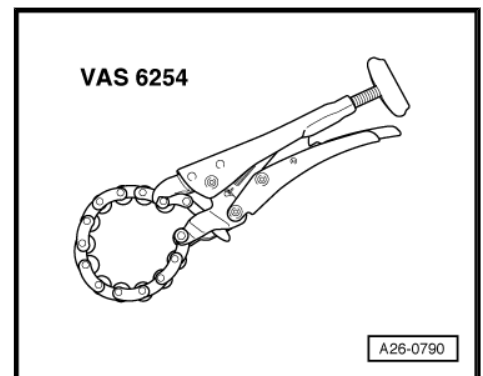


1.2 Separating starter/main catalytic converter and rear silencer

- ◆ Cutting point is provided in connecting pipe for separate replacement of starter/main catalytic converter or rear silencer.
- ◆ The cutting point is marked by an indentation on the circumference of the exhaust pipe.

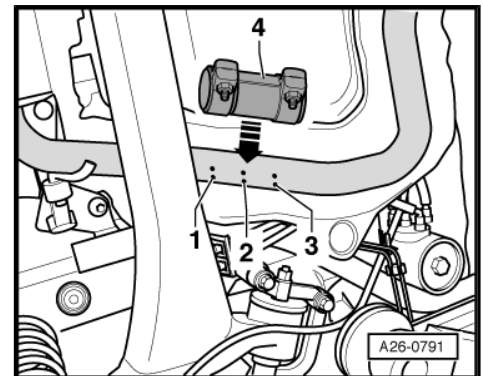
Special tools and workshop equipment required

- ◆ Chain pipe cutter -VAS 6254-



Procedure

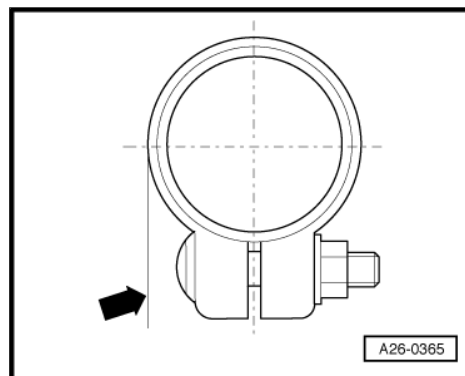
- Cut through exhaust pipe at a right angle at cutting point -2- using chain-type pipe cutter -VAS 6254-.
- When reassembling, position the clamp -4- centrally over the markings -1- and -3-.



- Install clamp so that bolts are positioned horizontally.
- Bolt connection faces downwards.

