Workshop Manual
Audi A4 1995 ➢

6-cylinder engine (5 valve), mechanics									
Engine ID	ACK	AGA	AJG	ALF	ALG	AML	AMM	AMX	APR
	APS	APZ	AQD	ARJ	ATX	AHA	ATQ		

Edition 04.2014

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List of Workshop Manual Repair Groups

Repair Group

00 - Technical data

10 - Removing and installing engine

13 - Crankshaft group

15 - Cylinder head, valve gear

17 - Lubrication

19 - Cooling

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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00 – Technical data

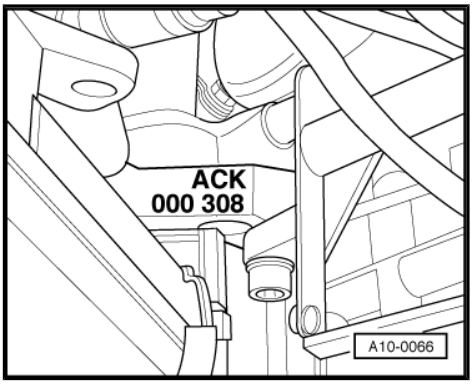
1 Technical data

(ARL003809; Edition 04.2014)

1.1 Engine number

The engine number (“engine code” and “serial number”) can be found on the flat surface of the cylinder block, on front of right cylinder bank.

The engine code is also to be found on the vehicle data sticker.



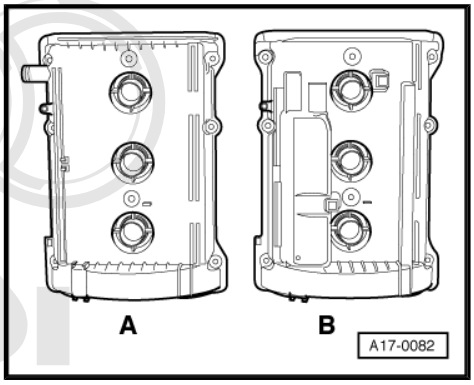
1.2 Distinguishing features of “engine generations II” and “III”

An external distinguishing feature of the “engine generations II” and “III” is the shape of the cylinder head cover:

A - “Engine generation II” (to approx. 04.1997)

B - “Engine generation III” (from approx. 04.1997 onwards)

“Engine generation I” only applies to 2V engines.



The new features of “engine generation III” as opposed to “engine generation II” are as follows:

- Cylinder block with wider main bearing caps.
- Industrially cracked instead of sawn conrods (gradual introduction).
- Chain-driven oil pump beneath crankshaft drive.
- Modified front sealing flange.
- Modified oil routing in cylinder head; originally with oil supply lines on camshaft bearing caps, subsequently replaced by integrated oil passages in camshaft bearing caps
- Modified sump (top section) with liquid gasket.
- Modified crankcase breather system.
- Modified tensioner and cover for toothed belt.

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1.3 Engine data

Code letters		ACK	AGA	AHA	AJG	ALF	ALG
Capacity	ltr.	2.771	2.393	2.771	2.393	2.393	2.771
Power output	kW at rpm	142/6000	121/5600	142/6000	120/5600	121/5600	142/6000
Torque	Nm at rpm	280/3200	230/3500	280/3200	230/3500	230/3500	280/3200
Bore	∅ mm	82.5	81.0	82.5	81.0	81.0	82.5
Stroke	mm	86.4	77.4	86.4	77.4	77.4	86.4
Compression ratio		10.6	10.5	10.6	10.5	10.5	10.3
RON	at least	98 1)	95 2)	98 1)	95 2)	95 2)	98 1)

Code letters	ACK	AGA	AHA	AJG	ALF	ALG
Injection/ignition system	Motronic	Motronic	Motronic	Motronic	Motronic	Motronic
Exhaust gas recirculation	no	no	no	no	no	no
Turbocharging/supercharging	no	no	no	no	no	no
Catalytic converter	yes	yes	yes	yes	yes	yes
Knock control	yes	yes	yes	yes	yes	yes
Lambda control	yes	yes	yes	yes	yes	yes
Secondary air system	no	no	yes	no	yes	yes

- 1) In exceptional circumstances, fuel with not less than 95 RON can also be used, but this will cause a loss of power.
- 2) In exceptional circumstances, fuel with not less than 91 RON can also be used, but this will cause a loss of power.

Code letters		AML	AMM	AMX	APR	APS
Capacity	ltr.	2.393	2.393	2.771	2.771	2.393
Power output	kW at rpm	121/6000	120/6000	142/6000	142/6000	121/6000
Torque	Nm at rpm	230/3200	230/3200	280/3200	280/3200	230/3200
Bore	∅ mm	81.0	81.0	82.5	82.5	81.0
Stroke	mm	77.4	77.4	86.4	86.4	77.4
Compression ratio		10.5	10.5	10.3	10.1	10.5
RON	at least	95 2)	95 2)	98 1)	98 1)	95 2)
Injection/ignition system		Motronic	Motronic	Motronic	Motronic	Motronic
Exhaust gas recirculation		no	no	no	no	no
Turbocharging/supercharging		no	no	no	no	no
Catalytic converter		yes	yes	yes	yes	yes
Knock control		yes	yes	yes	yes	yes
Lambda control		yes	yes	yes	yes	yes
Secondary air system		yes	no	no	yes	yes

- 1) In exceptional circumstances, fuel with not less than 95 RON can also be used, but this will cause a loss of power.
- 2) In exceptional circumstances, fuel with not less than 91 RON can also be used, but this will cause a loss of power.

Code letters		APZ	AQD	ARJ	ATQ	ATX	
Capacity	ltr.	2.393	2.771	2.393	2.771	2.771	
Power output	kW at rpm	120/6000	142/6000	121/6000	142/6000	140/6000	
Torque	Nm at rpm	230/3200	280/3200	230/3200	280/3200	260/3000	
Bore	∅ mm	81.0	82.5	81.0	82.5	82.5	
Stroke	mm	77.4	86.4	77.4	86.4	86.4	
Compression ratio		10.5	10.1	10.5	10.1	10.1	
RON	at least	95 2)	98 1)	95 2)	98 1)	98 1)	
Injection/ignition system		Motronic	Motronic	Motronic	Motronic	Motronic	
Exhaust gas recirculation		no	yes	no	no	no	

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Code letters	APZ	AQD	ARJ	ATQ	ATX	
Turbocharging/supercharging	no	no	no	no	no	
Catalytic converter	yes	yes	yes	yes	yes	
Knock control	yes	yes	yes	yes	yes	
Lambda control	yes	yes	yes	yes	yes	
Secondary air system	yes	yes	no	yes	yes	

- [1] In exceptional circumstances, fuel with not less than 95 RON can also be used, but this will cause a loss of power.
- [2] In exceptional circumstances, fuel with not less than 91 RON can also be used, but this will cause a loss of power.

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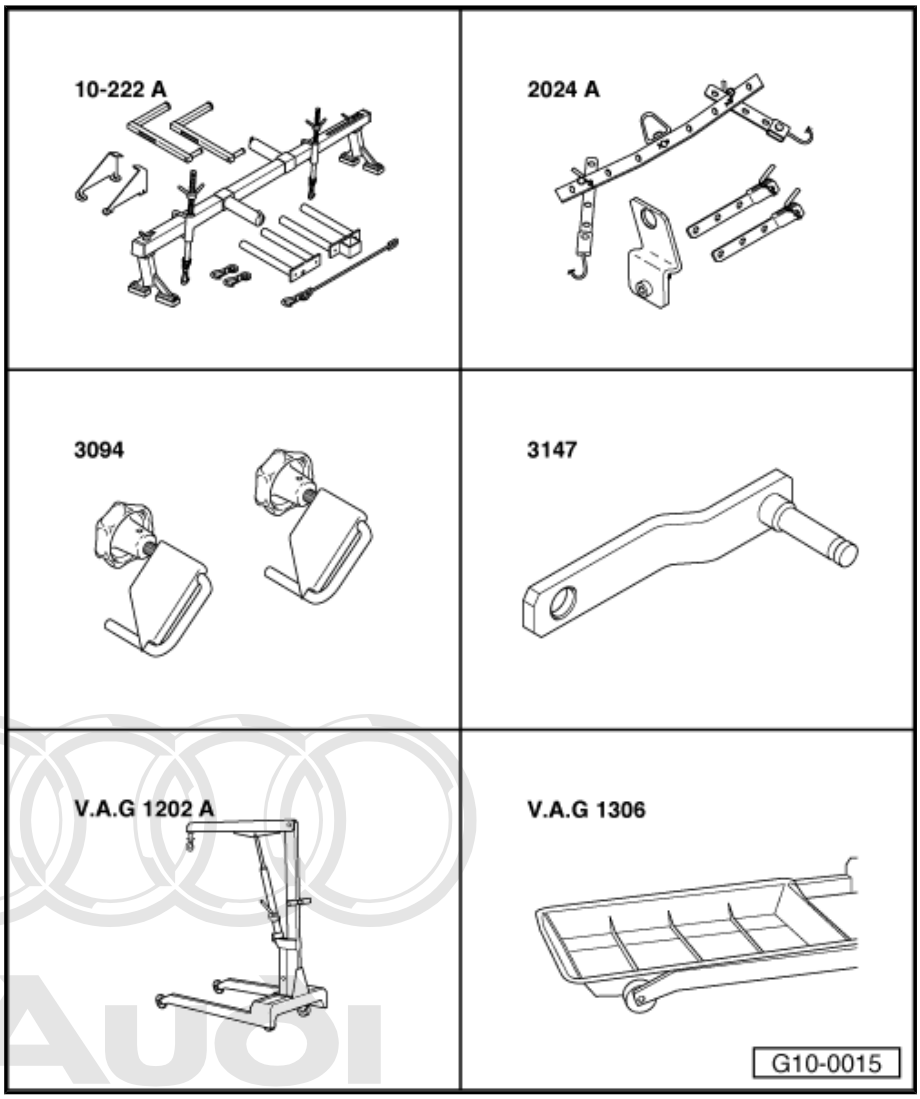
10 – Removing and installing engine

1 Removing and installing engine

1.1 Removing engine

Special tools and workshop equipment required

- Support bracket - 10-222 A-
- Lifting tackle - 2024 A-
- Hose clamps up to Ø 25 mm - 3094-
- Gearbox support - 3147-
- Workshop hoist - V.A.G 1202 A- or - VAS 6100-
- Drip tray for workshop hoist - VAS 6208- or -V.A.G 1306-



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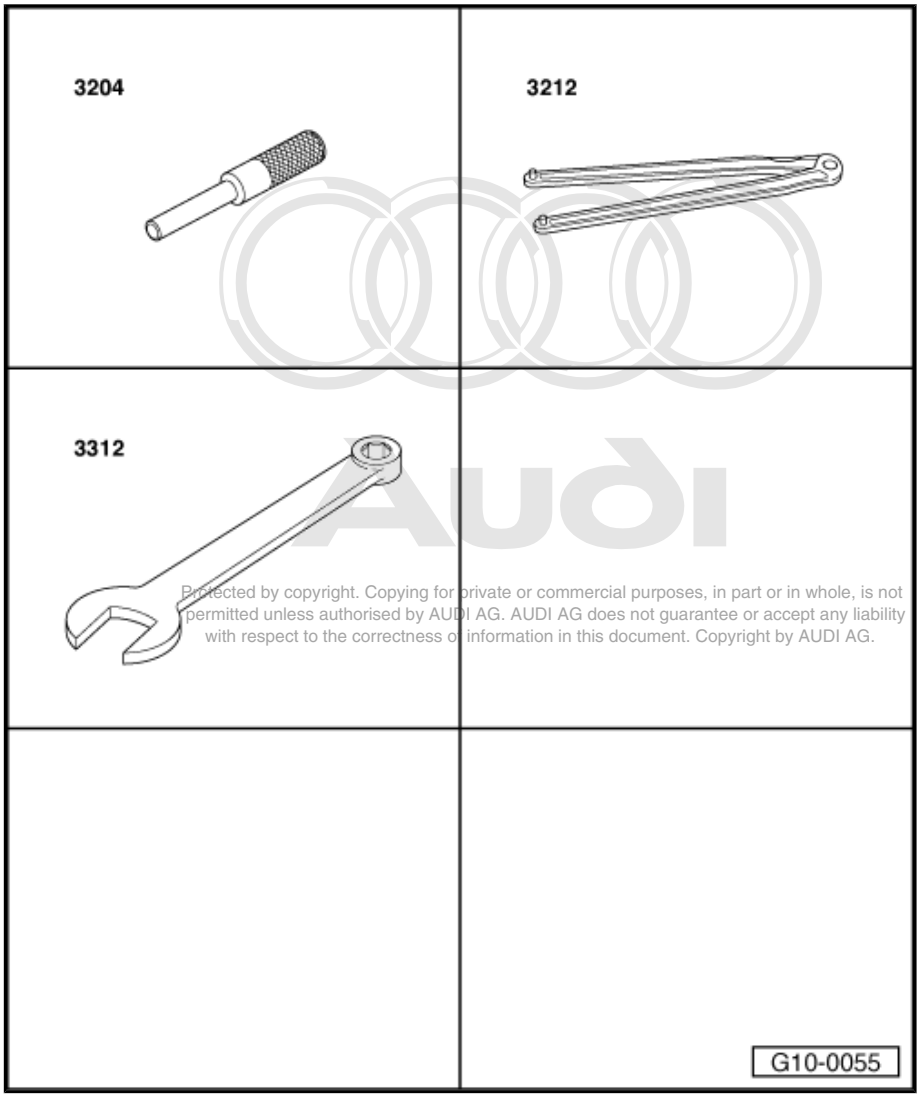
- Locking pin - 3204-
- Pin wrench - 3212-
- Open-end spanner - 3312-



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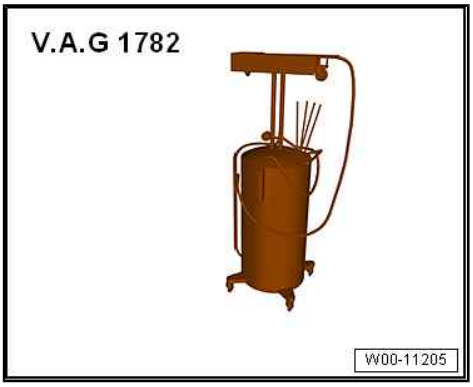
- Used oil collection and extraction unit - V.A.G 1782-



Procedure

Note

- *The engine is removed from the front without the gearbox.*
- *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.*

Vehicles with automatic gearbox:

– Move selector lever into position “N”.

All vehicles:

Caution

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

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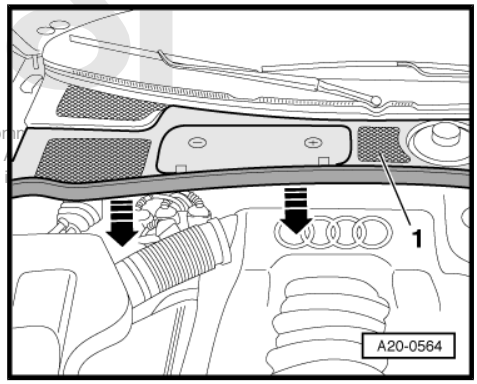
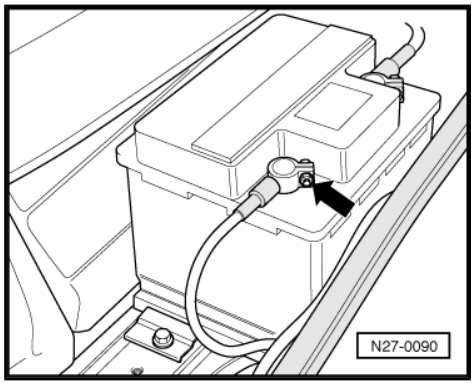
– Run windscreen wipers to the vertical position.

– Detach rubber seal from plenum chamber cover in direction of -arrow-.

– Detach plenum chamber cover -1- towards the front.



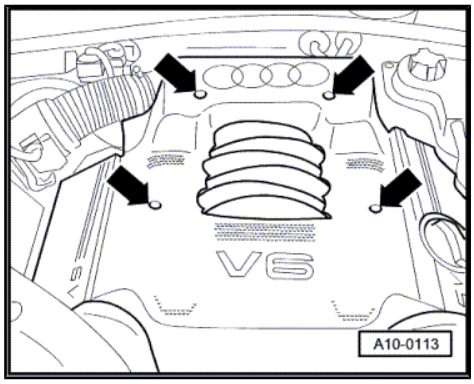
– With ignition switched off, disconnect battery earth cable -arrow-.



– Remove engine cover panel -arrows-.

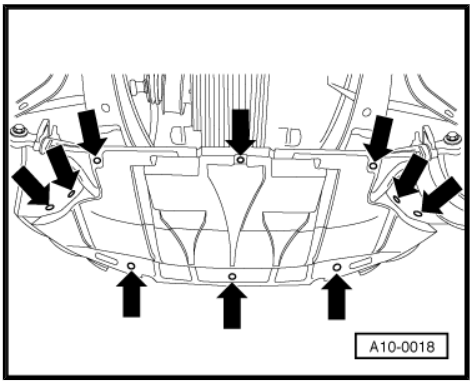
WARNING

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



– Open filler cap on coolant expansion tank.

– Remove noise insulation -arrows-.



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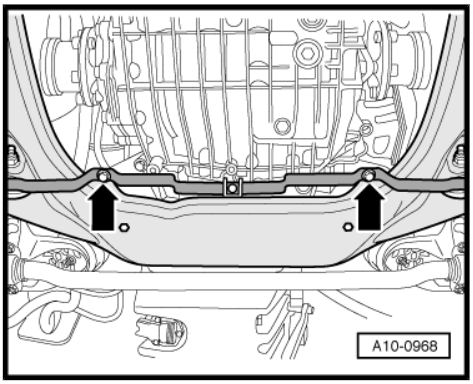
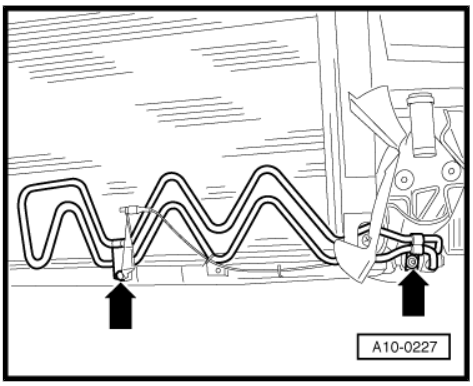
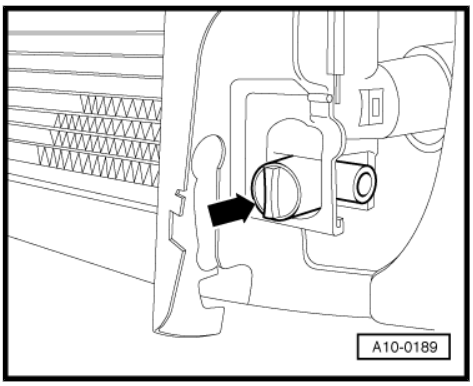
– Unbolt bracket for noise insulation -arrows-.



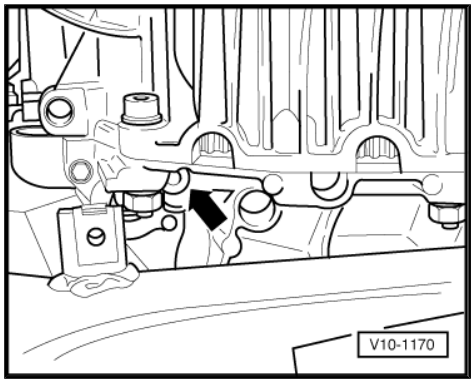
– Remove front bumper ⇒ Rep. gr. 63 .
– Unscrew cooling pipe for power steering hydraulic fluid -arrows- and move clear to side; do not open hydraulic fluid circuit.



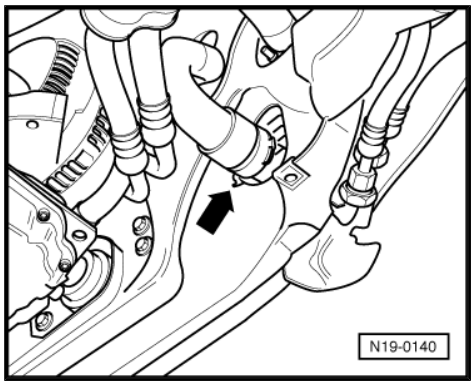
– Place drip tray for workshop hoist - VAS 6208- under engine.
– Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.



– Also open coolant drain plug on engine -arrow-.



– Pull out retaining clip -arrow- and disconnect coolant hose (bottom right) from radiator.

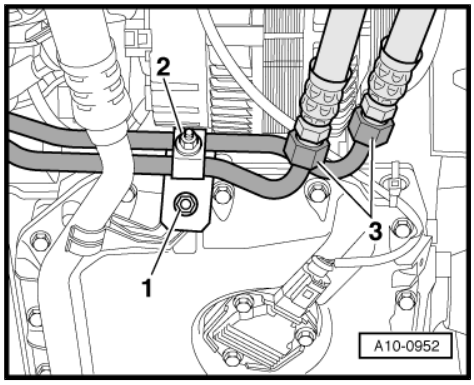


Vehicles with automatic gearbox:

Note

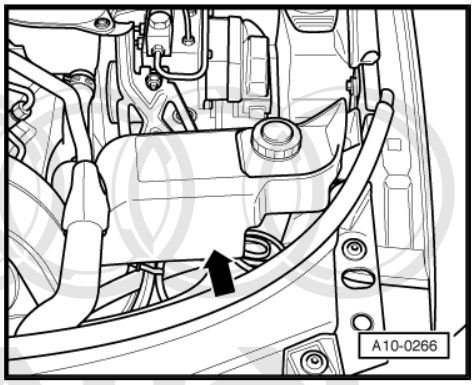
Observe rules for cleanliness when working on automatic gearbox ⇒ Rep. gr. 37 .

– Place a drip tray underneath.
– Unscrew union nuts -3- and disconnect ATF lines.
– Remove retainer for ATF lines (unscrew nuts -1- and -2-).



All vehicles:

– Remove cover -arrow- at front of ABS unit.



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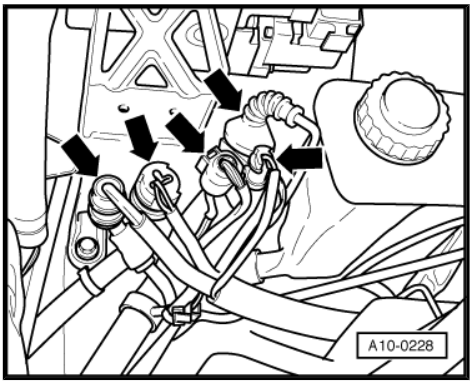
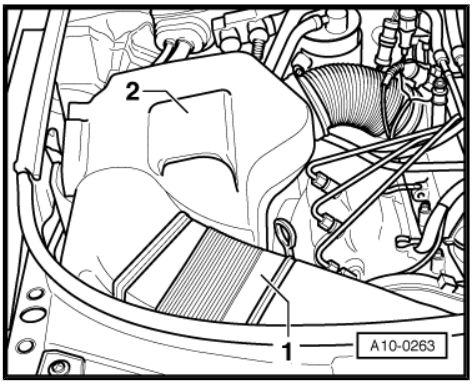
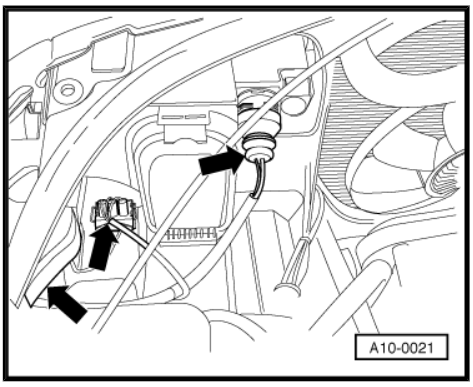
– Unplug electrical connectors -arrows-.
– Move wiring harness clear.



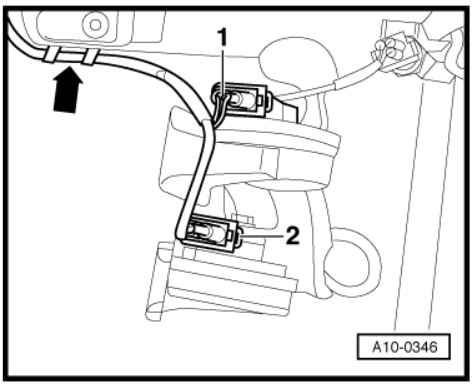
– Detach cover -2- from air cleaner.
– Unbolt air duct -1- for air cleaner at lock carrier and lift out.
– Disconnect coolant hose (top left) at radiator.



– Unplug electrical connectors for headlights and headlight range control on both sides of vehicle -arrows-.
– Turn bulb holders for turn signals anti-clockwise and remove from turn signal housing -left arrow-.



– Unplug electrical connectors -1- and -2- on both horns.
– Disengage wiring at retainer -arrow-.



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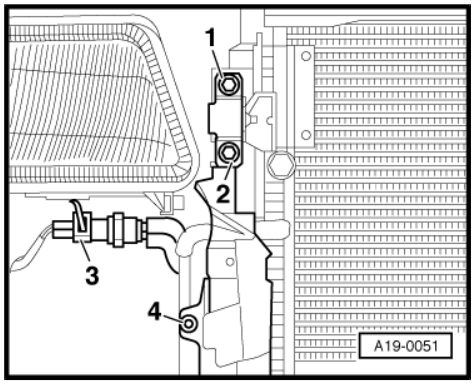
Vehicles with air conditioning:



– Remove air ducts -4- (left and right) from radiator.
– Unplug electrical connector -3- at low pressure switch for air conditioner - F73- .

WARNING

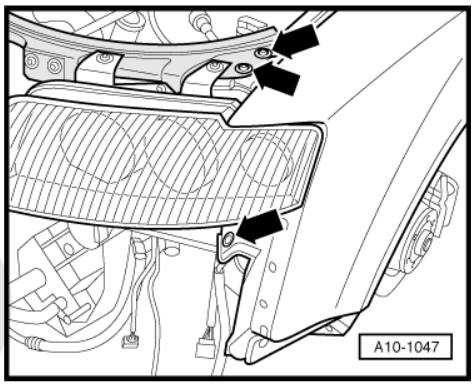
The air conditioner refrigerant circuit must not be opened.

Note

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

– Unscrew securing bolts -1- and -2- for condenser.
– Pull condenser up out of its bracket, pivot to side and secure to right-side front wheel with wire.

All vehicles:

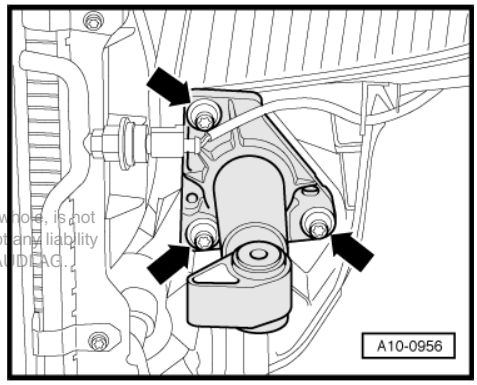


– Pull bonnet seals away from lock carrier and wing panels.

Note

Protect wing panels from damage.

– Remove bolts (left and right) -arrows-.
– Disconnect bonnet lock cable at bonnet lock.



– Unscrew bolts -arrows- from impact dampers (left and right).

Note

A second mechanic is required for removing the lock carrier.

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

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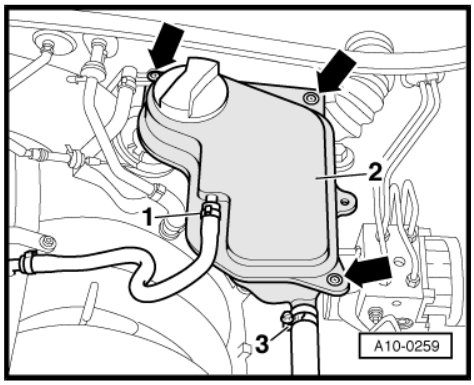
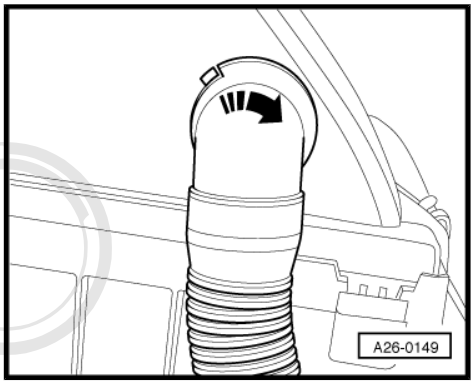


– Detach coolant hoses -1- and -3-.
– Unbolt coolant expansion tank -2- -arrows-.
– Detach electrical connector at coolant shortage indicator switch - F66- on coolant expansion tank (bottom).

– On vehicles with secondary air system, turn connecting pipe through 45° to the right -arrow- and detach from air cleaner housing.

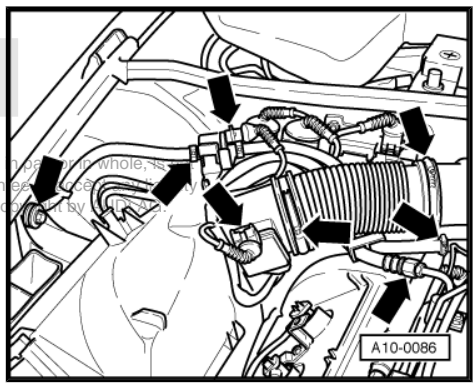


– Remove air intake hose between air mass meter - G70- and air intake elbow.

– Unplug electrical connector at solenoid valve 1 for activated charcoal filter system - N80- and detach solenoid valve from bracket.

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

– Unscrew and remove air cleaner housing.



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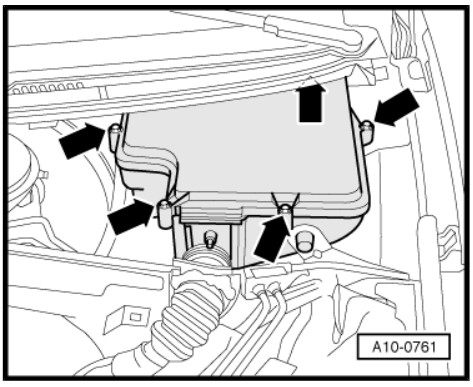
WARNING

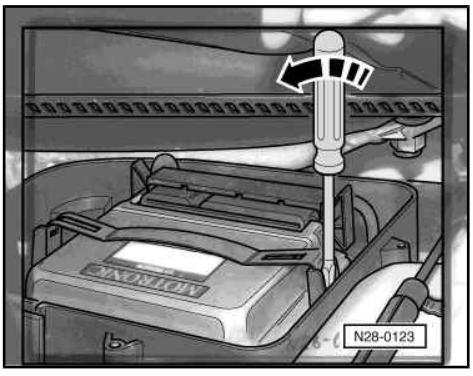
The fuel system is pressurised. Before opening the system place a clean cloth around the connection. Then release pressure by carefully loosening the connection.

– Unscrew fuel supply line and fuel return line

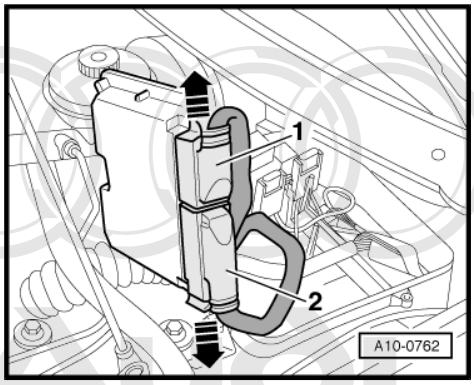
– Remove cover for electronics box in plenum chamber -arrows-.



– Carefully lever off retaining strap with a screwdriver -arrow-.



– Release retainer catches -arrows- and unplug connectors -1- and -2- from engine control unit.



– Release retainer -arrow- and pull auxiliary relay carrier in electronics box upwards to remove.
– Unplug electrical connectors at connector point and at altitude sensor - F96- .

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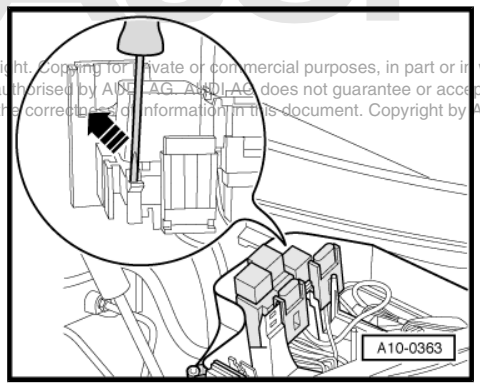
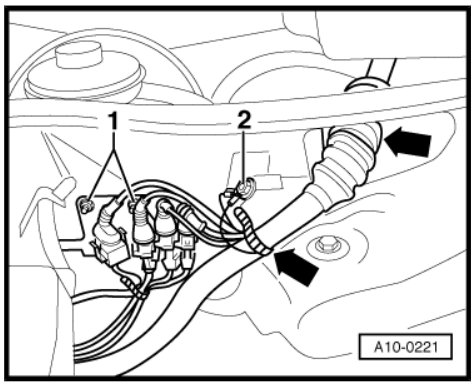
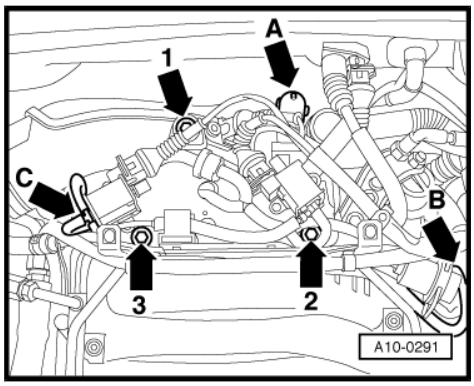


– Detach earth connection -2- and retainer -1- for electrical connectors from plenum chamber.
– Disengage engine wiring harness at electronics box and bulkhead -arrows- and move clear.
– Detach two coolant hoses for heat exchanger at engine (release retaining clamps on connecting flanges).



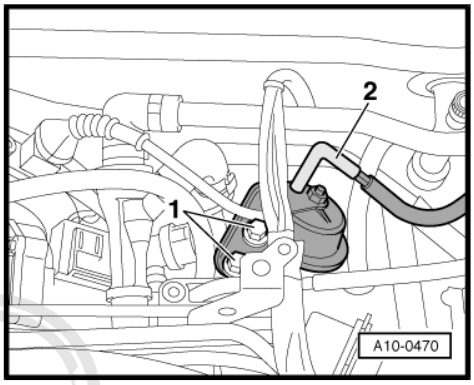
– Detach electrical connectors at intake manifold change-over valve - N156- (blue), secondary air inlet valve - N112- (green) and intake air temperature sender - G42- (black) on air inlet connection.
– Cut open cable ties and move wiring clear.
– Detach vacuum lines -arrows A ... C-.
– Unscrew bolts -arrows 1 ... 3- and remove retaining plate.
– Disconnect lines between suction-jet pump and air intake connection piece.



Vehicles with throttle cable and cruise control system:

– Detach vacuum hose -2- at vacuum unit for cruise control.

– Unscrew bolts -1- and move vacuum unit downwards.



All vehicles:

– Detach electrical connectors at camshaft control valves and injectors.

– Detach wiring between activated charcoal filter system solenoid valve 1 - N80- and throttle valve unit at throttle valve unit.

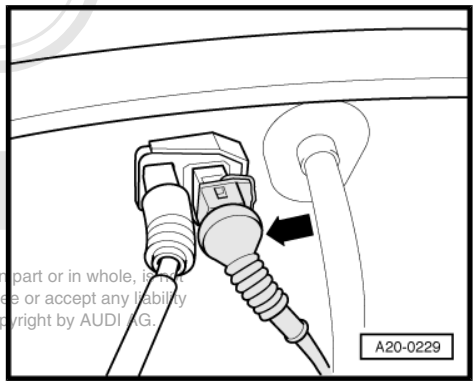
– Move the disconnected lines and wiring clear to one side.

– Remove air intake elbow.

Vehicles with throttle cable:

– Detach throttle cable from throttle valve module and from support bracket (do not remove retainer). Move throttle cable clear to the side.

– Unplug electrical connector at kick switch -arrow- on vehicles with automatic gearbox.



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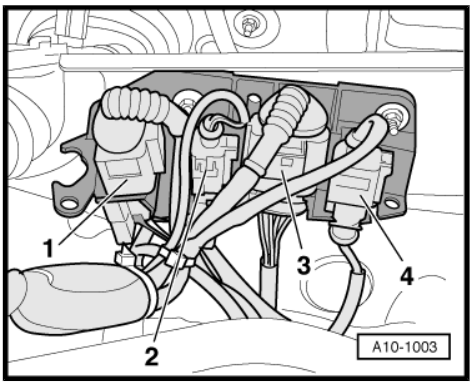
All vehicles:

– Detach connectors -1 ... 4- from retainer at right of bulkhead.

– Unplug electrical connectors -1-, -3- and -4-.

– Cut open cable tie on bracket for connectors.

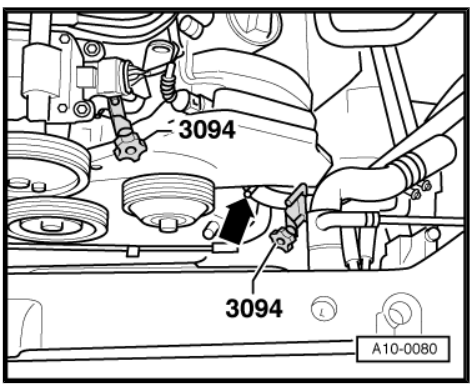
– Move Lambda probe wires clear.



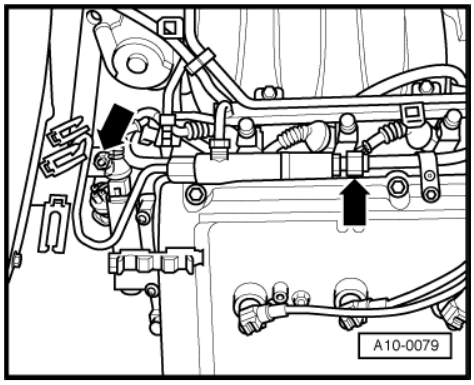
– Use hose clamps - 3094- to pinch off both hoses at hydraulic fluid supply pipe.

– Disconnect supply line -arrow- below cylinder head (left-side).

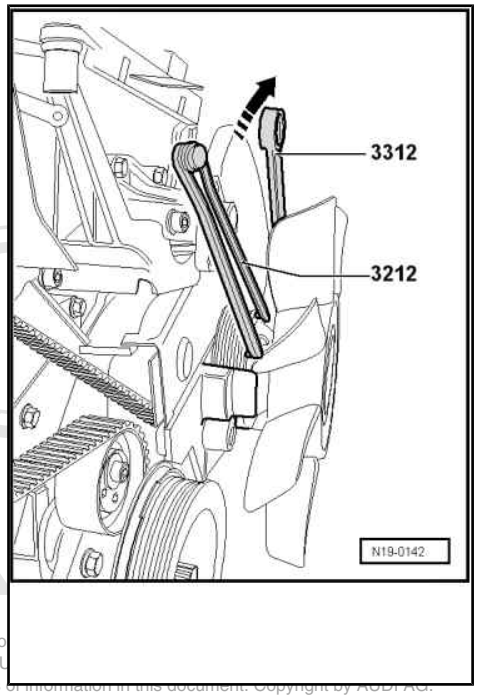
– Place a cloth under the screw connection to catch escaping fluid.



– Detach hydraulic pressure pipe at rear coolant pipe -left arrow-.
– Disconnect hydraulic pressure pipe at cylinder head (right-side) -right arrow-.



– Use 2-hole pin wrench - 3212- to support viscous fan pulley and unscrew viscous fan with open-ended wrench - 3312- -arrow- (left-hand thread).



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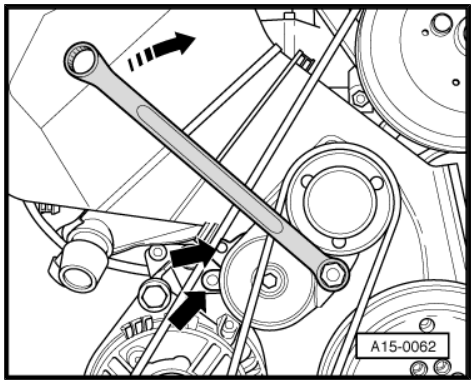
Tensioning roller with hexagon flats:

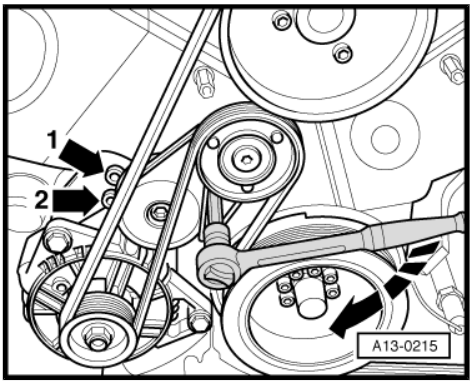
Note

Before removing, mark direction of rotation of poly V-belt with chalk or 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 17 mm ring spanner to slacken the poly V-belt.
– Lock tensioner in position by inserting locking pin - 3204- in locating holes -arrows-.
– Remove poly V-belt.



Tensioning roller with hexagon socket:



Note

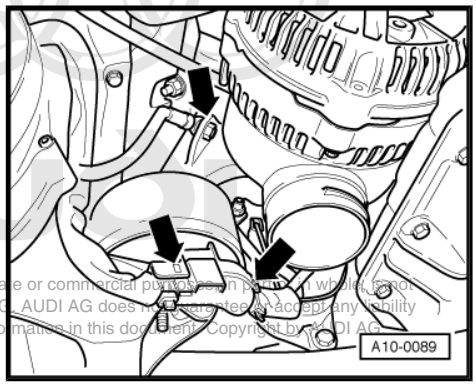
Before removing, mark direction of rotation of poly V-belt with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

- Turn the tensioner in the direction of the -arrow- using a 10 mm hexagon key to slacken the poly V-belt.
- Lock tensioner in position by inserting locking pin - 3204- in locating holes -arrow 1- and -arrow 2-.
- Remove poly V-belt.

Both types:

- Unscrew engine/gearbox securing bolts that are accessible from above. Leave one bolt in place (hand-tight).
- Unscrew nuts (accessible from above) securing exhaust manifold to front exhaust pipe (left and right).

Vehicles with automatic gearbox:



- Unbolt air duct for alternator from radiator cowl (bottom left) and pull air duct off alternator.
- Disconnect earth connection (engine / cross member) from engine -upper arrow-.
- Open cable duct for starter and alternator at longitudinal member -lower arrows-.
- Unscrew alternator.
- Pivot alternator to side and unscrew electrical wires.

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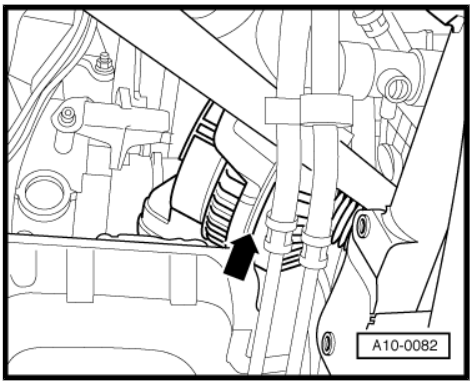
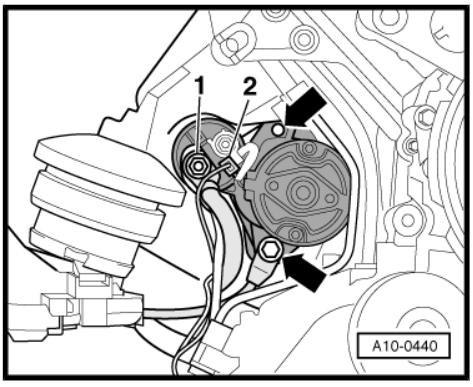
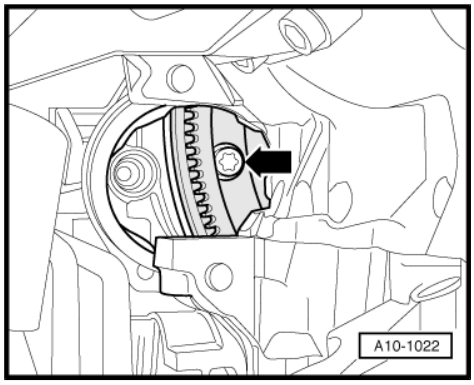


- Move alternator forwards between sump and body brace -arrow-.



- Detach wires -1- and -2- at starter and detach insulator at positive connection of starter.
- Remove starter bolts -arrows- from gearbox side.
- Unscrew clamp on right of top section of sump and move electrical wiring clear.
- Take out starter downwards through gap between sump and body brace; leave alternator in vehicle.

– Unscrew 3 bolts -arrow- for torque converter, working through opening of removed starter (turn crankshaft $^{1}/_{3}$ turn each time).

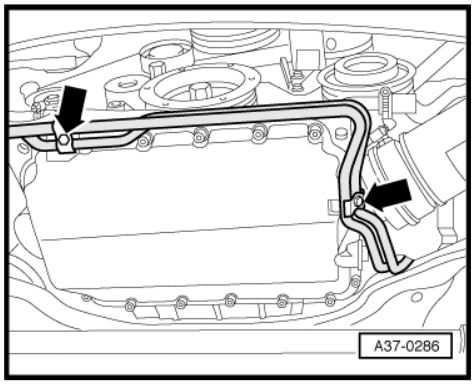


Note

When loosening torque converter bolts, counterhold crankshaft by applying spanner to central bolt on vibration damper.

– Secure alternator back on its bracket with one bolt in order to remove engine.

– Remove bracket for ATF lines -arrows-.



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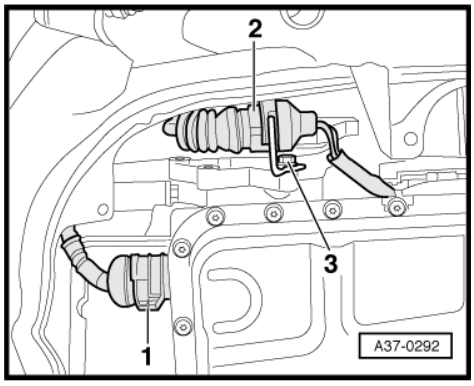
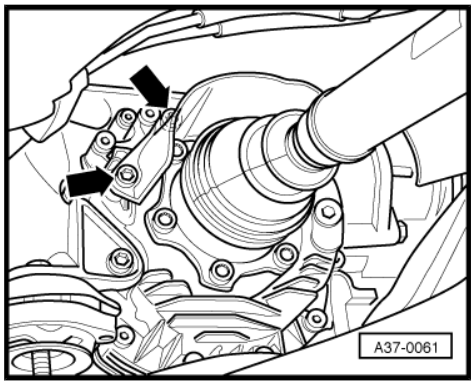
– Turn locking lever -1- and detach electrical connector for gearbox.

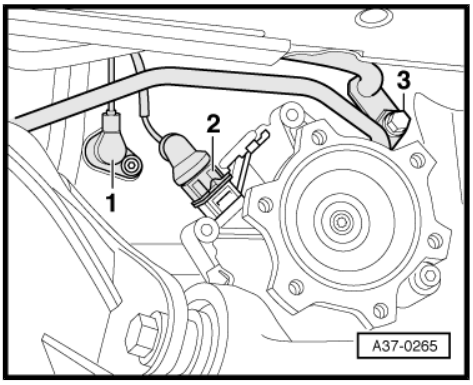
– Unplug electrical connector -2- at multi-function switch - F125- .



– Unscrew heat shields for drive shafts (left and right) -arrows-.



– Unscrew engine speed sender - G28- -item 1- at front left of gearbox.
– Unplug electrical connector -2- at speedometer sender - G22- .
– Unscrew bolt -3- and detach ATF lines from gearbox.



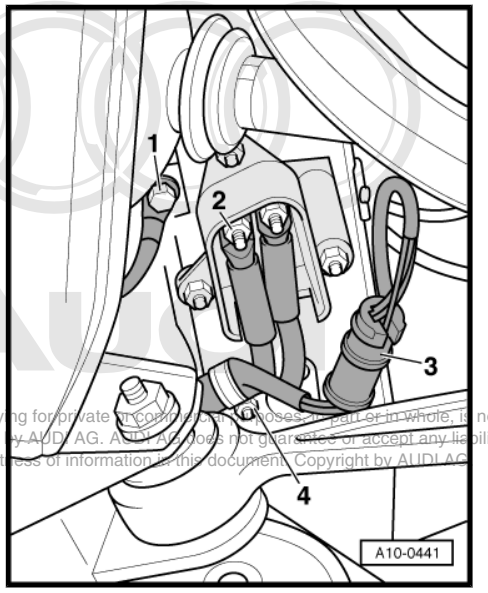
Note

Observe rules for cleanliness when working on automatic gearbox ⇒ Rep. gr. 37 .

– Move ATF lines clear.

Vehicles with manual gearbox:

– Unclip and unplug electrical connector -3-.
– Unclip cover for wiring connections.
– Unscrew earth cable -1-.
– Unscrew wiring connection -2-.
– Unscrew clamp -4- and move wiring clear.



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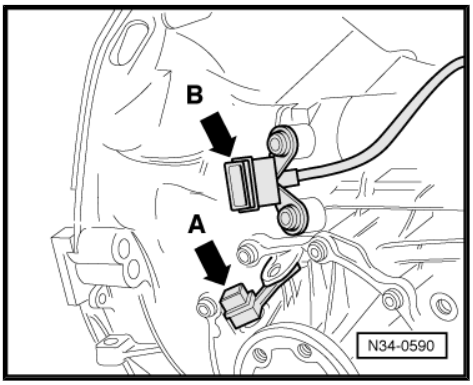
– Detach electrical connector from speedometer sender - G22- -arrow A-.
– Unplug electrical connector at reversing light switch - F4- -arrow B-.



Note

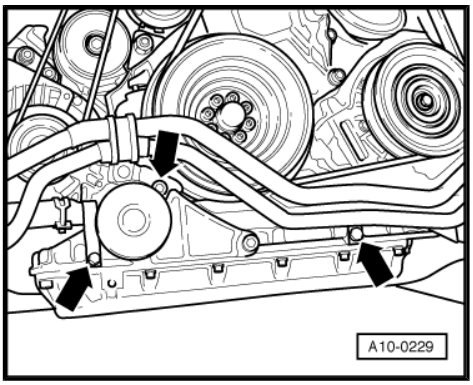
Shown in illustration with gearbox removed.

Vehicles with air conditioning:

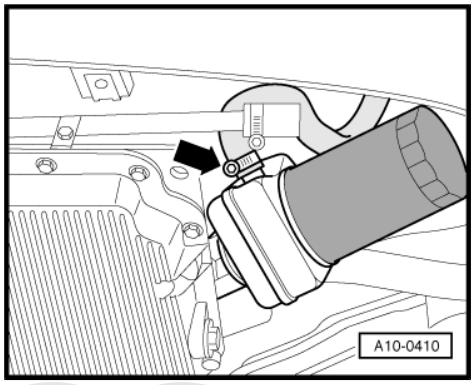
WARNING

The air conditioner refrigerant circuit must not be opened.

– Unbolt bracket at front of engine securing refrigerant pipes and coolant pipes to sump -arrows-.



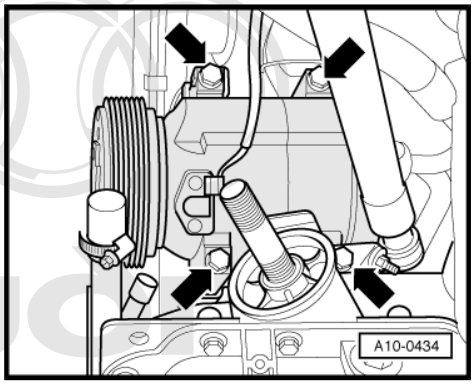
– Place drip tray for workshop hoist - VAS 6208- under engine.
– Disconnect coolant hose at bottom of oil cooler -arrow- and drain off remaining coolant.
– Place used oil collection and extraction unit - V.A.G 1782- under engine.
– Remove oil filter and oil cooler.



– Unplug connector for magnetic clutch of air conditioner compressor.

WARNING

The air conditioner refrigerant circuit must not be opened.



– Unscrew air conditioner compressor from bracket -arrows-.
– Tie up air conditioner compressor to longitudinal member, with lines attached.

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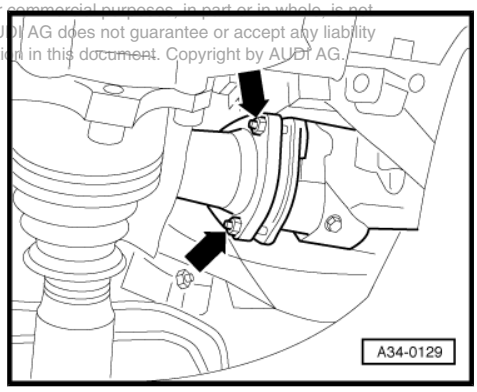
All vehicles:

– Unbolt left and right front exhaust pipes from exhaust manifolds -arrows-.
– Unscrew spring-loaded securing bolts on mounting brackets for catalytic converters.
– Pull exhaust system rearwards off studs on exhaust manifolds.

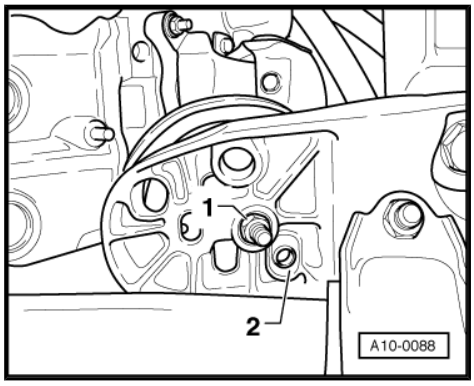


– Mark positions of bolt connections -1- and locating sleeves -2- on bottom of engine mountings (left and right).

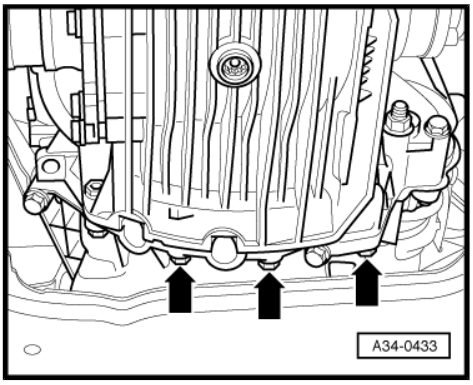
Note

Different mounting holes are provided for the different engine versions.

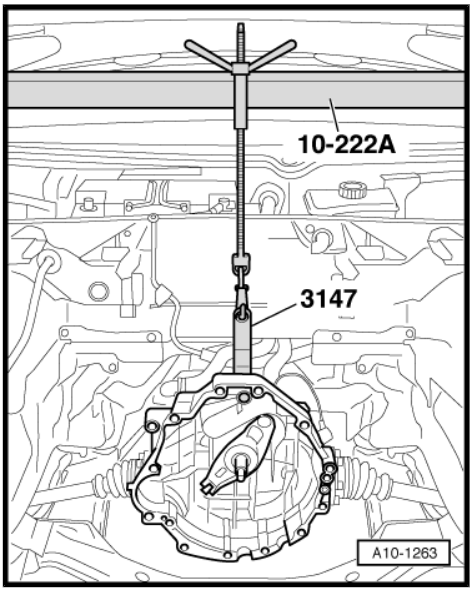
– Remove bottom nuts -1- at engine mounting (left and right).



– Remove bottom engine/gearbox securing bolts -arrows-.



– Set up support bracket - 10-222 A- behind gas-filled strut on wing panel flanges. The spindle must be at the front.
– Insert gearbox support - 3147- into bolt hole in gearbox bell housing.
– Connect the gearbox support - 3147- and support bracket - 10-222 A- .



Note

Illustration shows engine removed.

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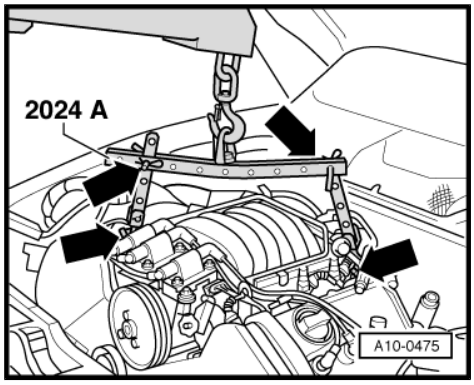
– Attach lifting tackle - 2024 A- to engine and workshop hoist - VAS 6100- or -V.A.G 1202 A- as shown in illustration.



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 support hooks and retaining pins on the lifting tackle must be secured with locking pins -arrows-.

– Unscrew remaining engine/gearbox securing bolt.

Note

Check that all hoses and other connections between engine and body have been detached.

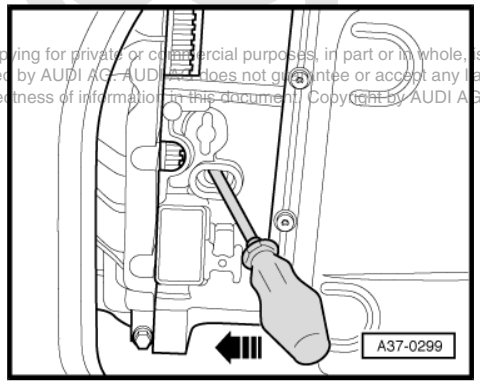
– Raise engine with workshop hoist - VAS 6100- or -V.A.G 1202 A- until the engine mounting studs are clear.
– Tighten spindle of support bracket - 10-222 A- further.

Note

Make sure no wires/pipes are damaged on the bulkhead.

Vehicles with automatic gearbox:

– Separate automatic gearbox from engine and simultaneously detach torque converter from drive plate



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All vehicles:

– Detach engine from gearbox and lift engine forwards out of engine compartment.

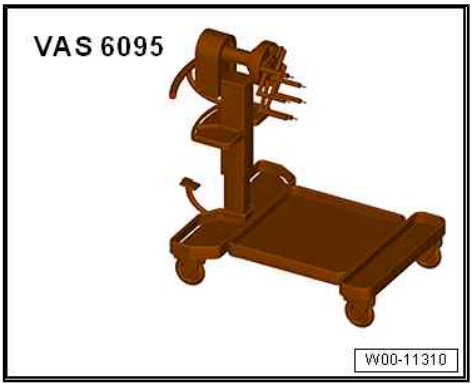
Vehicles with automatic gearbox:

– Secure the torque converter in the gearbox (using wire or similar) to prevent it falling out.

1.2 Securing engine to assembly stand

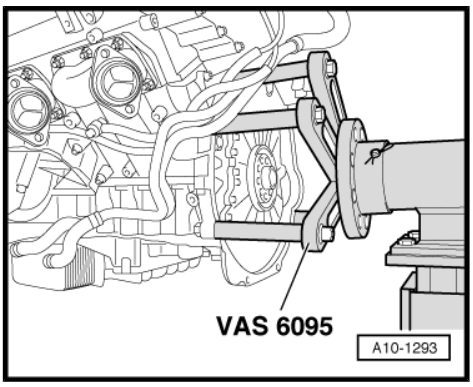
Special tools and workshop equipment required

♦ Engine and gearbox support - VAS 6095-



Procedure

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



1.3 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.*

♦ *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.*

– Check whether dowel sleeves for centring the engine/gearbox assembly are fitted in the cylinder block; install dowel sleeves if necessary.

Audi A4 1995 ➢ 6-cylinder engine (5 valve), mechanics - Edition 04.2014 Audi
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Vehicles with manual gearbox:

– 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.

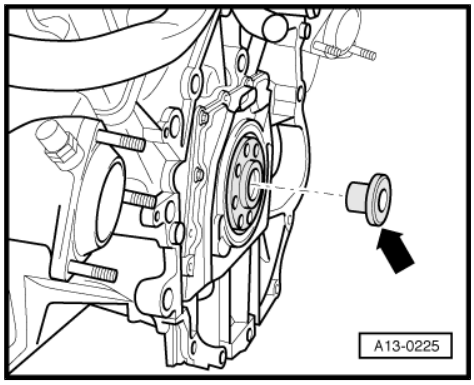
– Check that the clutch plate is properly centralised (only necessary if you have carried out other work on the clutch).

– Check clutch release bearing for wear; renew if necessary.

– A needle bearing must be fitted in the crankshaft on vehicles with manual gearbox; install needle bearing if not already fitted ⇒ page 50 .

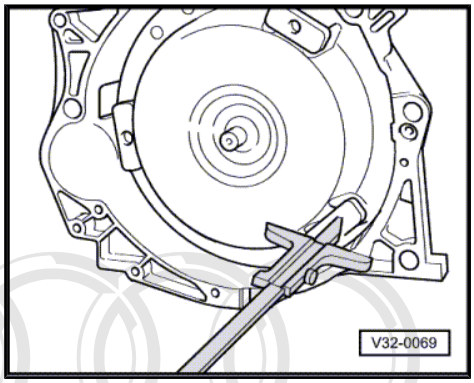
Vehicles with automatic gearbox:

– Before installing an exchange engine in a vehicle with automatic gearbox, check whether the centralising bush -arrow- for the torque converter is fitted at the rear of the crankshaft.



Checking installation position of torque converter:

If the torque converter has been correctly installed, the distance between the bottom contact surfaces at the attachment points on the torque converter and the contact surface on the torque converter bell housing (with automatic gearbox) is approx. 23 mm.



Caution

If the torque converter is not installed correctly, the drive lugs of the torque converter and the ATF pump will be seriously damaged when the gearbox is joined to the engine.

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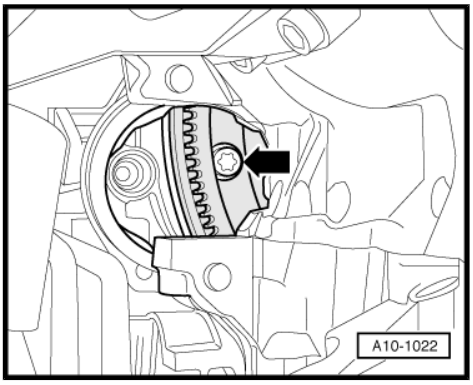
– Before bringing engine and gearbox together, turn torque converter and drive plate on engine so that the holes for one securing bolt are in line with the opening for the starter motor -arrow-.

– To secure torque converter on drive plate, use only new ribbed bolts of the correct type (same as original equipment) as specified in ⇒ Parts catalogue .



Caution

Before and during tightening of bolts on engine/gearbox flange, continually check that the torque converter behind the drive plate can be turned. If the converter cannot be turned, it must be assumed that it has not been installed correctly and the drive lugs of the ATF pump and consequently the gearbox will be damaged when the bolts are finally tightened.

– Secure ATF lines to gearbox ⇒ Rep. gr. 37 .

– Check ATF level ⇒ Rep. gr. 37 .

All vehicles:

– Install air conditioner compressor ⇒ Rep. gr. 87 .

– Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten bolts.

– Install poly V-belt ⇒ page 29 .

– Fill cooling system ⇒ page 155 .

Note

♦ *Drained-off coolant may only be used again if the original cylinder head and cylinder block are re-installed.*

♦ *Contaminated or dirty coolant must not be used again.*

– Install engine mountings free of stress. To do so, shake engine before tightening engine mountings.

– Align exhaust system so it is free of stress ⇒ page 190 .

– Install lock carrier ⇒ Rep. gr. 50 .

– Install front bumper ⇒ Rep. gr. 63 .

Vehicles with throttle cable:

– Check adjustment of throttle cable ⇒ Rep. gr. 20 .

All vehicles:

– Connect vacuum hoses ⇒ page 25 .

– Top up power steering fluid and bleed steering system ⇒ Rep. gr. 48 .

– Fill up with engine oil and check oil level ⇒ page 150 .

– Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

– Observe notes on procedures required after connecting battery ⇒ Rep. gr. 27 .

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Caution

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

Tightening torques

Note

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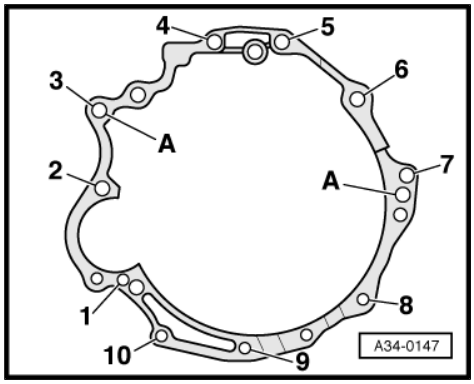
- *Tightening torques apply only to lightly greased, oiled, phosphated or black-finished nuts and bolts.*
- *Additional lubricant such as engine oil or gearbox oil may be used, but do not use lubricant containing graphite.*
- *Do not use degreased parts.*
- *Tolerance for tightening torques: ± 15%.*

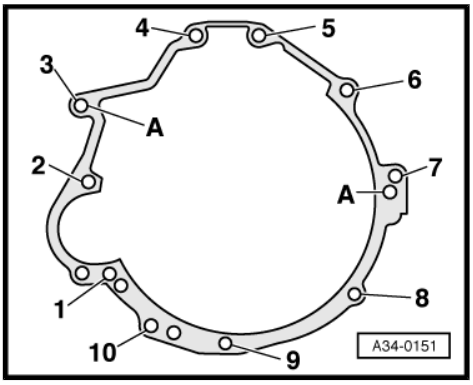
Securing engine to manual gearbox

Item	Bolt	Nm
1	M10x135	45
2	M12x130	65
3, 4, 5	M12x67	65
6	M12x90 1)	65
7	M12x80	65
8, 9, 10	M10x45	45
A	Dowel sleeves for centralising	

• 1) Bolt with washer.



Securing engine to automatic gearbox



Item	Bolt	Nm
1	M10x80	45
2	M12x110	65
3, 4, 5	M12x67	65
6	M12x90	65
7	M12x80	65
8	M10x60	45
9, 10	M10x45	45
A	Dowel sleeves for centralising	

Component		Nm
Bolts/nuts	M6	10
	M8	20
	M10	45
	M12	65
Except for the following:		
Coolant drain plug to cylinder block		20
Fuel supply line to fuel rail		23
Air duct to intake manifold		10
Power steering pressure pipe to pressure hose		40
Viscous fan to bearing using open-end spanner - 3312-		37
Alternator to engine	M8	22
	M10	45
Drive plate to torque converter		85 1)
Engine speed sender to gearbox		10
ATF line to gearbox		20
Stop for torque reaction support to lock carrier		28
Torque reaction support to top section of sump		40
Drive shaft heat shield to gearbox		23
Engine mounting to subframe		25
• 1) Use new genuine ribbed bolts ⇒ Parts catalogue .		

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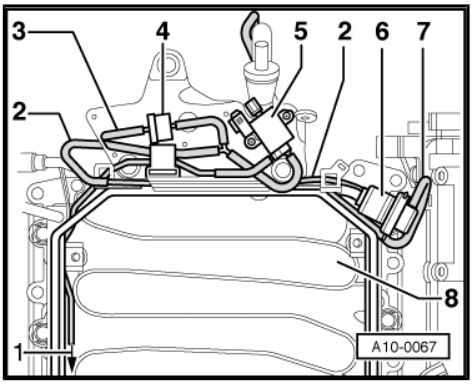
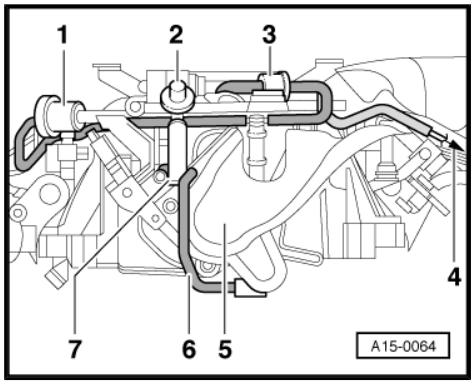
1.4 Vacuum connections

Vehicles without secondary air system (view from above)



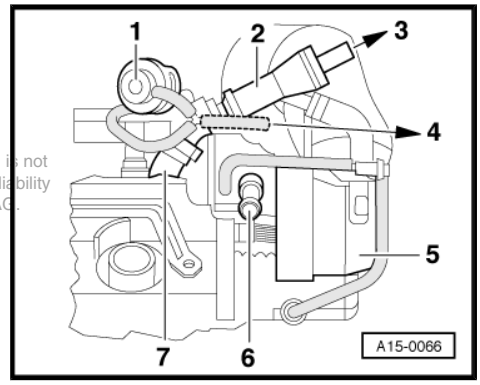
1 - To vacuum unit for intake manifold change-over
2 - To vacuum reservoir
3 - To connection on intake manifold
4 - Non-return valve
5 - Intake manifold change-over valve - N156-
6 - Fuel pressure regulator to T-connection
7 - To connection on intake manifold
8 - Intake manifold

Engine (rear)



1 - Fuel pressure regulator
2 - Suction-jet pump
3 - Non-return valve
4 - To vacuum reservoir
5 - Air intake connection
6 - Connection between air intake connection/throttle valve unit
7 - Connection between suction jet pump/air intake connection

Left side view



1 - Fuel pressure regulator
2 - Suction-jet pump
3 - To brake servo
4 - To air conditioner in footwell
5 - Air intake connection
6 - Connection on throttle valve unit to activated charcoal filter solenoid valve 1 - N80-
7 - Connection: suction-jet pump/intake manifold

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Vehicles with secondary air system:

1 - Combination valve for secondary air system (right-side)

- ❑ On cylinder head (rear right)

2 - To activated charcoal filter solenoid valve 1 - N80-

- ❑ On air cleaner

3 - Throttle valve module - J338-

4 - Secondary air inlet valve - N112-

5 - Non-return valve

6 - Variable intake manifold change-over valve - N156-

7 - To brake servo

8 - To fuel system diagnostic pump - V144-

- ❑ On USA models

9 - Combination valve for secondary air (left-side)

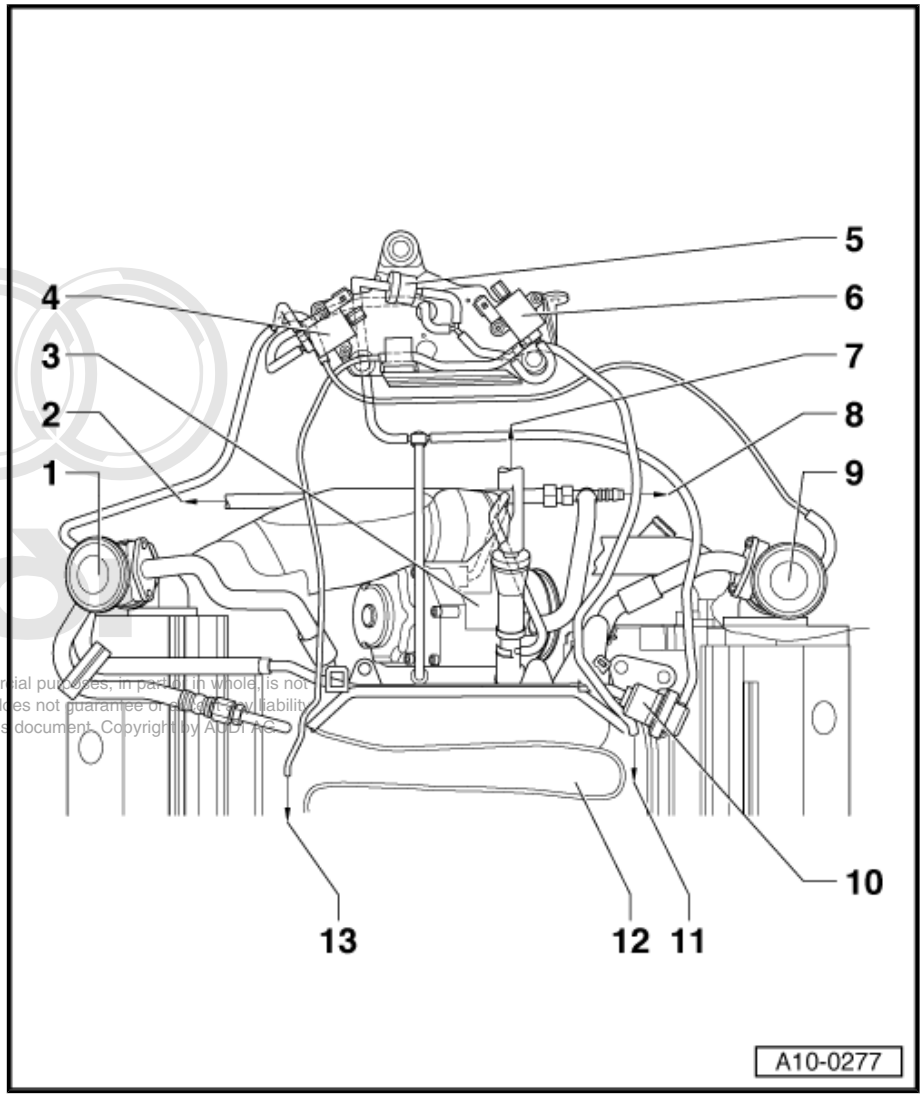
10 - Fuel pressure regulator

11 - To vacuum reservoir

- ❑ In wheel housing (front right)

12 - Intake manifold

13 - To actuator for intake manifold change-over



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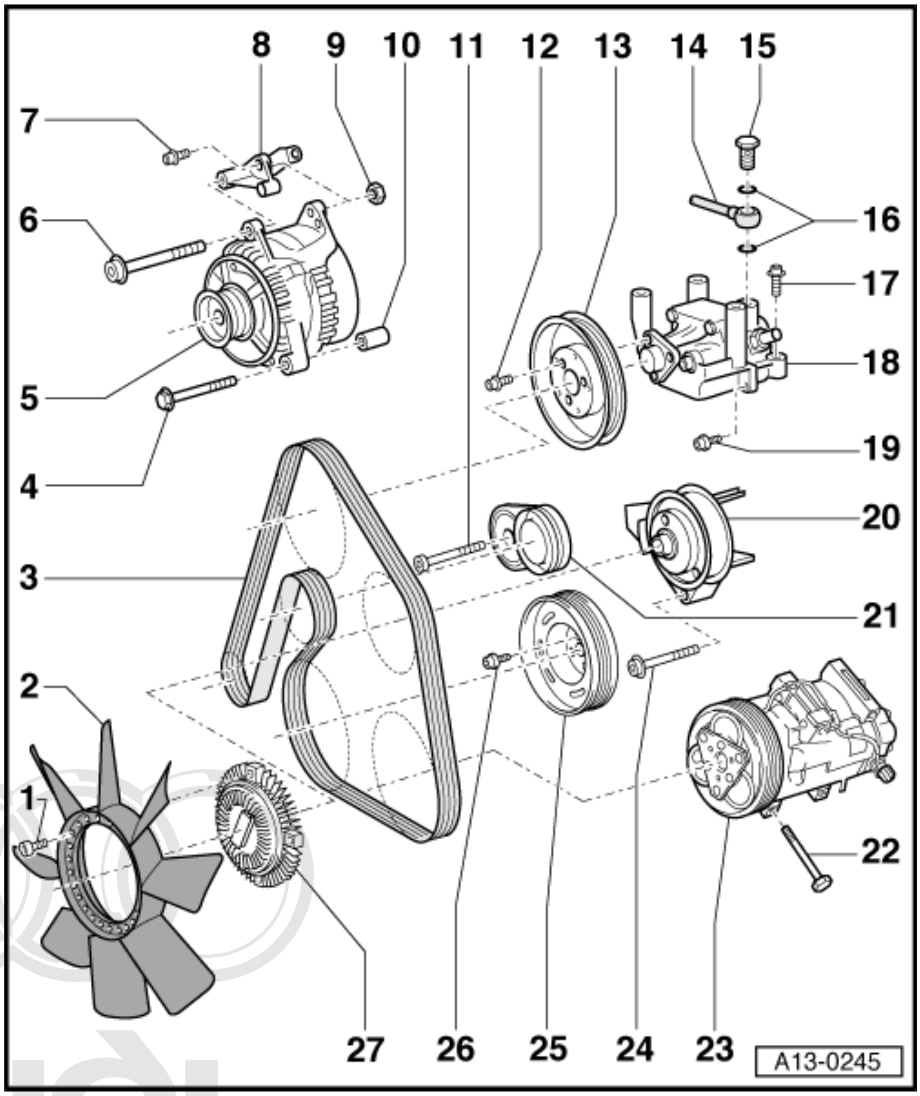
13 – Crankshaft group

1 Servicing work on pulley end

1.1 Poly V-belt drive for power steering pump, alternator, viscous fan and air conditioner - exploded view of components



1 - 11 Nm

2 - Fan wheel for viscous fan

- ❑ Removing and installing ⇒ page 175

3 - Poly V-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.
- ❑ Removing and installing ⇒ page 29

4 - 22 Nm

5 - Alternator

- ❑ Removing and installing ⇒ Rep. gr. 27

6 - 45 Nm

7 - 22 Nm

8 - Bracket for alternator

9 - 45 Nm

10 - Spacer sleeve

11 - 55 Nm

12 - 22 Nm

13 - Pulley for power steering pump

- ❑ To remove and install: counterhold with pin wrench - 3212- ⇒ page 29
- ❑ Marked “Vorne/Front”

14 - Pressure line

- ❑ To power-assisted steering

15 - Banjo bolt - 40 Nm

16 - Seal

- ❑ Renew

17 - 22 Nm

18 - Power steering pump with bracket

- ❑ Removing and installing ⇒ Rep. gr. 48

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19 - 22 Nm

20 - Pulley for viscous fan

- ❑ Removing and installing ⇒ page 176

21 - Tensioner for poly V-belt

22 - 25 Nm

23 - Air conditioner compressor

- ❑ Do not unscrew or disconnect refrigerant hoses or pipes.
- ❑ After removing compressor from mountings, secure it to longitudinal member with wire or similar. Do not leave it suspended from refrigerant pipes.

24 - M6: 10 Nm; M8: 22 Nm

25 - Belt pulley/vibration damper

- ❑ Removing and installing ⇒ page 31

26 - 22 Nm

27 - Viscous fan coupling

- ❑ Removing and installing ⇒ page 175

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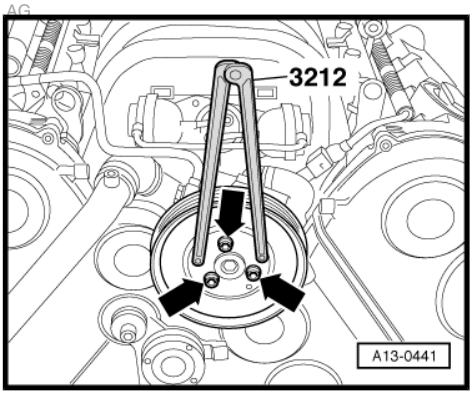
Removing and installing power steering pump pulley

- Poly V-belt must be removed ⇒ page 29 .

– Use pin wrench - 3212- to counterhold when slackening and tightening bolts -arrows-.

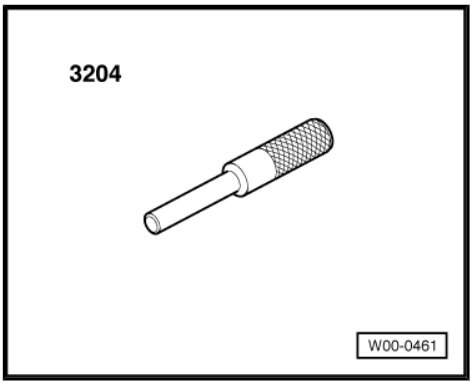
- Installation position: marking “Vorne/Front” faces in direction of travel.
- Tightening torque: 22 Nm



1.2 Removing and installing poly V-belt

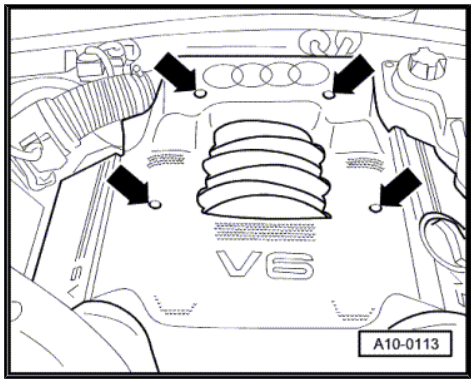
Special tools and workshop equipment required

♦ Locking pin - 3204-

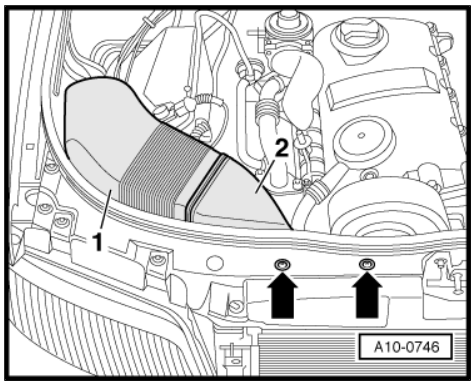


Removing

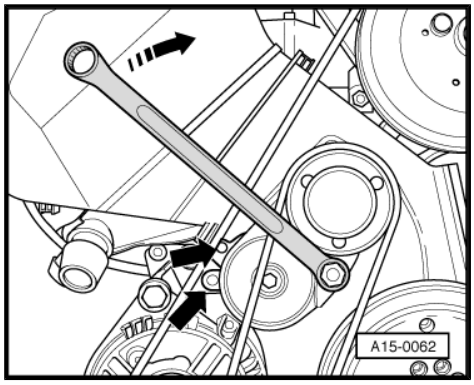
– Remove engine cover panel -arrows-.



– Remove bolts -arrows-.
– Remove air ducts -1- and -2-.



Tensioning roller with hexagon flats:



Note

Before removing, mark direction of rotation of poly V-belt with chalk or 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 17 mm ring spanner to slacken the poly V-belt.
– Lock tensioner in position by inserting locking pin - 3204- in locating holes -arrows-.
– Guide poly V-belt over viscous fan and detach belt.

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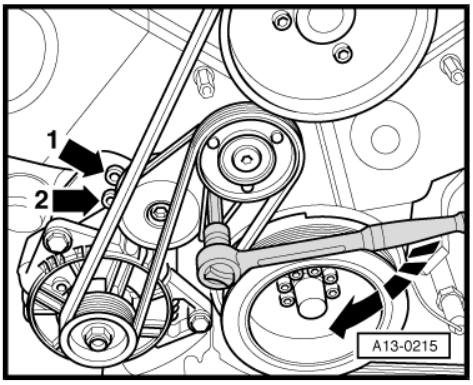
Tensioning roller with hexagon socket:



Note

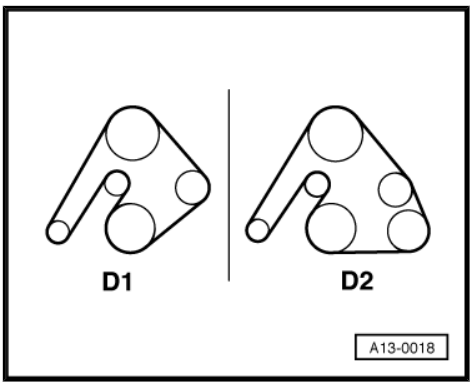
Before removing, mark direction of rotation of poly V-belt with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.

– Turn the tensioner in the direction of the -arrow- using a 10 mm hexagon key to slacken the poly V-belt.
– Lock tensioner in position by inserting locking pin - 3204- in locating holes -arrow 1- and -arrow 2-.
– Guide poly V-belt over viscous fan and detach belt.

Installing

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

– Start by fitting poly V-belt onto crankshaft pulley. Push belt onto tensioning roller last.



Note

When installing the poly V-belt ensure the belt seats correctly in the belt pulleys.

Routing of poly V-belt

D1 - without air conditioner

D2 - with air conditioner

Note

When installing poly V-belt, make sure it is properly seated on pulleys.

– Start engine and check that belt runs properly.

1.3 Removing and installing pulley/vibration damper

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Removing

– Move lock carrier to service position ⇒ Rep. gr. 50 .
– Remove poly V-belt ⇒ page 29 .

Note

Central bolt does not have to be loosened when removing pulley/ vibration damper.

– Unbolt pulley/vibration damper.

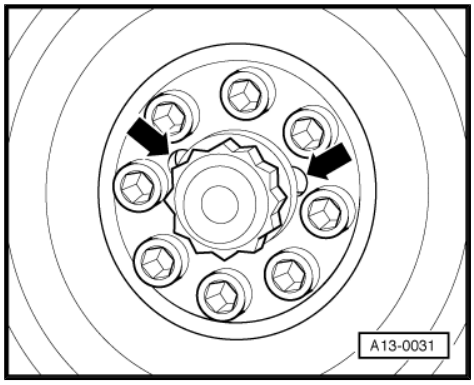
Installing

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

- Ensure that notches -arrows- in pulley/vibration damper are aligned with locating lugs on toothed belt sprocket.

– Install poly V-belt ⇒ page 31 .

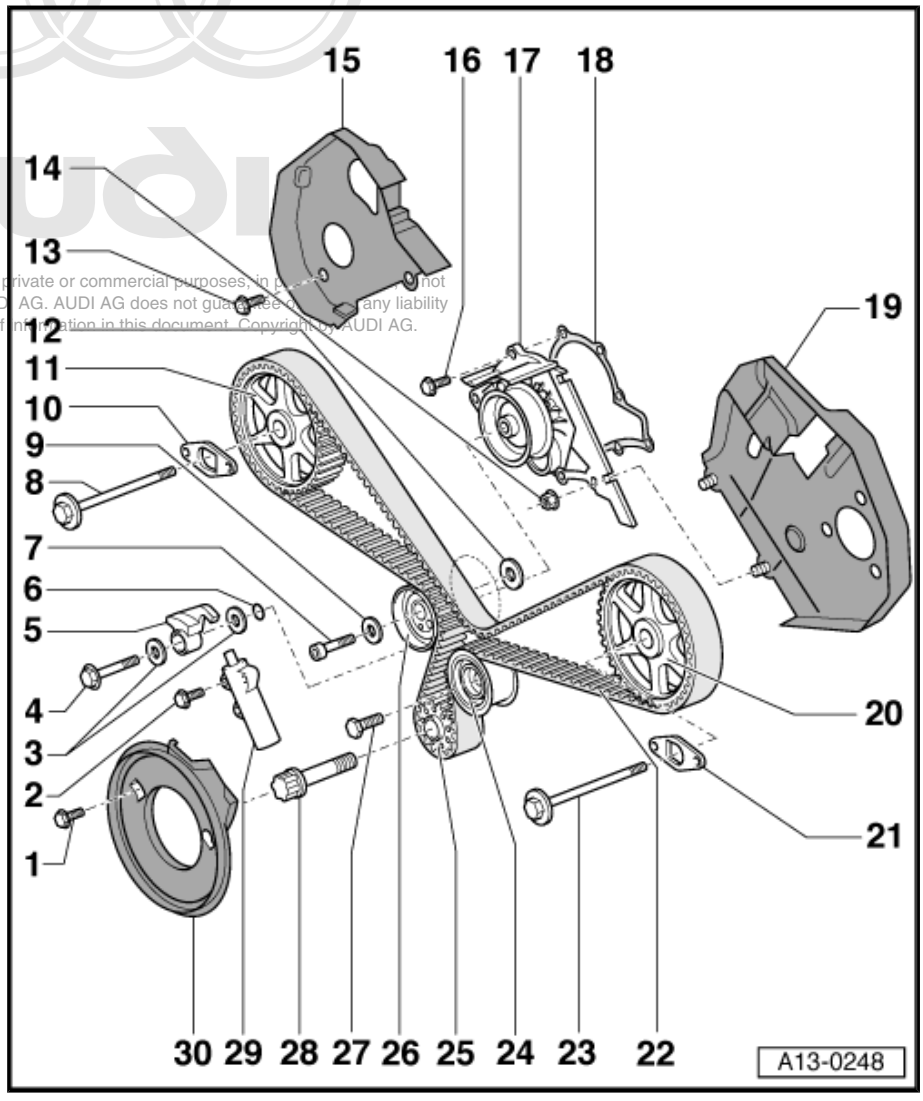
– Install lock carrier ⇒ Rep. gr. 50 .



Tightening torque

Component	Nm
Belt pulley/vibration damper to crankshaft sprocket	22

1.4 Toothed belt drive - exploded view



1 - 10 Nm

2 - 10 Nm

- ❑ Vehicles with “engine generation II”: Apply locking fluid when fitting; for locking fluid refer to ⇒ Parts catalogue

3 - Washer

4 - 22 Nm

5 - Tensioning lever with bearing bush

6 - O-ring

- ❑ Renew if damaged
- ❑ Locates ⇒ Item 3 (page 32) , ⇒ Item 4 (page 32) and ⇒ Item 5 (page 32) when assembled

7 - 22 Nm

8 - 55 Nm

9 - Washer

10 - Locating plate

- ❑ Side labelled “rear/hinten” faces rear

11 - Camshaft sprocket (right-side)

- ❑ Removing and installing ⇒ “1.5 Removing and installing toothed belt”, page 34
- ❑ Remove using puller - T40001-

12 - Spacer

13 - 10 Nm

- ❑ Install using locking fluid; for locking fluid refer to ⇒ Parts catalogue

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14 - 10 Nm

15 - Toothed belt cover (rear right)

16 - 10 Nm

17 - Coolant pump

- ❑ Removing and installing ⇒ page 161

18 - Gasket

- ❑ Renew

19 - Toothed belt cover (rear left)

20 - Camshaft sprocket (left-side)

- ❑ Removing and installing ⇒ “1.5 Removing and installing toothed belt”, page 34
- ❑ Remove using puller - T40001-

21 - Locating plate

- ❑ Side labelled “rear/hinten” faces rear

22 - 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 34
- ❑ Installing (adjusting valve timing) ⇒ page 37

23 - 55 Nm

24 - Idler roller

25 - Crankshaft sprocket

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

26 - Tensioning roller with bearing bush

27 - 43 Nm

28 - 200 Nm + 180° ($^1/_2$ turn) further

- ❑ Renew
- ❑ Do not additionally lubricate
- ❑ Use locking pin - 3242- when loosening and tightening
- ❑ Screwing in locking pin - 3242- ⇒ page 41

29 - Tensioner

30 - Toothed belt cover (bottom)

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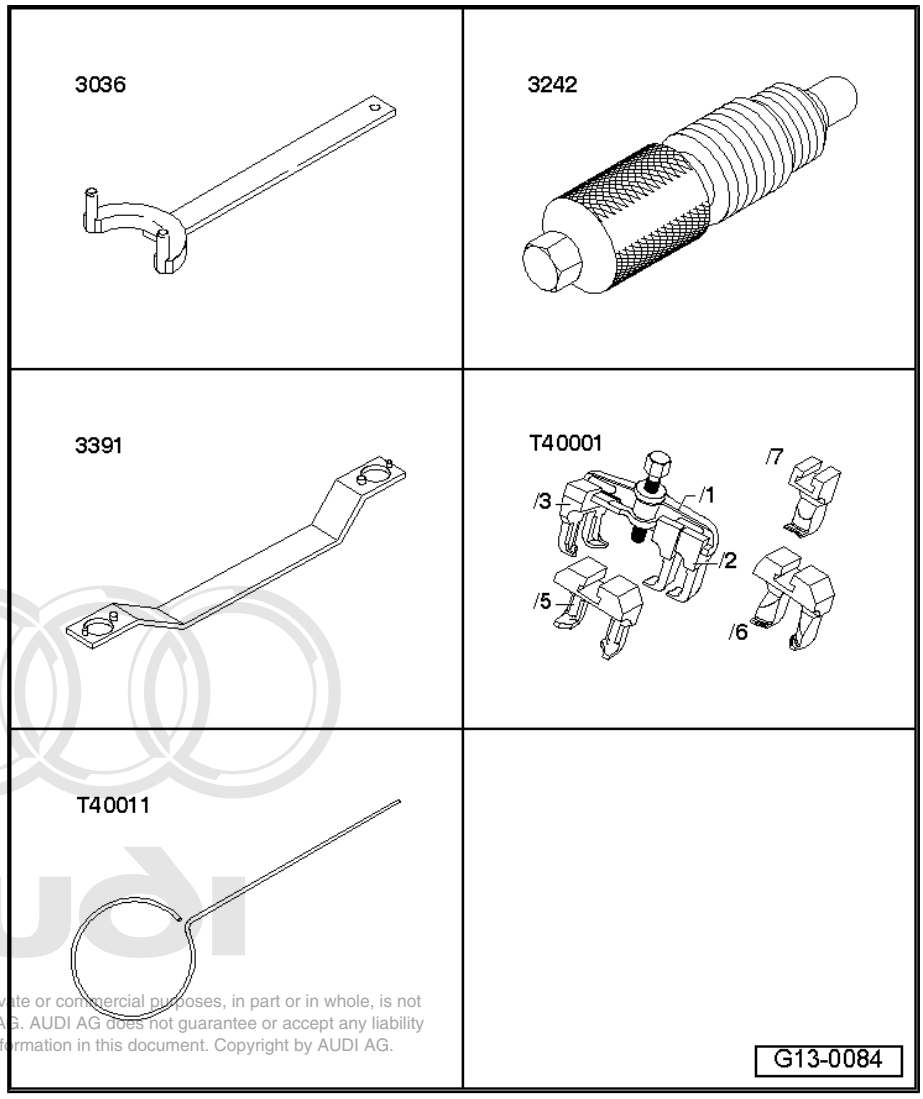
1.5 Removing and installing toothed belt

Special tools and workshop equipment required

- Counterhold tool - 3036-
- Locking pin - 3242-
- Camshaft clamp - 3391-
- Puller - T40001- with claws - T40001/2-
- Locking pin - T40011-



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Removing

- Engine in vehicle.

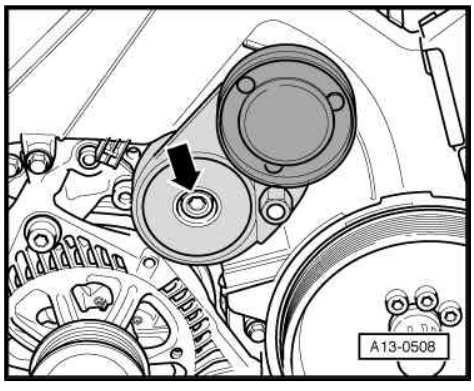
– Move lock carrier to service position ⇒ Rep. gr. 50 .

– Remove viscous fan ⇒ page 175 .

– Unscrew radiator cowl for viscous fan.

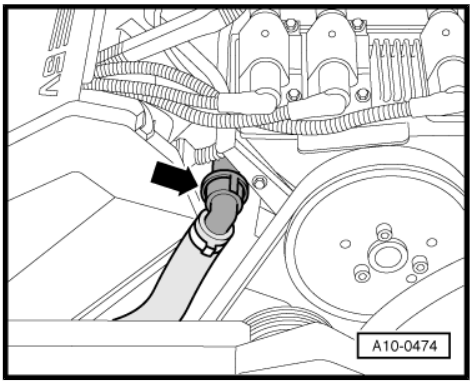
– Remove poly V-belt ⇒ page 29 .

– Unscrew bolt -arrow- and remove tensioner for poly V-belt.



Vehicles with secondary air system:

– Disconnect hose -arrow- from secondary air connecting pipe.



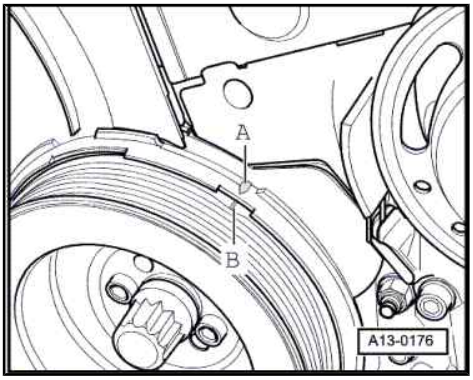
All vehicles:

– Remove toothed belt cover (left and right).

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

– Turn crankshaft by turning central bolt at crankshaft sprocket in normal direction of engine rotation until the marking is at TDC.

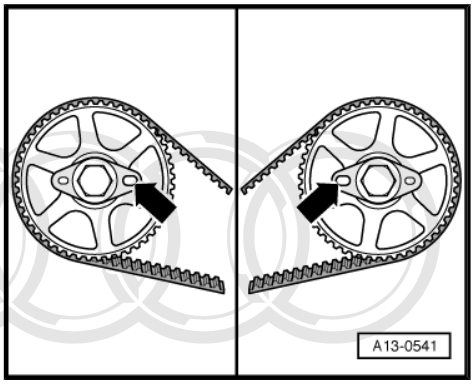
• Notch -B- is opposite mark -A-.