Tightening torque

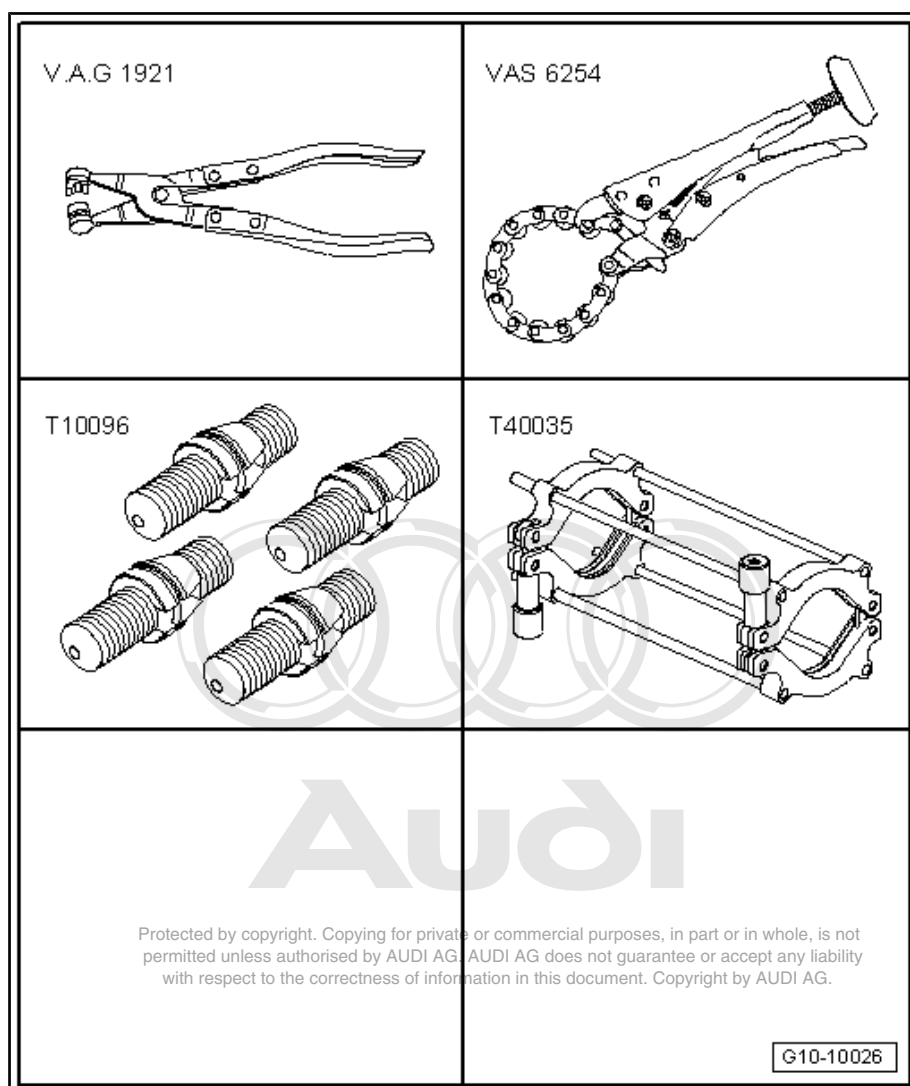
Component	Nm
Clamp	23



1.3 Removing and installing starter and main catalytic converter

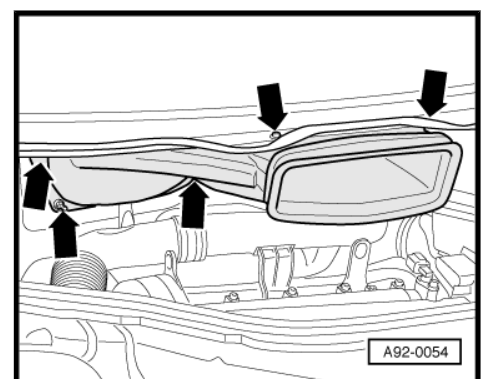
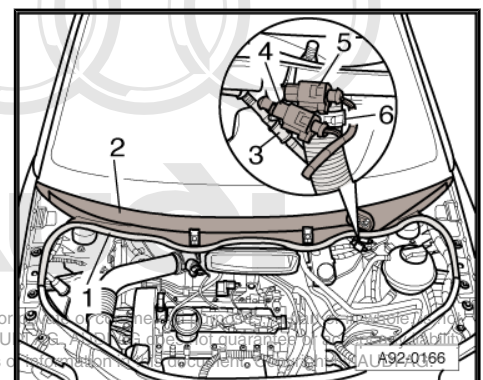
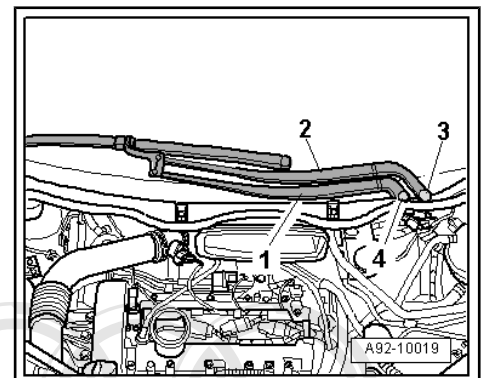
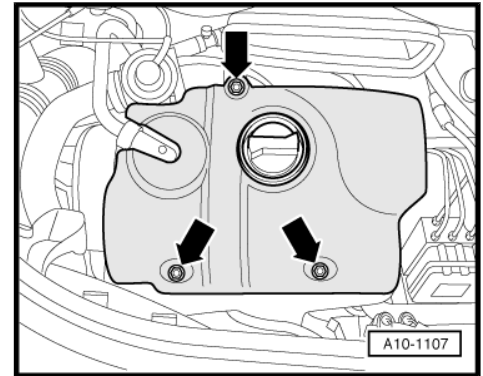
Special tools and workshop equipment required

- ◆ Hose clip pliers - V.A.G 1921-
- ◆ Chain pipe cutter -VAS 6254-
- ◆ Locating pins -T10096-
- ◆ Setting tool -T40035-