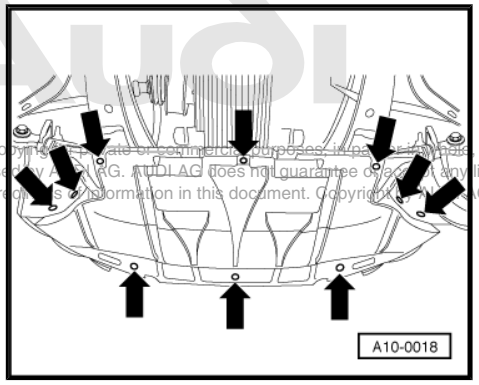
– Check position of camshafts:

• Large holes -arrows- in locating plates at camshaft sprockets must be opposite one another on inside.

– If this is not the case, turn crankshaft one revolution further.



– Remove noise insulation -arrows-.



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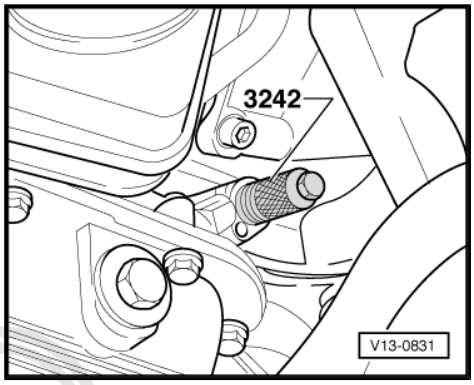
– Unscrew plug for TDC marking from cylinder block.



Note

There is a TDC drilling in the crankshaft directly behind the sealing plug (it is possible to feel the hole).

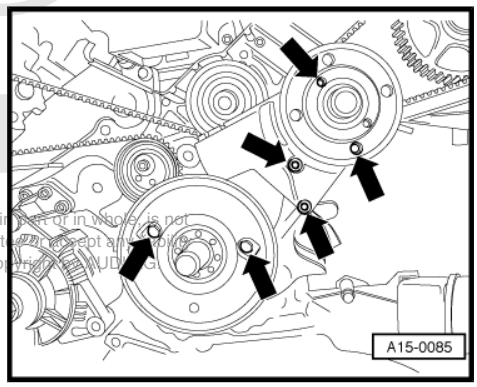
WARNING

To avoid any risk of injury, do not rotate the crankshaft while feeling for the TDC hole with your finger.

– Screw locking pin - 3242- into threaded hole where plug has been removed, and tighten.

– Remove pulley/vibration damper ⇒ page 31 .

– Unbolt toothed belt cover (bottom) and poly V-belt pulley for viscous fan -arrows-.



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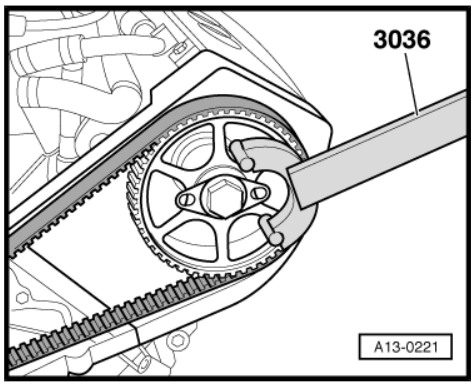
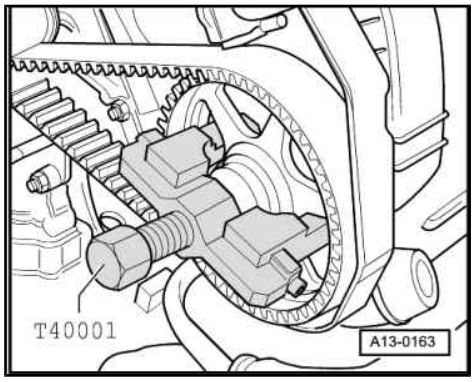
– Loosen both camshaft sprocket bolts using counterhold tool - 3036- .



Note

Leave bolts screwed in loosely.

– Pull camshaft sprockets (left and right) off their tapers using puller - T40001- with claws - T40001/2- .

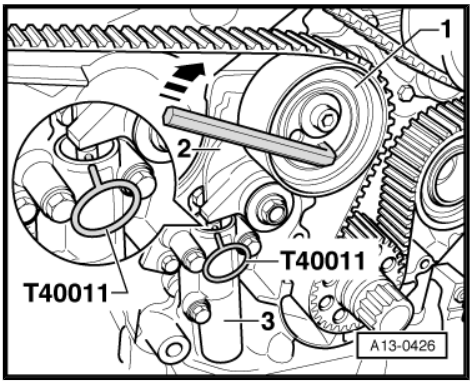


Note

- *Before removing, mark rotation direction of toothed belt with chalk or felt-tip pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.*
- *The toothed belt tensioner is oil-damped and can therefore only be compressed slowly by applying constant pressure.*

– Turn toothed belt tensioning roller -1- clockwise in direction of -arrow- using an 8 mm Allen key until tensioning lever -2- compresses tensioner -3- far enough for the pressure piston to be locked with locking pin - T40011- .

– Remove toothed belt.



Installing (adjusting valve timing)

- Crankshaft locked in position with locking pin - 3242- .
- Camshaft sprockets free to turn.

Note

♦ *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.*

♦ *The valve timing must be adjusted as described below, even when the toothed belt has only been removed from the camshaft sprocket.*

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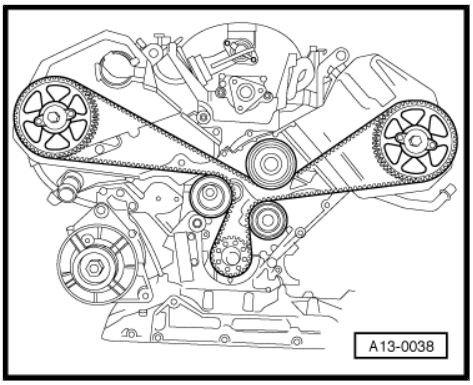
– Fit both camshaft sprockets with locating plates, washers and bolts.

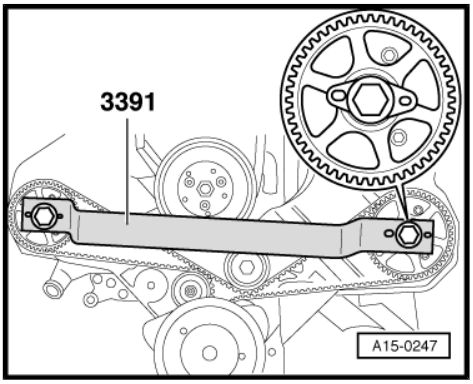
- Installation position of locating plates: labelled side “front/ vorne” faces front or marking “rear/hinten” faces rear.

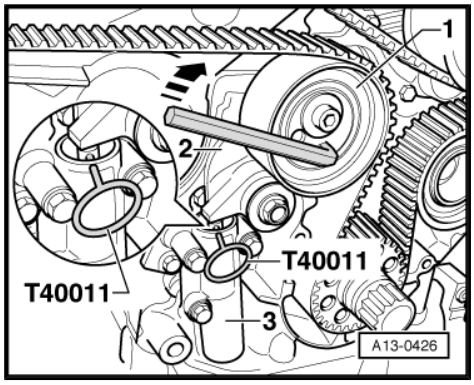
– Tighten the two camshaft sprocket bolts until the sprockets can still just be turned without axial movement.

– Position toothed belt as shown on all sprockets and finally on tensioning roller.



– Fit camshaft clamp - 3391- onto the locating plates of the two camshafts.





- Using an 8 mm Allen key, turn toothed belt tensioning roller -1- clockwise in direction of -arrow- until the locking pin - T40011- can be removed.
- Proceed as follows to pre-tension tensioning roller before first starting engine:
- Apply torque wrench to hexagon socket on tensioning roller.
- Tension belt by applying a torque of 15 Nm to the tensioning roller. This provides the correct amount of initial tension.
- Tighten camshaft sprockets to 30 Nm.
- Remove camshaft clamp - 3391- .
- Tighten camshaft sprockets fully. To do so, apply counterhold tool - 3036- for support.
- Install pulley/vibration damper ⇒ page 31 .
- Remove locking pin - 3242- .
- Screw plug for TDC marking into cylinder block with new O-ring.
- Install poly V-belt ⇒ page 31 .
- Install lock carrier ⇒ Rep. gr. 50 .

Tightening torques

Component		Nm
Camshaft sprocket to camshaft		55
Belt pulley/vibration damper to crankshaft sprocket		22
Tensioner for poly V-belt to cylinder block		55
Sealing plug in cylinder block		10
Toothed belt cover (bottom) to cylinder block		10
Viscous fan bracket to cylinder block	M6	10
	M8	22

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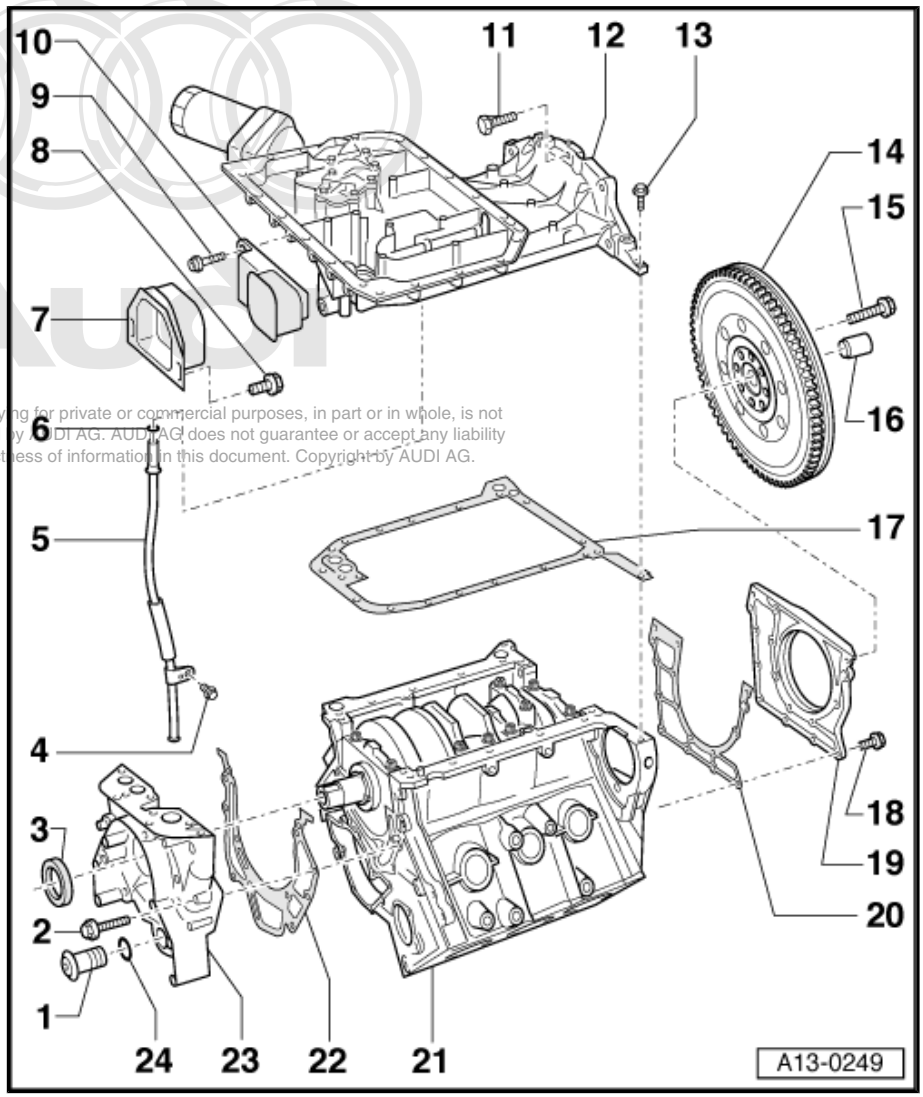
2 Sealing flanges and dual-mass flywheel/drive plate

2.1 Sealing flange and dual-mass flywheel/drive plate - exploded view of components

Note

- *The illustration shows the "engine generation II" version as an example for both engine generations.*
- *Components relating to "engine generation III" are noted separately in the text.*
- *Servicing clutch ⇒ Rep. gr. 30*



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1 - Spray nozzle valve, 40 Nm
- ❑ "Engine generation II" only

2 - M6: 10 Nm; M8: 30 Nm

3 - Crankshaft oil seal
- ❑ Removing and installing ⇒ page 41

4 - 10 Nm

5 - Guide tube for oil dipstick

6 - O-ring
- ❑ Renew

7 - Stop for torque reaction support

8 - 28 Nm

9 - 40 Nm

10 - Torque reaction support

11 - 45 Nm

12 - Sump (top section)
- ❑ Removing ⇒ page 128
- ❑ Installing ⇒ "1.8 Installing sump (top section) - engine generation II ", page 138 or ⇒ "1.9 Installing sump (top section) - engine generation III ", page 139

13 - M6 - 10 Nm; M7 - 16 Nm; M8 - 20 Nm

14 - Dual-mass flywheel/drive plate
- ❑ Removing and installing dual-mass flywheel ⇒ page 48
- ❑ Removing and installing drive plate ⇒ page 50

15 - Securing bolt for dual-mass flywheel/drive plate
- ❑ Renew

- ❑ Tightening torque for dual-mass flywheel: 60 Nm +$^1/_2$ turn (180°) further
- ❑ Tightening torque for drive plate (vehicles with automatic gearbox): 60 Nm +$^1/_4$ turn (90°) further.

16 - Needle bearing

- ❑ Only with manual gearbox
- ❑ Extracting and driving in ⇒ page 50
- ❑ With automatic gearboxes, a bearing bush is pressed into the crankshaft instead of the needle bearing in the dual-mass flywheel ⇒ page 56

17 - Gasket

- ❑ “Engine generation II” only
- ❑ Renew
- ❑ Install dry
- ❑ It is not necessary to apply additional sealant
- ❑ Replaced in “engine generation III” by liquid gasket ⇒ page 139

18 - 10 Nm

19 - Sealing flange (rear) with oil seal

- ❑ Renewing ⇒ page 52
- ❑ Lightly oil sealing lip of oil seal

20 - Gasket

- ❑ Renew

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21 - Cylinder block

- ❑ Removing and installing crankshaft ⇒ page 54
- ❑ Dismantling and assembling pistons and conrods ⇒ page 60

22 - Gasket

- ❑ Renew

23 - Oil pump for “engine generation II” or front sealing flange for “engine generation III”

- ❑ Removing and installing ⇒ “1.10 Removing and installing oil pump - engine generation II ”, page 140 or ⇒ “2.3 Removing and installing front sealing flange - engine generation III ”, page 42

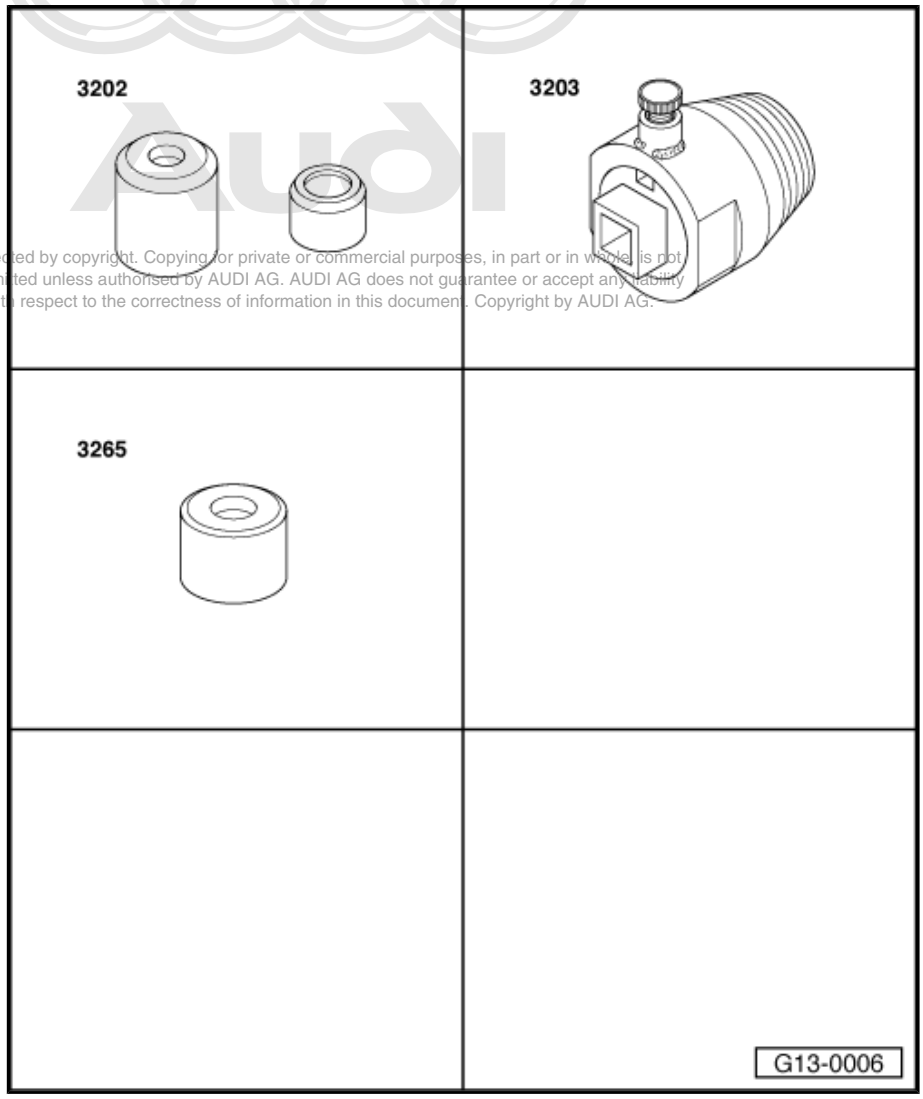
24 - O-ring

- ❑ “Engine generation II” only
- ❑ Renew

2.2 Renewing crankshaft oil seal (pulley end)

Special tools and workshop equipment required

- Fitting sleeves - 3202/1-
- Oil seal extractor - 3203-
- Fitting sleeve - 3265-



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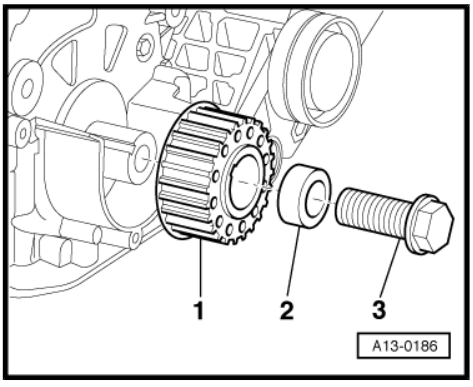
Procedure

- Engine in vehicle.

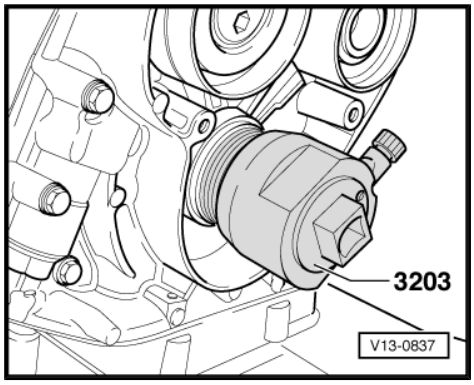
– Remove toothed belt ⇒ page 34 .

– Unscrew central bolt -3- for crankshaft sprocket -1-.

– Detach spacer -2- and toothed belt sprocket.



– Unscrew inner section of oil seal extractor - 3203- three turns out of outer section and lock with knurled screw.
– Lubricate threaded head of oil seal extractor, place it in position and screw it into oil seal as far as possible (applying firm pressure).
– Loosen knurled screw and turn inner part against crankshaft until oil seal is pulled out.
– Clamp flats of oil seal extractor in vice.
– Remove oil seal with pliers.

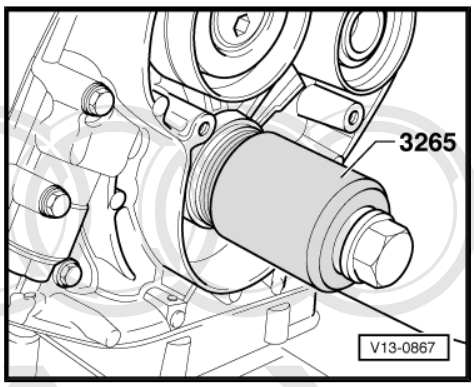


– Clean running surface and sealing surface.

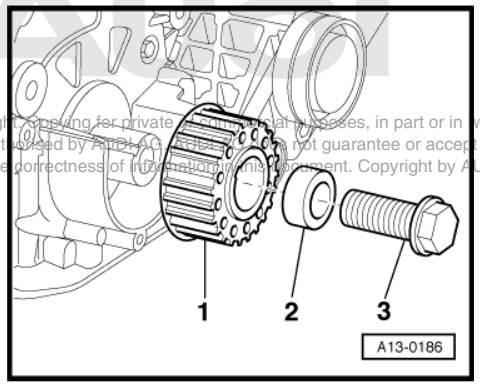
Note

Do not lubricate sealing lip and outer rim of oil seal before pressing in.

– Fit oil seal using fitting sleeves - 3202/1- .
– Press in seal until flush using fitting sleeve - 3265- and central bolt.



– Install crankshaft sprocket -1- with spacer -2- and new central bolt -3-.



Note

- *Contact surface between toothed belt sprocket and crankshaft must be free of oil.*
- *Do not additionally lubricate bolt for crankshaft toothed belt sprocket.*

– Install toothed belt (adjust valve timing) ⇒ page 37 .

Tightening torque

Component	Nm
Toothed belt sprocket to crankshaft	200 + 180° 1)2)
• 1) Renew bolt. • 2) 180° = one half turn.	

2.3 Removing and installing front sealing flange - “engine generation III”

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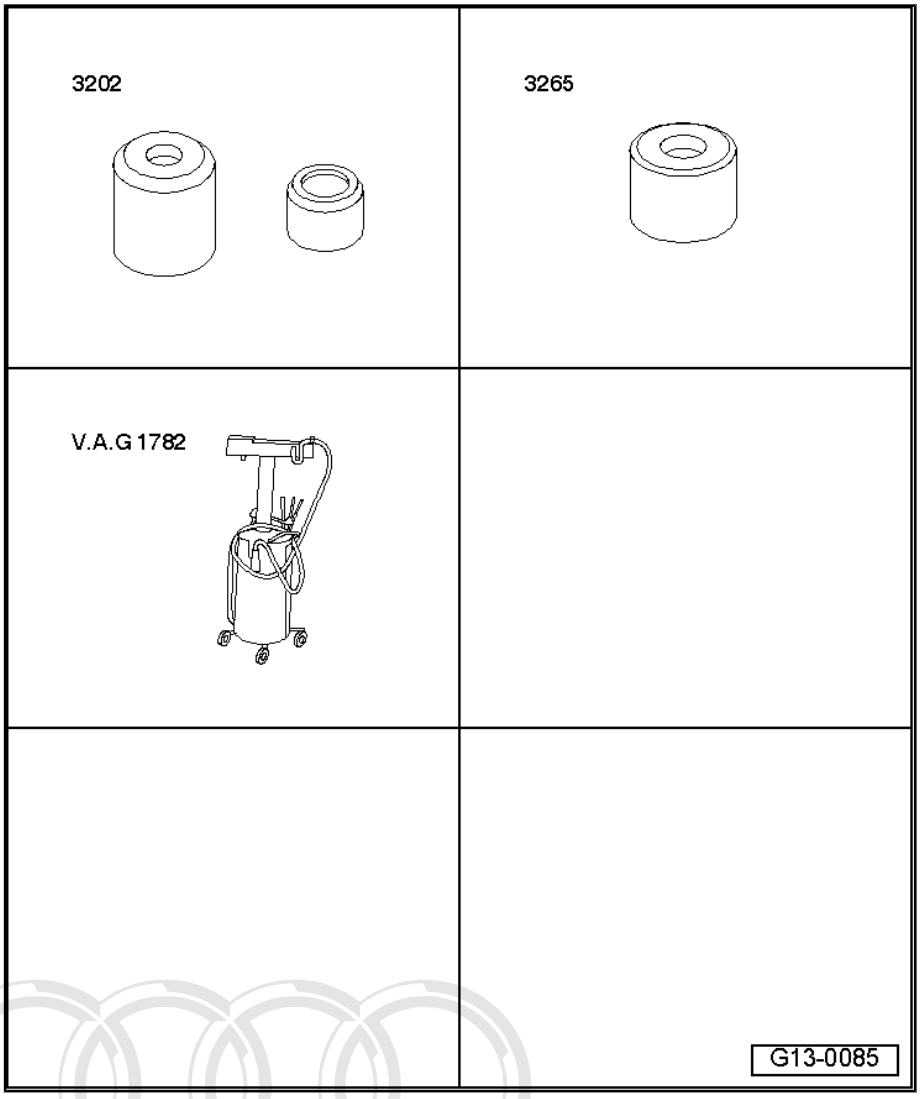
Special tools and workshop equipment required

- Fitting sleeve - 3202/1- from fitting sleeves - 3202-
- Fitting sleeve - 3265-
- Used oil collection and extraction unit - V.A.G 1782-
- Electric drill with plastic brush attachment
- Safety goggles
- Sealant ⇒ Parts catalogue



Removing

- Engine in vehicle.

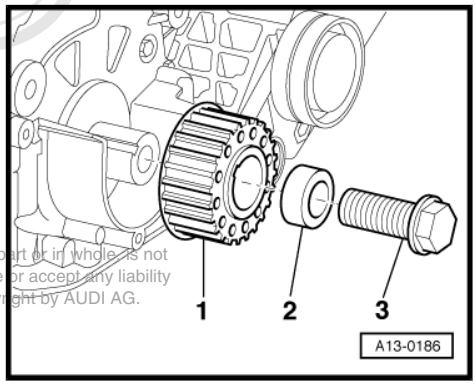
– Remove toothed belt ⇒ page 34 .

– Unscrew central bolt -3- for crankshaft sprocket -1-.

– Detach spacer -2- and toothed belt sprocket.

– Place used oil collection and extraction unit - V.A.G 1782- under engine.

– Drain off engine oil.



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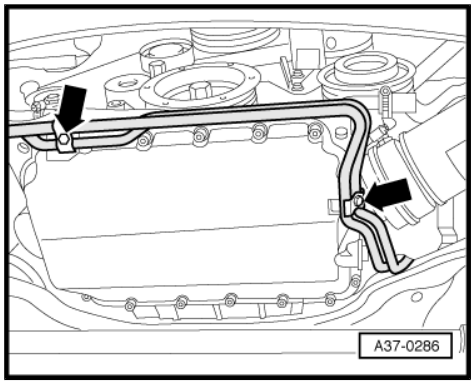
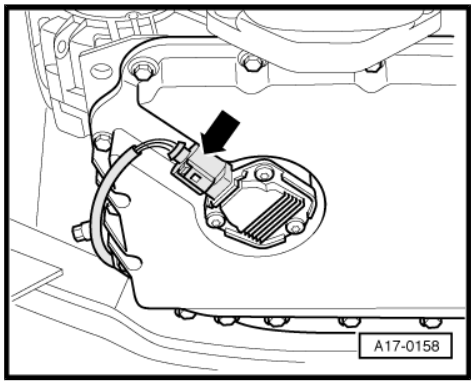
Vehicles with automatic gearbox:

– Remove bracket for ATF lines -arrows-.

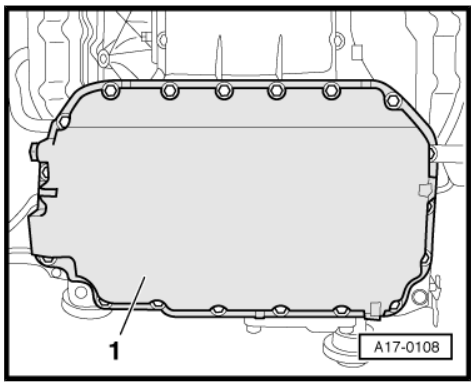


All vehicles:

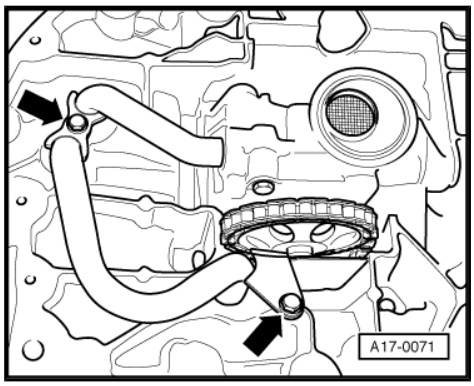
– If fitted, unplug electrical connector -arrow- at oil level/temperature sender - G266- and move wiring clear.



– Remove sump (bottom section) -1-.



– Unscrew brackets for oil supply pipes -arrows- and detach front (long) oil supply pipe.



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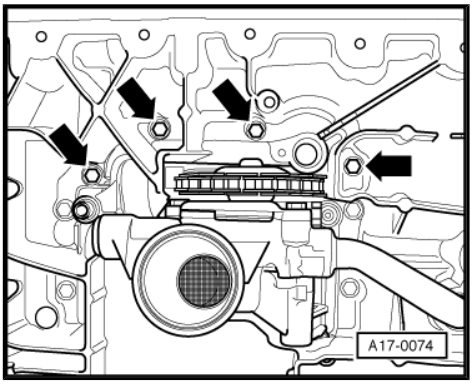
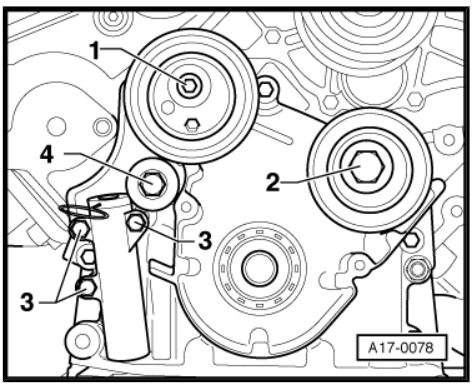
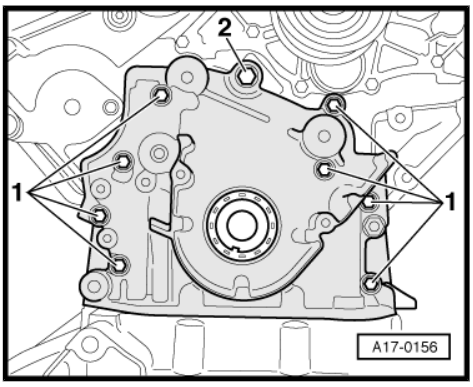
– Unscrew 4 bolts -arrows- from sump (top section).



– Remove idler roller -2-, tensioning roller -1-, tensioning lever -4- and tensioner -3-.



– Remove bolts -1- and -2-.
– Pull off sealing flange (front).
– Drive out oil seal with flange removed.



Installing

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

– Remove sealant residue from sealing flange and bottom and top sections of sump with rotating plastic brush or similar.

WARNING

Wear safety goggles.

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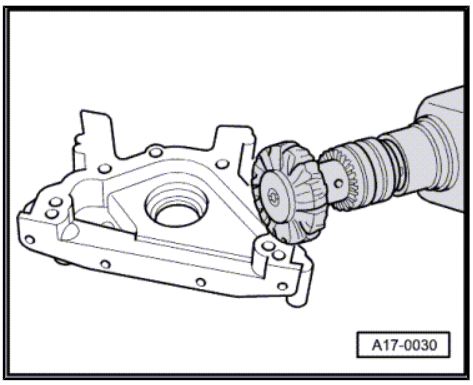
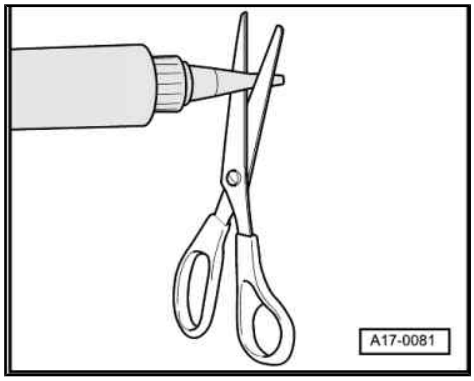
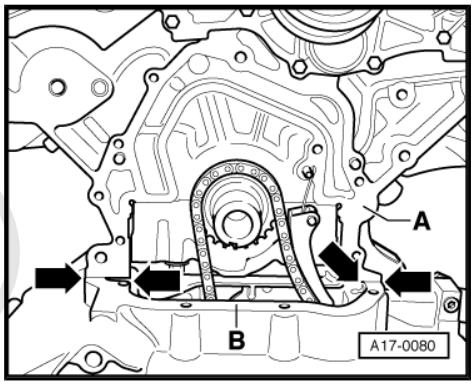
– Clean sealing surfaces; they must be free of oil and grease.



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



– Fit gasket onto dowel pins on sealing surfaces -A-.



Note

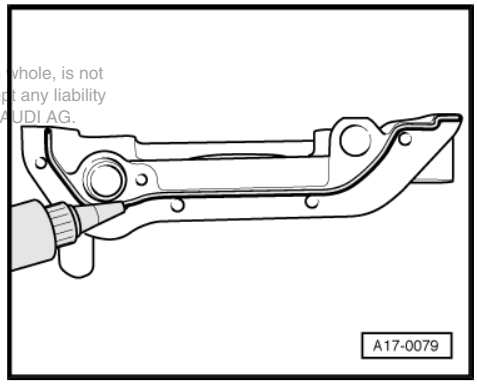
Do not apply sealant to sealing surface -A- on cylinder block.

– After fitting gasket, apply a small sealant bead in each case to edges between -left arrows- and -right arrows-.

Note

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

– Apply sealant bead to clean sealing surface of sealing flange, as shown in illustration.



• Thickness of sealant bead: 2 - 3 mm

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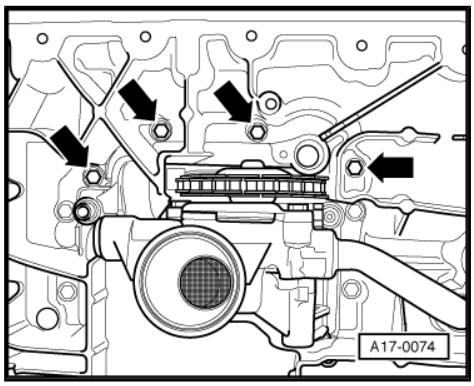
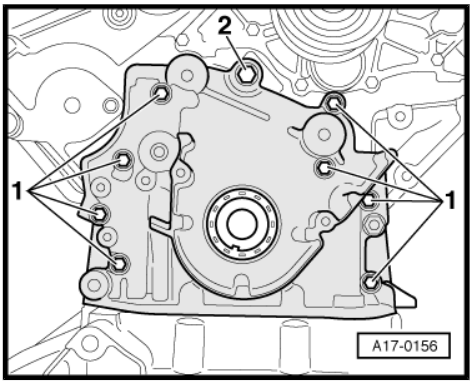
Note

- *Sealant bead must not be wider than 3 mm, otherwise excess sealant could ingress into sump and clog strainer in oil intake pipe.*
- *For fitting sealing flange with oil seal in position, attach fitting sleeves - 3202/1- to end of crankshaft.*

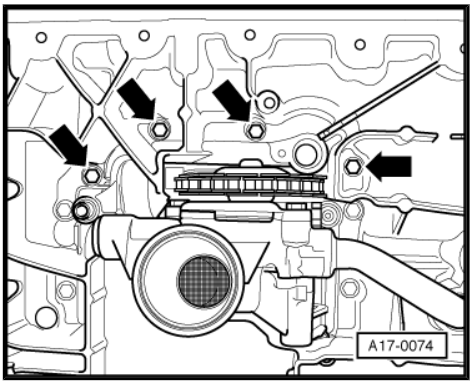
– Hand-tighten the 4 bolts -arrows-.



– Insert bolt -2- with locking fluid; Locking fluid ⇒ Parts catalogue .
– Tighten bolts -1- to 10 Nm and bolt -2- to 30 Nm.



– Tighten the 4 bolts -arrows- fully.
• M6 - 10 Nm
• M7 - 16 Nm



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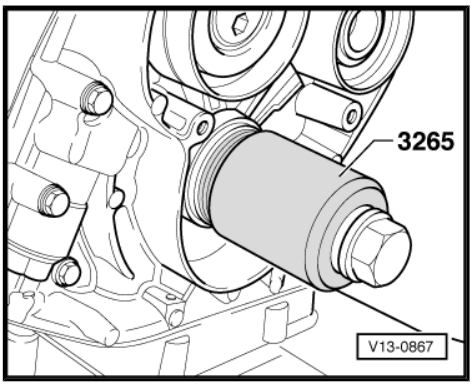
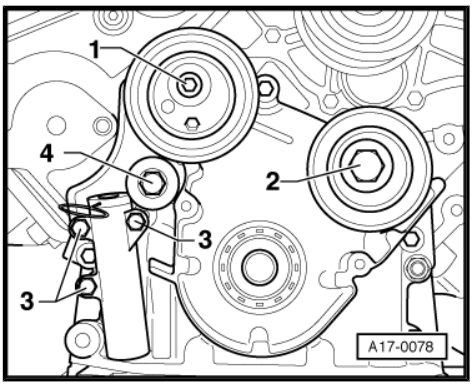
Note

Do not lubricate sealing lip and outer rim of oil seal before pressing in.

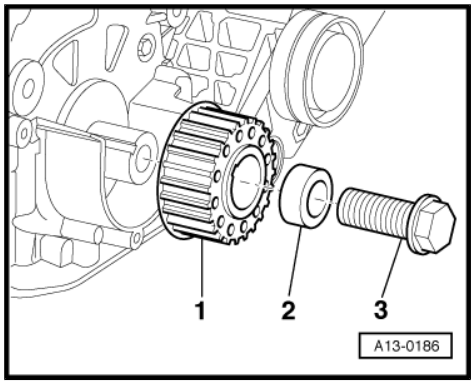
– Fit oil seal using fitting sleeves - 3202/1- .
– Press in seal until flush using fitting sleeve - 3265- and central bolt.



– Install components in the specified sequence:
1. Toothed belt tensioner -item 3-.
2. Tensioning lever -item 4-.
3. Toothed belt tensioning roller -item 1-.
4. Idler roller -item 2-.
– Pay attention to shims beneath tensioning roller and tensioning lever.



– Install crankshaft sprocket -1- with spacer -2- and new central bolt -3-.



Note

- *Contact surface between toothed belt sprocket and crankshaft must be free of oil.*
- *Do not additionally lubricate bolt for crankshaft toothed belt sprocket.*

– Install toothed belt (adjust valve timing) ⇒ page 37 .

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Tightening torques

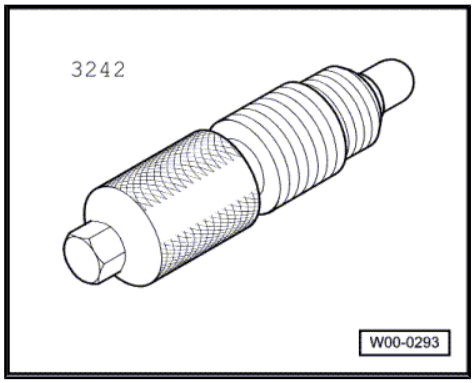
Component		Nm
Front sealing flange to cylinder block	M6	10
	M8	30
Sealing flange (front) to sump (top section)	M6	10
	M7	16
Toothed belt sprocket to crankshaft		200 + 180° 1)2)
Toothed belt tensioning roller to sealing flange (front)/oil pump		22
Tensioner to sealing flange (front)/oil pump		10
Tensioning lever to sealing flange (front)/oil pump		22
Idler roller to sealing flange (front)/oil pump		43

- 1) Renew bolt.
- 2) 180° = one half turn.

2.4 Removing and installing dual-mass flywheel

Special tools and workshop equipment required

- Locking pin - 3242-

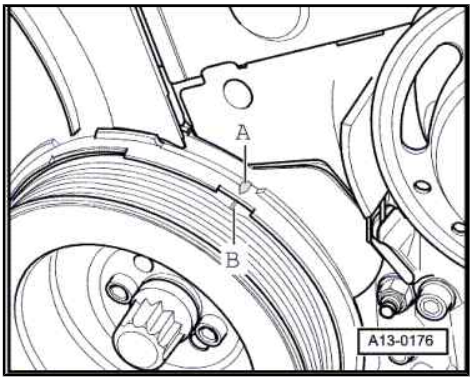


Removing

- Gearbox removed.

Caution

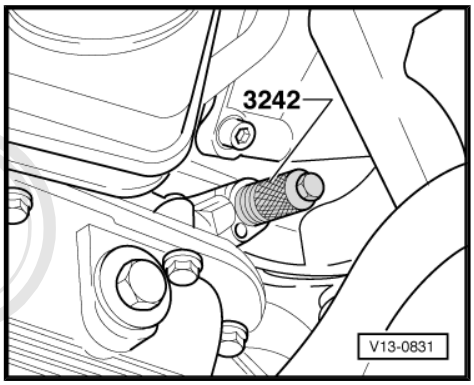
The engine must only be turned at the crankshaft, in the direction of normal engine rotation (clockwise).



– Turn crankshaft by turning central bolt at crankshaft sprocket in normal direction of engine rotation until the marking is at TDC.

- Notch -B- is opposite mark -A-.

– Unscrew plug for TDC marking from cylinder block.



Note

There is a TDC drilling in the crankshaft directly behind the sealing plug (it is possible to feel the hole).

WARNING

To avoid any risk of injury, do not rotate the crankshaft while feeling for the TDC hole with your finger.

– Screw locking pin - 3242- into threaded hole where plug has been removed, and tighten.

– Mark position of dual-mass flywheel on engine.

– Unbolt dual-mass flywheel.

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Installing

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

– Renew bolts and tighten to final setting.

Note

The needle bearing is located in the dual-mass flywheel and must be pressed in when renewing the dual-mass flywheel
⇒ page 50 *.*

– Remove locking pin - 3242- .

– Screw plug for TDC marking into cylinder block with new O-ring.

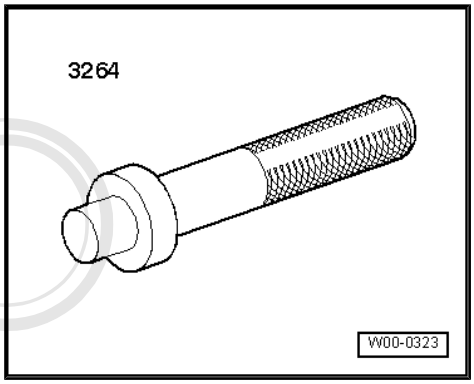
Tightening torques

Component	Nm
Dual-mass flywheel to crankshaft	60 + 180° 1)2)
Sealing plug in cylinder block	10
• 1) Renew bolts. • 2) 180° = one half turn.	

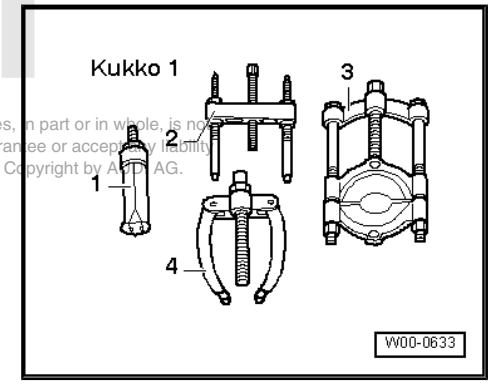
2.5 Extracting and driving in needle bearing for dual-mass flywheel

Special tools and workshop equipment required

- Punch - 3264-



- 1 - Internal puller - Kukko 21/1-



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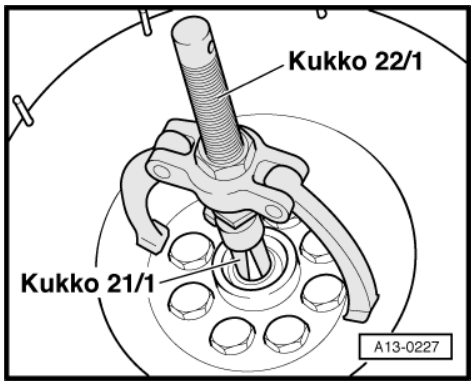
- 4 - Counter-support - Kukko 22/1-

Procedure

– Remove needle bearing using internal puller - Kukko 21/1- and counter-support - Kukko 22/1- .

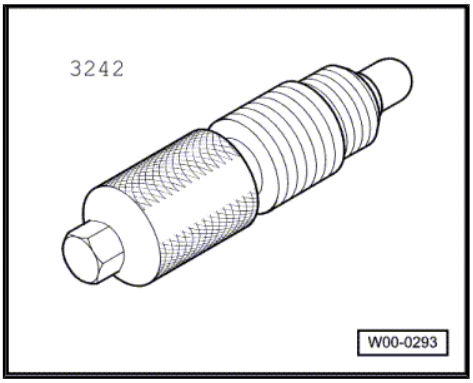
– Drive in needle bearing until flush using punch - 3264- .



2.6 Removing and installing drive plate

Special tools and workshop equipment required

♦ Locking pin - 3242-



Removing

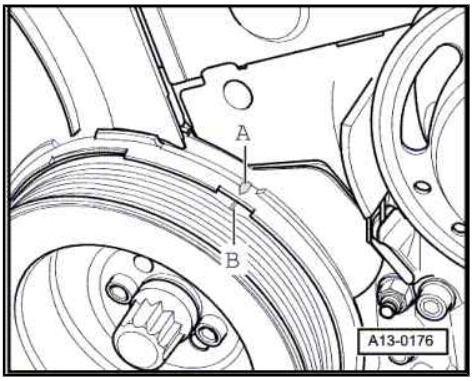
- Gearbox removed.

Caution

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

– Turn crankshaft by turning central bolt at crankshaft sprocket in normal direction of engine rotation until the marking is at TDC.

- Notch -B- is opposite mark -A-.



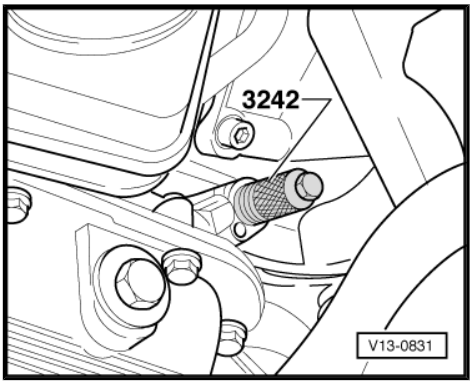
– Unscrew plug for TDC marking from cylinder block.

Note

There is a TDC drilling in the crankshaft directly behind the sealing plug (it is possible to feel the hole).

WARNING

To avoid any risk of injury, do not rotate the crankshaft while feeling for the TDC hole with your finger.



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– Screw locking pin - 3242- into threaded hole where plug has been removed, and tighten.

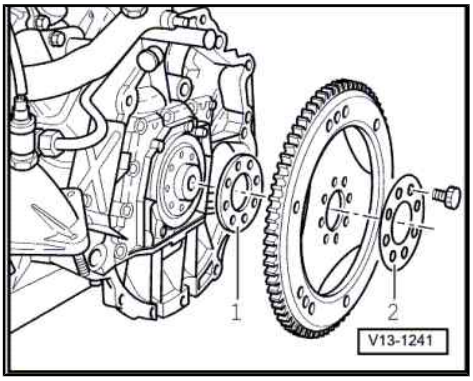
– Mark installation position of drive plate on engine.

– Unbolt drive plate.

Installing

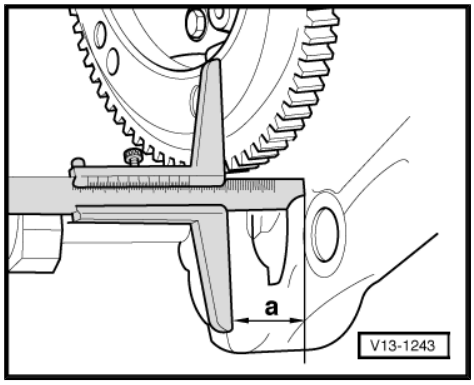
– Fit drive plate in position with packing plate -2- and shim -1- of “3.0 mm” or “4.0 mm” thickness.

– Insert at least 3 old securing bolts and tighten to 30 Nm.



– Measure distance -a- at three points and calculate average value.

• Specification for automatic gearbox 01V: 18.1 … 19.7 mm.



If specification is not obtained:

– Remove drive plate again and install with different shim -1-. Tighten bolts to 30 Nm again.

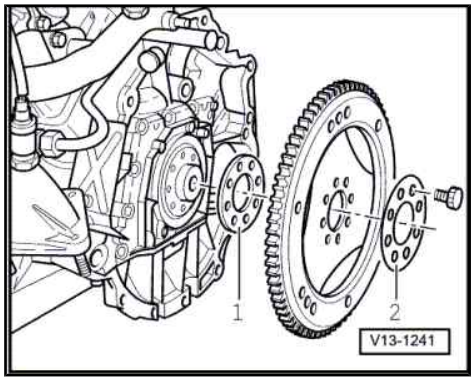
– Repeat measurement procedure.

If specification is obtained:

– Renew bolts and tighten to final setting.

– Remove locking pin - 3242- .

– Screw plug for TDC marking into cylinder block with new O-ring.



Tightening torques

Component	Nm
Drive plate to crankshaft	60 + 180° 1)2)
Sealing plug in cylinder block	10

• 1) Renew bolts.

• 2) 90° = one quarter turn.

2.7 Renewing sealing flange (gearbox end)

Special tools and workshop equipment required

♦ Sealant ⇒ Electronic parts catalogue

♦ Assembly sleeve - T20097-

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Removing

• Engine or gearbox removed.

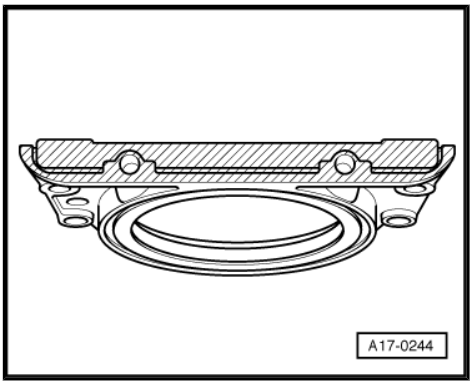
• Tightening torque
⇒ "2.1 Sealing flange and dual-mass flywheel/drive plate - exploded view of components", page 39

– Remove dual-mass flywheel on vehicles with manual gearbox ⇒ page 48 .
– Remove drive plate on vehicles with automatic gearbox ⇒ page 50 .
– Remove bolts and detach sealing flange (gearbox end).

Installing

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

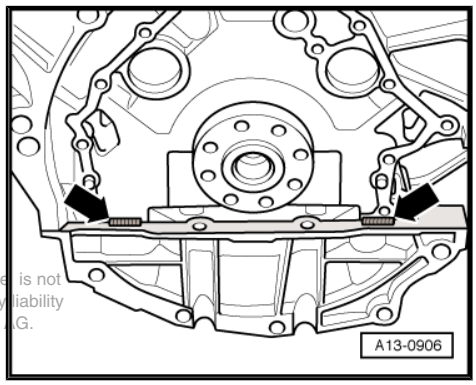
– Clean sealing surface on cylinder block; it must be free of oil and grease.
– Coat the lower sealing surface on the sealing flange lightly with sealant -hatched area-.



Note

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

– Apply a thin bead of sealant at the edge of the joints between the cylinder block and top section of sump -arrows-.
– Fit assembly sleeve - T20097- onto crankshaft journal.
– Push sealing flange carefully onto dowel sleeves on cylinder block.



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

Tightening torque
⇒ "2.1 Sealing flange and dual-mass flywheel/drive plate - exploded view of components", page 39

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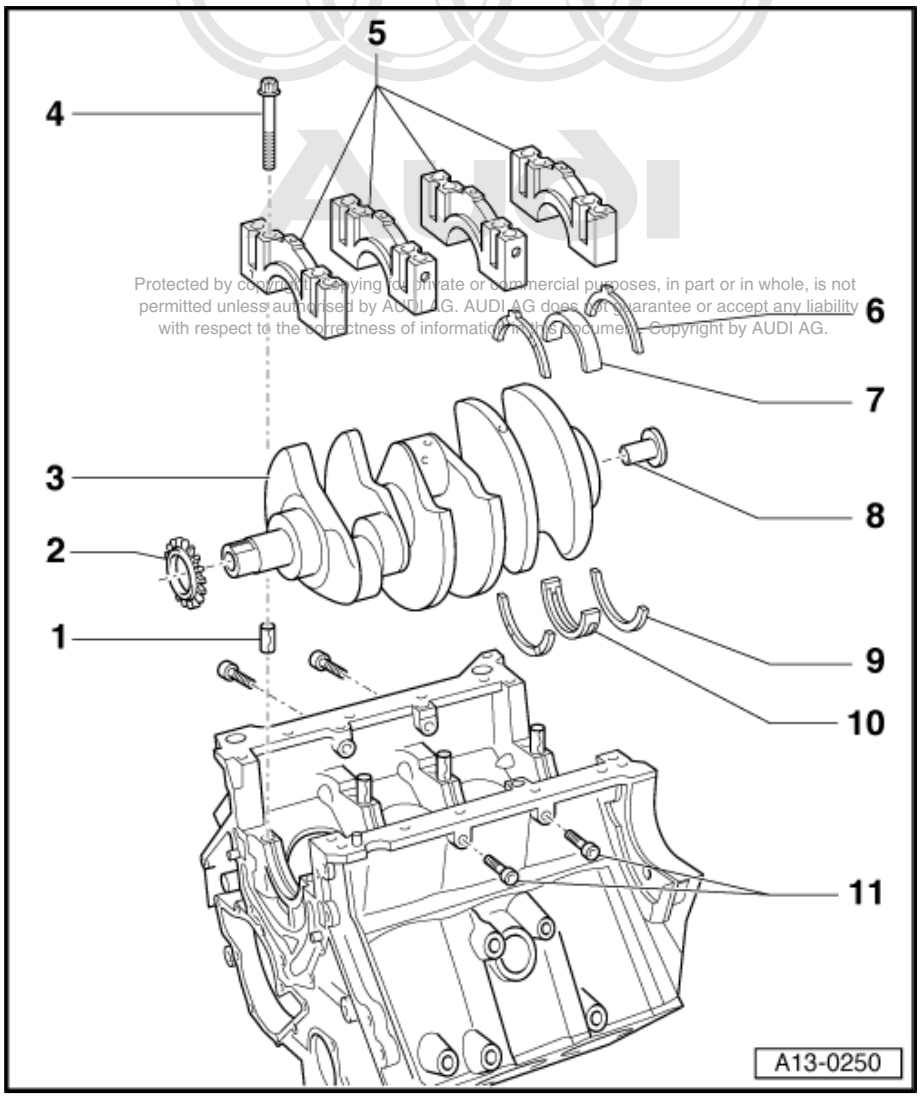
– Install dual-mass flywheel on vehicles with manual gearbox ⇒ page 48 .
– Install drive plate on vehicles with automatic gearbox ⇒ page 50 .

3 Removing and installing crankshaft

3.1 Crankshaft - exploded view

Note

- *The illustration shows the "engine generation III" version as an example for both engine generations.*
- *Secure engine to engine and gearbox support - VAS 6095- prior to performing assembly work ⇒ page 20 .*



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1 - Dowel sleeve
- ❑ Insert in cylinder block

2 - Chain sprocket
- ❑ "Engine generation III" only
- ❑ Removing and installing ⇒ page 58

3 - Crankshaft
- ❑ Measuring axial clearance ⇒ page 57
- ❑ Measuring radial clearance ⇒ page 58
- ❑ Do not rotate the crankshaft when checking the radial clearance
- ❑ Crankshaft dimensions ⇒ page 56

4 - Bearing cap bolts
- ❑ Renew
- ❑ Use old bolts when measuring radial clearance
- ❑ Tightening sequence ⇒ page 56

5 - Bearing caps
- ❑ Note marking ⇒ page 55
- ❑ Installing ⇒ page 56

6 - Thrust washer
- ❑ Only fitted on 4th crankshaft bearing
- ❑ Oil grooves face outwards
- ❑ Note location
- ❑ Measuring axial clearance of crankshaft ⇒ page 57

7 - Bearing shell for bearing cap
- ❑ Without oil groove
- ❑ Do not interchange used bearing shells (mark positions)
- ❑ Install new bearing shells for the bearing caps with the correct coloured markings ⇒ page 56

8 - Bearing bush
- ❑ Automatic gearbox only

- ❑ Driving in ⇒ page 56

9 - Thrust washer

- ❑ Only fitted on 4th crankshaft bearing
- ❑ Oil grooves face outwards
- ❑ Measuring axial clearance of crankshaft ⇒ page 57

10 - Bearing shell for cylinder block

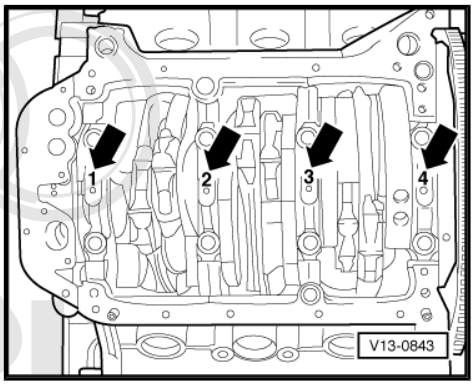
- ❑ With oil groove
- ❑ Do not interchange used bearing shells (mark positions)
- ❑ Install new bearing shells for the cylinder block with the correct coloured markings ⇒ page 55

11 - Bearing cap bolts

- ❑ Tightening sequence ⇒ page 56

Markings on crankshaft bearing caps

- ♦ Bearing -1- is on pulley end.
- ♦ Bearing -4- is on flywheel end



Matching crankshaft bearing shells to bearings in cylinder block

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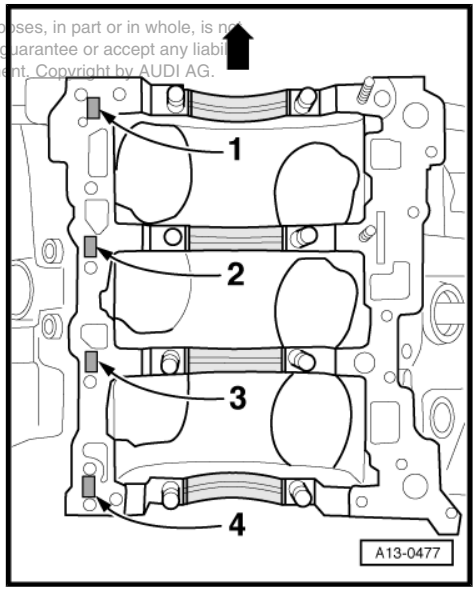
Note

The -arrow- points to pulley end.

- ♦ Bearing shells of the correct thickness are matched to the bearings in the cylinder block at the factory. Coloured dots on the bearing shells are used to identify the bearing shell thickness.
- ♦ The allocation of the bearing shells to the cylinder block is identified by a code letter next to the relevant bearing.

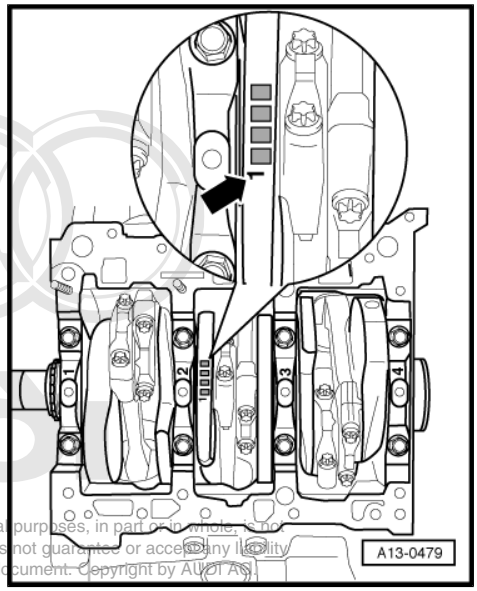
Letter on cylinder block	Colour coding of bearing
G =	Yellow
B =	Blue
S =	Black



Matching crankshaft bearing shells to bearing caps

- Bearing shells of the correct thickness are assigned to the bearing caps at the factory. Coloured dots on the bearing shells are used to identify the bearing shell thickness.
- The correct allocation of bearing shells to crankshaft is indicated by a sequence of letters on the crankshaft web. The number "1" -arrow- preceding the sequence of letters indicates the colour code for No. 1 bearing.

Letter on crankshaft	Colour coding of bearing
G =	Yellow
B =	Blue
S =	Black



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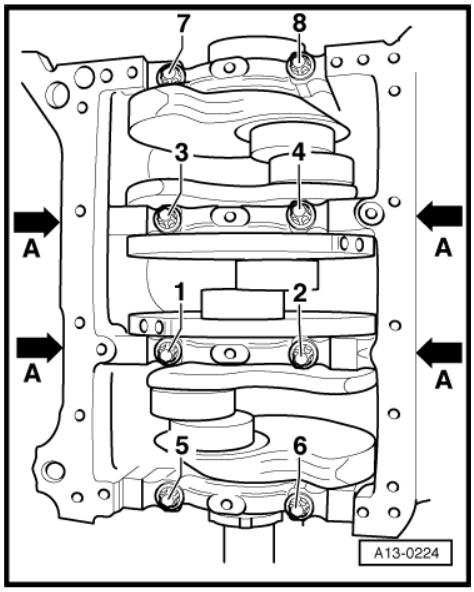
Installing crankshaft bearing caps

– Renew bolts -1 … 8-.
– Insert dowel sleeves in cylinder block.
– Tighten bearing cap bolts in following sequence:

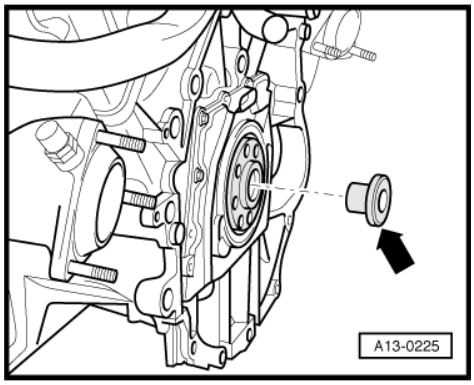
1. Screw in bolts -A- hand-tight.
2. Tighten bolts -1 ... 8- to 60 Nm with torque wrench.
3. Turn bolts -1 ... 8- 90° further ($^1/_4$ turn) using a rigid wrench.
4. Tighten bolts -A- to 25 Nm with torque wrench.



Bearing bush for torque converter

Note

Short engines and reconditioned (exchange) engines, as well as new and reconditioned crankshafts, are supplied without bush -arrow-. The bush must therefore be knocked in before fitting drive plate on vehicles with automatic gearbox. This bush must not be fitted in vehicles with manual gearbox.



3.2 Crankshaft dimensions

2.4 ltr. engines

Honing dimension (in mm)	Crankshaft main bearing journal ∅	Crankshaft conrod journal ∅
Basic dimension	58.00 – 0.022 – 0.042	50.00 – 0.022 – 0.042

Honing dimension (in mm)	Crankshaft main bearing journal ∅	Crankshaft conrod journal ∅
Repair undersize 1	57.75 – 0.022 – 0.042	49.75 – 0.022 – 0.042
Repair undersize 2	57.50 – 0.022 – 0.042	49.50 – 0.022 – 0.042
Repair undersize 3	57.25 – 0.022 – 0.042	49.25 – 0.022 – 0.042

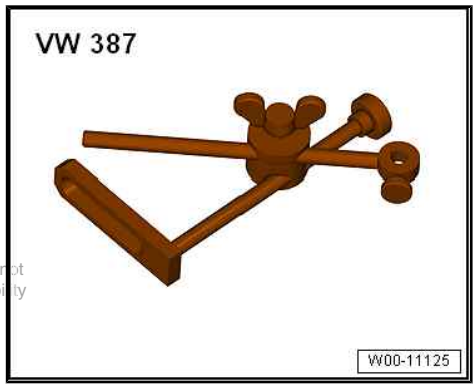
2.8 ltr. engines

Honing dimension (in mm)	Crankshaft main bearing journal ∅	Crankshaft conrod journal ∅
Basic dimension	65.00 – 0.022 – 0.042	54.00 – 0.022 – 0.042
Repair undersize 1	64.75 – 0.022 – 0.042	53.75 – 0.022 – 0.042
Repair undersize 2	64.50 – 0.022 – 0.042	53.50 – 0.022 – 0.042
Repair undersize 3	64.25 – 0.022 – 0.042	53.25 – 0.022 – 0.042

3.3 Measuring axial clearance of crankshaft

Special tools and workshop equipment required

- Universal dial gauge bracket - VW 387-



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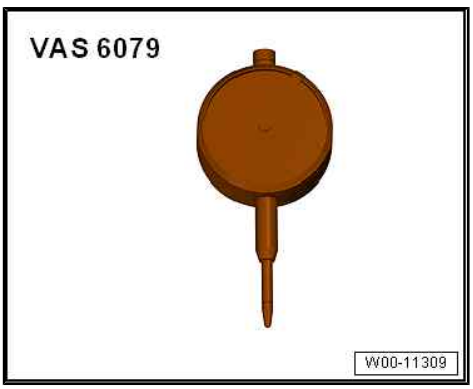
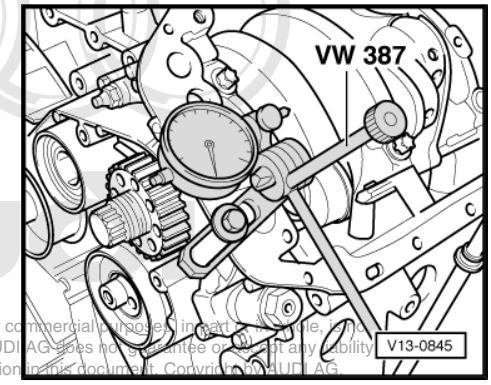
- Dial gauge - VAS 6079-



Procedure



– Bolt dial gauge with universal dial gauge bracket - VW 387- onto cylinder block and apply gauge against crank web.
– Push crankshaft against dial gauge by hand and set gauge to “0”.
– Push crankshaft away from dial gauge and read off value for axial clearance:
• New: 0.07 ... 0.23 mm.
• Wear limit: 0.25 mm.

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3.4 Measuring radial clearance of crankshaft

Special tools and workshop equipment required

♦ Plastigage

Procedure

Note

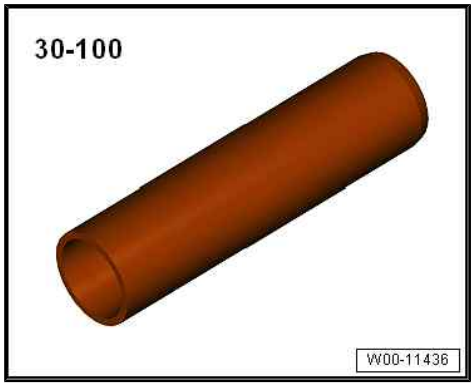
Do not interchange used bearings.

– Remove crankshaft bearing cap and clean bearing cap and journal.
– Place a length of Plastigage corresponding to the width of the bearing on the bearing journal or bearing shell.
• The Plastigage must be positioned in the centre of the bearing shell
– Fit main bearing cap and secure with old bolts ⇒ Item 4 (page 54) without rotating crankshaft.
– Remove crankshaft bearing cap again.
– Compare width of Plastigage with measurement scale:
• Radial clearance (new): 0.018 ... 0.045 mm
• Radial clearance (wear limit): 0.10 mm
• When carrying out final assembly, renew bolts.

3.5 Removing and installing chain sprocket - “engine generation III”

Special tools and workshop equipment required

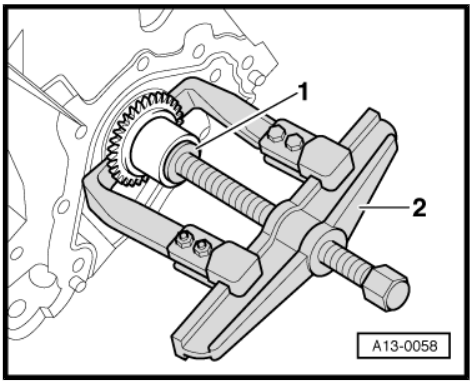
♦ Drift sleeve - 30-100-



Removing

– Remove chain for oil pump ⇒ page 145

– Pull chain sprocket off crankshaft with a puller -2- (normal commercial type); use a suitable washer -1- to protect end of crankshaft.



Installing

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

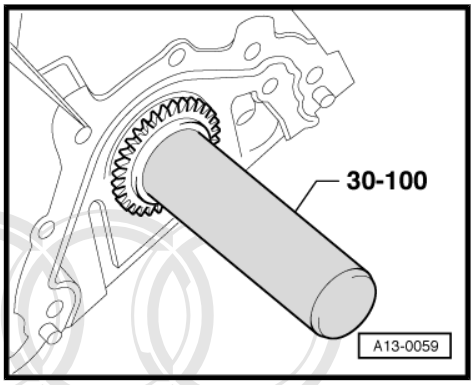
Note

Installation position: lettering on chain sprocket must be visible.

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

WARNING

Wear protective gloves.



– Fit chain sprocket on end of crankshaft using pliers, and press onto crankshaft as far as the stop using drift sleeve - 30-100- .

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4 Dismantling and assembling pistons and conrods

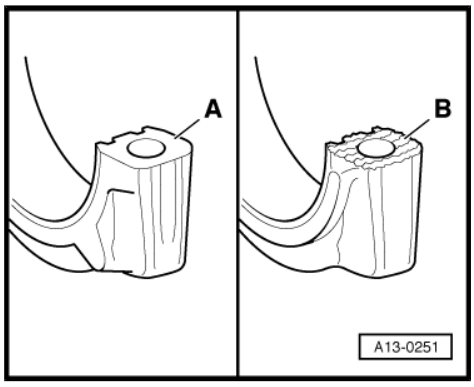
4.1 Different versions of conrods and conrod bolts

The following new features were gradually introduced with “engine generation III”:

- Industrially cracked instead of sawn conrods from approx. 10.1997 onwards
- Distinguishing features of sawn and industrially cracked conrods:

A - Sawn conrods = smooth mating surface

B - Industrially cracked conrods = rough mating surface (produced by industrial cracking process)



- Gradual introduction of M8.5 conrod bolts instead of M8 bolts.

4.2 Exploded view of sawn conrods

Note

Oil spray jet for piston cooling ⇒ *page 65* .

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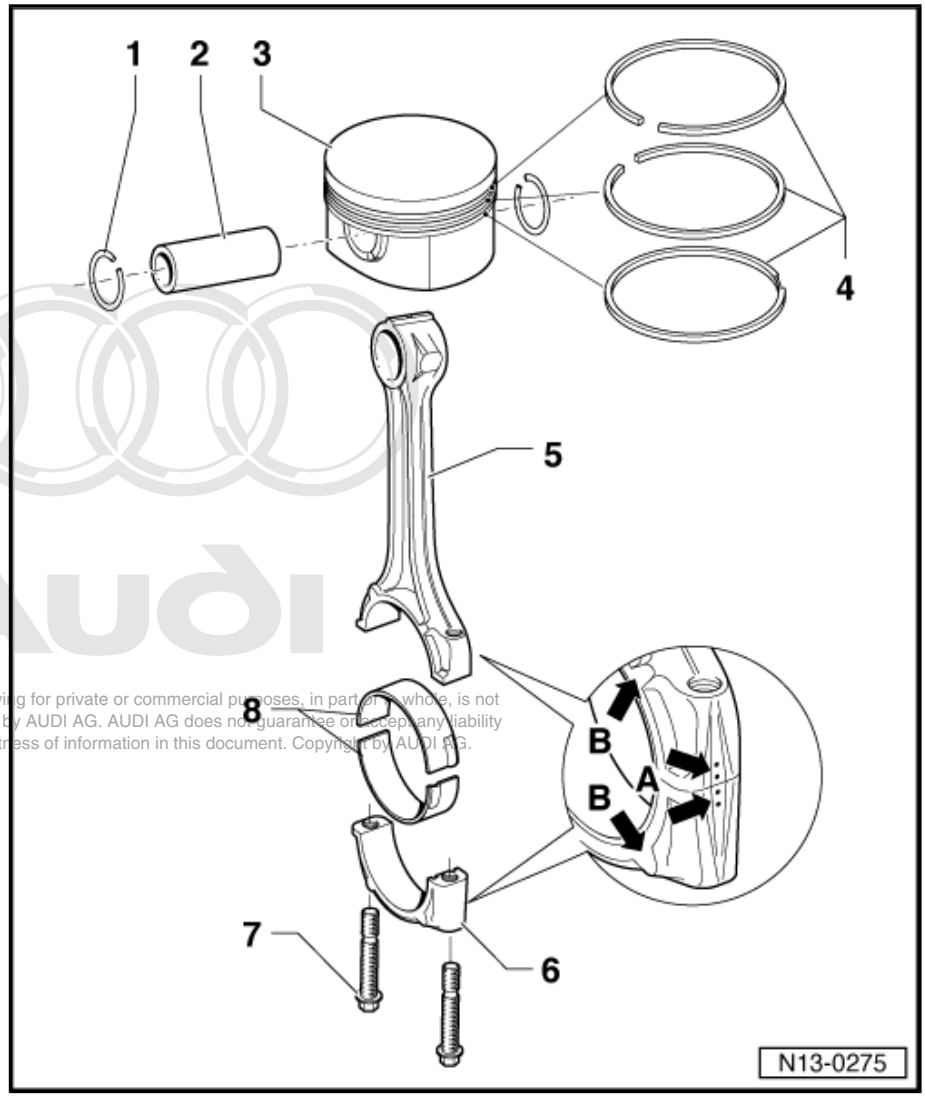

1 - Circlip

2 - Piston pin

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

3 - Piston

- ❑ Mark installation position and cylinder number ⇒ page 64
- ❑ Arrow on piston crown points to pulley end
- ❑ Checking ⇒ page 64
- ❑ Install using piston ring clamp
- ❑ Piston and cylinder dimensions ⇒ page 65
- ❑ Checking cylinder bore ⇒ page 64

4 - Piston rings

- ❑ Offset gaps by 120°
- ❑ Use piston ring pliers to remove and install
- ❑ “TOP” must face towards piston crown
- ❑ Checking ring gap ⇒ page 63
- ❑ Checking ring-to-groove clearance ⇒ page 63

5 - Conrod

- ❑ Only renew as a complete set
- ❑ Mark cylinder allocation -A- ⇒ page 64
- ❑ Installation position: Markings -B- face towards pulley end on cylinders 1 ... 3 and towards flywheel end on cylinders 4 ... 6.

6 - Conrod bearing cap

- ❑ Note installation position

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

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

8 - Bearing shell

- ❑ Note installation position
- ❑ Do not interchange used bearing shells (mark positions)
- ❑ Measuring radial clearance ⇒ page 65
- ❑ To measure radial clearance, tighten bolts ⇒ Item 7 (page 61) to 30 Nm but do not turn further

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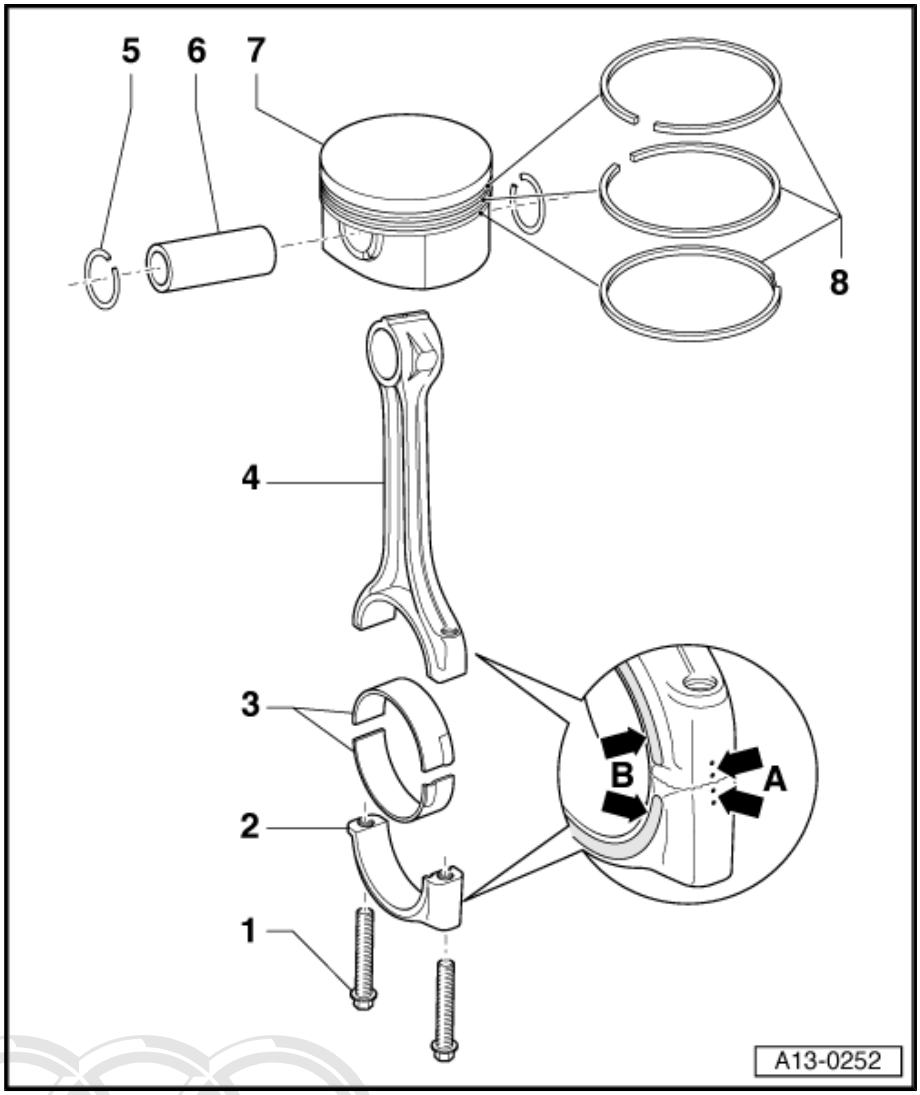
4.3 Exploded view of industrially cracked conrods

Note

Oil spray jet for piston cooling ⇒ page 65 .



1 - Conrod bolt M8 = 30 Nm + further 90° (1/4) turn; conrod bolt M8.5 = 40 Nm + further 90° (1/4) turn

Caution

Both M8 and M8.5 conrod bolts are used with industrially cracked conrods.

The use of M8 bolts in M8.5 threads will cause serious engine damage.

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

2 - Conrod bearing cap

- ❑ Note installation position: split contact surfaces on side of conrod must be in alignment -B-

3 - Bearing shell

- ❑ Note installation position
- ❑ Do not interchange used bearing shells (mark positions)
- ❑ Measuring radial clearance ⇒ page 65
- ❑ To measure radial clearance, tighten bolts ⇒ Item 1 (page 62) to 30 Nm but do not turn further

4 - Conrod

- ❑ Only renew as a complete set
- ❑ Mark cylinder allocation -A- ⇒ page 64
- ❑ Note when fitting bearing cap: split contact surfaces on side of conrod must be in alignment -B-
- ❑ Installation position of conrod pairs ⇒ page 65

5 - Circlip

6 - Piston pin

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

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7 - Piston

- ❑ Mark installation position and cylinder number ⇒ page 64
- ❑ Arrow on piston crown points to pulley end

- ❑ Checking ⇒ page 64
- ❑ Install using piston ring clamp
- ❑ Piston and cylinder dimensions ⇒ page 65
- ❑ Checking cylinder bore ⇒ page 64

8 - Piston rings

- ❑ Offset gaps by 120°
- ❑ Use piston ring pliers to remove and install
- ❑ “TOP” must face towards piston crown
- ❑ Checking ring gap ⇒ page 63
- ❑ Checking ring-to-groove clearance ⇒ page 63

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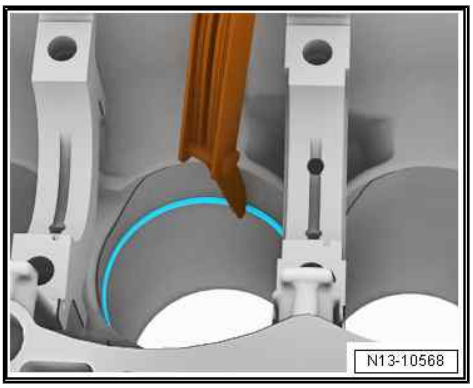
Checking piston ring gap



– Insert ring at right angle to cylinder wall from above and push down into lower cylinder opening approx. 15 mm from bottom of cylinder. Use a piston without rings to push ring into bore.

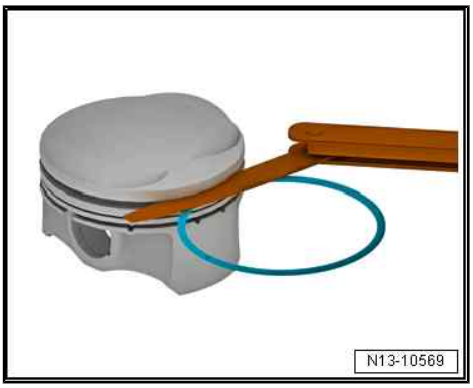
2.4 ltr. engines

Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.20 … 0.40	0.98
2nd compression ring	0.20 … 0.40	0.98
Oil scraper ring	0.25 … 0.50	0.8

2.8 ltr. engines

Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.35 … 0.50	1.0
2nd compression ring	0.50 … 0.70	1.4
Oil scraper ring	0.25 … 0.50	0.8

Checking ring-to-groove clearance



– Clean groove in piston before checking clearance.

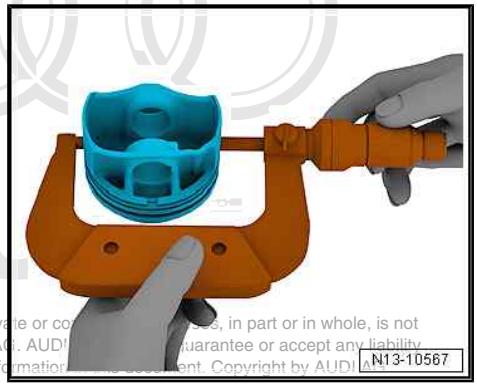
Piston ring Dimensions in mm	New	Wear limit
Compression rings	0.02 … 0.08	0.10
Oil scraper ring	0.02 … 0.08	0.10

Checking piston

– Using a micrometer (75 ... 100 mm), measure approx. 10 mm from the lower edge, perpendicular to the piston pin axis.

• Maximum deviation from nominal dimension: 0.04 mm.

Nominal dimension
⇒ “4.4 Piston and cylinder dimensions”, page 65



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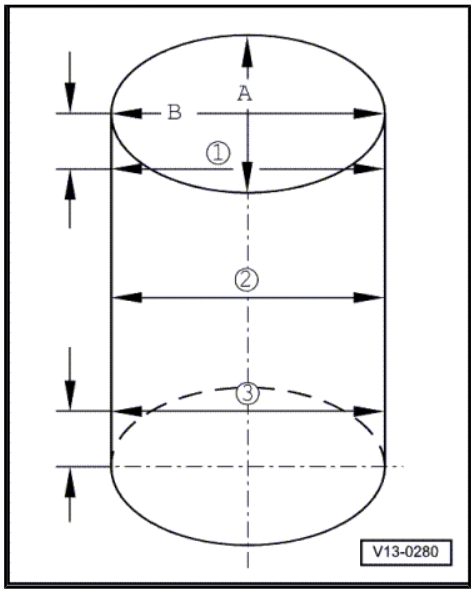
Checking cylinder bore

– Use 50 ... 100 mm internal dial gauge to take measurements at 3 points in transverse direction -A- and longitudinal direction -B-.

• Maximum deviation from nominal dimension: 0.08 mm.

Nominal dimension
⇒ “4.4 Piston and cylinder dimensions”, page 65



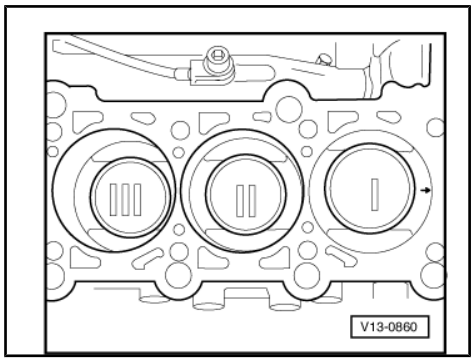
Piston installation position and piston/cylinder allocation

– Use chalk or waterproof felt-tip pen to mark installation position and cylinder allocation on piston crown.

Note

Do not use a centre punch or scriber, as this would damage the coating of the piston crown.

• Installation position: Arrow on piston crown points to pulley end.



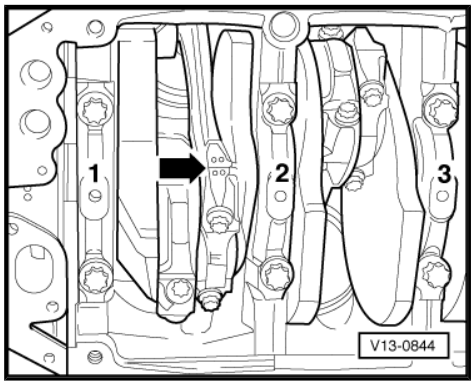
Marking conrods

Note

◆ *Only renew conrods as a complete set.*

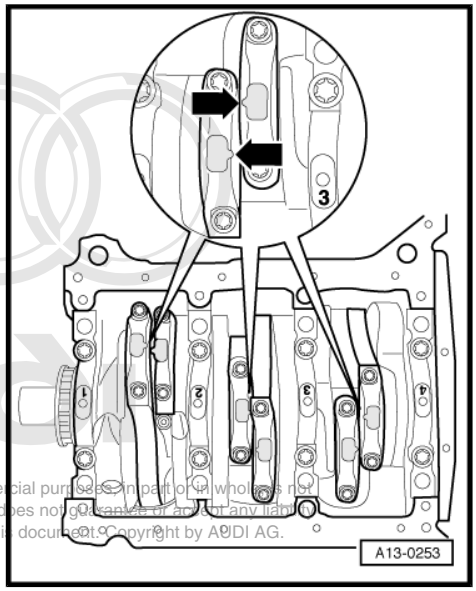
◆ *Do not interchange conrod bearings.*

– Before removing, mark mating positions of conrods and conrod bearing caps with coloured pen -arrow-.



Installation position of conrod pairs with industrially cracked conrods

- The cast lugs -arrows- at ground surfaces of conrod pairs 1 and 2, 3 and 4, and 5 and 6 must face one another.



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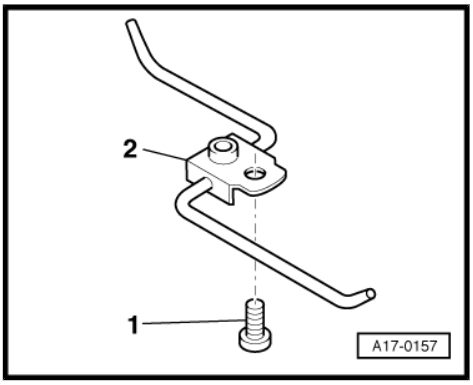
Oil spray jet for piston cooling

1 - Bolt, 10 Nm

2 - Oil spray jet for piston cooling



4.4 Piston and cylinder dimensions

2.4 ltr. engines

Honing dimension (in mm)	Piston Ø mm	Cylinder bore Ø mm
Basic dimension	80.965	81.01

2.8 ltr. engines

Honing dimension (in mm)	Piston Ø mm	Cylinder bore Ø mm
Basic dimension	82.485	82.51

Note

Replacement pistons are only available with basic dimension.

4.5 Checking radial clearance of conrod bearings

Special tools and workshop equipment required

♦ Plastigage

Test sequence

– Remove conrod bearing caps.

– Clean bearing caps and bearing journals.

– Place Plastigage onto bearing journal or into bearing shells corresponding to width of bearing.

• The Plastigage must be positioned in the centre of the bearing shell

– Fit conrod bearing cap and tighten with old bolts ⇒ Item 7 (page 61) or ⇒ Item 1 (page 62) . Do not rotate crankshaft.

– Remove conrod bearing caps once more.

– Compare width of Plastigage with measurement scale.

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Radial clearance:

• New: 0.015 ... 0.062 mm.

• Wear limit: 0.12 mm.

– Renew bolts for conrod bearings.

15 – Cylinder head, valve gear

1 Removing and installing cylinder head

1.1 Different cylinder head versions

The new features of “engine generation III” as opposed to “engine generation II” are as follows:

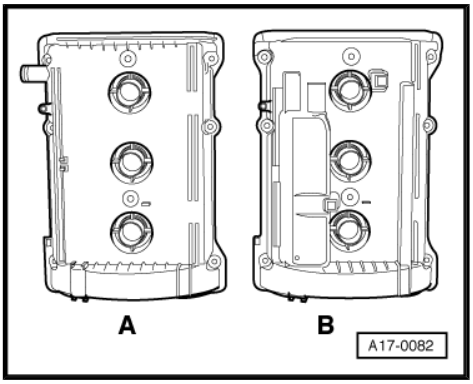
- Modified oil routing in cylinder head; originally with oil supply lines on camshaft bearing caps, subsequently replaced by integrated oil passages in camshaft bearing caps

Distinguishing feature

An external distinguishing feature of the “engine generations II” and “III” is the shape of the cylinder head cover:

A - “Engine generation II” (to approx. 04.1997)

B - “Engine generation III” (from approx. 04.1997 onwards)



Note

- *“Engine generation II” cylinder heads may only be fitted on an “engine generation II” cylinder block. A combination of the two versions is not permitted.*
- *“Engine generation III” cylinder heads may only be fitted on an “engine generation III” cylinder block. A combination of the two versions is not permitted.*
- *“Engine generation III” cylinder heads can be combined regardless of the type of oil routing (with or without oil line).*

1.2 Cylinder head - exploded view

Note

The illustration shows the left cylinder head for “engine generation III” with oil lines.

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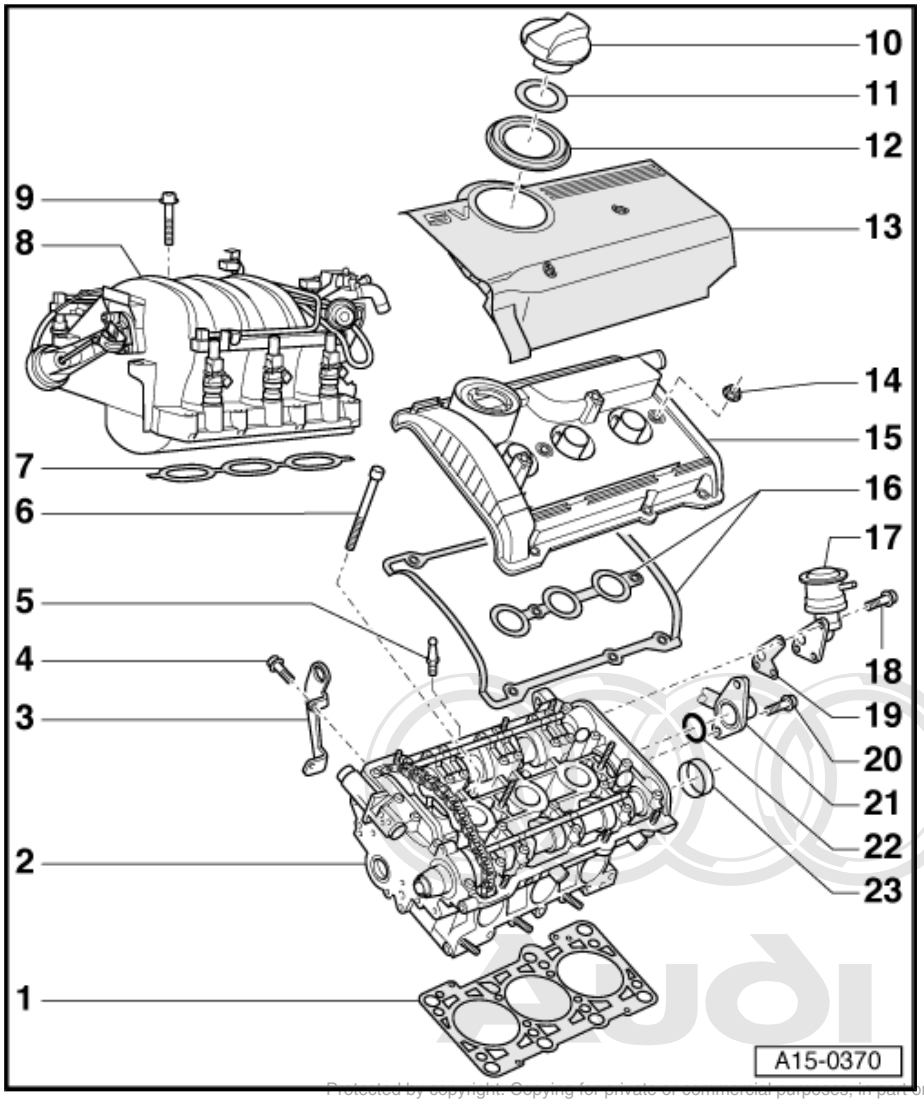

1 - Cylinder head gasket

- ❑ Renewing ⇒ “1.5 Removing cylinder head (left-side)”, page 74 and ⇒ “1.6 Removing cylinder head (right-side)”, page 77
- ❑ Installation position: Part No. towards cylinder head
- ❑ If renewed, refill system with fresh coolant

2 - Cylinder head

- ❑ Removing: left-side ⇒ page 74 ; right-side ⇒ page 77
- ❑ Checking for distortion ⇒ page 69
- ❑ Machining limit ⇒ page 69
- ❑ Driving sealing cap into cylinder head ⇒ page 70
- ❑ Installing ⇒ page 80
- ❑ If renewed, refill system with fresh coolant

3 - Lifting eye

4 - 25 Nm

5 - Centring pin for intake manifold

6 - Cylinder head bolt

- ❑ Renew
- ❑ Different bolts ⇒ page 69
- ❑ Note correct sequence when loosening ⇒ page 76 and ⇒ page 79
- ❑ Note correct sequence when tightening ⇒ page 82

7 - Intake manifold gasket

- ❑ Renew

8 - Intake manifold

- ❑ Removing and installing ⇒ page 83

9 - 10 Nm

- ❑ Tighten in stages and in diagonal sequence

10 - Filler cap

11 - Seal

- ❑ Renew if damaged or leaking

12 - Rubber grommet

13 - Cover panel for cylinder head cover

14 - 10 Nm

- ❑ Note correct sequence when tightening ⇒ page 71 or ⇒ page 73

15 - Cylinder head cover

- ❑ Removing and installing: left-side ⇒ page 70 , right-side ⇒ page 72

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16 - Gaskets for cylinder head cover

- ❑ Renew if damaged or leaking
- ❑ Apply sealant at sealing points before installing ⇒ page 70 ; Sealant ⇒ Parts catalogue

17 - Combination valve for secondary air system

18 - 10 Nm

19 - Gasket

- ❑ Renew

20 - 10 Nm

21 - Coolant pipe (rear)

22 - O-ring

- ❑ Renew

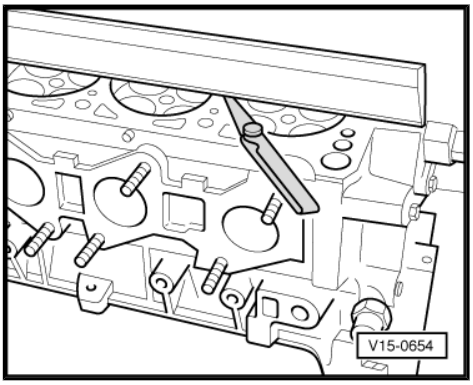
23 - Sealing cap

- ❑ Removing and installing ⇒ page 95

Checking cylinder head for distortion

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

• Maximum permissible distortion: 0.1 mm.



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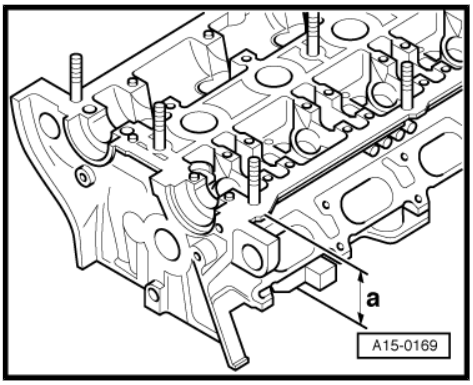
Cylinder head machining limit

– Machining of the cylinder head (surface grinding) is only permissible down to the minimum dimension -a-.