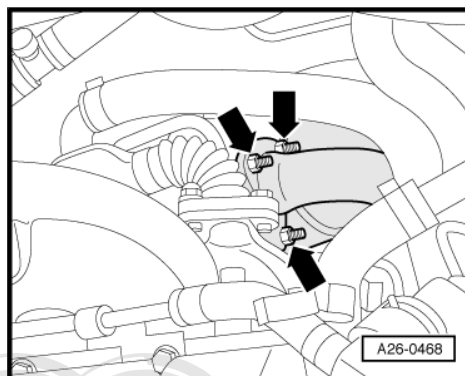
Removing

- Remove bonnet ⇒ [page 4](#) .
- Take off engine cover panel -arrows-.
- Remove noise insulation underneath (detach crankcase breather hose).
- Use screwdriver to lever off cover caps -3- and -4- from wiper arms.
- Slacken nuts on both wiper arms a few turns.
- Loosen wiper arms -1- and -2- from wiper shafts by tilting slightly.
- Completely remove nuts and take off wiper arms.
- Disconnect washer fluid hose -3-.
- If fitted, unplug electrical connectors -4- and -5- for heated washer jets.
- Open hose clip -6- using hose clip pliers -V.A.G 1921- and detach water drain hose from cowl panel grille.
- Pull off rubber seal -1- on cowl panel grille.
- Disconnect cowl panel grille -2-.
- Unscrew nuts and bolts -arrows-.
- Pull air duct forwards, move it to right side of vehicle and remove.

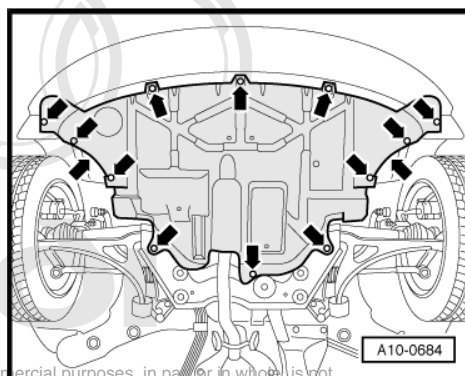


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- Unscrew nuts -arrows- at turbocharger/starter catalytic converter.



- Remove noise insulation -arrows-.

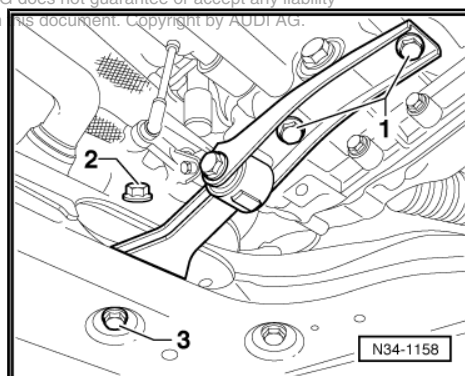


- Remove bolts -1- and -3- and detach pendulum support.

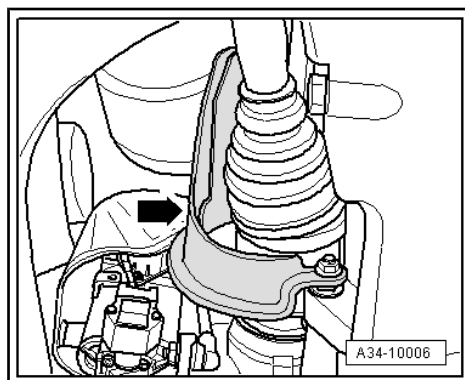


Note

Disregard -item 2-.



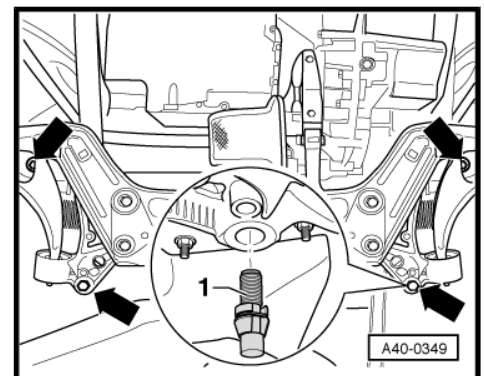
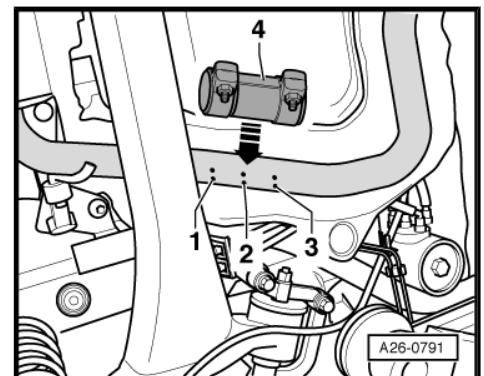
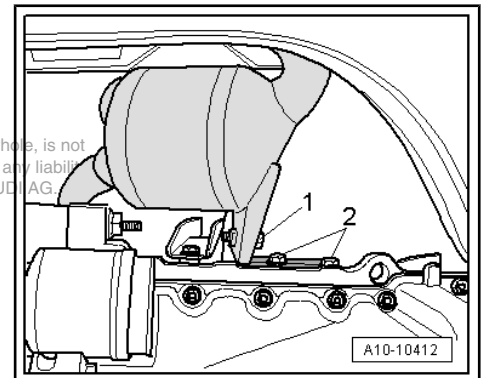
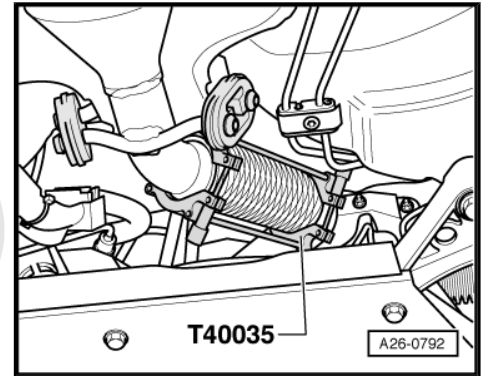
- Unbolt heat shield -arrow- for drive shaft (right-side).