• Minimum dimension: -a- = 139.25 mm

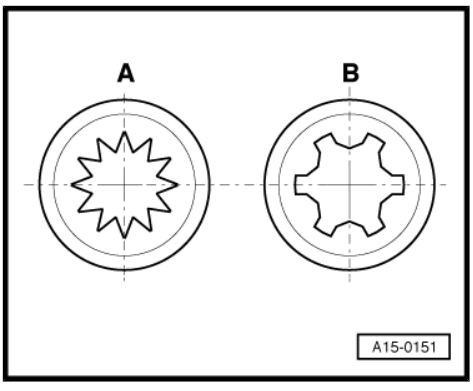


Different cylinder head bolts

The cylinder head bolts have been gradually converted from a multi-point socket to Polydrive. It is necessary to establish the type of bolt heads installed before slackening off or tightening the cylinder head bolts:

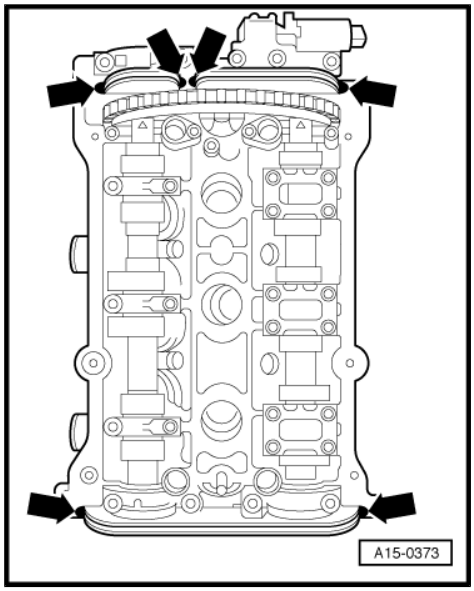
A - Multi-point socket head (use socket - 3410-)

B - Polydrive head (use special wrench, long reach - T10070-)



Sealing points for bearing caps on cylinder head

– Apply small quantity of sealant to transitions -arrows- at top sealing surface of cylinder head; sealant ⇒ Parts catalogue .

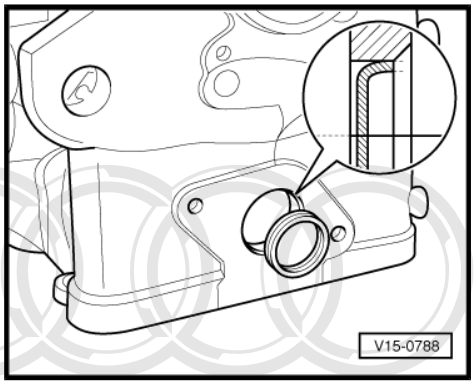


Driving sealing cap into cylinder head

Replacement cylinder heads without camshafts can be used on both the left and right-side and must be fitted with a sealing cap on the appropriate front side.

– Coat rim of sealing cap with sealant; sealant ⇒ Parts catalogue .

– Drive in sealing cap with drift - VW 295- until outer rim of sealing cap is flush with end of chamfer in cylinder head.



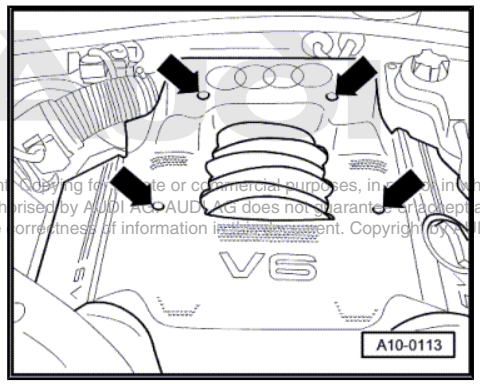
1.3 Removing and installing cylinder head cover (left-side)

Removing

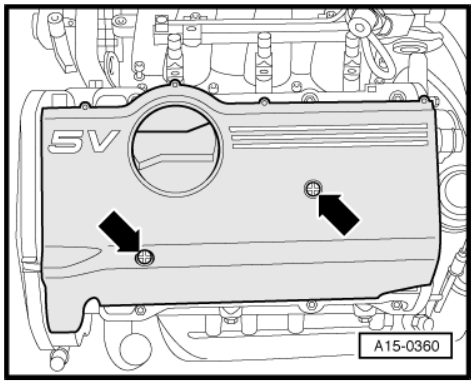
Note

All cable ties which are released or cut open when removing must be fitted in the same position when installing.

– Remove engine cover panel -arrows-.



– Remove cover panel for cylinder head cover (left-side) -arrows-.



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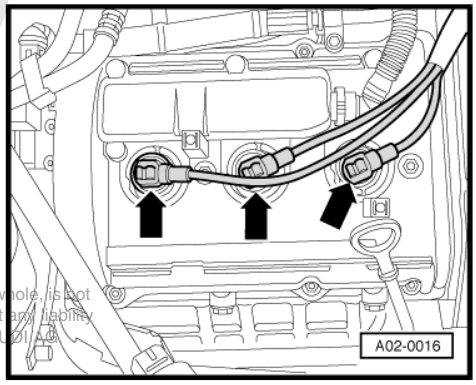
– Disconnect spark plug connectors -arrows-.
– Remove crankcase breather hose from cylinder head cover.
– Unfasten cable tie and move wire clear.



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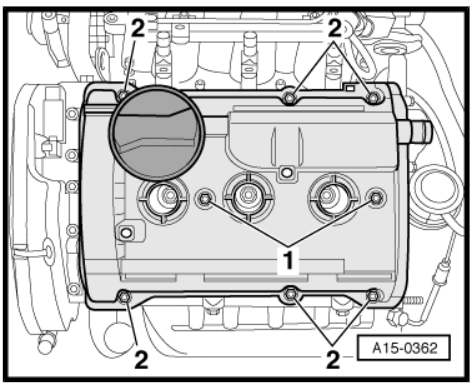
– Unscrew nuts -1- and -2- and remove cylinder head cover.



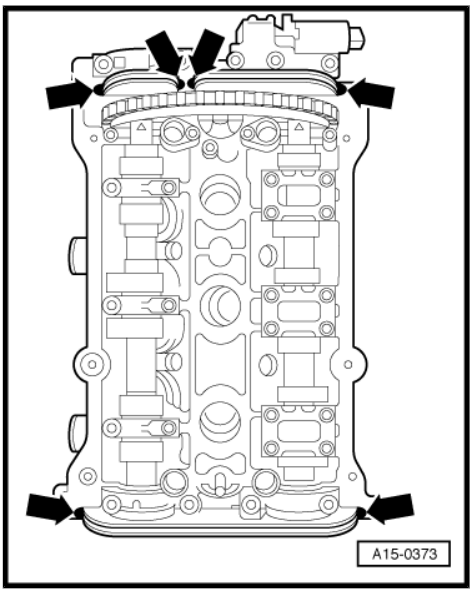
Installing

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

Note

- *Renew cylinder head cover gaskets if damaged.*
- *Fit all cable ties in the original positions when installing.*

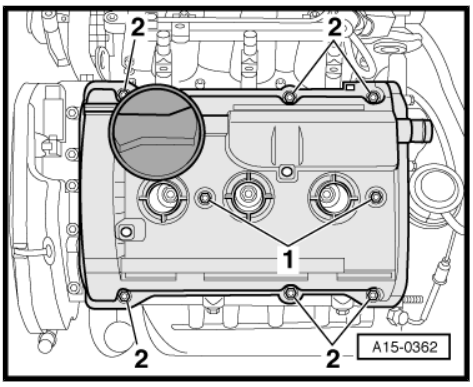
– Apply small quantity of sealant to transitions -arrows- at top sealing surface of cylinder head; sealant ⇒ Parts catalogue .



– Tighten inner nuts -1- for cylinder head cover.
– Then tighten outer nuts -2- in stages and in diagonal sequence.

Tightening torque

Component	Nm
Cylinder head cover to cylinder head	10

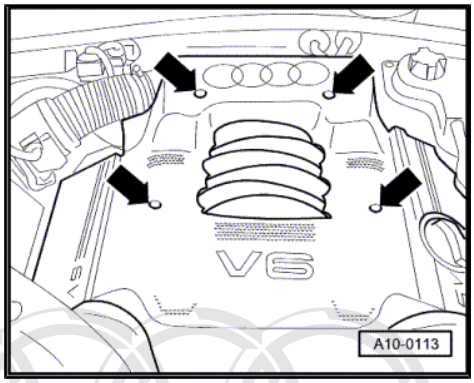


1.4 Removing and installing cylinder head cover (right-side)

Removing

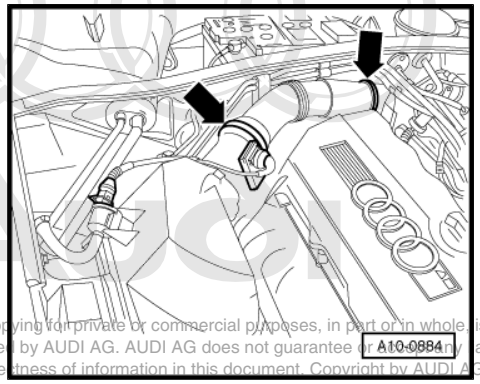
Note

All cable ties which are released or cut open when removing must be fitted in the same position when installing.



– Remove engine cover panel -arrows-.

– Remove air intake hose between air mass meter - G70- and intake manifold -arrows-.



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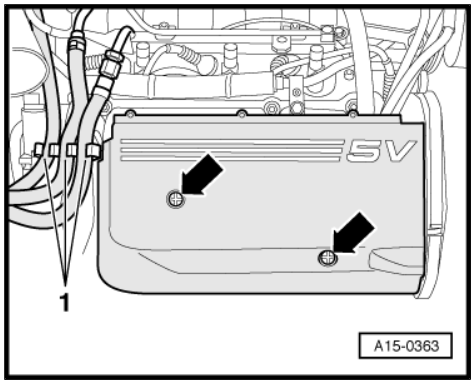
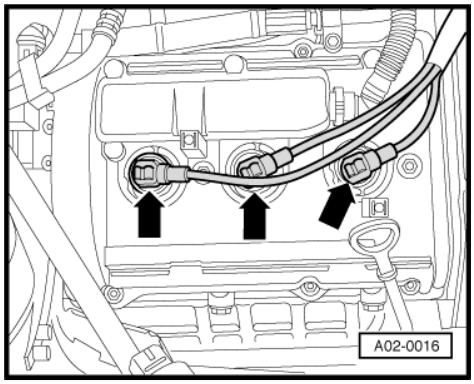
– Disengage 3 hoses -1- from bracket on cylinder head cover.

– Remove cover panel for cylinder head cover (right-side) -arrows-.

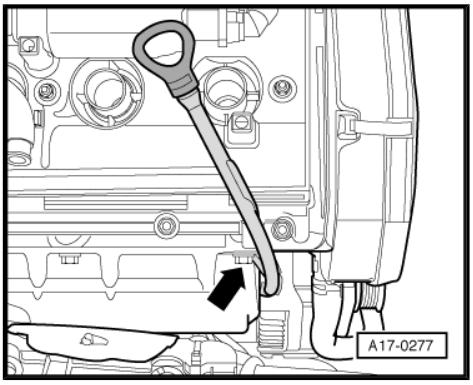
– Unbolt bracket for power steering at cylinder head cover.



– Disconnect spark plug connectors -arrows-.



– Detach guide tube for dipstick at cylinder head -arrow-.

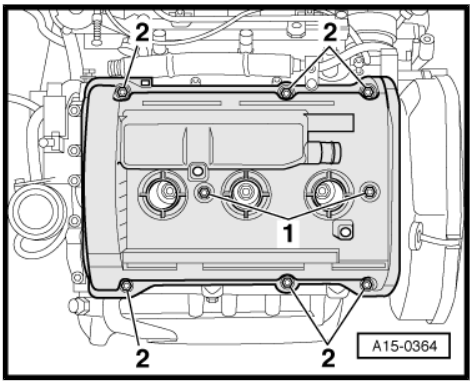


Note

The guide tube for the engine oil dipstick must not be lifted out completely, as otherwise the O-ring at the base of the guide tube will have to be renewed.

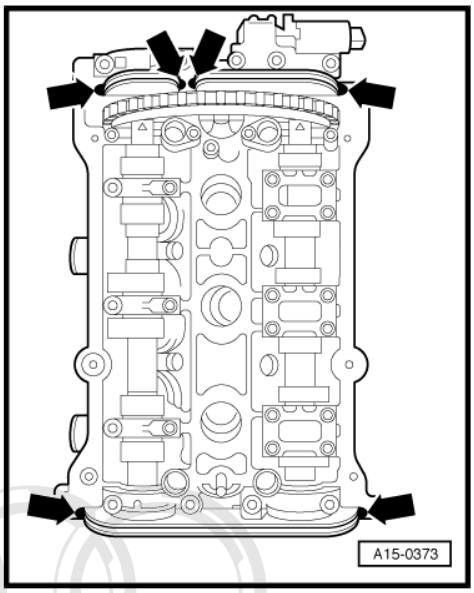
– Remove crankcase breather hose from cylinder head cover.
– Unfasten cable tie and move wire clear.

– Unscrew nuts -1- and -2- and remove cylinder head cover.



Installing

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

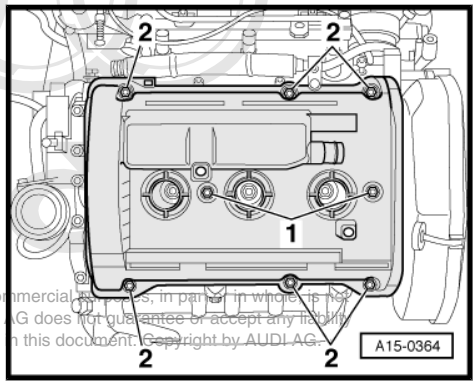


Note

- *Renew gasket for cylinder head cover if damaged.*
- *Fit all cable ties in the original positions when installing.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue .*

– Apply small quantity of sealant to transitions -arrows- at top sealing surface of cylinder head; sealant ⇒ Parts catalogue .

– Tighten inner nuts -1- for cylinder head cover.
– Then tighten outer nuts -2- in stages and in diagonal sequence.



Tightening torques

Component	Nm
Cylinder head cover to cylinder head	10
Guide tube for dipstick to cylinder head	22
Bracket for power steering pipe to cylinder head	10

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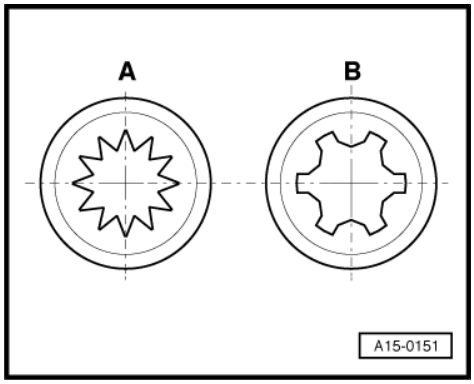
1.5 Removing cylinder head (left-side)

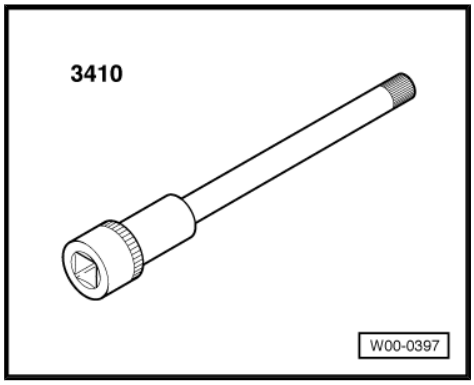


Note

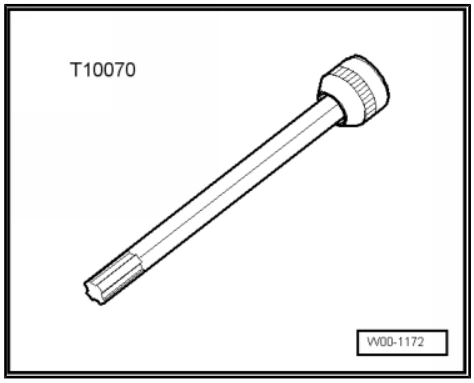
- *The cylinder head bolts have been gradually converted from a multi-point socket to Polydrive. It is necessary to establish the type of bolt heads installed before slackening off or tightening the cylinder head bolts:*
- *A - Multi-point socket head (use socket - 3410-).*
- *B - Polydrive head (use special wrench, long reach - T10070-)*

Special tools and workshop equipment required

- Socket - 3410-



- Special wrench, long reach - T10070-



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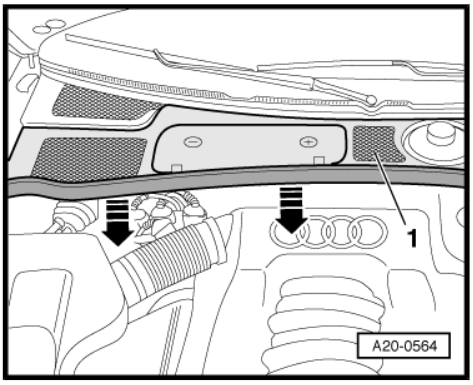
Procedure

- Engine in vehicle.



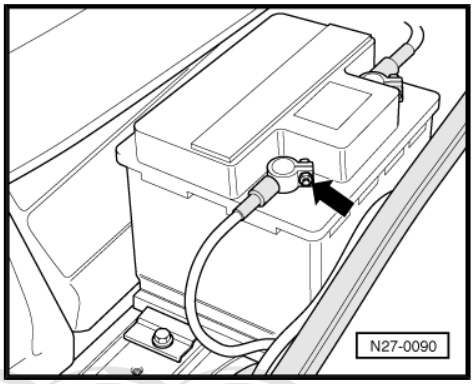
Note

All cable ties which are released or cut open when removing must be fitted in the same position when installing.

Caution

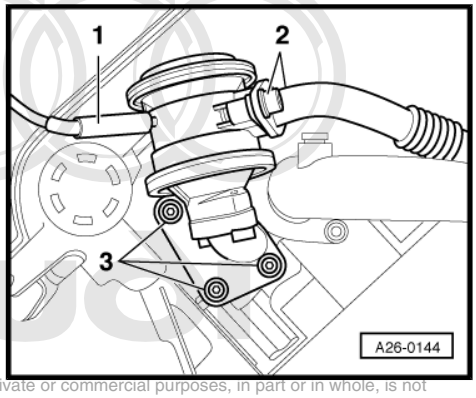
Observe notes on procedure for disconnecting the battery ⇒ Rep. gr. 27 .

– Detach rubber seal from plenum chamber cover in direction of -arrow-.
– Detach plenum chamber cover -1- towards the front.



– With ignition switched off, disconnect battery earth cable -arrow-.
– Remove front bumper ⇒ Rep. gr. 63 .
– Move lock carrier to service position ⇒ Rep. gr. 50 .
– Drain off coolant ⇒ page 152 .
– Remove front exhaust pipe (left-side).

Vehicles with secondary air system:



– Remove bolts -3- on combination valve for secondary air system.

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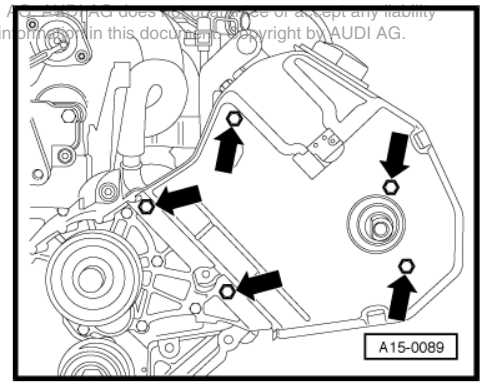
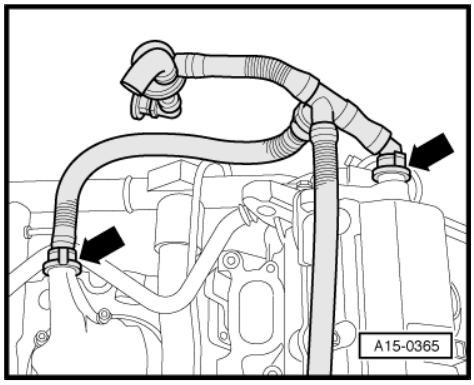
All vehicles:



– Remove toothed belt ⇒ page 34 .
– Take off camshaft sprocket.
– Unscrew toothed belt cover (rear left) -arrows-.

– Remove intake manifold ⇒ page 83 .
– Remove crankcase breather hose -arrows-.
– Detach electrical connectors from Hall sender and from camshaft control valve.



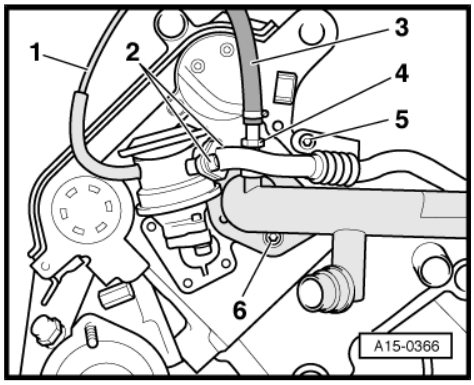
– Detach coolant hose -3-.

Vehicles with secondary air system:

– Detach vacuum hose -1- at combination valve.
– Unscrew hose connection -4-.
– Unscrew bolts -2- and remove combination valve.
– Remove bolt -5-.

All vehicles:

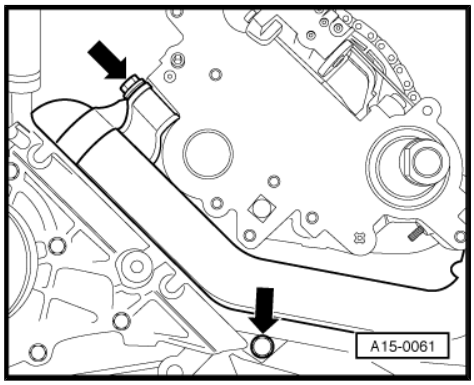
– Detach rear coolant pipe from cylinder head (2 bolts -6-).



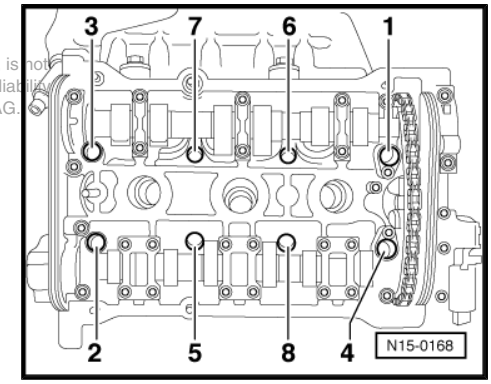
Note

The coolant pipe remains installed.

– Unbolt front coolant pipe from cylinder head -arrows-.



– Remove cylinder head cover (left-side) ⇒ page 70 .
– Loosen cylinder head bolts in the sequence: -1 ... 8-.
– Remove cylinder head bolts and carefully detach cylinder head.



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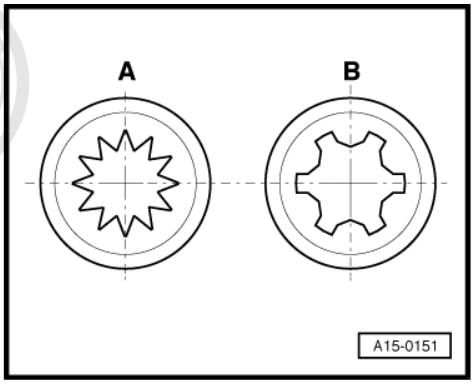
1.6 Removing cylinder head (right-side)



Note

- *The cylinder head bolts have been gradually converted from a multi-point socket to Polydrive. It is necessary to establish the type of bolt heads installed before slackening off or tightening the cylinder head bolts:*
- *A - Multi-point socket head (use socket - 3410-).*
- *B - Polydrive head (use special wrench, long reach - T10070-)*

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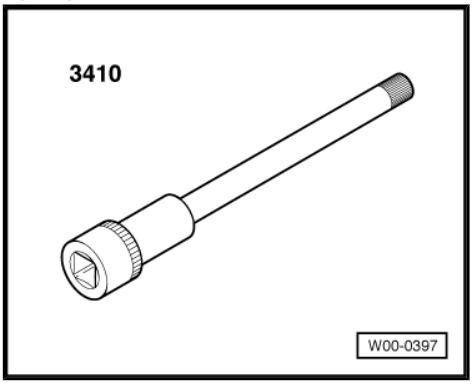
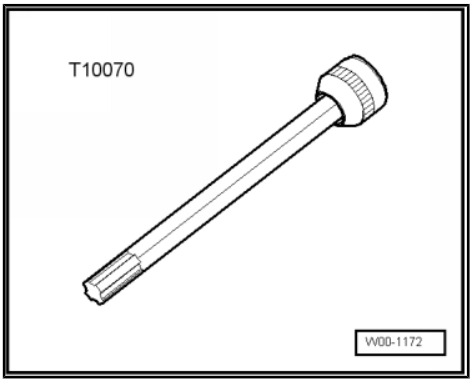
Special tools and workshop equipment required

- Socket - 3410-

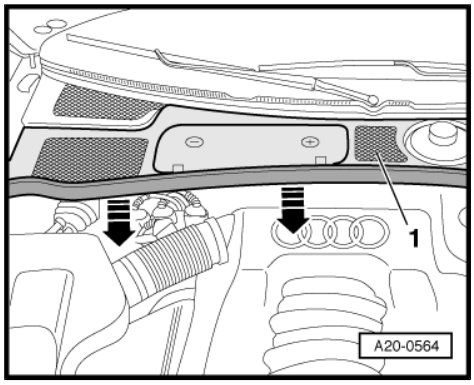


- Special wrench, long reach - T10070-



Procedure

- Engine in vehicle.



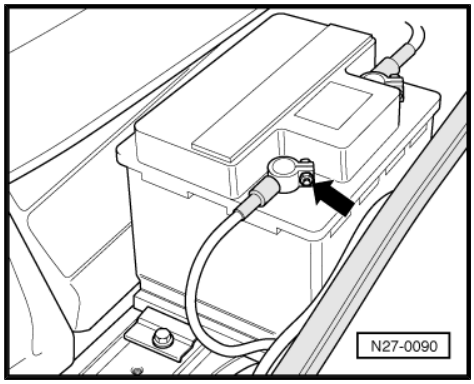
Note

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 .

– Detach rubber seal from plenum chamber cover in direction of -arrow-.
– Detach plenum chamber cover -1- towards the front.



– With ignition switched off, disconnect battery earth cable -arrow-.
– Remove front bumper ⇒ Rep. gr. 63 .
– Move lock carrier to service position ⇒ Rep. gr. 50 .
– Drain off coolant ⇒ page 152 .
– Remove front exhaust pipe (right-side).

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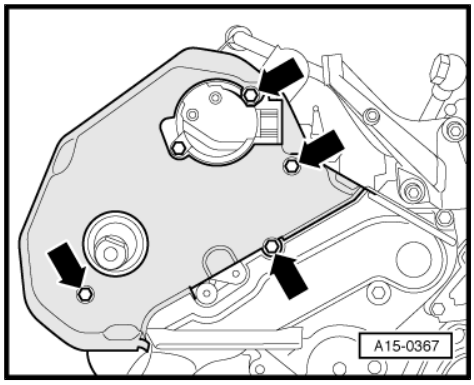
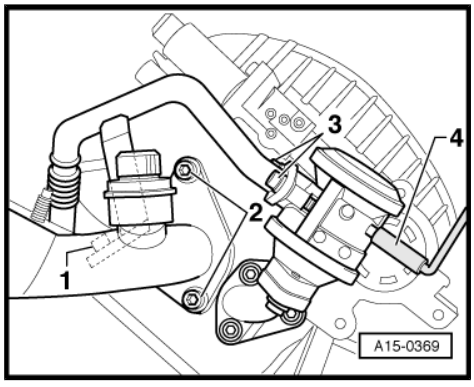


– Remove toothed belt ⇒ page 34 .
– Take off camshaft sprocket.
– Unscrew toothed belt cover (rear right) -arrows-.
– Remove intake manifold ⇒ page 83 .

Vehicles with secondary air system:



– Detach vacuum hose -4- at combination valve.
– Remove bolts -3-.
– Unscrew bolt -1- for connecting pipe bracket.

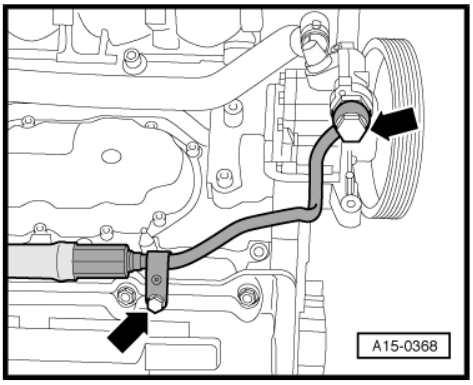
All vehicles:

– Unscrew bolts -2- on coolant pipe.

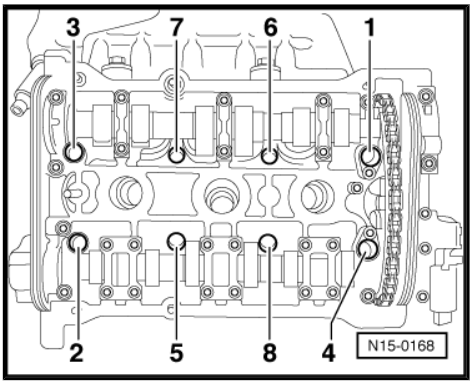
Note

The coolant pipe remains installed.

– Detach electrical connectors from Hall sender and from camshaft control valve.
– Detach pressure pipe for power steering at power steering pump and at cylinder head cover -arrows-.



– Remove cylinder head cover (right-side) ⇒ page 72 .
– Loosen cylinder head bolts in the sequence: -1 ... 8-.
– Remove cylinder head bolts and carefully detach cylinder head.



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1.7 Installing cylinder head

Note

- *Renew the cylinder head bolts.*
- *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.*
- *No oil or coolant must be allowed to remain in the blind holes for the cylinder head bolts in the cylinder block.*
- *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.*
- *Position cylinder head gasket on dowel sleeves. The word "oben" (top) or the Part No. should face towards cylinder head.*
- *Cylinder heads which have cracks between the valve seats or between a valve seat insert and the spark plug thread can be re-installed without reducing service life, provided the cracks are only slight and do not exceed a maximum of 0.3 mm in width, and no more than the first 4 turns of the spark plug threads are cracked.*
- *When installing an exchange cylinder head with the camshafts fitted, the contact surfaces between bucket tappet and cam running surface must be oiled after installation of 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.*
- *When installing a replacement cylinder head supplied without fitted camshafts, a sealing cap (core plug) must be driven into the front of the respective cylinder head* *⇒ page 70* *.*
- *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.*
- *After working on the valve gear, turn the engine carefully at least 2 rotations by hand to ensure that none of the valves make contact when the starter is operated.*
- *When fitting a new cylinder head or cylinder head gasket, drain off all the old coolant and refill with new coolant.*

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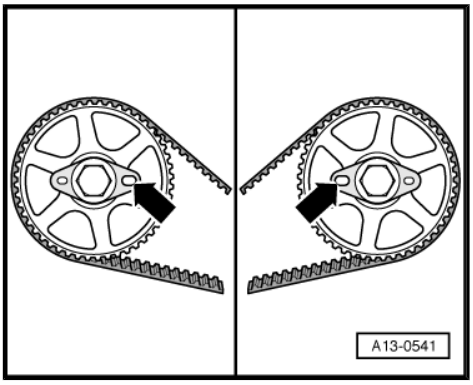
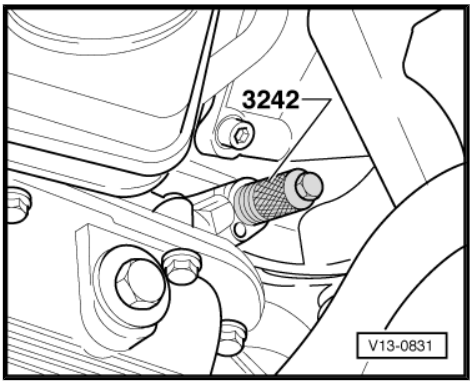
Installation is carried out in the reverse order; note the following:

– Before installing cylinder head, set crankshaft and camshafts to TDC:

• Large holes -arrows- in locating plates at camshaft sprockets must be opposite one another on inside.



• The locking pin - 3242- must be screwed in.



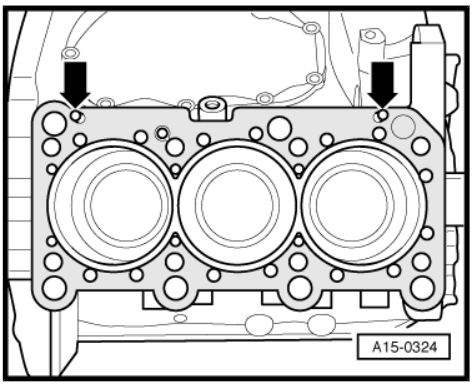
– Fit cylinder head gasket.

• Note position of centring pins -arrows- 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.

– Insert new cylinder head bolts and tighten hand-tight.



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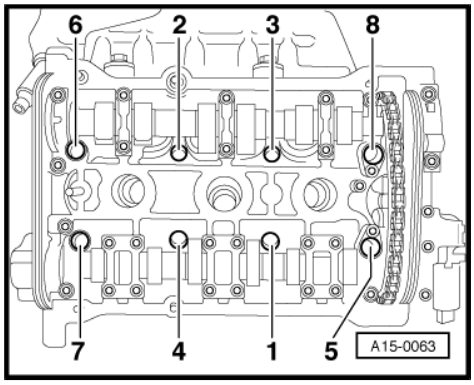
– Tighten cylinder head bolts in 3 stages in the sequence indicated:

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



Note

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

– Fit centring pin for intake manifold.
– Install intake manifold ⇒ page 86 .
– Connect vacuum hoses ⇒ page 25 .
– Install cylinder head cover: left-side ⇒ page 70 , right-side ⇒ page 72 .
– Install toothed belt (adjust valve timing) ⇒ page 37 .
– Install poly V-belt ⇒ page 31 .
– Fill cooling system with fresh coolant ⇒ page 152 .
– Observe notes on procedures required after connecting battery ⇒ Rep. gr. 27 .
– Top up power steering fluid and bleed steering system ⇒ Rep. gr. 48 .
– Install lock carrier ⇒ Rep. gr. 50 .

Tightening torques

Component		Nm
Coolant pipe (rear) to cylinder head		10
Combination valve to cylinder head		10
Connecting pipe to combination valve		10
Connecting pipe to cylinder head	M6	10
	M8	22
Hose connection to coolant pipe (rear)		15
Front coolant pipe to cylinder head	M6	10
	M8	22
Power steering pressure pipe to power steering pump		40
Pressure pipe for power-assisted steering to cylinder head		10
Guide tube for dipstick to cylinder head		22
Rear toothed belt cover to cylinder head		10 1)

• 1) Install bolts using locking fluid, locking fluid ⇒ Parts catalogue .

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1.8 Removing and installing intake manifold

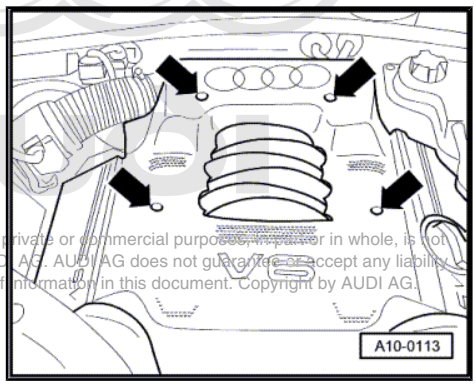
Removing

Note

All cable ties which are released or cut open when removing must be fitted in the same position when installing.

– Drain off coolant from engine ⇒ page 152 .

– Remove engine cover panel -arrows-.



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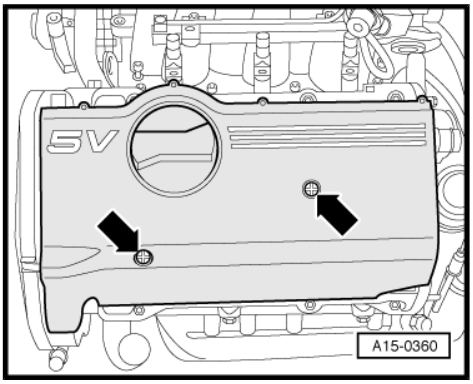
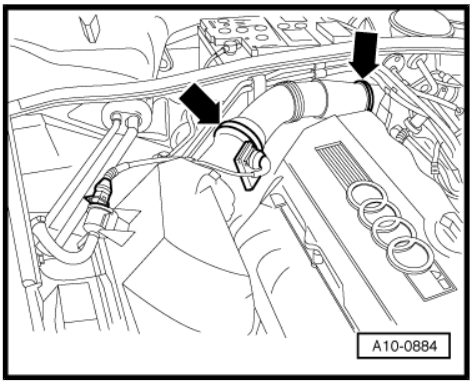
– Remove caps (left and right) -arrows-.



– Remove air intake hose between air mass meter - G70- and intake manifold -arrows-.

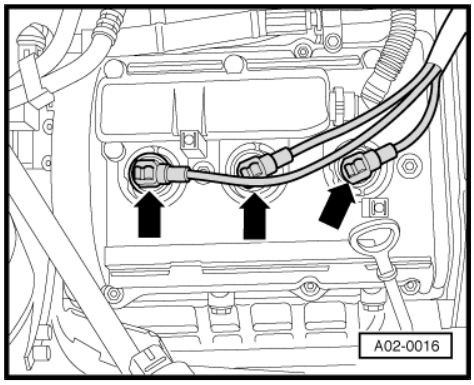


WARNING

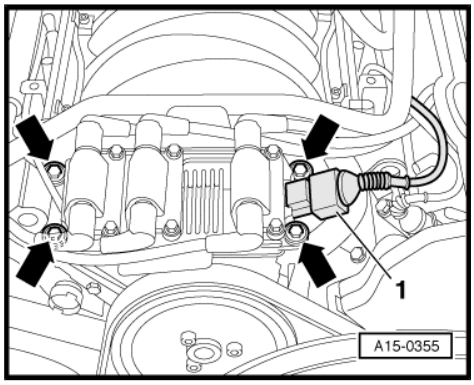
The fuel system is pressurised. Before opening the system place a clean cloth around the connection. Then release pressure by carefully loosening the connection.

– Disconnect fuel supply line and fuel return line.

– Disconnect all six spark plug connectors -arrows-.

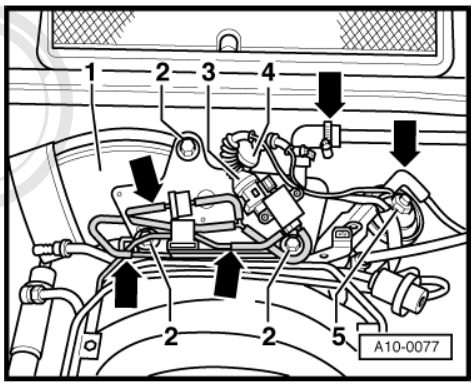


– Unscrew ignition coils -arrows- and remove with ignition cables.
– Remove crankcase breather hose from cylinder head cover (right-side).



Vehicles without secondary air system:

– Carefully detach vacuum pipes -arrows-.
– Unplug electrical connectors at variable intake manifold change-over valve - N156- -item 3- and intake air temperature sender - G42- -item 4-.
– Unscrew bolts -2- of retaining plate for variable intake manifold change-over valve.
– Detach retaining plate and disconnect hose from intake connecting pipe.
– Unscrew bolt of air intake connection -1- and detach intake connecting pipe.
– Unscrew nuts -5- and move vacuum unit downwards.



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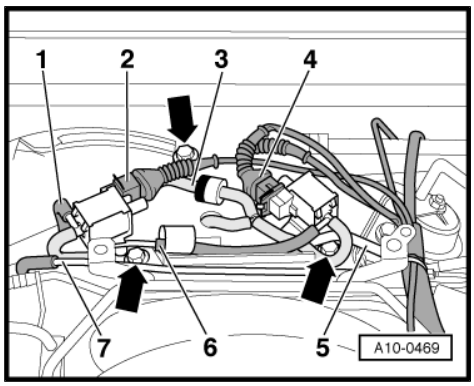
Vehicles with secondary air system:

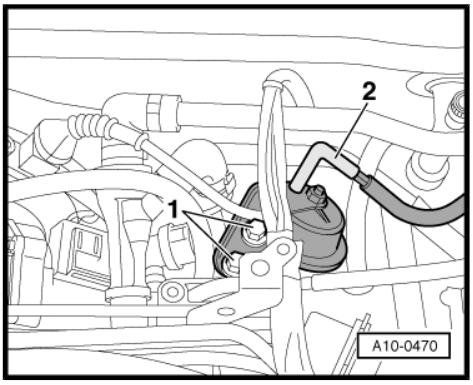
– Unplug electrical connectors -2- and -4-.
– Carefully disconnect vacuum hoses -1-, -3-, -5-, -6- and -7-.
– Unbolt the retaining plate for solenoid valves -arrows-.



Vehicles with throttle cable and cruise control system:

– Detach vacuum hose -2- at vacuum unit for cruise control.

– Unscrew bolts -1- and move vacuum unit downwards.

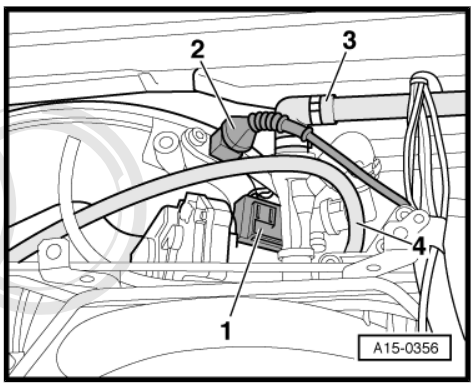


All vehicles:

– Unplug electrical connectors -1- and -2-.

– Disconnect hose connection -3- leading to brake servo.

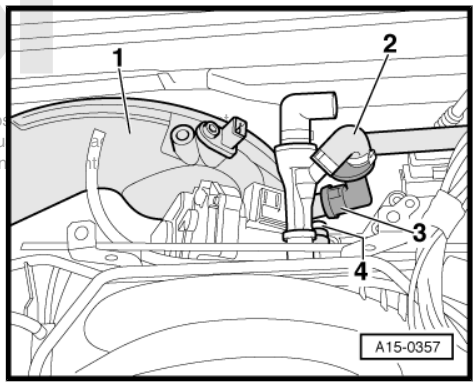
– Detach vacuum hose -4- at solenoid valve 1 for activated charcoal filter system - N80- .



– Detach hose -2-.

– Unscrew bolt -4- and detach air duct -1- with seal from throttle valve module.

– Detach hose -3- and take out air duct.



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Vehicles with throttle cable:

– Disengage cruise control operating rod at throttle valve module.

– Disengage throttle cable at throttle valve housing and support bracket (do not remove retainer). Move throttle cable clear to the side.

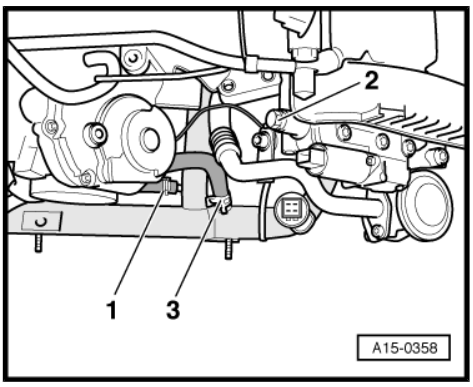
All vehicles:

– Unscrew earth wire -2- at rear of cylinder head (right-side).

– Disconnect coolant hoses -1- and -3- from throttle valve module and from coolant pipe (rear).

– Unplug electrical connectors at all injectors.

– Move wiring harness and crankcase breather pipe clear of intake manifold.

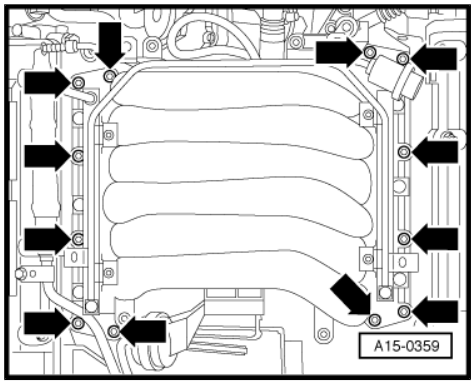


Vehicles with secondary air system:

– Disconnect vacuum hose at secondary air combination valve.

All vehicles:

– Unscrew and remove intake manifold -arrows-.



Note

Seal intake ports on cylinder heads with clean cloths.

Installing

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

Note

- *Renew self-locking nuts, gaskets and seals.*
- *Fit all cable ties in the original positions when installing.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue .*

– Fill cooling system ⇒ page 155 .

Vehicles with throttle cable:

– Check adjustment of throttle cable ⇒ Rep. gr. 20 .

Tightening torques

Component	Nm
Intake manifold to cylinder head	10
Fuel pipes to fuel rail/fuel pressure regulator	23
Air duct to intake manifold	10

1.9 Checking compression

Special tools and workshop equipment required

- Spark plug socket and extension - 3122 B-

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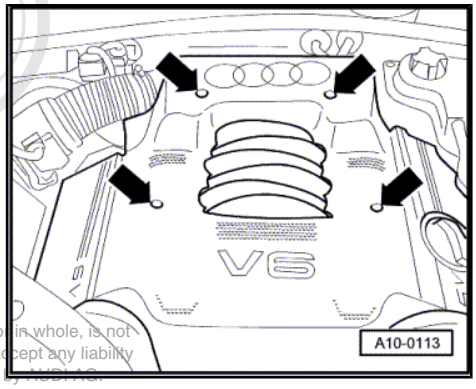
♦ Compression tester - V.A.G 1763-

Procedure

- Engine oil temperature at least 30 °C.
- Battery voltage at least 12.5 V.

– Remove engine cover panel -arrows-.



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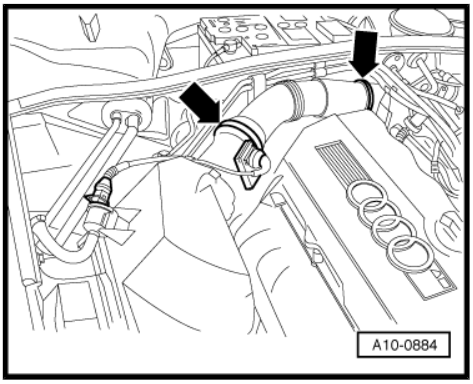
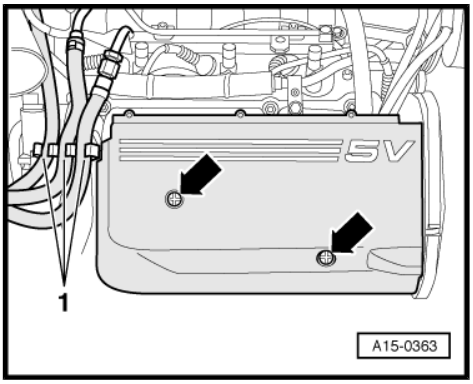
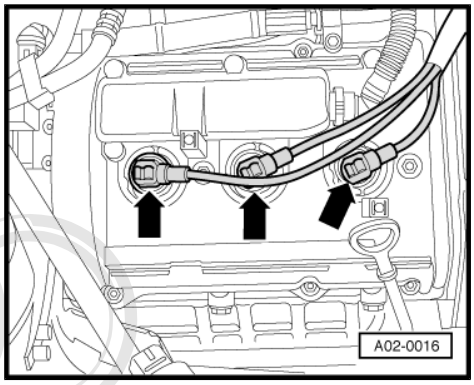
– Remove air intake hose between air mass meter - G70- and intake manifold -arrows-.



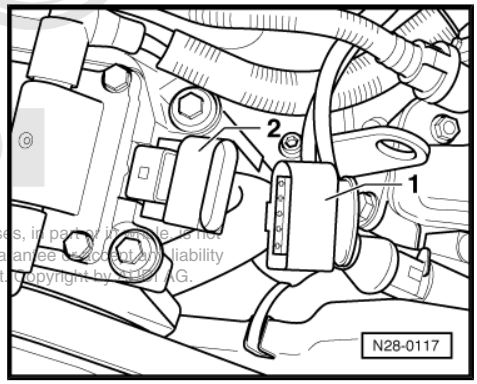
– Remove caps (left and right) -arrows-.



– Disconnect all six spark plug connectors -arrows-.
– Remove spark plugs with spark plug socket - 3122 B- .



– Unplug 5-pin connector -1- from output stage of ignition coils -2-.
– Unplug electrical connectors at all injectors.
– Test the compression pressure with the compression tester - V.A.G 1763- .



Note

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Using the compression tester ⇒ operating instructions .

– Have a 2nd mechanic press down the accelerator pedal completely and simultaneously operate the starter until the pressure no longer increases on the tester display.

Compression pressure	bar
When new	9.0 … 14.0
Wear limit	7.5
Difference between cylinders	3.0 (maximum)

– Install spark plugs ⇒ Rep. gr. 28 .
– Interrogate and erase fault memory for engine control unit after testing compression pressure, as faults will have been stored when connectors are unplugged ⇒ Vehicle diagnostic tester.

2 Servicing valve gear

Note

- *Cylinder heads which have cracks between the valve seats or between a valve seat insert and the spark plug thread can be re-installed without reducing service life, provided the cracks are only slight and do not exceed a maximum of 0.3 mm in width, and no more than the first 4 turns of the spark plug threads are cracked.*
- *After installing camshafts, wait for approx. 30 minutes before starting engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).*
- *After working on the valve gear, turn the engine carefully at least 2 rotations by hand to ensure that none of the valves make contact when the starter is operated.*
- *Renew gaskets and seals.*

2.1 Valve gear - exploded view

Note

The illustration shows the right cylinder head for “engine generation III” with oil lines ⇒ page 67 .

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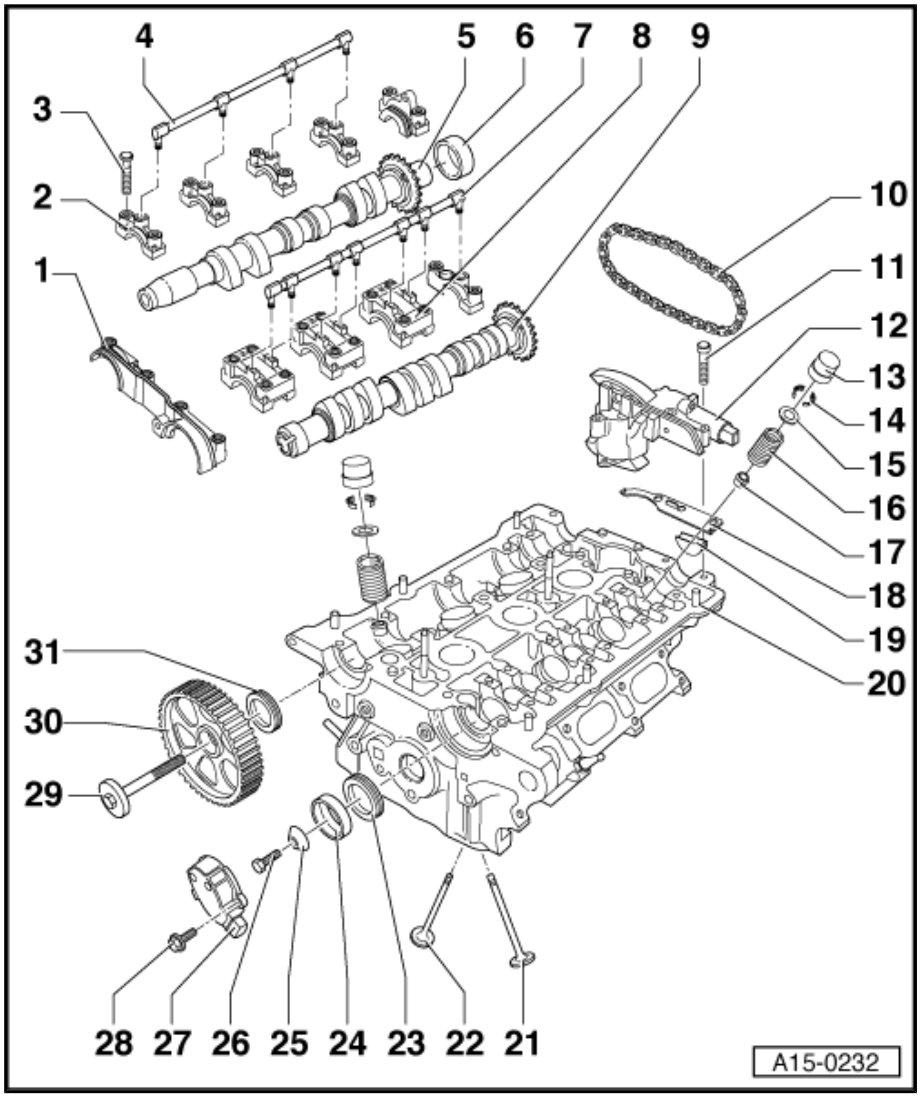

1 - Double bearing cap

- ❑ Before installing, coat contact surfaces of bearing caps at front and rear with a small quantity of sealant ⇒ page 92

2 - Bearing cap on exhaust camshaft

- ❑ Watch position of dowel sleeve
- ❑ Note installation position and allocation ⇒ page 101
- ❑ Prior to installation, apply thin coat of sealant to bearing cap next to chain ⇒ page 92

3 - 10 Nm

4 - Oil line (exhaust side)

- ❑ For lubrication of bearing caps
- ❑ Types differ depending on version ⇒ page 67
- ❑ Always renew after removing
- ❑ Note installation position ⇒ page 92

5 - Exhaust camshaft

- ❑ Checking axial clearance ⇒ page 92
- ❑ Removing and installing ⇒ page 99
- ❑ Check radial clearance with Plastigage (bucket tappets removed)
- ❑ Radial clearance: wear limit: 0.1 mm
- ❑ Runout: max. 0.01 mm

6 - Sealing cap

- ❑ Renewing ⇒ page 95
- ❑ Detach bearing cap to remove
- ❑ With bearing cap in position, drive in carefully with fitting sleeve - 3202-

7 - Oil line (inlet side)

- ❑ For lubrication of bearing caps
- ❑ Types differ depending on version ⇒ page 67
- ❑ Always renew after removing
- ❑ Note installation position ⇒ page 92

8 - Bearing cap on inlet camshaft

- ❑ Note installation position and allocation ⇒ page 101

9 - Inlet camshaft

- ❑ Checking axial clearance ⇒ page 92
- ❑ Removing and installing ⇒ page 99
- ❑ Check radial clearance with Plastigage (bucket tappets removed)
- ❑ Radial clearance: wear limit: 0.1 mm

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- ❑ Runout: max. 0.01 mm

10 - Drive chain

- ❑ Installing ⇒ page 101

11 - 10 Nm

12 - Mechanical camshaft adjuster

- ❑ With inlet camshaft control valve 1 - N205-
- ❑ Before removing, lock in position with chain tensioner retainer - 3366- ⇒ page 99

13 - Hydraulic bucket tappet (inlet valve)

- ❑ Checking ⇒ page 103
- ❑ Removing and installing ⇒ page 99
- ❑ Do not interchange
- ❑ Place down with contact surface facing downwards
- ❑ Check axial clearance of camshaft before installing ⇒ page 92
- ❑ Lubricate contact surface

14 - Valve cotters

15 - Valve spring plate

16 - Valve spring

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17 - Valve stem oil seal

- ❑ Renewing ⇒ page 104

18 - Rubber/metal gasket

- ❑ Renew

19 - Seal

- ❑ Renew

20 - Cylinder head

- ❑ See note ⇒ page 89
- ❑ Checking valve guides, grinding-in valve seats ⇒ page 108
- ❑ Machining valve seats ⇒ page 109

21 - Exhaust valve

- ❑ Do not machine, only grinding-in is permitted
- ❑ Valve dimensions ⇒ page 108
- ❑ Checking valve guides, grinding-in valve seats ⇒ page 108

22 - Inlet valve

- ❑ Do not machine, only grinding-in is permitted
- ❑ Valve dimensions ⇒ page 108
- ❑ Checking valve guides, grinding-in valve seats ⇒ page 108

23 - Oil seal

- ❑ Note direction of rotation
- ❑ Renewing ⇒ page 95 and ⇒ page 96

24 - Rotor for Hall sender

- ❑ Note fitting position (notch on camshaft)

25 - Washer

- ❑ Conical

26 - 25 Nm

27 - Hall sender

28 - 10 Nm

29 - 55 Nm

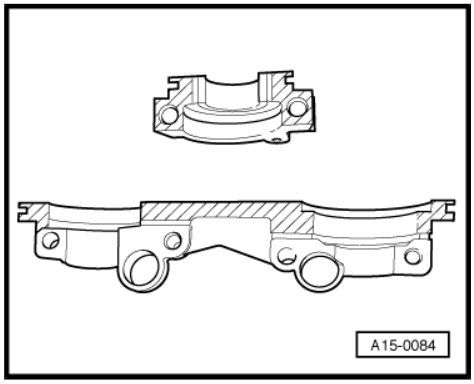
30 - Camshaft sprocket

31 - Oil seal

- ❑ Note direction of rotation
- ❑ Renewing ⇒ page 93

Applying sealant to bearing cap

– Coat -hatched areas- of bearing caps at front and rear on inlet camshaft with a small quantity of sealant and fit bearing caps (pay attention to dowel sleeves); sealant ⇒ Parts catalogue .



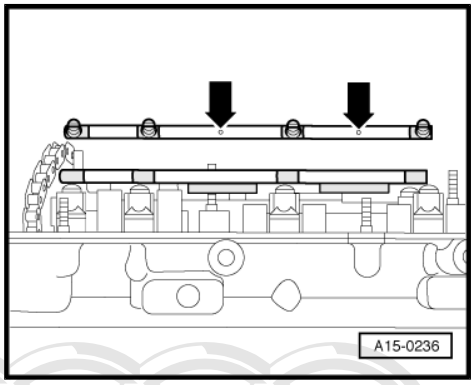
Installation position of exhaust camshaft oil line

If connections are incorrectly located as shown here, the drillings in the oil line will be exposed -arrows-.

– To fit correctly, turn the oil line 180° and push the connections onto the drillings.

Caution

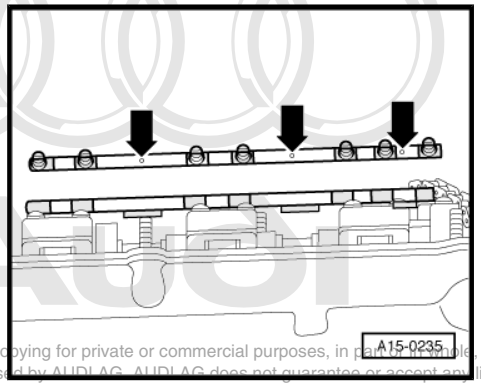
The camshaft bearings will not be lubricated if the oil lines have not been fitted properly.



Installation position of inlet camshaft oil line

If connections are incorrectly located as shown here, the drillings in the oil line will be exposed -arrows-.

– To fit correctly, turn the oil line 180° and push the connections onto the drillings.



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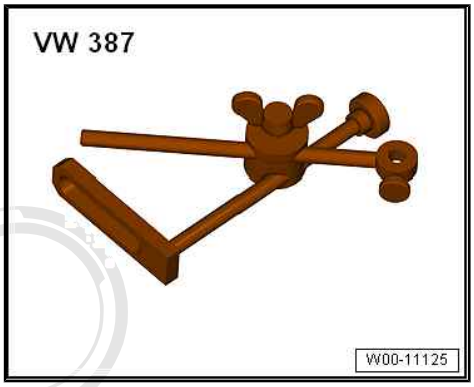
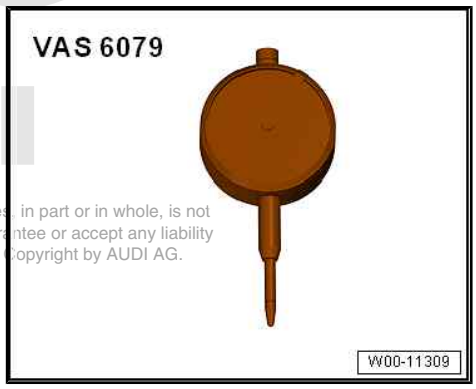
2.2 Checking axial clearance of camshafts

Special tools and workshop equipment required

♦ Universal dial gauge bracket - VW 387-



♦ Dial gauge - VAS 6079-



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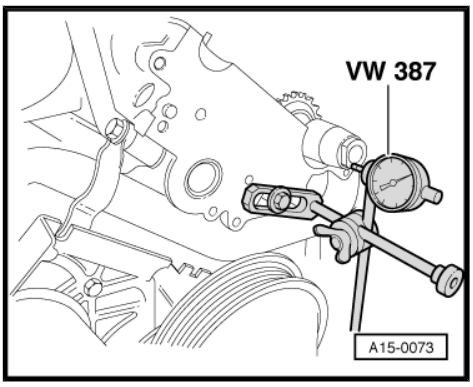
Test sequence



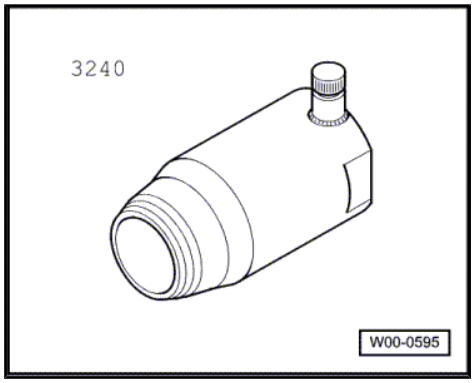
– Remove camshafts ⇒ page 99 .
– Remove bucket tappets.
– Fit camshafts in cylinder head without drive chain and secure with bearing caps 2 and 4.
– Attach dial gauge - VAS 6079- with dial gauge bracket - VW 387- to cylinder head.
– Press camshaft against dial gauge by hand.
– Set dial gauge to “0”.
– Press camshaft away from dial gauge.
– Read off value for axial clearance:

• New: 0.05 ... 0.15 mm.
• Wear limit: 0.20 mm.

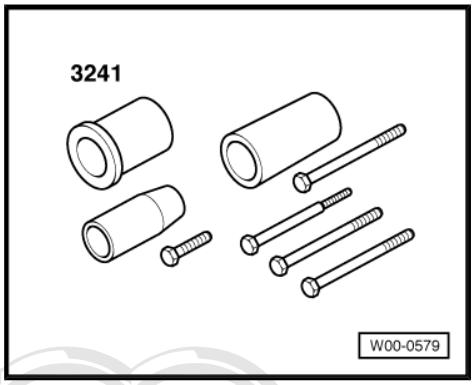
2.3 Renewing camshaft oil seals

Special tools and workshop equipment required

♦ Oil seal extractor - 3240-



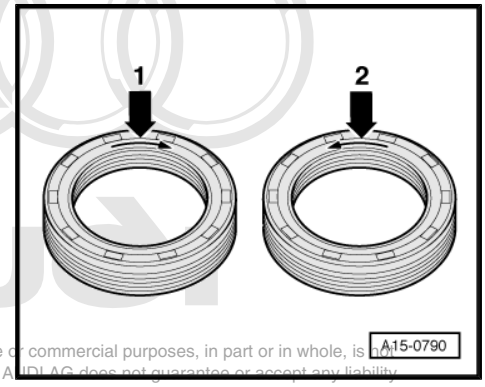
♦ Fitting sleeves - 3241-



Procedure

Note

- *PTFE oil seals are matched to the direction of shaft rotation (see arrow on oil seal). Incorrect allocation to direction of rotation will result in oil leaks.*
- *The direction of rotation of the oil seals at the front of the engine is "clockwise" -arrow 1-. The direction of rotation of the oil seals on the back of the engine is "anti-clockwise" -arrow 2-.*



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– Remove toothed belt ⇒ page 34 .
– Take off camshaft sprocket.

Note

If one of the oil seals is leaking, renew seals on both cylinder heads.

– Position inner section of oil seal extractor - 3240- flush with outer section.

Cylinder head (left-side):

– Unscrew inner section of oil seal extractor 5 turns and lock with knurled screw.

Cylinder head (right-side):

– Unscrew inner section of oil seal extractor 11 turns and lock with knurled screw.

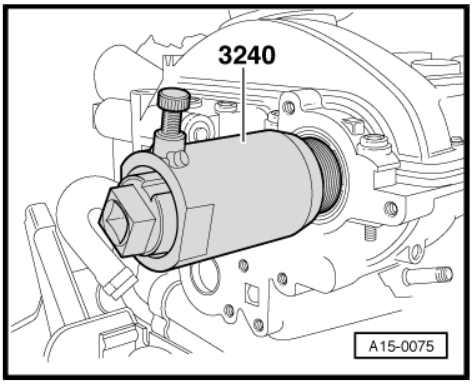
Continuation for both sides:

– Lubricate threaded head of oil seal extractor - 3240- , place it in position and, exerting firm pressure, screw it into 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.

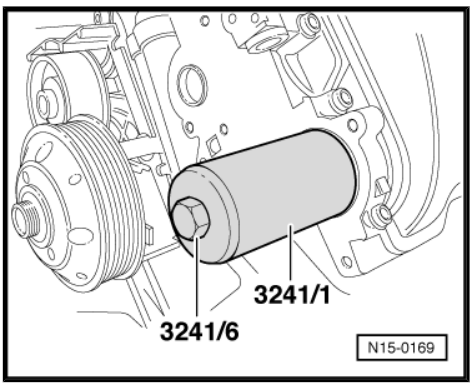
– Check that oil seal is correctly matched to direction of rotation before installing.

• Direction of shaft rotation “clockwise” (arrow on oil seal).

– Slide oil seal over taper on camshaft.

– Press in the oil seal with fitting sleeve - 3241/1- and hexagon bolt - 3241/6- until flush.

– Install toothed belt (adjust valve timing) ⇒ page 37 .



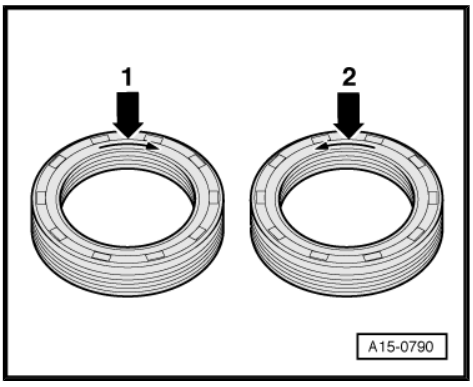
2.4 Renewing oil seal for Hall sender and sealing cap - cylinder head (left-side)

Procedure

Note

♦ *PTFE oil seals are matched to the direction of shaft rotation (see arrow on oil seal). Incorrect allocation to direction of rotation will result in oil leaks.*

♦ *The direction of rotation of the oil seals at the front of the engine is “clockwise” -arrow 1-. The direction of rotation of the oil seals on the back of the engine is “anti-clockwise” -arrow 2-.*



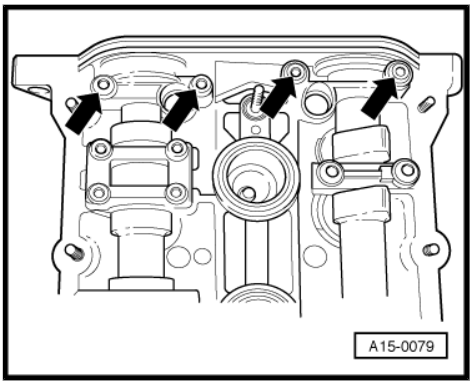
• Engine in vehicle.

– Remove cylinder head cover (left-side) ⇒ page 70 .

– Remove Hall sender ⇒ Item 27 (page 92) and Hall sender rotor ⇒ Item 24 (page 91) .

– Unscrew double bearing cap -arrows-.

– Take out oil seal and sealing cap.



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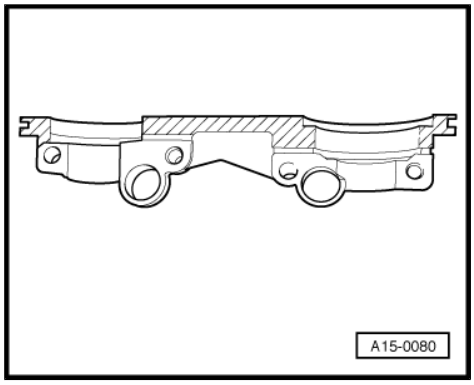
– Clean running and sealing surfaces as well as contact surfaces of double bearing cap.
– Apply a small amount of sealant to -hatched area- of double bearing cap; sealant ⇒ Parts catalogue .
– Check that oil seal is correctly matched to direction of rotation before installing.
• Direction of shaft rotation “anti-clockwise” (arrow on oil seal)
– Fit oil seal and install double bearing cap.
– Use assembly lever to press in sealing cap.



Note

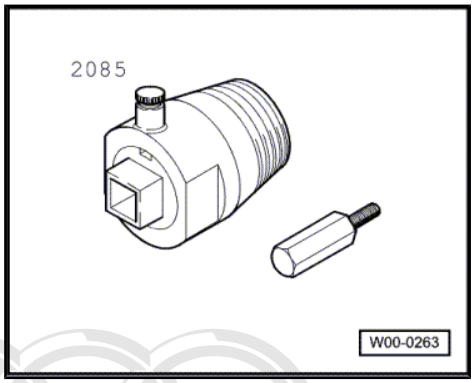
The bearing cap can remain installed after removing engine when renewing oil seal and sealing cap. Procedure ⇒ page 96

– Install Hall sender rotor ring ⇒ Item 24 (page 91) and washer ⇒ Item 25 (page 91) .
– Install Hall sender ⇒ Item 27 (page 92) .
– Install cylinder head cover (left-side) ⇒ page 71 .

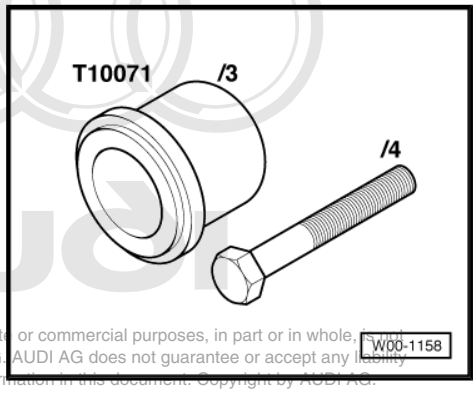
2.5 Renewing oil seal for Hall sender - cylinder head (right-side)

Special tools and workshop equipment required

♦ Oil seal extractor - 2085-



♦ Assembly tool - T10071-



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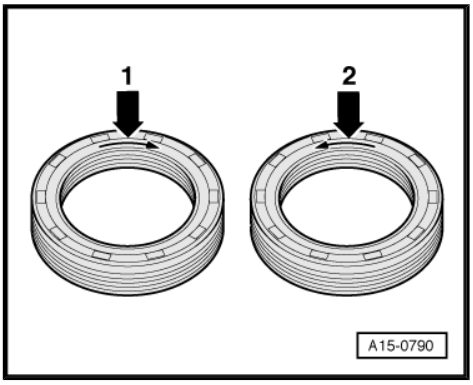
♦ Bolt M8x50
♦ Bolt M8x60

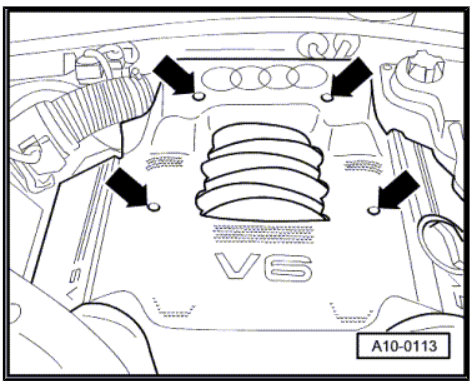
Procedure



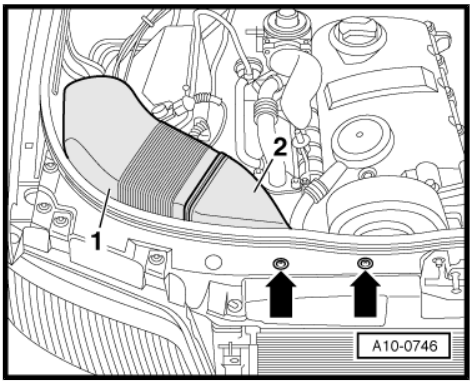
Note

- *PTFE oil seals are matched to the direction of shaft rotation (see arrow on oil seal). Incorrect allocation to direction of rotation will result in oil leaks.*
- *The direction of rotation of the oil seals at the front of the engine is “clockwise” -arrow 1-. The direction of rotation of the oil seals on the back of the engine is “anti-clockwise” -arrow 2-.*

– Remove engine cover panel -arrows-.

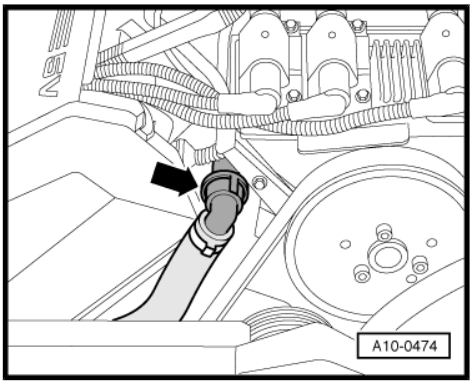


– Remove bolts -arrows-.
– Remove air ducts -1- and -2-.



Vehicles with secondary air system:

– Disconnect hose -arrow- from secondary air connecting pipe.



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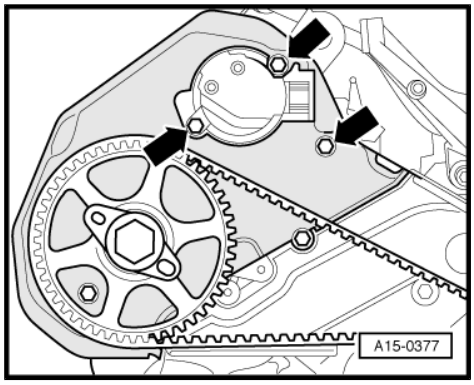
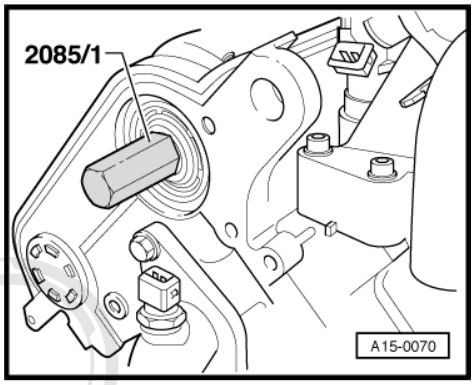
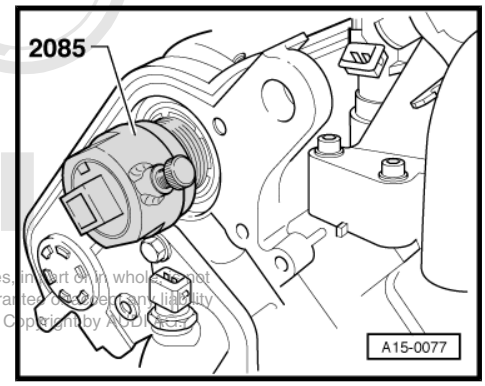
All vehicles:



- Remove toothed belt cover (top).
- Unclip toothed belt cover (centre).
- Unplug electrical connector at Hall sender.
- Unscrew bolts -arrows-.
- Pull toothed belt cover forwards slightly and detach Hall sender.
- Remove rotor for Hall sender ⇒ Item 24 (page 91) and washer ⇒ Item 25 (page 91) .



- Screw in bolt - 2085/1- for oil seal extractor - 2085- .
- Position inner section of oil seal extractor - 2085- flush with outer section.
- Unscrew inner section of oil seal extractor 3 turns and lock with knurled screw.



- Lubricate threaded head of oil seal extractor - 2085- , place it in position and, exerting firm pressure, screw it into 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.
- Unscrew bolt - 2085/1- for oil seal extractor - 2085- .

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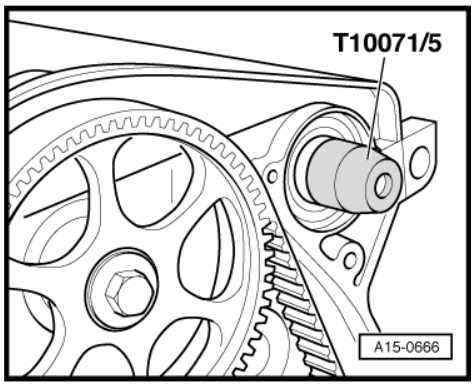
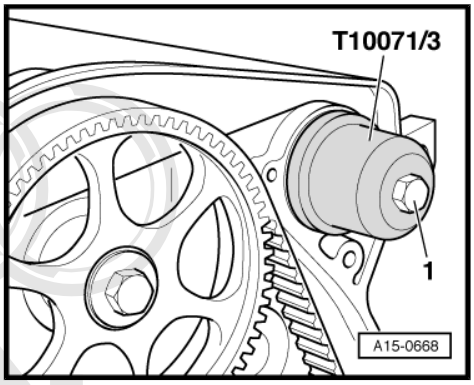


- Clean running surface and sealing surface.
- Fit guide sleeve - T10071/5- onto camshaft journal and secure with bolt M8x50.
- Check that oil seal is correctly matched to direction of rotation before installing.

• Direction of shaft rotation “clockwise” (arrow on oil seal).

- Push oil seal over guide sleeve onto shaft.
- Detach guide sleeve.

– Press oil seal in onto stop with press sleeve - T10071/3- and bolt M8x60 -item 1-.
– Install Hall sender rotor ring ⇒ Item 24 (page 91) and washer ⇒ Item 25 (page 91) .
– Install Hall sender ⇒ Item 27 (page 92) .
– Fit toothed belt cover (top section).



Tightening torques

Component	Nm
Hall sender rotor to camshaft	25
Hall sender housing to cylinder head	10
Rear toothed belt cover to cylinder head	10 1)

• 1) Install bolts using locking fluid; locking fluid ⇒ Parts catalogue .

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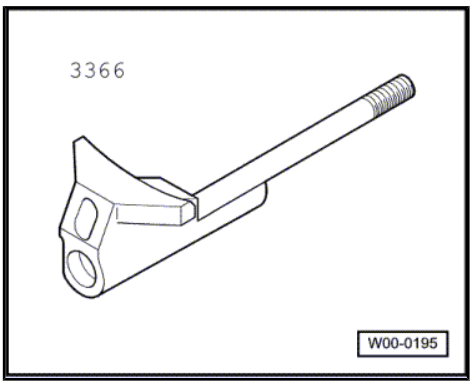
2.6 Removing and installing camshafts and camshaft adjuster

Special tools and workshop equipment required

♦ Chain tensioner retainer - 3366-



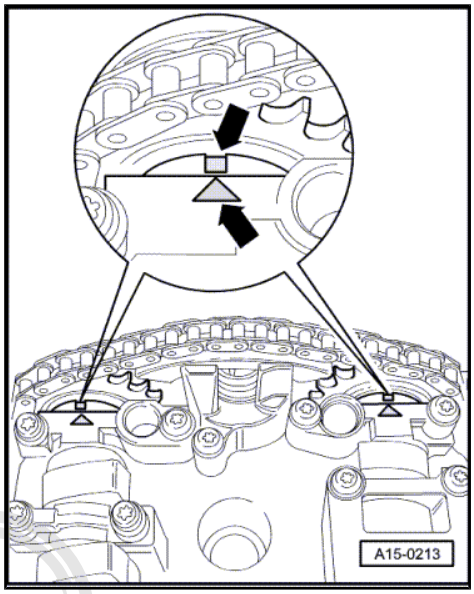
♦ Sealant ⇒ Parts catalogue

Removing

– Remove toothed belt ⇒ page 34 .
– Take off camshaft sprocket.
– Unscrew toothed belt cover (rear).
– Remove cylinder head cover: left-side ⇒ page 70 , right-side ⇒ page 72 .
– Unplug electrical connector at camshaft adjuster.

– Remove Hall sender ⇒ Item 27 (page 92) and Hall sender rotor ⇒ Item 24 (page 91) .

– If applicable, carefully prise camshaft bearing oil lines off camshaft bearings using a screwdriver.



Note

Make sure retainers do not break off when prising out.

– Turn the crankshaft approx. 45° anti-clockwise at the toothed belt sprocket bolt so that all pistons are clear of TDC position.

– Check TDC position of camshafts again:

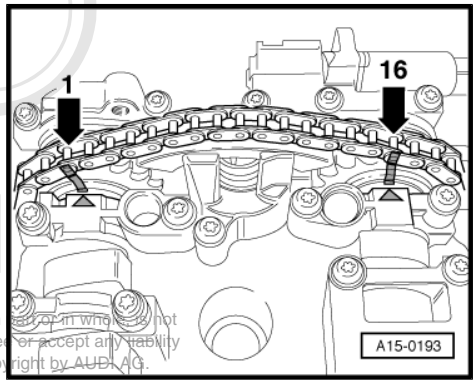
• The two marks on the camshafts must be opposite the two arrows on the bearing caps.

If old drive chain is to be reused:

– Clean drive chain and sprockets of camshafts opposite the two arrows on the bearing caps and mark installation position with a coloured dot.

• The distance between the two arrows (and thus between the coloured markings) is 16 rollers on the chain.

• Notch on exhaust camshaft has a slight inward offset with respect to chain roller -1-.



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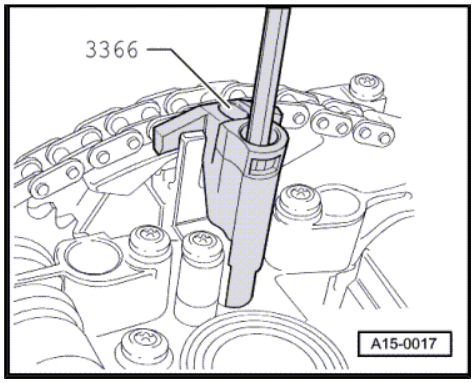
Note

Do not mark chain with a centre punch or by making a notch or similar.

Continued:

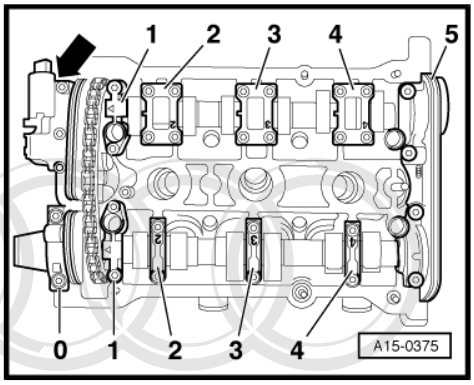
– Hold camshaft adjuster in position with chain tensioner retainer - 3366- .



Note

Over-tightening retainer for chain tensioner can damage the camshaft adjuster.

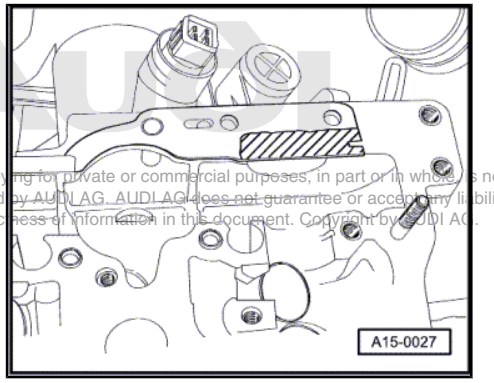
– Mark the sequence and installation positions of all bearing caps, as shown, regardless of any existing markings on the bearing caps.
– Unscrew bolts securing camshaft adjuster -arrow-.
– Remove bearing cap -0-.
– Remove bearing caps -1-, -3- and -5- and place them in the correct order on a clean surface.
– Slacken off bearing caps -2- and -4- of inlet and exhaust camshafts alternately and diagonally, and remove.
– Lift out both camshafts with camshaft adjuster.



Installing

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

– Renew the semi-circular sealing plug.
– Renew rubber/metal gasket for camshaft adjuster and apply a thin coat of sealant to the -hatched area-; Sealant ⇒ Parts catalogue .



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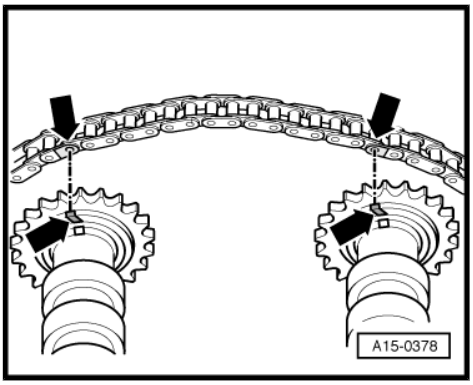
– Position drive chain as follows on camshaft chain sprockets:

If old drive chain is being used:

• Adjust the colour markings -arrows- so they are aligned.

If new drive chain is being used:

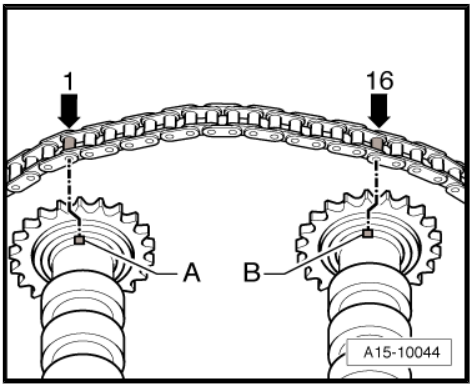


> **Caution**
>
> ◆ *The stated number of rollers merely provides assistance for fitting the drive chain onto the camshafts.*
>
> ◆ *Make sure that the arrows on the bearing caps and the notches on the camshafts align when installing camshafts (with drive chain) in cylinder head* *⇒ page 101* *.*

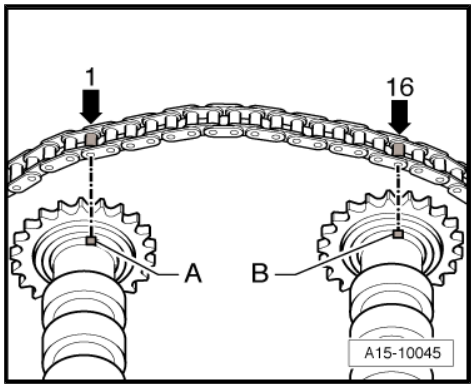
Cylinder head (left-side):

• The distance between notches -A- and -B- on the camshafts must be 16 drive chain rollers. The illustration shows the exact positions of the 1st and 16th rollers on the sprockets.

• The chain rollers -1- and -16- are offset $^{1}/_{2}$ tooth outwards in relation to notches -A- and -B-



Cylinder head (right-side):



- The distance between notches -A- and -B- on the camshafts must be 16 drive chain rollers. The illustration shows the exact positions of the 1st and 16th rollers on the sprockets.
- The chain rollers -1- and -16- are located vertically above notches -A- and -B-.

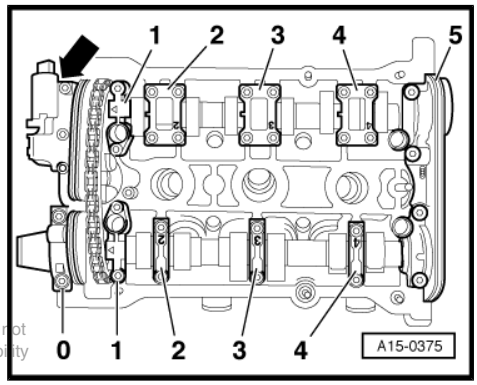
Continued for all drive chains:

– Insert camshaft adjuster into the chain (2nd mechanic required).

– Insert camshafts with drive chain and camshaft adjuster into cylinder head.

– Lubricate running surfaces of camshafts.

- Dowel sleeves for bearing caps and camshaft adjuster must be positioned in cylinder head



– Secure camshaft adjuster -arrow- (watch position of dowel sleeves).

– Install bearing caps -2- and -4- as per marking.

– Tighten bearing caps -2- and -4- of inlet camshaft and exhaust camshaft alternately in diagonal sequence.

– Install the two bearing caps -1- next to the chain sprockets on the inlet and exhaust camshafts.

– Remove chain tensioner retainer - 3366- .

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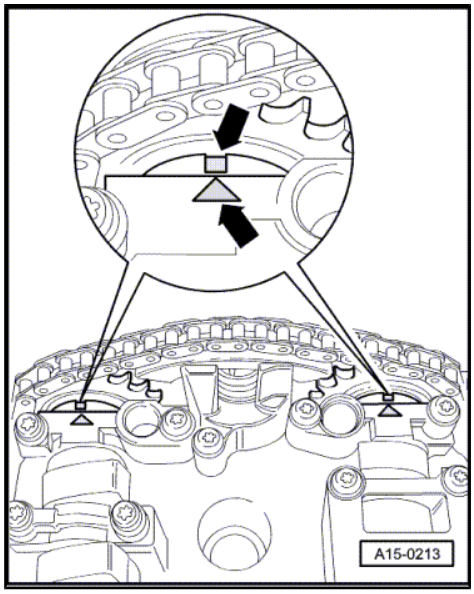
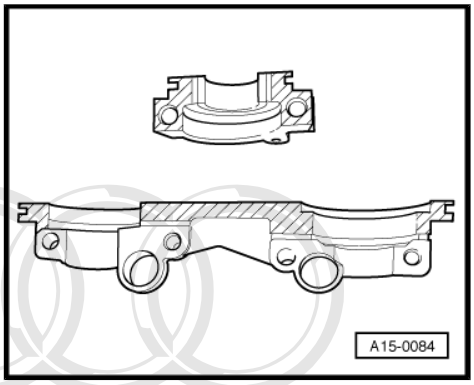
– Check correct setting of camshafts:



- The two marks on the camshafts must be opposite the two arrows on the bearing caps -arrows-.

Note

If necessary, turn camshaft slightly backwards or forwards so that the two marks coincide.



- Apply a small quantity of sealant to the -hatched area- of the double bearing cap and the outer bearing cap adjacent to the camshaft adjuster; Sealant ⇒ Parts catalogue .
- Install bearing cap (pay attention to dowel sleeves).
- Install remaining bearing caps (pay attention to dowel sleeves).
- If applicable, renew oil lines for lubricating camshaft bearings and install ⇒ page 92 and ⇒ page 92
- Renew oil seals for inlet and exhaust camshaft ⇒ page 93 , ⇒ page 95 or ⇒ page 96 .
- Torque down remaining bearing caps.
- Turn the crankshaft approx. 45° clockwise back to TDC at the toothed belt sprocket bolt and secure crankshaft with locking pin.
- Install toothed belt (adjust valve timing) ⇒ page 37 .
- Install cylinder head cover: left-side ⇒ page 70 , right-side ⇒ page 72 .

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Note

- *After installing camshafts, wait for approx. 30 minutes before starting engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).*
- *After working on the valve gear, turn the engine carefully at least 2 rotations by hand to ensure that none of the valves make contact when the starter is operated.*

Tightening torques

Component	Nm
Bearing cap to cylinder head	10
Camshaft adjuster to cylinder head	10
Hall sender rotor to camshaft	25
Hall sender housing to cylinder head	10
Toothed belt cover (rear) to cylinder head/ cylinder block	10 1)
• 1) Install bolts using locking fluid; locking fluid ⇒ Parts catalogue .	

2.7 Checking hydraulic bucket tappets

Special tools and workshop equipment required

- Feeler gauge
- Wooden/plastic wedge

Note

- *Hydraulic bucket tappets cannot be serviced.*
- *Irregular valve noises when starting engine are normal.*

Procedure

– Start engine and run until coolant temperature reaches approx. 80 °C.

– Increase engine speed to approx. 2500 rpm for 2 minutes (perform road test if necessary).

Note

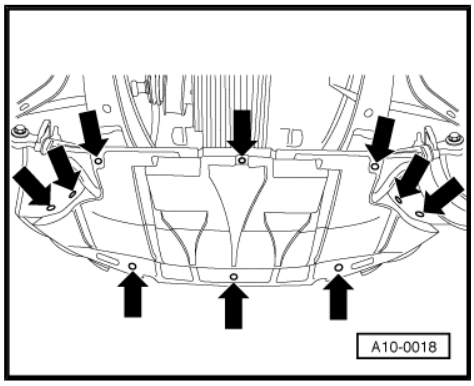
If irregular valve noise disappears but repeatedly re-occurs when travelling short distances, renew oil retention valves. Fitting location of oil retention valves: beneath cover on intake manifold ⇒ page 146 .

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

– Remove cylinder head cover: left-side ⇒ page 70 , right-side ⇒ page 72 .

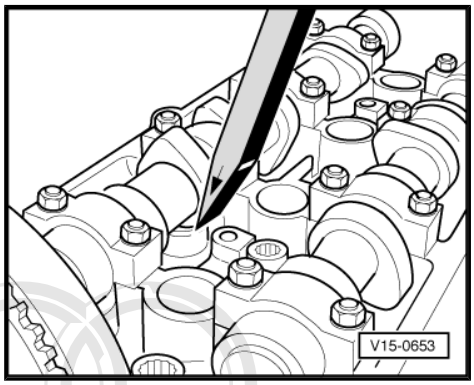
– Remove noise insulation -arrows-.

– Rotate crankshaft clockwise at centre bolt for toothed belt sprocket until cams of cylinder to be checked are pointing upwards.



– Determine clearance between cams and bucket tappets.

– Push tappet down with a wooden or plastic wedge.



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

– Renew bucket tappet ⇒ “2.6 Removing and installing camshafts and camshaft adjuster”, page 99 .

Note

- *After installing camshafts, wait for approx. 30 minutes before starting engine. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).*
- *After working on the valve gear, turn the engine carefully at least 2 rotations by hand to ensure that none of the valves make contact when the starter is operated.*

2.8 Renewing valve stem oil seals

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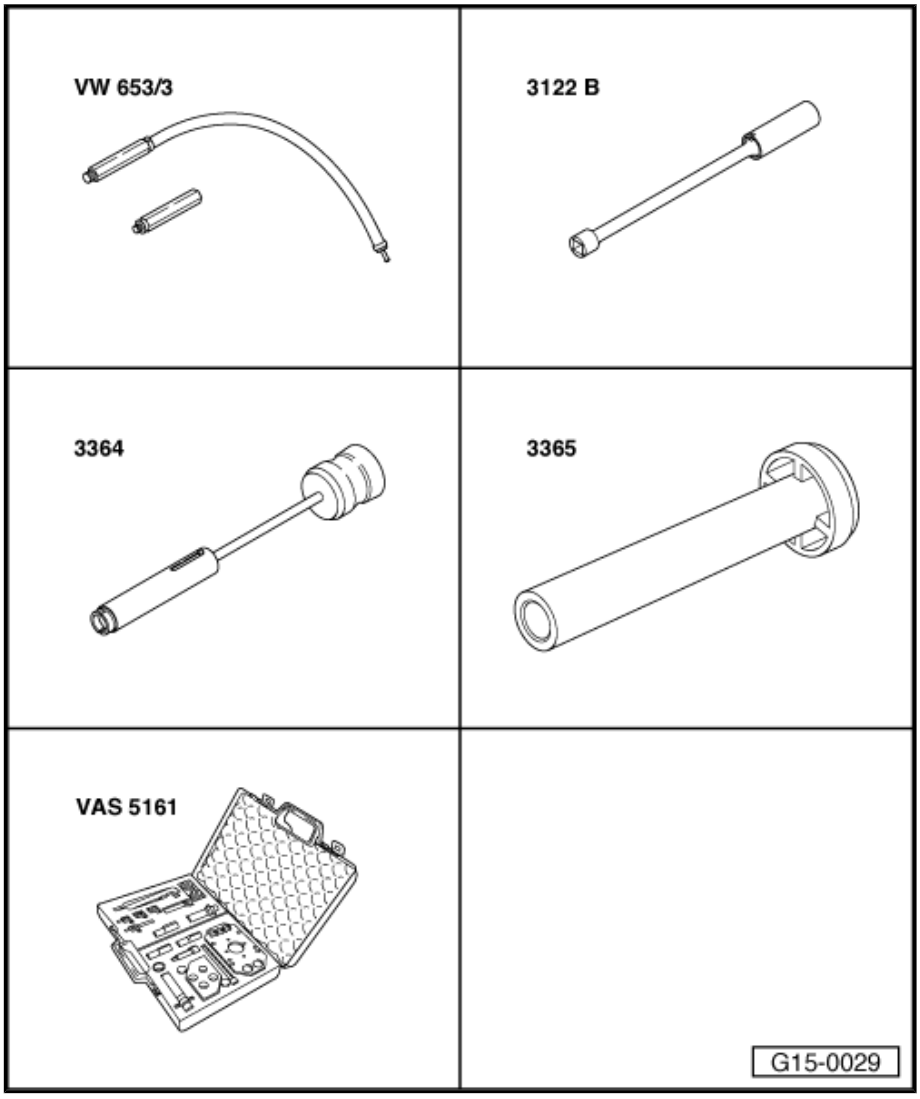
Special tools and workshop equipment required

- Pressure hose - VW 653/3-
- Spark plug socket and extension - 3122 B-
- Valve stem seal puller - 3364-
- Valve stem seal fitting tool - 3365-
- Removal and installation device - VAS 5161-



Procedure

- Cylinder head installed.

– Remove camshafts and camshaft adjuster ⇒ page 99 .

Note

Use waterproof felt-tip pen to mark assignment of bucket tappets on back to ensure that the tappets are not interchanged.

– Remove the bucket tappets from the guides and put them down with the contact surface downwards.

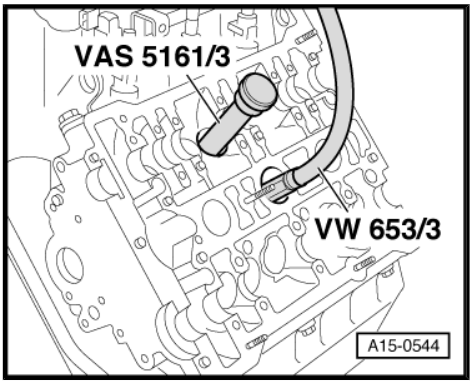
– Remove spark plugs with spark plug socket - 3122 B- .