**Note**

Do not bend the flexible joint (de-coupling element) between starter catalytic converter and main catalytic converter more than 10°, otherwise it could be damaged.

- Support flexible joint (decoupling element) with fixing tool - T40035- .
- Remove bolts -1- and -2- and detach bracket for starter catalytic converter.
- Disconnect starter catalytic converter from turbocharger.
- Remove heat shield panels below exhaust system from underbody.
- On vehicles with two-piece exhaust pipes, loosen nuts on clamp -4- and move clamp towards rear to separate exhaust system.
- On vehicles with one-piece exhaust pipes, cut through exhaust pipe at a right angle at cutting point -2- using chain-type pipe cutter -VAS 6254- .
- Locate subframe with locating pins -T10096- -item 1- ⇒ Rep. gr. 40 .
- Unscrew subframe from body -arrows- ⇒ Rep. gr. 40 .
- Lower subframe approx. 40 mm.



- Disengage rubber mountings for main catalytic converter -arrows-.
- Turn starter and main catalytic converter through 180° in anti-clockwise direction and remove (press engine/gearbox assembly to front).

Installing

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



Note

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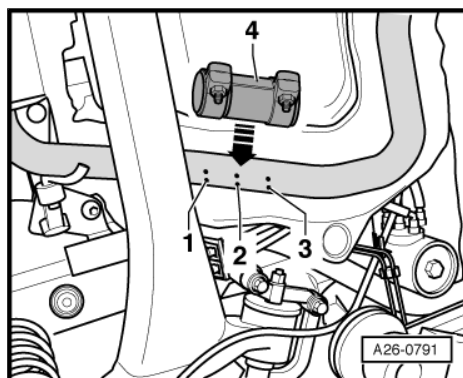
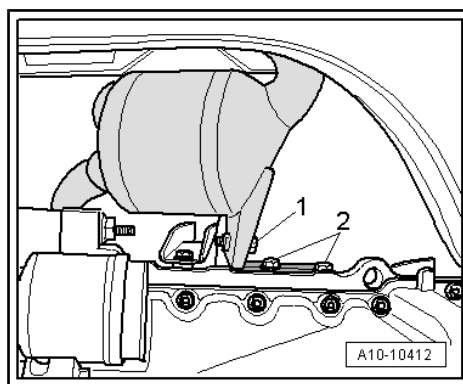
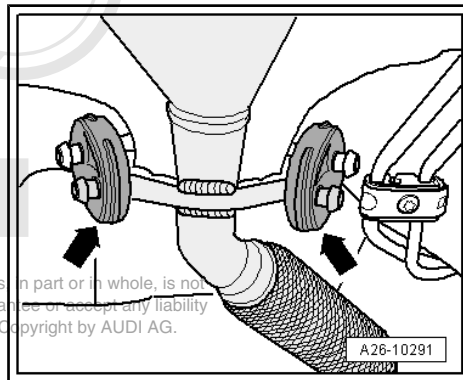
Renew gaskets and self-locking nuts.

- Install pendulum support ⇒ [page 31](#) .
- Install subframe ⇒ Rep. gr. 40 .
- Install bracket for starter catalytic converter.

Tightening sequence:

1. Screw in bolt -1- finger-tight.
2. Screw in bolt -2- finger-tight.
3. Tighten bolt -1- to 23 Nm with torque wrench.
4. Tighten bolt -2- to 23 Nm with torque wrench.