– Set piston of the respective cylinder to “bottom dead centre”.

– Connect pressure hose - VW 653/3- to compressed air supply.

- Minimum pressure: 6 bar

– Insert punch - VAS 5161/3- into bucket tappet guide.



– Knock valve cotters on all five valves loose using a plastic hammer.

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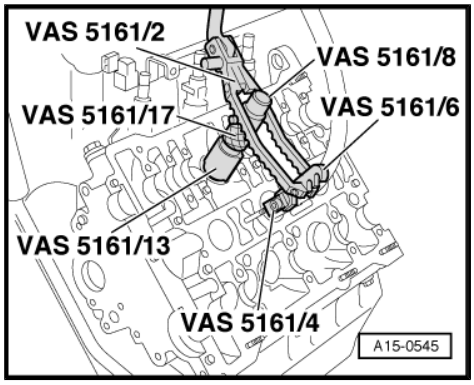
Inlet side:



- Screw snap-in device - VAS 5161/6- with interlocking fork - VAS 5161/4- onto stud on cylinder head.
- Push guide bush - VAS 5161/13- as far as it will go into bucket tappet guide for valve to be removed.
- Installation position: knurled surfaces face perpendicular to direction of travel.
- Slide knurled spacer ring - VAS 5161/17- onto assembly cartridge - VAS 5161/8- .
- Insert assembly cartridge into guide bush.
- 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.
- Take out assembly cartridge with spacer ring, guide bush, valve spring plate and valve spring.

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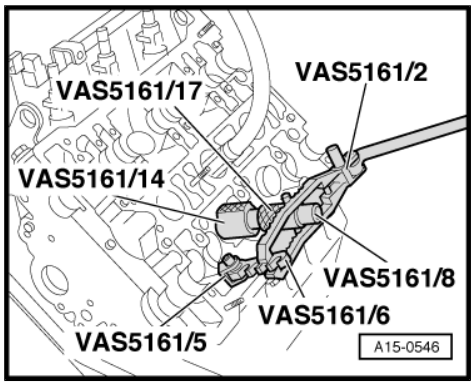
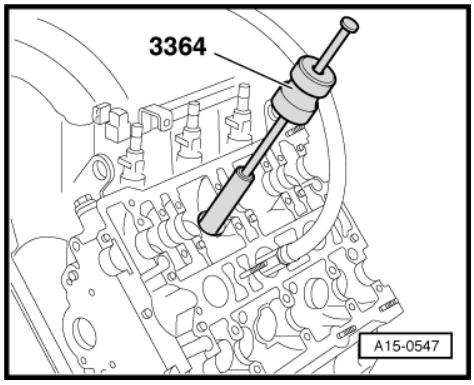
Exhaust side:



- Screw snap-in device - VAS 5161/6- with interlocking fork - VAS 5161/5- into threaded hole on cylinder head.
- Push guide bush - VAS 5161/14- as far as it will go into bucket tappet guide for valve to be removed.
- Installation position: knurled surfaces face perpendicular to direction of travel.
- Slide knurled spacer ring - VAS 5161/17- onto assembly cartridge - VAS 5161/8- .
- Insert assembly cartridge into guide bush.
- 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.
- Take out assembly cartridge with spacer ring, guide bush, valve spring plate and valve spring.

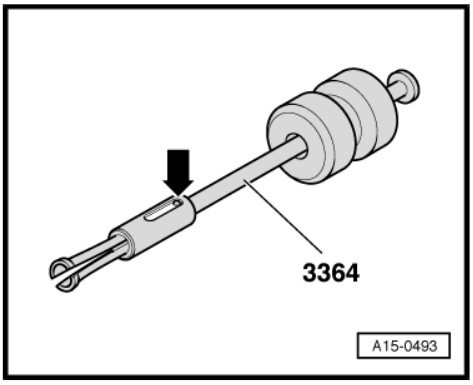
Continuation for both sides:



- Remove valve stem oil seals using the valve stem seal puller - 3364- .

If the valve stem seal puller - 3364- cannot be used on some of the valve stem oil seals due to the confined space, proceed as follows:

– Knock pin -arrow- of valve stem seal puller - 3364- out using a punch and remove extractor attachment.



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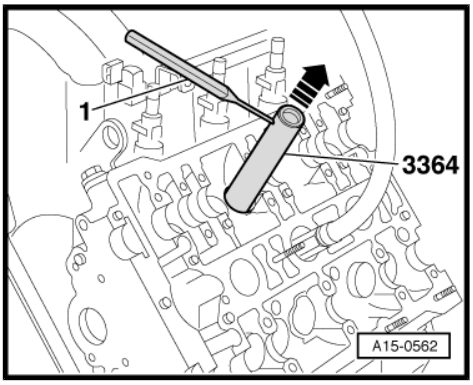
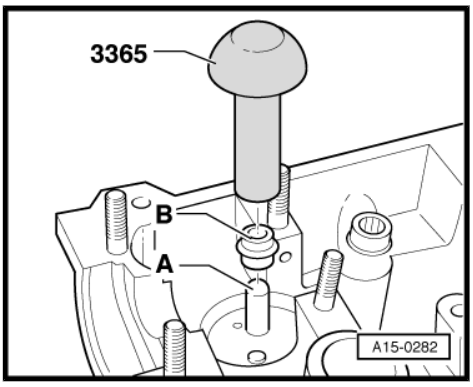
– Apply lower part of valve stem seal puller - 3364- to valve stem oil seal.
– Secure valve stem seal puller - 3364- with a punch -1- or other suitable tool, as illustrated.
– Apply an assembly lever to valve stem seal puller - 3364- and pull out valve stem oil seal -arrow-.



Note

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

– To prevent damage to the new valve stem seals -B-, attach plastic sleeve -A- to valve stem.
– Lightly oil sealing lip of valve stem oil seal.
– Slip valve stem oil seal over plastic sleeve.
– Carefully press valve stem oil seal onto valve guide using valve stem seal fitting tool - 3365- .
– Remove plastic sleeve.



Note

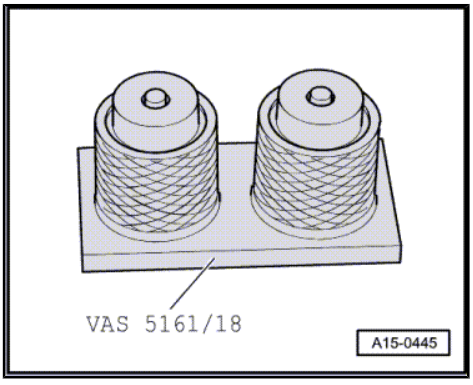
Ensure correct positioning in cylinder head when fitting valve springs of exhaust valves (otherwise assembly is not possible).

– If valve cotters have been removed from assembly cartridge, they need to be put into insertion device - VAS 5161/18- first.

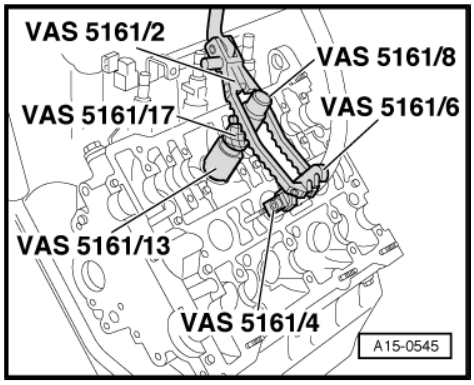
Note

Larger diameter of valve cotters faces upwards.

– Press assembly cartridge - VAS 5161/8- onto insertion device from above and pick up valve cotters.



– Reinstall assembly cartridge - VAS 5161/8- in guide bush - VAS 5161/13- and -VAS 5161/14- .
– Push pressure fork down and pull knurled screw upwards, while turning screw in both directions – this will insert the valve cotters.
– Release pressure fork with knurled screw still in pulled position.
– Insert bucket tappets.
– Install camshafts and camshaft adjuster ⇒ page 101 .



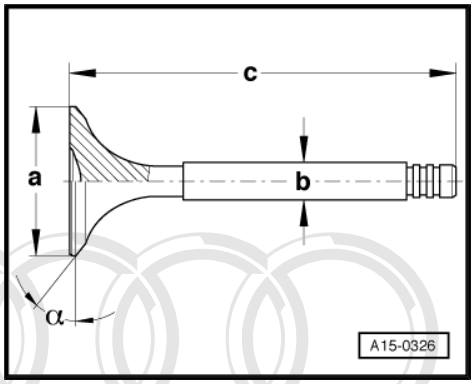
Note

- *After installing camshafts, wait for approx. 30 minutes before starting engine. Hydraulic valve compensation elements 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.*

2.9 Valve dimensions

Note

Valves must not be machined. Only grinding-in is permitted.



Dimension		Inlet valve	Exhaust valve
∅ a	mm	26.80 … 27.00	29.80 … 30.00
∅ b	mm	5.960 … 5.970	5.940 … 5.950
c	mm	104.84 … 105.34	103.64 … 104.14
α	∠°	45	45

WARNING

- ***Care must be taken when disposing of old sodium-cooled exhaust valves.***
- ***The valves must be sawn in two with a metal saw between the centre of the stem and valve head. When doing so, the valves must not come into contact with water. After preparing the valves, throw a maximum of ten into a bucket of water. Then step away immediately, since a chemical reaction will occur in which the sodium filling burns.***
- ***After performing these steps the valves can be disposed of in the normal way.***

2.10 Checking valve guides

Special tools and workshop equipment required

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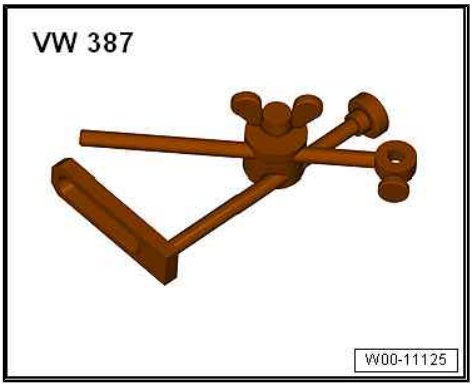
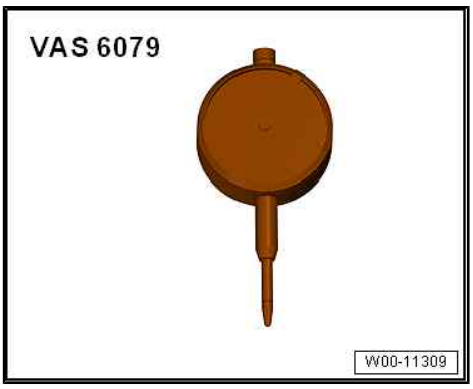
- Universal dial gauge bracket - VW 387-



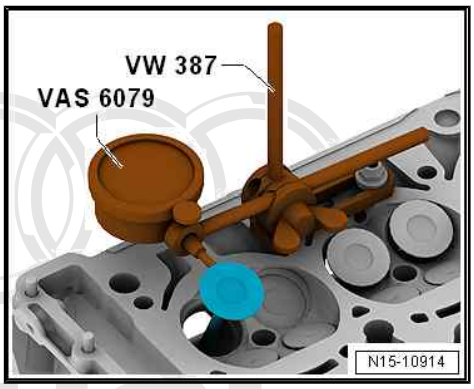
- Dial gauge - VAS 6079-



Procedure

– Insert valve into valve guide.

• End of valve stem must be flush with guide.



Note

Only insert inlet valve into inlet guide and exhaust valve into exhaust guide, as the stem diameters are different.

– Determine amount of sideways play.

• Wear limit: 0.80 mm.

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.*

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2.11 Machining valve seats

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

Special tools and workshop equipment required

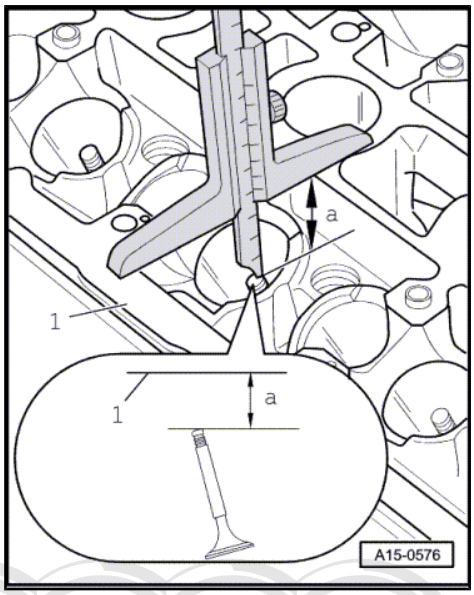
- Depth gauge
- Valve seat machining tool

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 108 *.*
- *Valve seats should only be machined to the extent required to give a proper seating pattern.*
- *Calculate the maximum permissible machining dimension before machining.*
- *If the maximum machining dimension is exceeded, the hydraulic valve clearance compensation will not work properly and the cylinder head will have to 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.

– Use a depth gauge to measure distance -a- between end of valve stem (upper edge) and top surface of cylinder head.
– Calculate max. permissible machining dimension from measured distance and minimum dimension.

Minimum dimensions		
Inlet valves (outer)	Inlet valve (centre)	Exhaust valves
31.0 mm	32.2 mm	31.9 mm

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

Example for inlet valve (outer):	
Measured distance	31.4 mm
Minimum dimension	– 31.0 mm
Max. permissible machining dimension	= 0.4 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.

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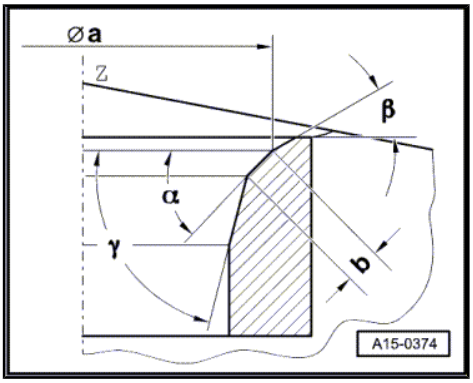
Machining valve seats



Inlet valve seat:

a - ∅ 26.2 mm

b - 1.5 … 1.8 mm

Z - Bottom surface of cylinder head

α - 45° valve seat angle

β - 30° upper correction angle

γ - 60° lower correction angle

Exhaust valve seat:

a - ∅ 29.0 mm

b - approx. 1.8 mm

Z - Bottom surface of cylinder head

α - 45° valve seat angle

β - 30° upper correction angle

γ - 60° lower correction angle

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2.12 Checking valves

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

If scoring is clearly visible:

– Renew the relevant valve.

3 Checking variable valve timing

The timing of the inlet camshaft is controlled according to engine load and engine speed. Oil pressure is fed to the mechanical camshaft adjuster via the electrical camshaft control valve (solenoid valve).

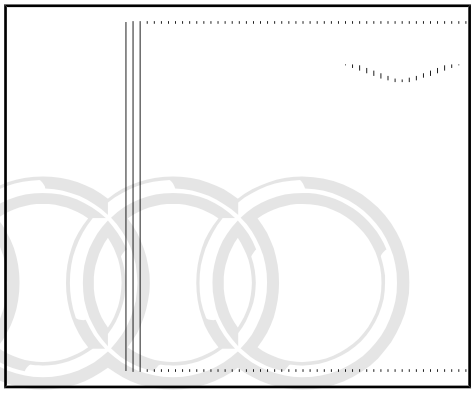
3.1 Checking function of variable valve timing

Note

The variable valve timing is not activated until about 25 seconds after the engine has started.

Special tools and workshop equipment required

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



Test conditions

- Vehicle diagnostic, testing and information system - VAS 5051- with diagnosis lead - VAS 5051/1- is connected; vehicle self-diagnosis and vehicle system “01 - Engine electronics” is selected.
- Coolant temperature at least 80 °C.
- Vehicles with automatic gearbox: selector lever in position “P” or “N”.

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Test sequence

WARNING

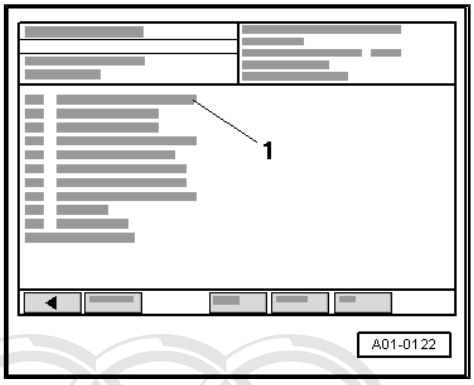
- *Test equipment must always be secured on the rear seat and operated from that position by a second person.*
- *If test and measuring instruments are operated from front passenger's seat and the vehicle is involved in an accident, the person sitting in this seat could be seriously injured when the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

– Start engine and run at idling speed.

Vehicles with throttle cable:

Display on -VAS 5051-

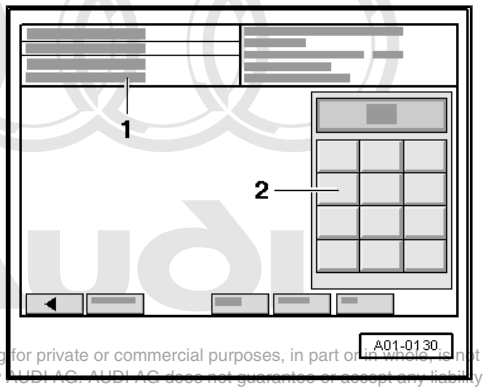
– From the list -1- select diagnostic function “08 - Read measured value block”.



Display on -VAS 5051-

1 - Enter display group

– Use keypad -2- to enter “27” for “Display group number 027” and confirm by touching the Q key.



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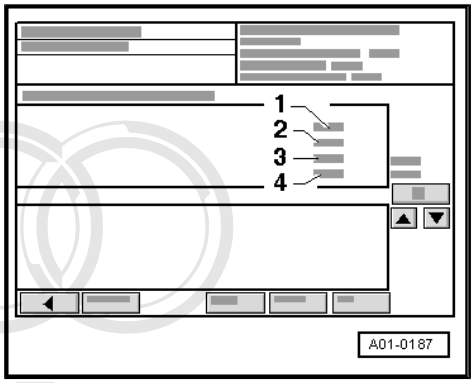
Display on -VAS 5051-



Note

Engine running at idling speed.

– Check specifications in display zones -1-, -3- and -4-.

Display zones		Explanatory notes
1	---	Variable valve timing (camshaft adjustment) • Specification: 0 (= “Variable valve timing OFF”)
3	... °CA	Variable valve timing bank 1 (cylinder bank right-side) • Specification: -3 ... 6 CA
4	... °CA	Variable valve timing bank 2 (cylinder bank left-side) • Specification: -3 ... 6 CA

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– Perform test drive.

– Check specifications in display zones -1-, -3- and -4-.

Display zones		Explanatory notes
1	---	Variable valve timing (camshaft adjustment) • Specification: 1 (= “Variable valve timing ON”)
3	... °CA	Variable valve timing bank 1 (cylinder bank right-side) • Specification: 16 ... 25 CA [1)]
4	... °CA	Variable valve timing bank 2 (cylinder bank left-side) • Specification: 16 ... 25 CA [1)]
• [1)] If the readout only shows a value between 6.0° CA (crankshaft angle) and 16.0° CA during the test drive, this indicates that the camshaft control valve is working correctly and feeding the oil pressure to the camshaft adjustment mechanism, but the mechanism is not able to reach its end position (possibly because it is not moving freely).		

– Exit function “08 - Read measured value block” by pressing the ← key.

– Press “06 - End output”.

– Switch off ignition.

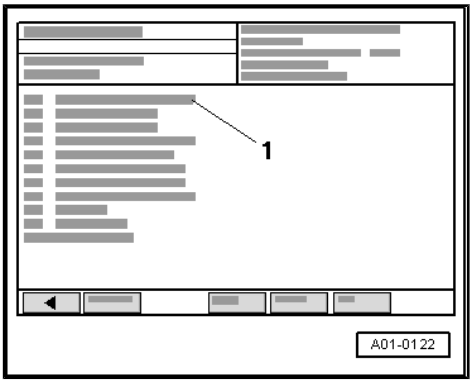
If the specifications are not obtained:

– Check the camshaft control valves ⇒ page 116 .

Vehicles with electronic throttle:

Display on -VAS 5051-

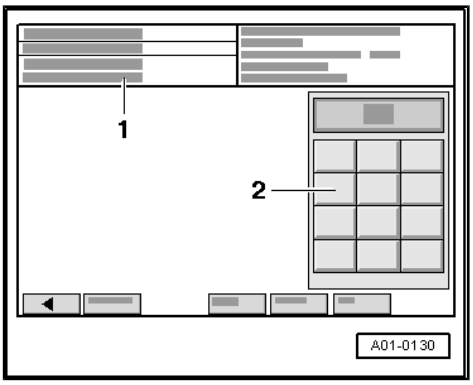
– From the list -1- select diagnostic function “08 - Read measured value block”.



Display on -VAS 5051-

1 - Enter display group

– Use keypad -2- to enter “90” for “Display group number 090” and confirm by touching the Q key.



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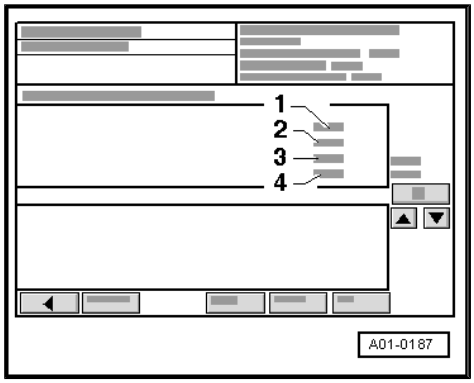
Display on -VAS 5051-



Note

Engine running at idling speed.

– Check specifications in display zones -2-, -3- and -4-.

Display zones		Explanatory notes
2	---	Variable valve timing (camshaft adjustment) • Specification: “CS-ctrl.OFF”
3	... °CA	Variable valve timing bank 1 (cylinder bank right-side) • Specification: -3 ... 6 CA
4	... °CA	Variable valve timing bank 2 (cylinder bank left-side) • Specification: -3 ... 6 CA

– Perform test drive.

– Check specifications in display zones -2-, -3- and -4-.

Display zones		Explanatory notes
2	---	Variable valve timing (camshaft adjustment) • Specification: “CS-ctrl.ON”
3	... °CA	Variable valve timing bank 1 (cylinder bank right-side) • Specification: 16 ... 25 CA [1)]
4	... °CA	Variable valve timing bank 2 (cylinder bank left-side) • Specification: 16 ... 25 CA [1)]
• [1)] If the readout only shows a value between 6.0° CA (crankshaft angle) and 16.0° CA during the test drive, this indicates that the camshaft control valve is working correctly and feeding the oil pressure to the camshaft adjustment mechanism, but the mechanism is not able to reach its end position (possibly because it is not moving freely).		

– Exit function “08 - Read measured value block” by pressing the ← key.

– Press “06 - End output”.

– Switch off ignition.

If the specifications are not obtained:

– Check the camshaft control valves ⇒ page 116 .

3.2 Checking camshaft control valves (solenoid valves)

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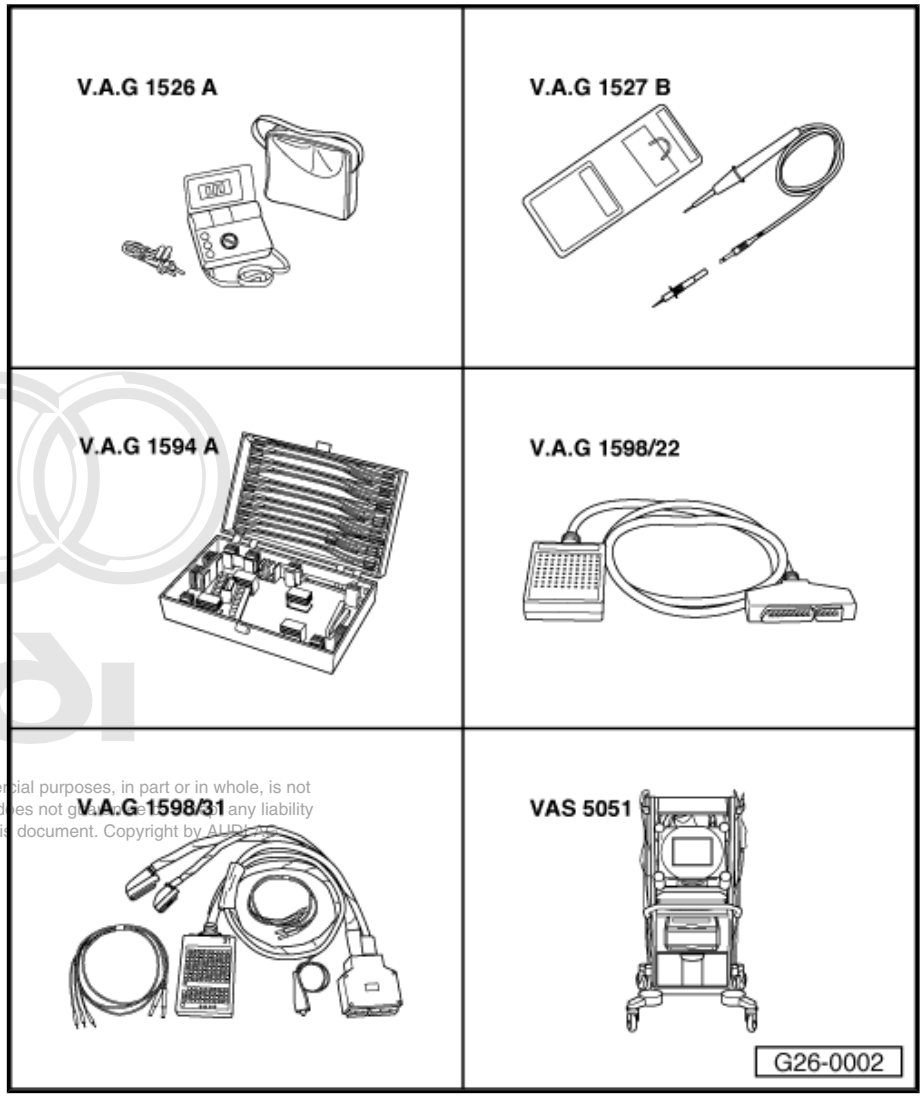
Special tools and workshop equipment required

- Hand-held multimeter - V.A.G 1526 B- or -V.A.G 1526 A-
- Voltage tester - V.A.G 1527 B-
- Auxiliary measuring set - V.A.G 1594 C- or -V.A.G 1594 A-
- Test box - V.A.G 1598/22- (vehicles with throttle cable)
- Test box - V.A.G 1598/31- (vehicles with electronic throttle)
- Vehicle diagnostic, testing and information system - VAS 5051- with diagnosis lead - VAS 5051/1-



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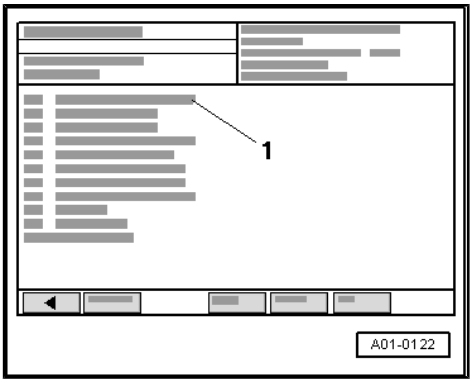
Test conditions

- Vehicle diagnostic, testing and information system - VAS 5051- with diagnosis lead - VAS 5051/1- is connected; vehicle self-diagnosis and vehicle system “01 - Engine electronics” is selected. When doing this, the ignition must be switched on.
- Vehicles with automatic gearbox: selector lever in position “P” or “N”.

Test sequence



Display on -VAS 5051-

– From the menu -1- select the diagnostic function “03 - Final control diagnosis”.

– Keep tapping → key until camshaft control valves are activated.

- Camshaft control valves should click.

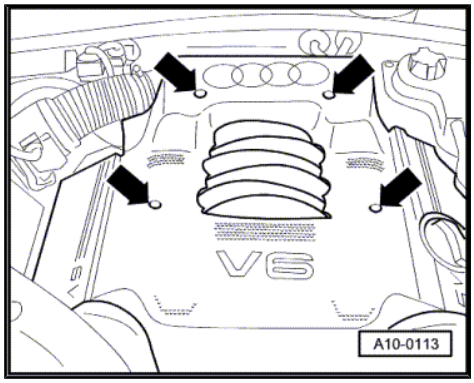
– Press ← key to exit “03 - Final control diagnosis” function.

– Switch off ignition.

If one of the valves is not activated (does not click):

Checking internal resistance

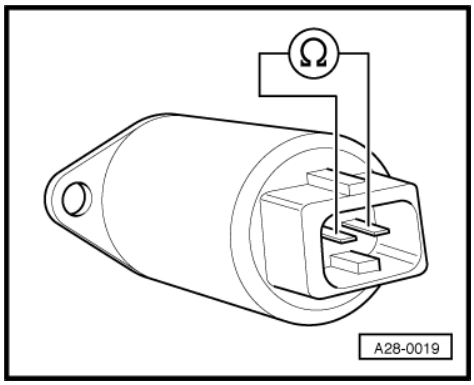
– Take off engine cover panel -arrows-.



– Unplug electrical connector at relevant solenoid valve.
– Connect multimeter (resistance measuring range) to valve.
• Specification: 10 ... 18 Ω.

If specification is not obtained:

– Renew solenoid valve.

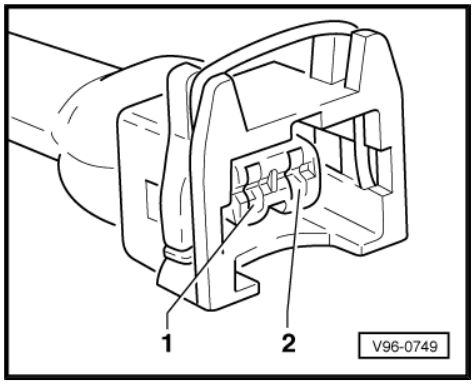


Checking voltage supply

• Fuse for camshaft control valves OK ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
• Fuel pump relay - J17- OK.

Note

The camshaft control valves are supplied with power via the fuel pump relay.



– Unplug electrical connector at relevant solenoid valve.
– Connect voltage tester - V.A.G 1527 B- between contact -1- and earth.
– Operate the starter briefly.
• The LED should light up.

If LED does not light up:

– Check for open circuit in wiring from contact 1 of connector via fuse to fuel pump relay ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
– Eliminate open circuit in wiring if necessary.

If the LED lights up:

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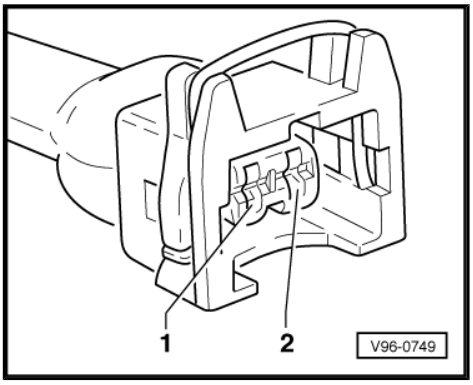
Checking activation



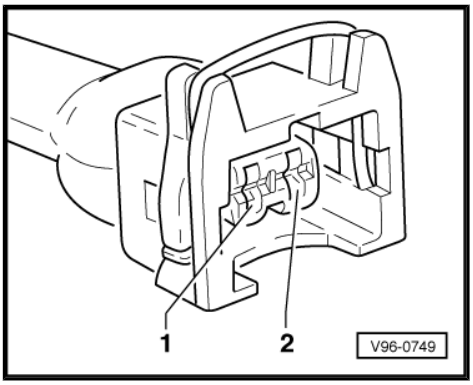
– Connect voltage tester - V.A.G 1527 B- to contacts -1- (plus) and -2- of the connector.
– Repeat function “03 - Final control diagnosis”.
– Keep tapping ⇨ key until camshaft control valves are activated.

• The LED should flash.

– Press ⇦ key to exit “03 - Final control diagnosis” function.
– Switch off ignition.

If the LED does not flash or lights up continuously:

– Connect test box - V.A.G 1598/22- or -V.A.G 1598/31- to wiring harness for engine control unit, but do not connect the engine control unit itself ⇒ Rep. gr. 24 .



– Check for open circuit and short to earth/positive in the following wiring from inlet camshaft control valve 1 - N205- or inlet camshaft control valve 2 - N208- :

Vehicles with throttle cable:

Connector Contact	Test box - V.A.G 1598/22- Socket
-2-	55

Vehicles with electronic throttle:

Connector Contact	Test box - V.A.G 1598/31- Socket
-2-	115

All vehicles:

– Repair wiring connection if necessary.

If wiring is OK:

– Fit a new engine control unit ⇒ Rep. gr. 24 .

If no fault is found:

– Renew mechanical camshaft adjuster
⇒ “2.6 Removing and installing camshafts and camshaft adjuster”, page 99 .

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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, and the oil cooler must be renewed 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.*
- *Oil spray jet for piston cooling ⇒ page 124 .*

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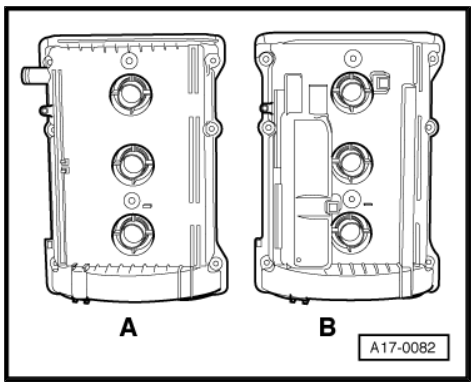
Viscosity grades and oil specifications ⇒ Maintenance ; Booklet 802 .

Oil capacities ⇒ Maintenance tables .

1.1 Different oil circuits

The new features of “engine generation III” as opposed to “engine generation II” are as follows:

- Chain-driven oil pump beneath crankshaft drive.
- Modified front sealing flange.
- Modified oil routing in cylinder head; originally with oil supply lines on camshaft bearing caps, subsequently replaced by integrated oil passages in camshaft bearing caps
- Modified sump (top section) with liquid gasket.



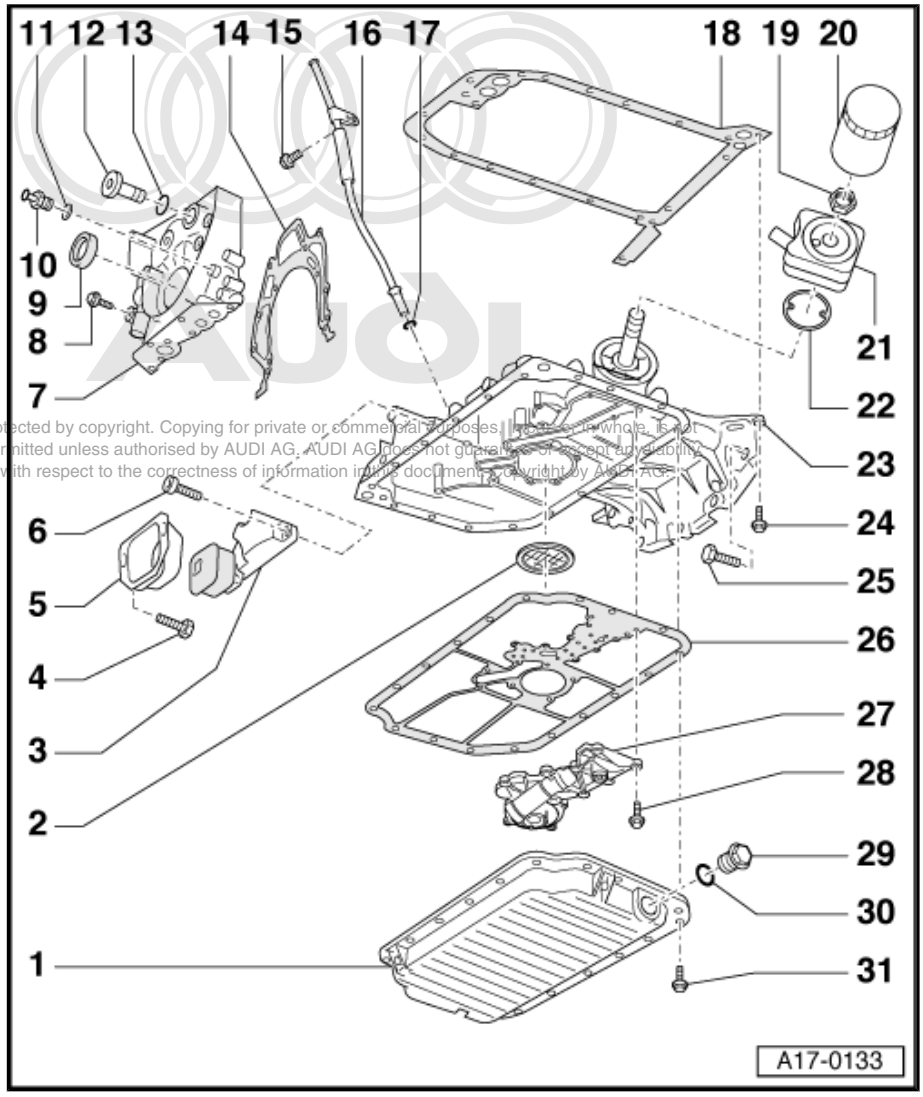
Distinguishing feature

An external distinguishing feature of the “engine generations II” and “III” is the shape of the cylinder head cover:

A - “Engine generation II” (to approx. 04.1997)

B - “Engine generation III” (from approx. 04.1997 onwards)

1.2 Exploded view of lubrication system - “engine generation II”



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1 - Sump (bottom section)

- ❑ Removing ⇒ page 124
- ❑ Installing ⇒ “1.5 Installing sump (bottom section) - engines with moulded gasket”, page 126

2 - Oil strainer

- ❑ Engages in 3 lugs in top section of sump

3 - Torque reaction support

4 - 28 Nm

5 - Stop for torque reaction support

- ❑ Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight, and tighten bolts to 28 Nm.

6 - 40 Nm

7 - Oil pump

- ❑ Removing and installing ⇒ page 140

8 - 10 Nm

9 - Oil seal

- ❑ For crankshaft
- ❑ Removing and installing ⇒ page 41

10 - Oil temperature sender - G8- , 10 Nm

11 - Seal

- ❑ If seal is leaking, cut open and renew

12 - Spray nozzle valve, 40 Nm

13 - O-ring

- ❑ Renew

14 - Gasket

- ❑ Renew

15 - 22 Nm

16 - Guide tube for oil dipstick

17 - O-ring

- ❑ Renew

18 - Gasket

- ❑ Renew
- ❑ Install dry
- ❑ It is not necessary to apply additional sealant

19 - 30 Nm

20 - Oil filter - 20 Nm

- ❑ Observe change intervals ⇒ Maintenance ; Booklet 802
- ❑ Loosen with oil filter wrench - 3417-

- ❑ Observe installation instructions on oil filter
- ❑ After installing new oil filter, check clearance of hoses from oil cooler with respect to adjacent components and correct position of oil cooler if necessary

21 - Oil cooler

- ❑ See note ⇒ page 120

22 - Gasket

- ❑ Renew
- ❑ Engage in lugs on oil cooler

23 - Sump (top section)

- ❑ Removing ⇒ page 128
- ❑ Installing ⇒ “1.8 Installing sump (top section) - engine generation II ”, page 138

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24 - 10 Nm

- ❑ Tighten in stages and in diagonal sequence

25 - 45 Nm

26 - Gasket

- ❑ Renew
- ❑ Replacement involves removing ⇒ Item 27 (page 122)

27 - Cover plate

28 - 10 Nm

29 - Oil drain plug, 30 Nm

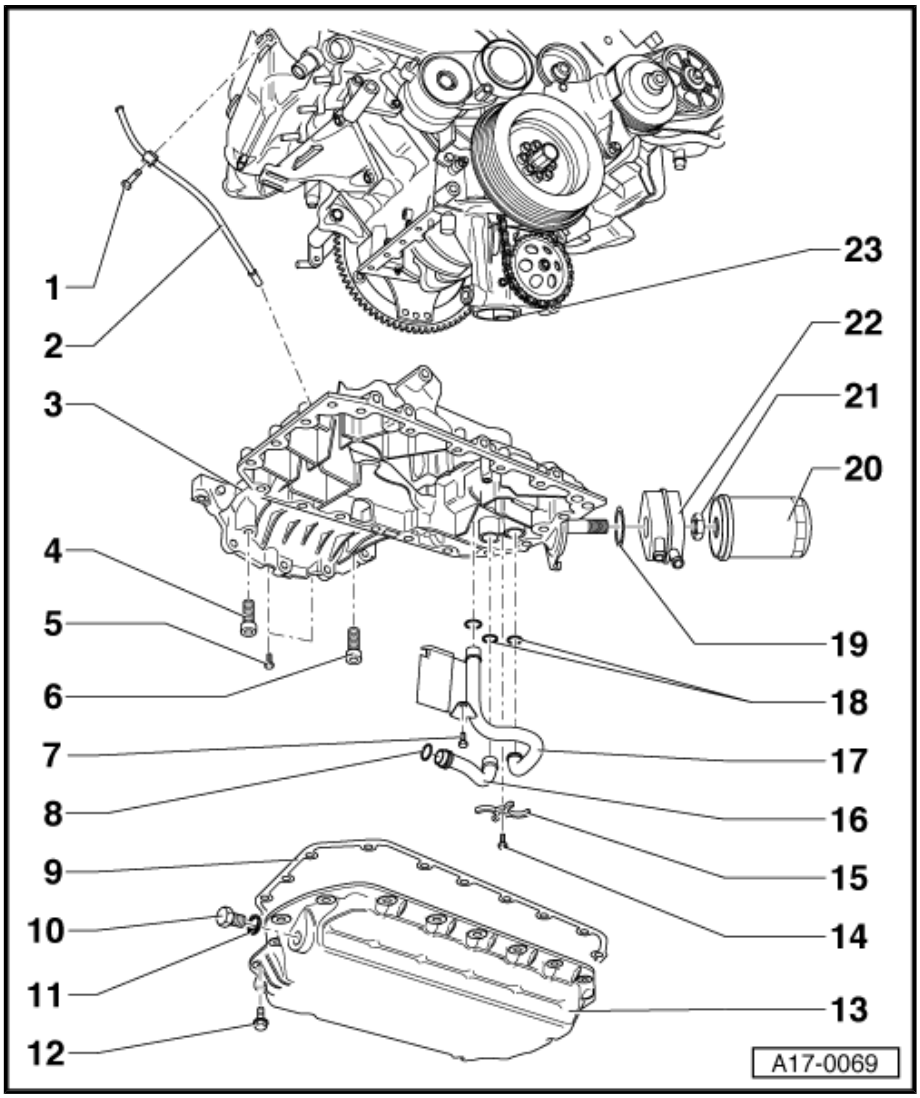
30 - Seal

- ❑ Renew

31 - 10 Nm

- ❑ Tighten in stages and in diagonal sequence

1.3 Exploded view of lubrication system - “engine generation III”



1 - 22 Nm

2 - Guide tube for oil dipstick

3 - Sump (top section)

- ❑ Fitted with liquid gasket
- ❑ Removing ⇒ page 128
- ❑ Installing ⇒ “1.9 Installing sump (top section) - engine generation III ”, page 139

4 - M8 - 22 Nm

5 - M6 - 10 Nm; M7 - 16 Nm

6 - M8 - 22 Nm

7 - 10 Nm

8 - O-ring

- ❑ Renew

9 - Gasket

- ❑ Moulded gasket (to approx. 09.98)
- ❑ Renewing ⇒ “1.5 Installing sump (bottom section) - engines with moulded gasket”, page 126
- ❑ Liquid gasket (from approx. 10.1998 onwards)
- ❑ Renewing ⇒ “1.6 Installing sump (bottom section) - engines with liquid gasket”, page 127

10 - Oil drain plug, 30 Nm

11 - Seal

- ❑ Renew

12 - 10 Nm

13 - Sump (bottom section)

- ❑ Removing ⇒ page 124
- ❑ Installing ⇒ “1.5 Installing sump (bottom section) - engines with moulded gasket”, page 126 or ⇒ “1.6 Installing sump (bottom section) - engines with liquid gasket”, page 127

14 - 10 Nm

15 - Bracket for oil pipes

16 - Oil supply pipe

- ❑ From pump to oil filter

17 - Oil supply pipe

- ❑ From oil filter to engine oil circuit

18 - O-ring

- ❑ Renew

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19 - Seal

- ❑ Renew
- ❑ Engage in lugs on oil cooler

20 - Oil filter

- ❑ Observe change intervals ⇒ Maintenance ; Booklet 802
- ❑ Loosen with oil filter wrench - 3417-
- ❑ Observe installation instructions on oil filter
- ❑ After installing new oil filter, check clearance of hoses from oil cooler with respect to adjacent components and correct position of oil cooler if necessary
- ❑ Tighten to 20 Nm

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21 - 30 Nm

22 - Oil cooler

- ❑ See note ⇒ page 120

23 - Oil pump

- ❑ Components ⇒ page 124
- ❑ Chain-driven off crankshaft
- ❑ Removing and installing ⇒ page 143

Oil pump components

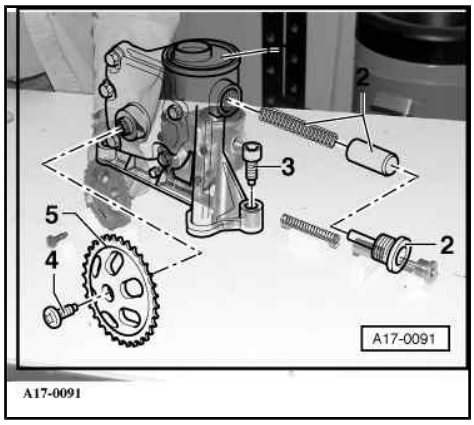
1 - Oil pump (cannot be dismantled)

2 - Pressure control valve, 40 Nm

3 - 22 Nm

4 - 25 Nm

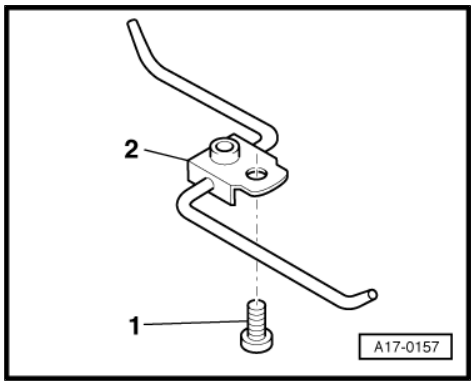
5 - Chain sprocket



Oil spray jet

1 - Bolt, 10 Nm

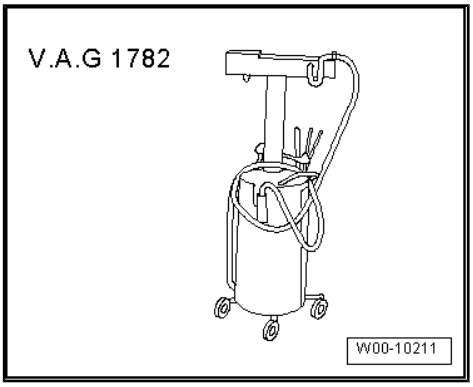
2 - Oil spray jet for piston cooling



1.4 Removing sump (bottom section)

Special tools and workshop equipment required

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

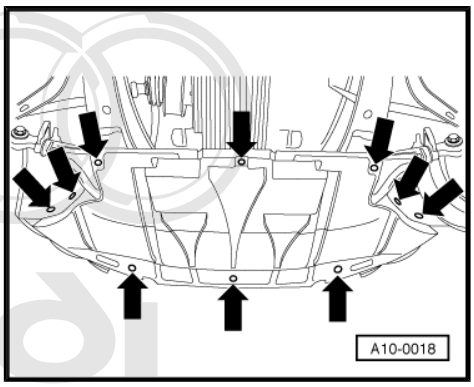


Procedure

– Remove noise insulation -arrows-.

– Place used oil collection and extraction unit - V.A.G 1782- under engine.

– Drain off engine oil.



– Unscrew both support brackets -2- for anti-roll bar from subframe.

– Lower anti-roll bar by max. 10 cm and secure with welding wire or similar.