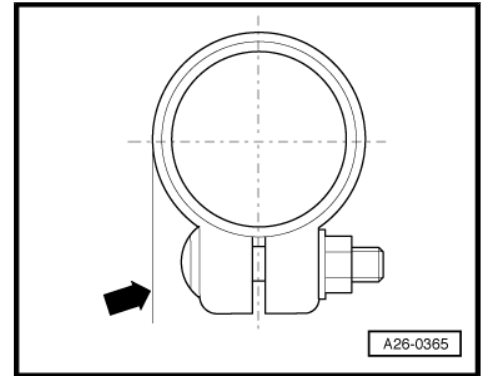
- When reassembling, position the clamp -4- centrally over the markings -1- and -3-.



- Install clamp so that bolts are positioned horizontally.
- Bolt connection faces downwards.

Tightening torques

Component		Nm
Starter catalytic converter to turbocharger		23 ¹⁾²⁾
Bracket for starter catalytic converter to	Starter catalytic converter	23
	Cylinder block	23
Clamp		23
Drive shaft heat shield to gearbox		23
• ¹⁾ Renew nuts. • ²⁾ Coat threads and contact surface of bolt heads with high-temperature paste; for high-temperature paste refer to ⇒ Parts catalogue .		



1.4 Removing and installing exhaust manifold

Removing

- Remove turbocharger ⇒ [page 161](#) .
- Unscrew exhaust manifold.

Installing

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

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Note

- ◆ *Renew gasket and self-locking nuts.*
- ◆ *Note installation position of gasket.*
- Install turbocharger ⇒ [page 161](#) .

Tightening torque

Component	Nm
Exhaust manifold to cylinder head	25

1.5 Checking exhaust system for leaks

- Start engine and run at idling speed.
- Plug tailpipe with cloth or plug, etc. while checking for leaks.
- Listen at joints between cylinder head/exhaust manifold, turbocharger/starter catalytic converter etc. to check for leaks.
- Repair any leaks that are found.

2 Exhaust gas recirculation system



Note

- ◆ The exhaust gas recirculation system is activated by the diesel direct injection system control unit -J248- via the exhaust gas recirculation valve -N18- and the mechanical exhaust gas recirculation valve.
- ◆ The tapered plunger in the mechanical exhaust gas recirculation valve varies the opening cross section according to valve travel.
- ◆ Pulsed actuation makes it possible to obtain any required valve position.
- ◆ The exhaust gas recirculation is switched off after approx. 2 minutes at idling speed.
- ◆ Renew self-locking nuts.
- ◆ Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.

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2.1 Exhaust gas recirculation system - exploded view of components

1 - Intake manifold

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

2 - O-ring

- Renew

3 - Intake connecting pipe

- With mechanical EGR valve and intake manifold change-over valve

4 - Mechanical exhaust gas recirculation valve

- Integrated in intake connecting pipe
- Checking ⇒ [page 183](#)

5 - 10 Nm

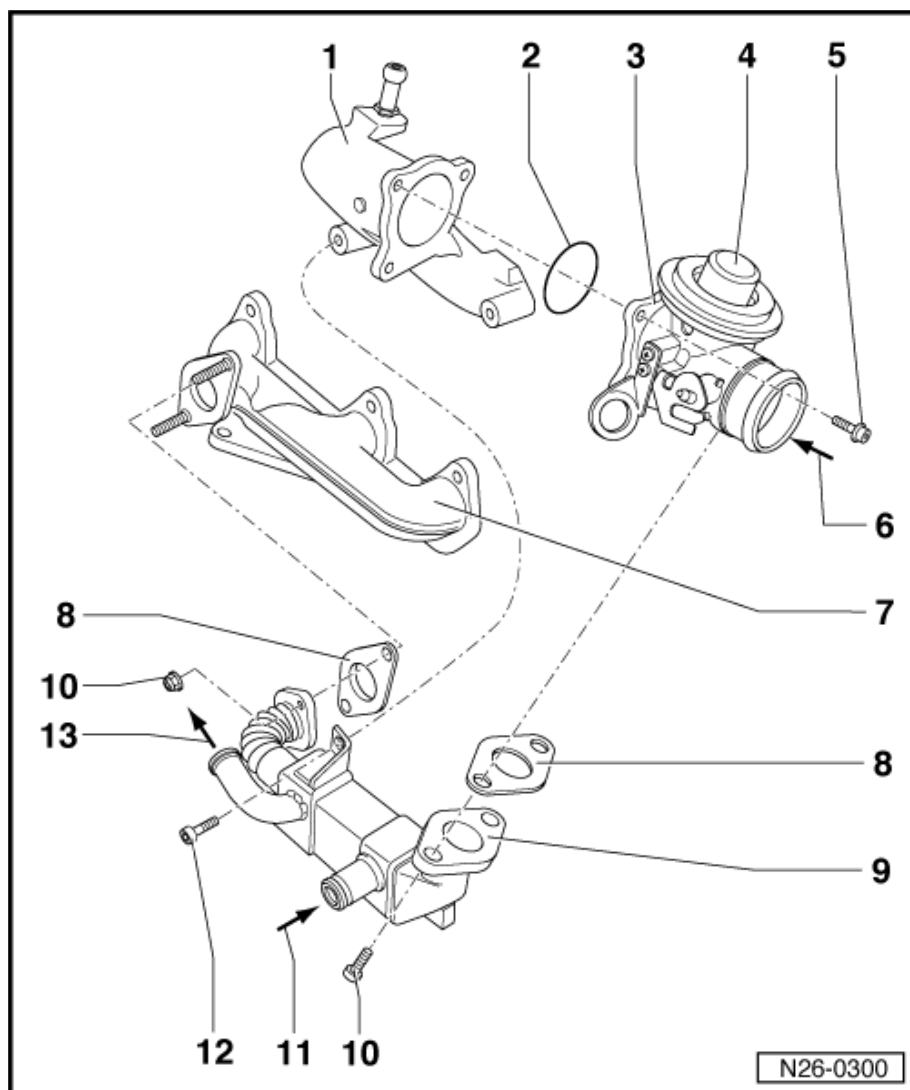
6 - From charge air cooler

7 - Exhaust manifold

- Removing and installing
⇒ [page 179](#)

8 - Gasket

- Renew



9 - Exhaust gas recirculation cooler

10 - 25 Nm

11 - From hose connection

12 - 25 Nm

13 - To heat exchanger

2.2 Diagram of vacuum hose connections

1 - Vacuum reservoir

2 - Throttle butterfly valve - N211-

3 - Exhaust gas recirculation valve -N18-

4 - Non-return valve

- ☐ White connection to charge pressure control solenoid valve -N75-

5 - Charge pressure control solenoid valve -N75-

- ☐ Checking vacuum actuation at turbocharger
⇒ [page 155](#)

6 - To brake servo

7 - Non-return valve

8 - Vacuum unit for charge pressure control

9 - Turbocharger

10 - Charge air cooler

11 - Intake manifold

12 - Tandem pump

- ☐ For fuel and vacuum supply

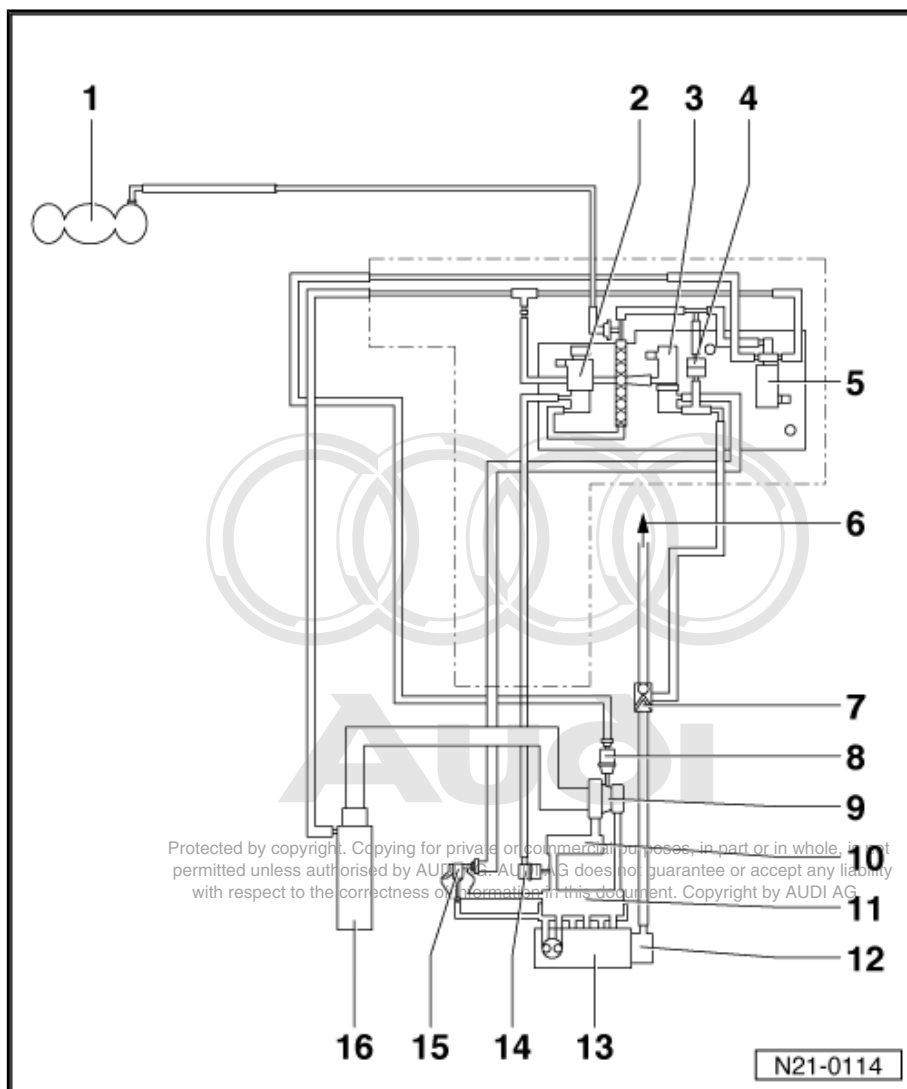
13 - Cylinder head

14 - Vacuum unit for intake manifold flap

15 - Mechanical exhaust gas recirculation valve

- ☐ Part of intake connecting pipe
- ☐ Can only be renewed together with intake connecting pipe

16 - Air cleaner

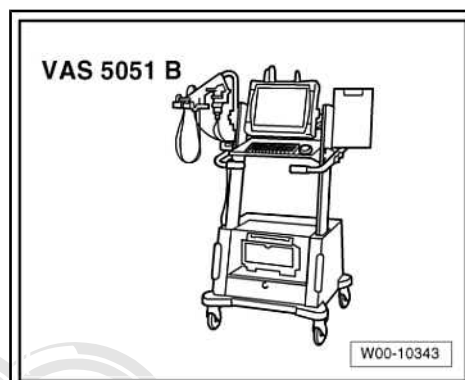


2.3 Checking exhaust gas recirculation

Checking of exhaust gas recirculation is done with the vehicle diagnosis, testing and information system -VAS 5051- under the function „basic setting“. In this test, the EGR valve is pulsed every 10 seconds, so that the extreme values for the EGR (air mass meter -G70-) can be read off.

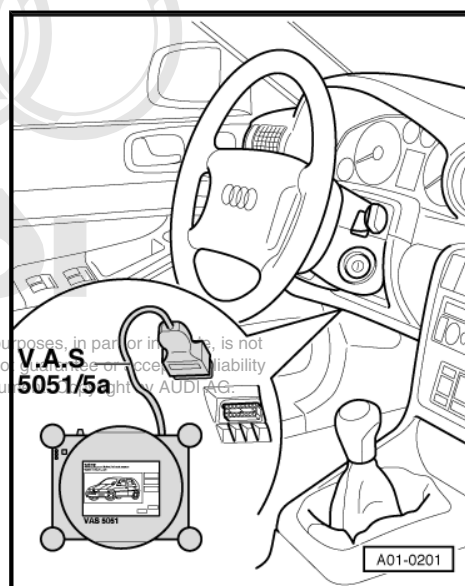
Special tools and workshop equipment required

- ◆ Vehicle diagnosis, testing and information system -VAS 5051-



Procedure

- Coolant temperature at least 80 °C.
- Connect up vehicle diagnostic, testing and information system -VAS 5051- with diagnosis lead -VAS 5051/5A- and select vehicle self-diagnosis and vehicle system „01 - Engine electronics“. Engine must be idling.



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Display on -VAS 5051- :

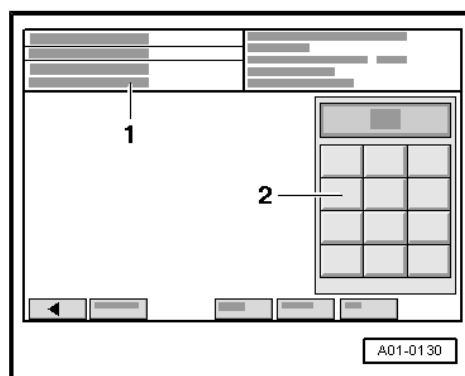
- From list -1- select diagnostic function „04 - Basic setting“.



Display on -VAS 5051- :

- Use keypad -2- to enter „003“ for „Display group number 003“ and confirm by touching the key.

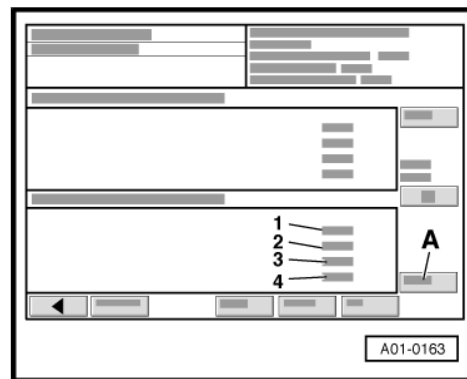
1 - Enter display group



Display on -VAS 5051- :

- Activate basic setting by touching key .
- The idling speed is increased to 1350 rpm ... 1450 rpm.
- Check display in zones -2-, -3- and -4-.
- Press „Print - Save result“ on -VAS 5051- .

Display zone	Readout	Specification
-2-	Activation of exhaust gas recirculation valve -N18-	Display alternates at 10 second intervals: „EGR active“ and „EGR inactive“
-3-	Intake air mass	Display alternates at 10 second intervals: Difference min. 100 mg/H
-4-	Duty cycle of exhaust gas recirculation valve -N18-	Display alternates at 10 second intervals: „20 %“ and „65 %“



- Exit function „04 - Basic setting“ by pressing the  key.
- Press „06 - End output“.
- Switch off ignition.

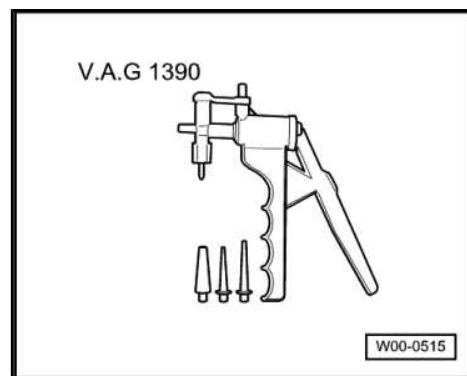
If the specifications are not obtained:

- Check mechanical exhaust gas recirculation valve
⇒ [page 183](#) .
- Check vacuum hose connections ⇒ [page 181](#) .
- Check exhaust gas recirculation valve -N18- → Vehicle diagnostic tester.

2.4 Checking mechanical exhaust gas recirculation valve

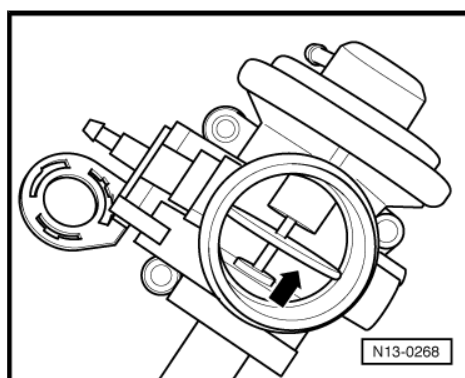
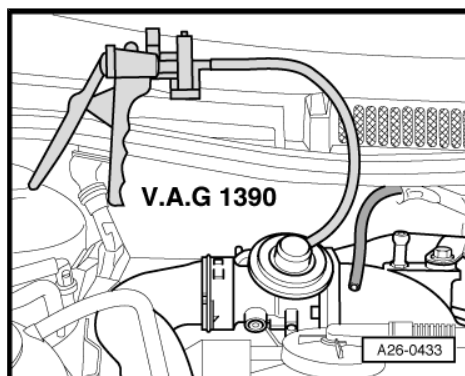
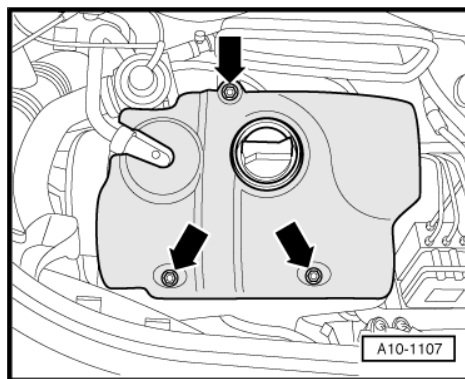
Special tools and workshop equipment required

- ◆ Hand vacuum pump with accessories -V.A.G 1390-



Procedure

- Remove bonnet ⇒ [page 4](#) .
- Take off engine cover panel -arrows-.
- Remove noise insulation underneath (detach crankcase breather hose).
- Remove air intake hose at intake connecting pipe.
- Disconnect vacuum hose at exhaust gas recirculation valve.
- Connect hand vacuum pump -V.A.G 1390- to exhaust gas re-circulation valve.
- Use hand vacuum pump to generate vacuum.
 - The diaphragm rod must move in -direction of arrow-.
- Pull hose of hand vacuum pump off exhaust gas recirculation valve.
 - The diaphragm rod must return to normal position.



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