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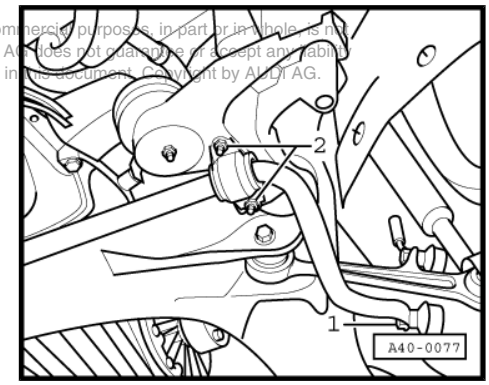
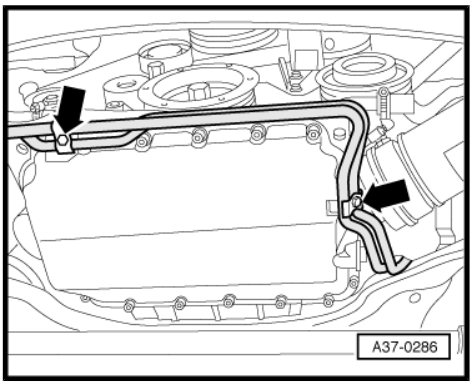


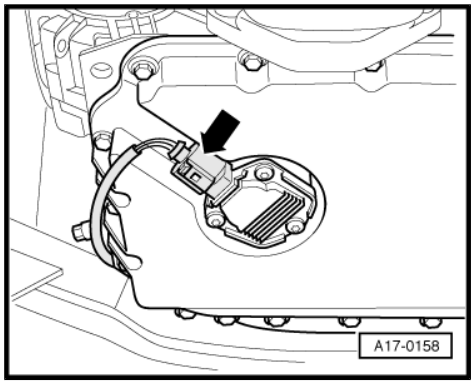
Vehicles with automatic gearbox:

– Remove bracket for ATF lines -arrows-.



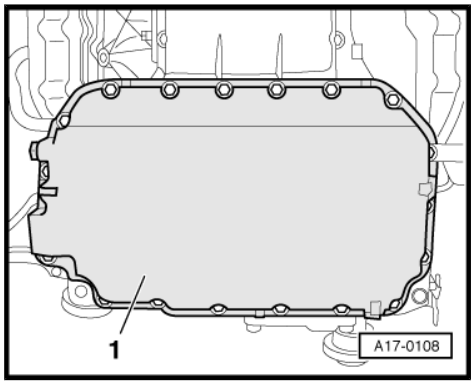
All vehicles:

– If fitted, unplug electrical connector at oil level/temperature sender - G266- -arrow- and move wiring clear.



– Place drip tray for engine oil under the engine (more oil will drain out).

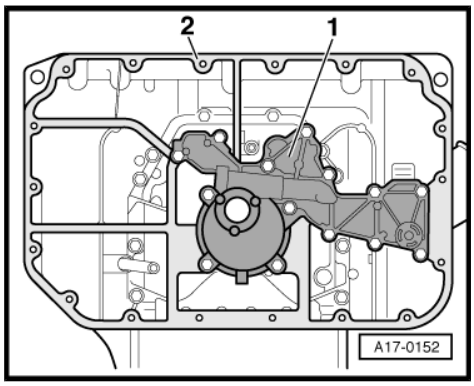
– Unbolt sump (bottom section) -1- and remove it carefully.



Vehicles with “engine generation II”:

– Unscrew cover plate -1-.

– Remove gasket -2-.



1.5 Installing sump (bottom section) - engines with moulded gasket

Procedure

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

Note

Renew gaskets and seals.

Caution

It is essential to use a moulded gasket again if sump (bottom section) was previously fitted with such a gasket.

– Clean sealing surfaces before installing sump (bottom section).

Vehicles with "engine generation II":

– Fit gasket -2- for sump (bottom section).

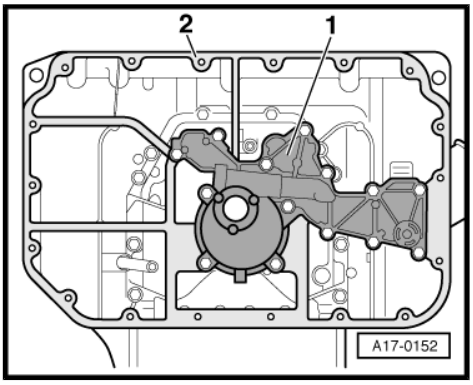
– Screw on cover plate -1-.

All vehicles:

– Fit sump (bottom section) and tighten all bolts initially to 5 Nm in diagonal sequence.

– Tighten bolts on sump (bottom section) in diagonal sequence.

– Fill up with engine oil and check oil level ⇒ page 150 .



Tightening torques

Component	Nm
Cover plate to sump (top section)	10
Sump (bottom section) to sump (top section)	10
Oil drain plug	30

1.6 Installing sump (bottom section) - engines with liquid gasket

Special tools and workshop equipment required

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

Procedure

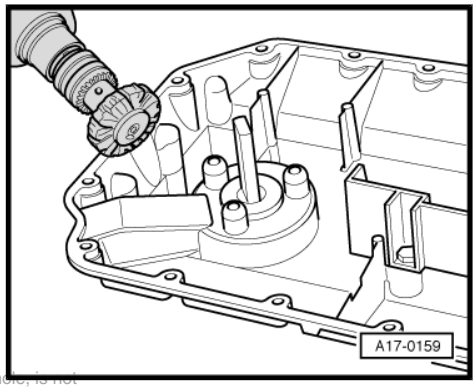
Note

Renew seals.

Caution

It is essential to use a liquid gasket again if sump (bottom section) was previously fitted with such a gasket.

– Remove sealant residue from bottom section of sump and top section of sump with rotating plastic brush or similar.



WARNING

Wear safety goggles.

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

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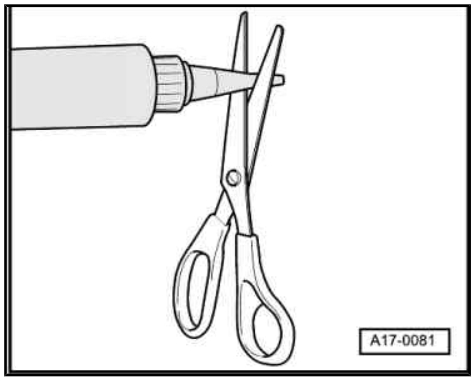
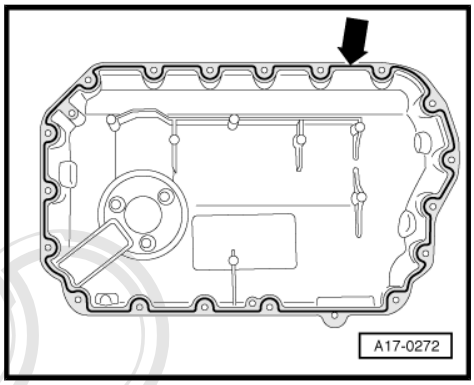
– Cut off tube nozzle at front marking (diameter of nozzle approx. 3 mm).



– Apply sealant bead to clean sealing surface of bottom section of sump, as shown in illustration.

• The bead of sealant should be approx. 1.5 mm wide -arrow-.



Note

◆ *The sump (bottom section) must be installed within 5 minutes after applying sealant.*

◆ *The sealant bead must not be thicker than specified, otherwise excess sealant could enter the sump and clog the strainer in the oil pump.*

– Fit sump (bottom section) and tighten all bolts initially to 5 Nm in diagonal sequence.

– Tighten bolts on sump (bottom section) in diagonal sequence.

– Fill up with engine oil and check oil level ⇒ page 150 .

Tightening torques

Component	Nm
Sump (bottom section) to sump (top section)	10
Oil drain plug	30

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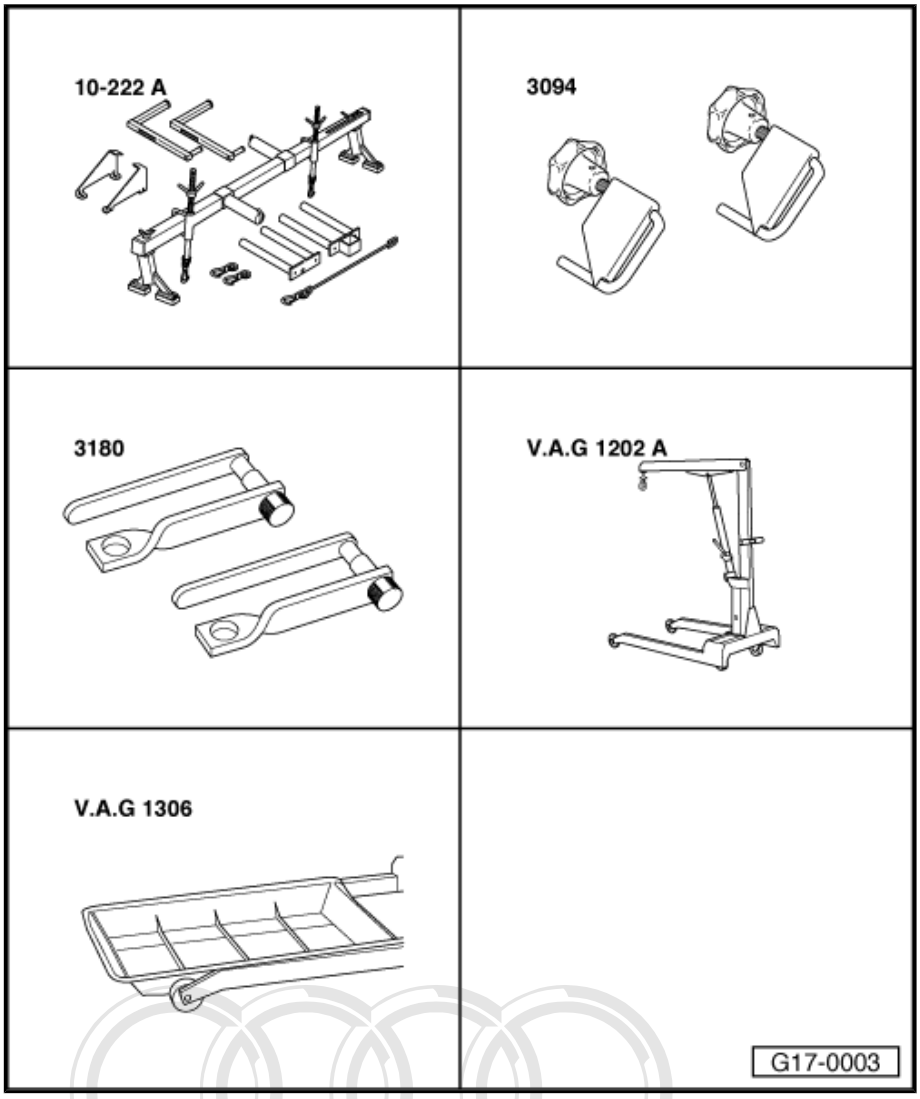
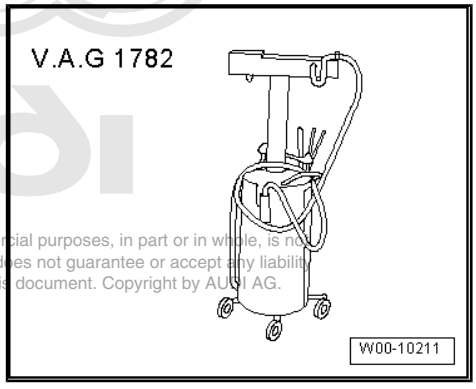
1.7 Removing sump (top section)

Special tools and workshop equipment required

- Support bracket - 10-222 A- and adapter - 10-222 A/4-
- Hose clamps up to Ø 25 mm - 3094-
- Retainer - 3180-
- Workshop hoist - VAS 6100- or -V.A.G 1202 A-
- Drip tray for workshop hoist - VAS 6208- or -V.A.G 1306-



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



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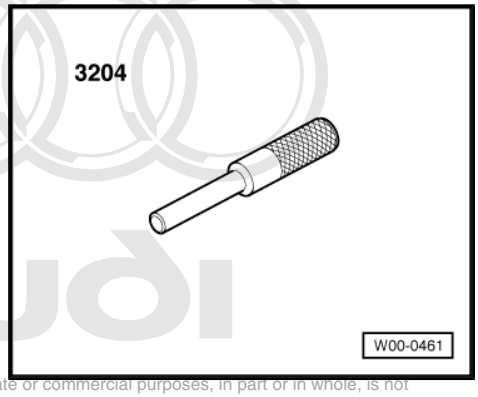
♦ Locking pin - 3204-



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♦ TORX wrench T45

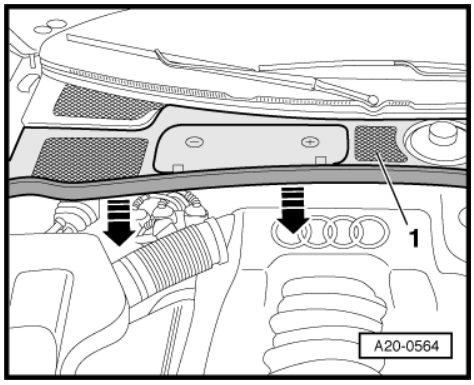
Procedure

Caution

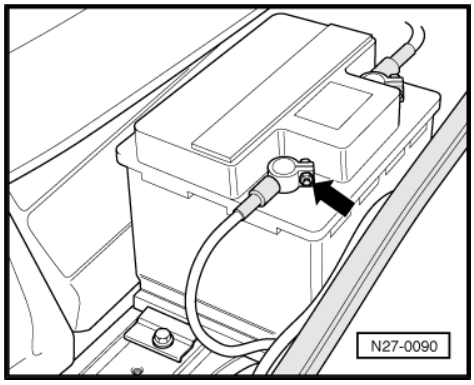
Observe notes on procedure for disconnecting the battery ⇒ Rep. gr. 27 .

– Detach rubber seal from plenum chamber cover in direction of -arrow-.

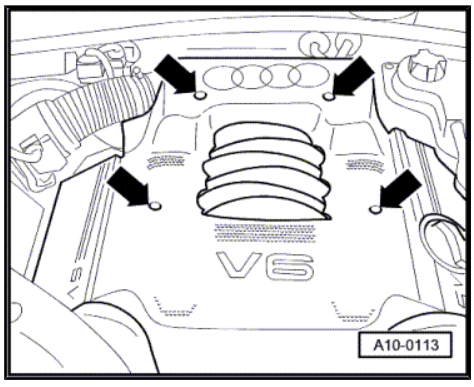
– Detach plenum chamber cover -1- towards the front.



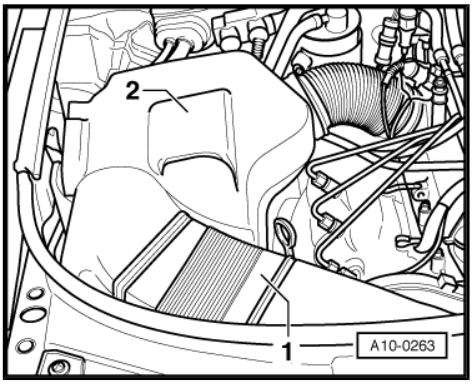
– With ignition switched off, disconnect battery earth cable -arrow-.



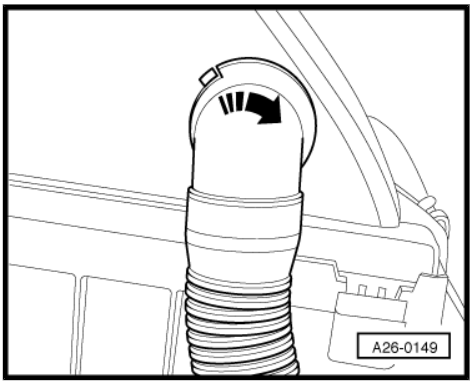
– Remove engine cover panel -arrows-.



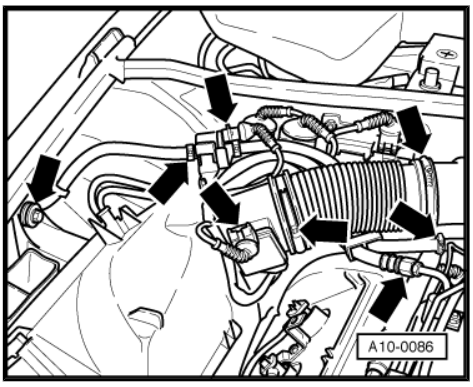
– Detach cover -2- from air cleaner.
– Unbolt air duct -1- for air cleaner at lock carrier and lift out.



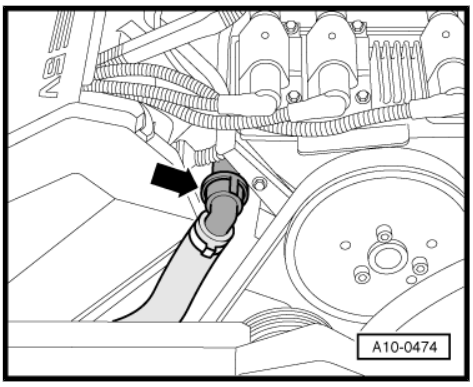
– On vehicles with secondary air system, turn connecting pipe through 45° to the right -arrow- and detach from air cleaner housing.



– Remove air intake hose between air mass meter - G70- and air intake elbow.
– Unplug electrical connector at solenoid valve 1 for activated charcoal filter system - N80- and detach solenoid valve from bracket.
– Detach electrical connector at air mass meter - G70- .
– Unscrew and remove air cleaner housing.



– On vehicles with secondary air system, disconnect hose -arrow- from secondary air connecting pipe.



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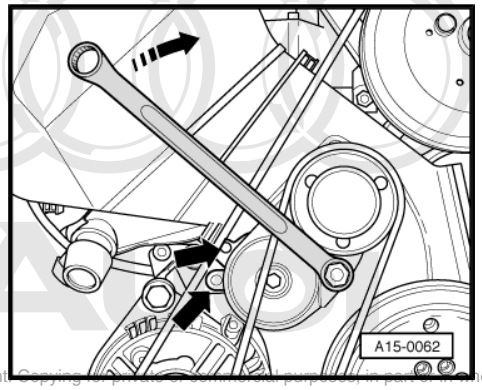
Tensioning roller with hexagon flats:



Note

Before removing, mark direction of rotation of poly V-belt with chalk or 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 17 mm ring spanner to slacken the poly V-belt.
- Lock tensioner in position by inserting locking pin - 3204- in locating holes -arrows-.
- Guide poly V-belt over viscous fan and detach belt.

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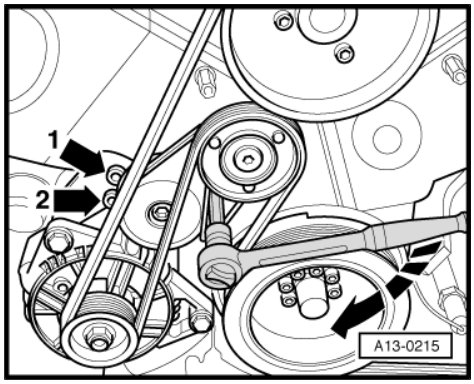
Tensioning roller with hexagon socket:



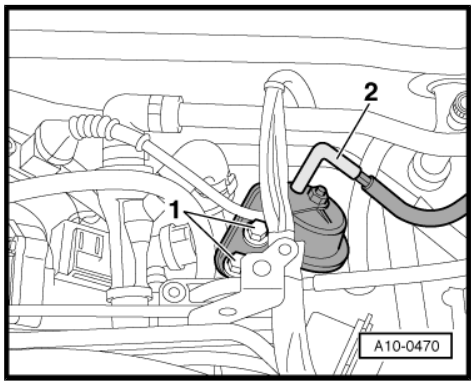
Note

Before removing, mark direction of rotation of poly V-belt with chalk or 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 10 mm hexagon key to slacken the poly V-belt.
- Lock tensioner in position by inserting locking pin - 3204- in locating holes -arrow 1- and -arrow 2-.
- Guide poly V-belt over viscous fan and detach belt.

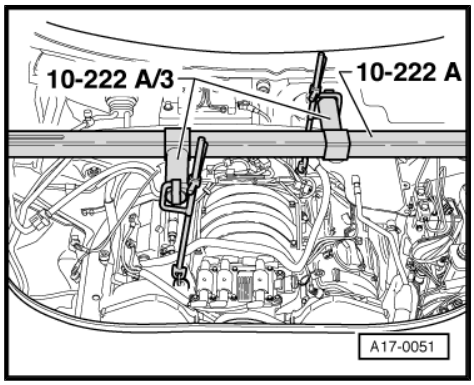
Vehicles with throttle cable and cruise control system:

- Detach vacuum hose -2- at vacuum unit for cruise control.
- Unscrew bolts -1- and move vacuum unit downwards.

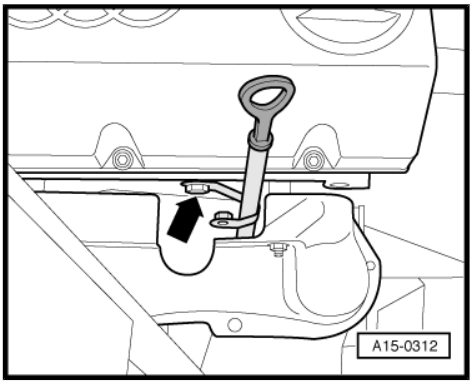


All vehicles:

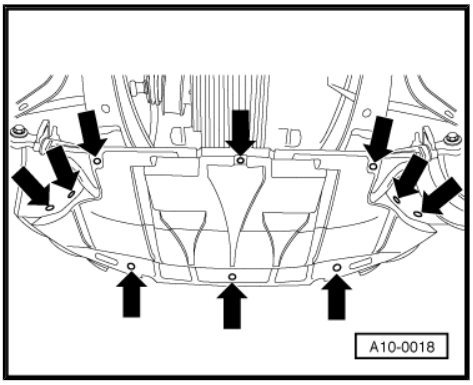
- Set up support bracket - 10-222 A- with adapter - 10-222 A/3- on wing panel flanges.
- Connect support bracket to front and rear lifting eyes on engine.
- Raise engine as far as possible with spindles of support bracket.



– Unbolt dipstick guide tube on cylinder head -arrow- and lift out upwards.



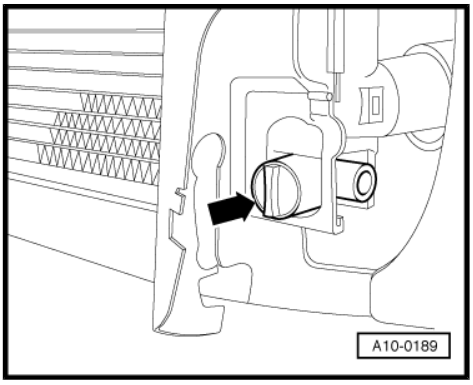
– Remove noise insulation -arrows-.
– Place used oil collection and extraction unit - V.A.G 1782- under engine.
– Drain off engine oil.
– Remove front bumper ⇒ Rep. gr. 63 .
– Move lock carrier to service position ⇒ Rep. gr. 50 .



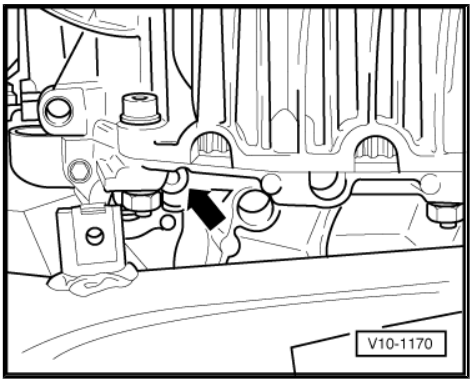
WARNING

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

– Open filler cap on coolant expansion tank.
– Place drip tray for workshop hoist - VAS 6208- under engine.
– Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.



– Also open coolant drain plug on engine -arrow-.
– Drain off coolant.



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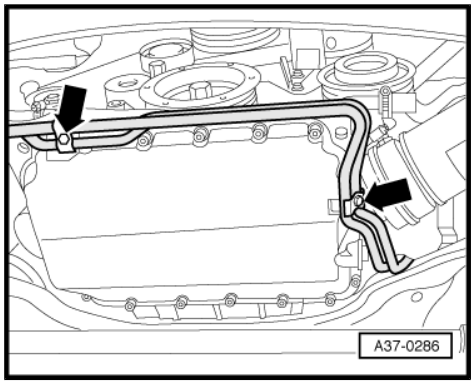
Vehicles with automatic gearbox:

– Remove bracket for ATF lines -arrows-.



All vehicles:

– If fitted, unplug electrical connector -arrow- at oil level/temperature sender - G266- and move wiring clear.

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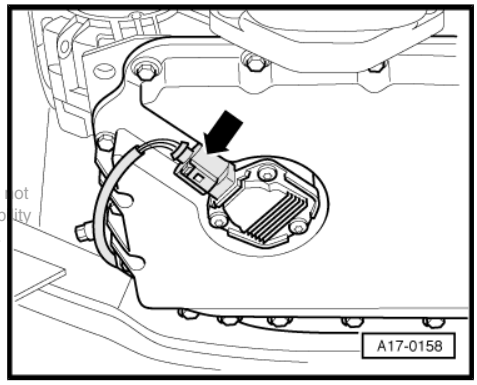
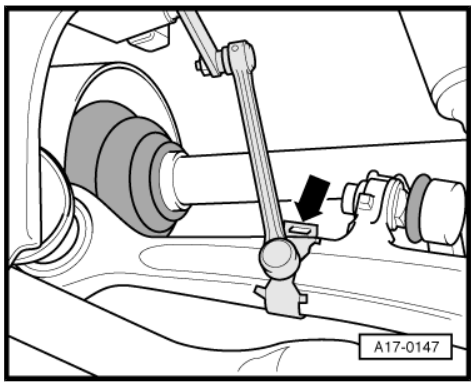
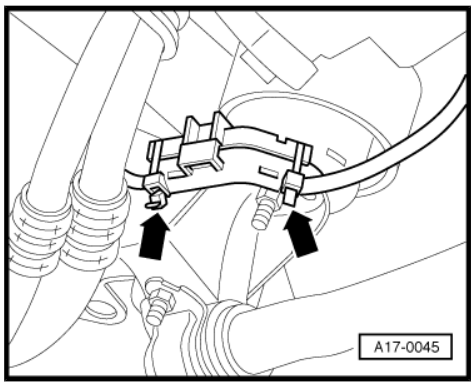


– If fitted, unclip actuator rod for vehicle level sender at bottom transverse link -arrow-.

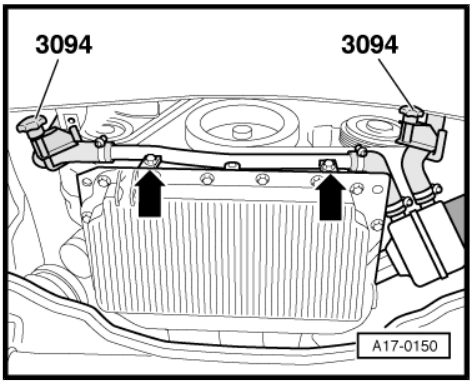


– Cut through cable ties -arrows-. Open retainer for starter wiring and take out wiring.

– Unbolt torque reaction support and stop for torque reaction support.



– Clamp off both coolant hoses leading to oil cooler with hose clamps - 3094- .
– Place drip tray for workshop hoist - VAS 6208- under engine.
– Unscrew coolant pipe -arrows- and detach it from hoses.
– Unplug connector at oil pressure switch - F1- and move wiring clear.

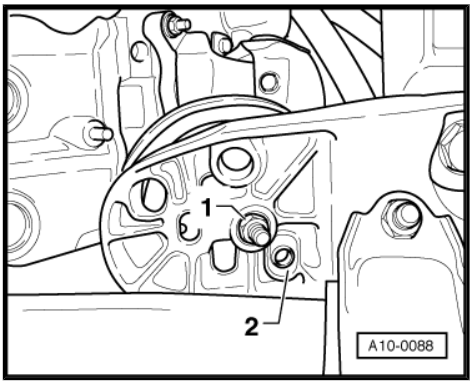


– Mark positions of bolt connections -1- and locating sleeves -2- on bottom of engine mounts (left and right).

Note

Different mounting holes are provided for the different engine versions.

– Remove bottom nut -1- at engine mounting (left and right).
– Remove engine mounting (left-side).

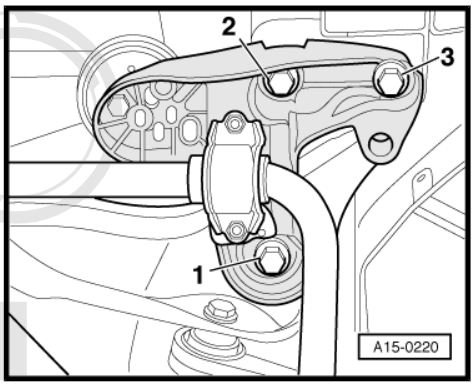


– First remove front subframe bolts -2- and -3- (left and right). Then remove bolts -1-.

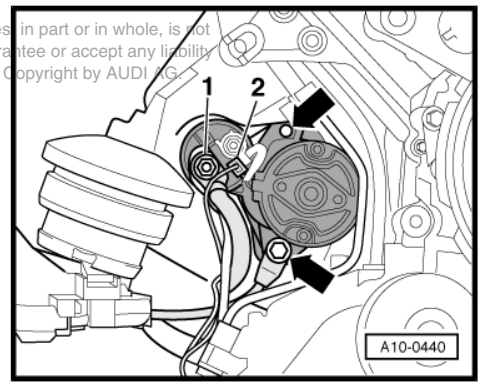
Note

To avoid having to check and adjust wheel alignment, only loosen the front subframe mountings and lower the subframe at the front.

– Pivot anti-roll bar downwards.



– Detach wires -1- and -2- at starter and detach insulator at positive connection of starter.
– Remove starter bolts -arrows- from gearbox side.
– Unscrew clamp on right of top section of sump and move electrical wiring clear.
– Detach starter.



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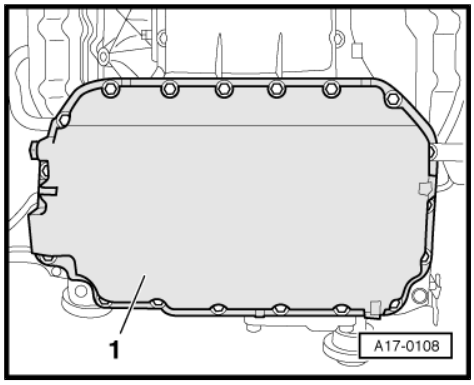
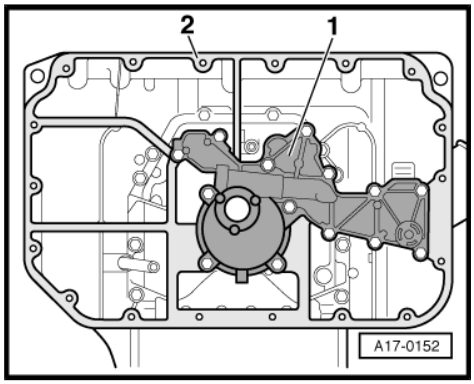
– Remove sump (bottom section) -1-.



Vehicles with “engine generation II”:

– Unscrew cover plate -1-.

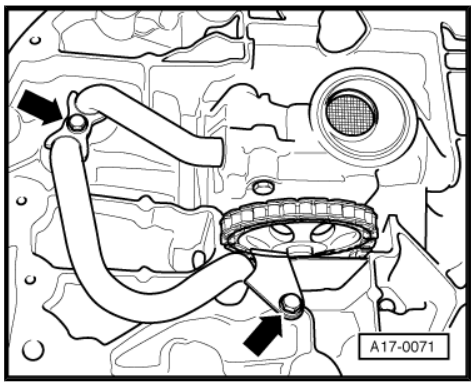
– Remove gasket -2-.



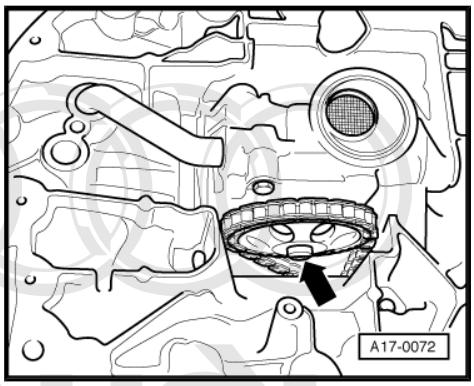
Vehicles with “engine generation III”:

– Place used oil collection and extraction unit - V.A.G 1782- under engine.

– Unbolt brackets -arrows- and pull off long oil supply pipe from below.



– Unscrew chain sprocket using TORX wrench T45 -arrow- and pull it off oil pump.



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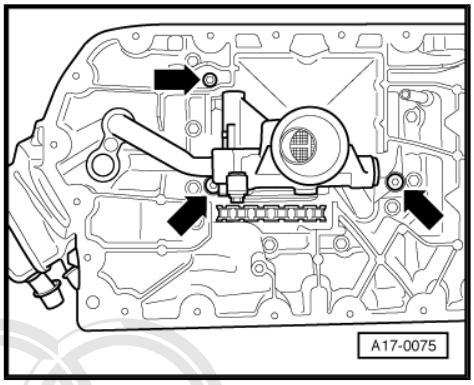
– Remove oil pump together with short oil supply pipe -arrows-.



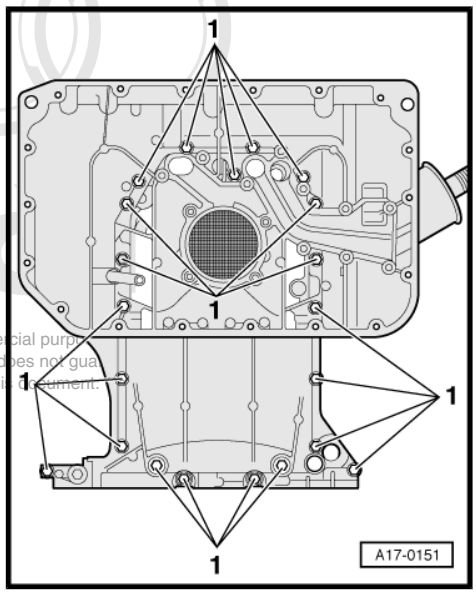
All vehicles:

– Unscrew engine/gearbox securing bolts in area of sump (top section).

– Unscrew bolts -1- for sump (top section).

– Press sump (top section) off spring pins on cylinder block.

– Remove sump (top section).



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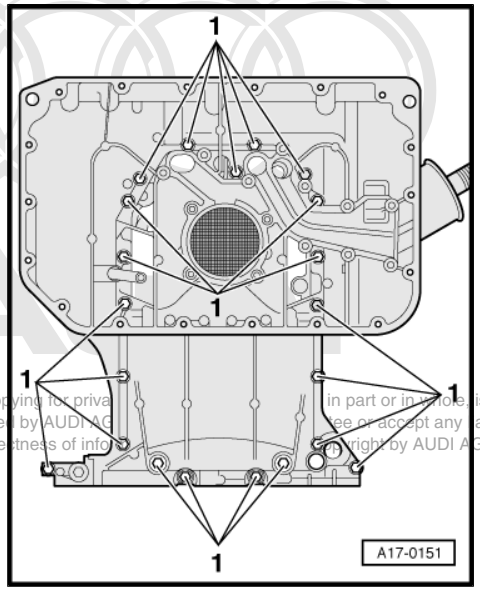
1.8 Installing sump (top section) - “engine generation II”

Procedure



Note

Renew self-locking nuts, gaskets and seals.

- Clean sealing surfaces before installing sump (top section).
- Fit sump (top section) and tighten bolts -1- securing sump (top section) to cylinder block initially to 5 Nm in diagonal sequence.
- Tighten bolts securing sump (top section) to gearbox.
- Tighten bolts securing sump (top section) to cylinder block diagonally to final setting.

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

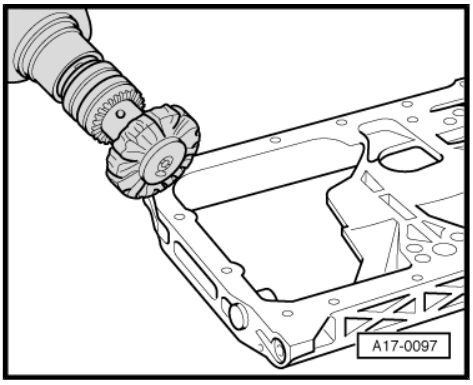
- Install sump (bottom section) ⇒ “1.5 Installing sump (bottom section) - engines with moulded gasket”, page 126 .
- Install subframe (note tightening sequence) ⇒ Rep. gr. 40 .
- Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten bolts.
- Fill up with engine oil and check oil level ⇒ page 150 .
- Observe notes on procedures required after connecting battery ⇒ Rep. gr. 27 .
- Fill cooling system ⇒ page 155 .

Tightening torques

Component	Nm
Sump (top section) to cylinder block	10
Sump (top section) to gearbox	45
Oil cooler to sump (top section)	30
Engine mounting to subframe	25
Torque reaction support to top section of sump	40
Stop for torque reaction support to lock carrier	28
Vacuum unit for cruise control to intake manifold	10

1.9 Installing sump (top section) - “engine generation III”

Procedure



Note

Renew self-locking nuts, gaskets and seals.

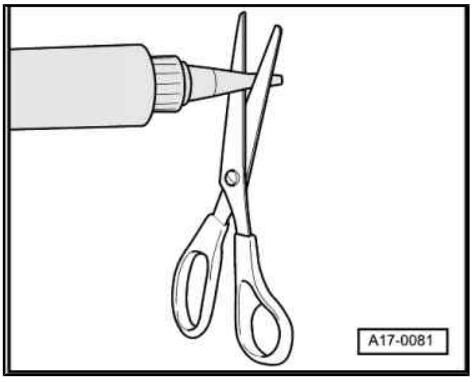
– Remove sealant residue from sump (top section) and cylinder block with rotating plastic brush or similar.

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. 3 mm).



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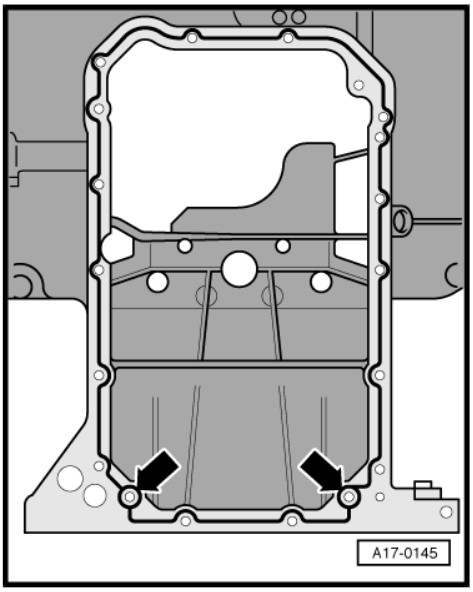
– Apply sealant bead to clean sealing surface of top section of sump, as shown in illustration.

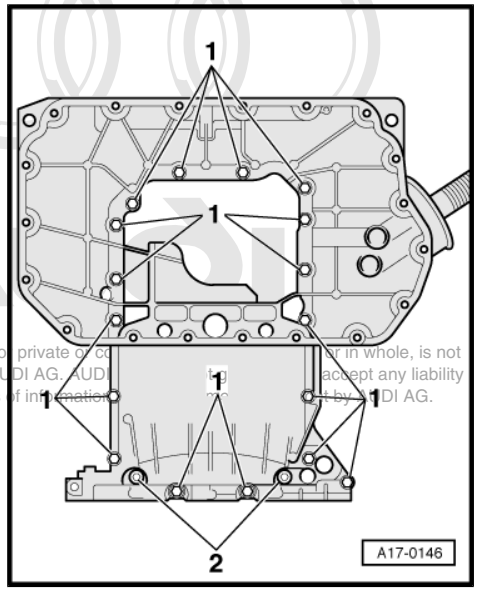
- Thickness of sealant bead: 2 ... 3 mm



Note

- *The sump (top section) must be installed within 5 minutes after applying sealant.*
- *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-.*

– Fit top section of sump in position (2nd mechanic required) and pre-tighten bolts -1- and -2- securing top section of sump to cylinder block diagonally to 5 Nm.
– Tighten bolts securing sump (top section) to gearbox.
– Tighten bolts securing sump (top section) to cylinder block diagonally to final setting.



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

– Install oil pump ⇒ page 143 .
– Install sump (bottom section) ⇒ “1.5 Installing sump (bottom section) - engines with moulded gasket”, page 126 or ⇒ “1.6 Installing sump (bottom section) - engines with liquid gasket”, page 127 .
– Install subframe (note tightening sequence) ⇒ Rep. gr. 40 .
– Renew O-ring on guide tube for oil dipstick and insert guide tube into hole in top section of sump.
– Install starter ⇒ Rep. gr. 27 .
– Install poly V-belt ⇒ page 31 .
– Allow stop for torque reaction support to rest on rubber buffer for torque reaction support under its own weight and tighten bolts.
– Fill up with engine oil and check oil level ⇒ page 150 .
– Observe notes on procedures required after connecting battery ⇒ Rep. gr. 27 .
– Fill cooling system ⇒ page 155 .

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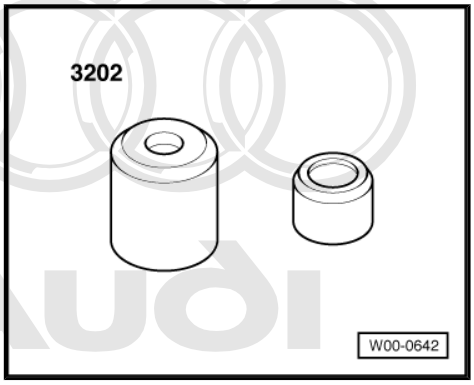
Tightening torques

Component		Nm
Sump (top section) to cylinder block	M6	10
	M7	16
	M8	22
Sump (top section) to gearbox		45
Oil cooler to sump (top section)		30
Engine mounting to subframe		25
Torque reaction support to top section of sump		40
Stop for torque reaction support to lock carrier		28
Vacuum unit for cruise control to intake manifold		10

1.10 Removing and installing oil pump - “engine generation II”

Special tools and workshop equipment required

♦ Fitting sleeves - 3202/1-



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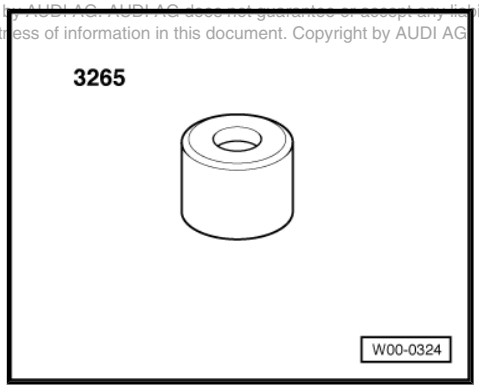
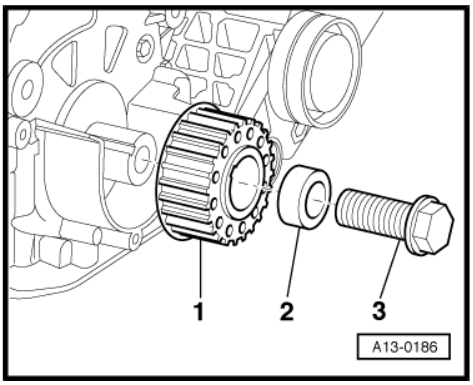
♦ Fitting sleeve - 3265-

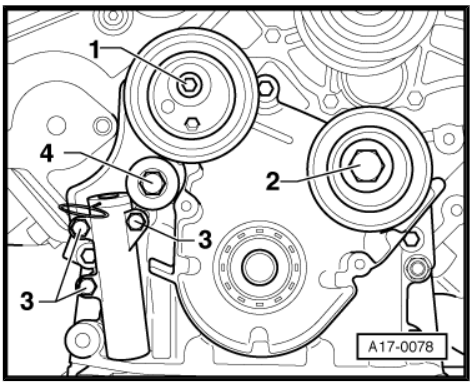


Removing

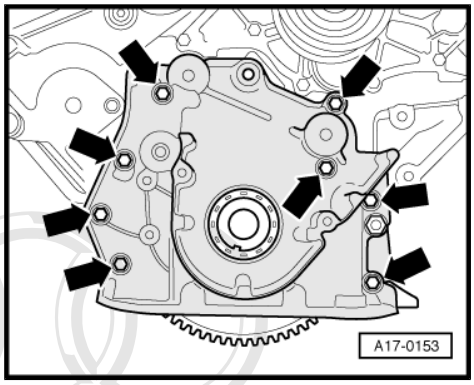
– Remove toothed belt ⇒ page 34 .
– Unscrew central bolt -3- for crankshaft sprocket -1-.
– Detach spacer -2- and toothed belt sprocket.
– Remove top section of sump ⇒ page 128 .



– Remove idler roller -2-, tensioning roller -1-, tensioning lever -4- and tensioner -3-.
– Unscrew spray nozzle valve ⇒ Item 12 (page 121) .



– Unplug connector at oil temperature sender.
– Unscrew bolts -arrows-.
– Detach oil pump at front.
– Drive out oil seal with oil pump removed.



Installing

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

Note

Renew gaskets and seals.

– Clean sealing surfaces before installing oil pump.
– Fit oil pump so that it engages in drive lugs on crankshaft.

Note

If the oil pump is installed with the oil seal already fitted, place fitting sleeve - 3202/1- on end of crankshaft before installing oil pump.

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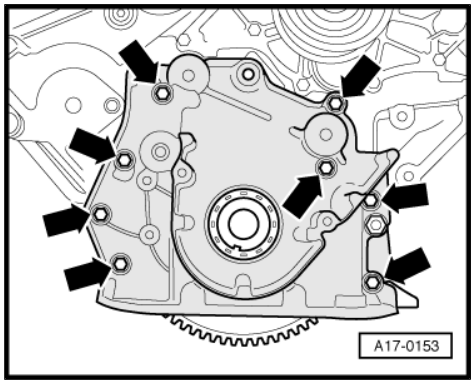
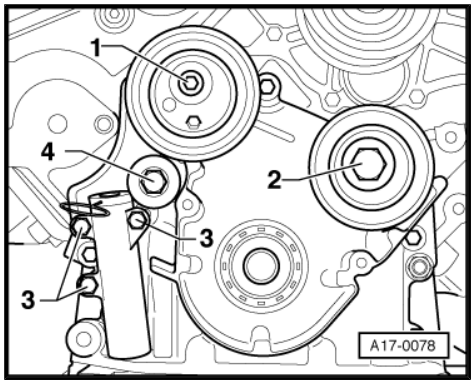
– Tighten bolts -arrows-.



– Install components in the following sequence:

1. Spray nozzle valve ⇒ Item 12 (page 121) .
2. Toothed belt tensioner -item 3-; apply locking fluid to bolts when installing; for locking fluid refer to ⇒ Parts catalogue
3. Tensioning lever -item 4-.
4. Toothed belt tensioning roller -item 1-.
5. Idler roller -item 2-.

– Pay attention to shims beneath tensioning roller and tensioning lever.

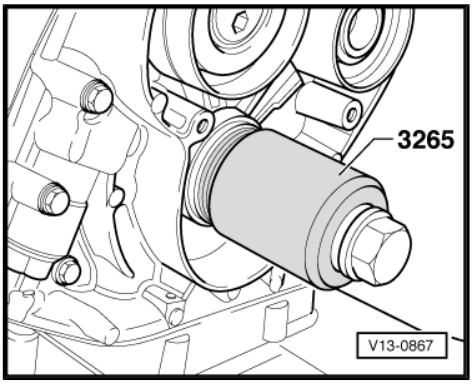


Note

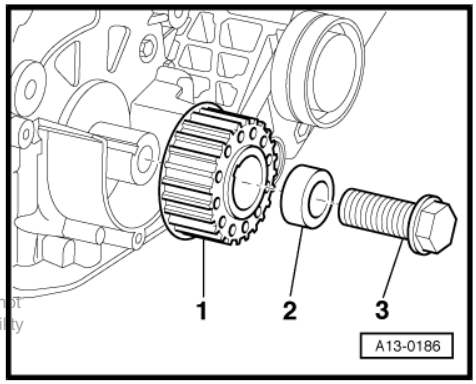
Do not lubricate sealing lip and outer rim of oil seal before pressing in.

– Push on oil seal using fitting sleeve - 3202/1- .

– Press in oil seal until flush using the centre bolt and fitting sleeve - 3265- .



– Install crankshaft sprocket -1- with spacer -2- and new central bolt -3-.



Note

- *Contact surface between toothed belt sprocket and crankshaft must be free of oil.*
- *Do not additionally lubricate bolt for crankshaft toothed belt sprocket.*

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– Install toothed belt (adjust valve timing) ⇒ page 37 .

– Install sump (top section)
⇒ “1.8 Installing sump (top section) - engine generation II ”, page 138 .

– Install sump (bottom section)
⇒ “1.5 Installing sump (bottom section) - engines with moulded gasket”, page 126 .

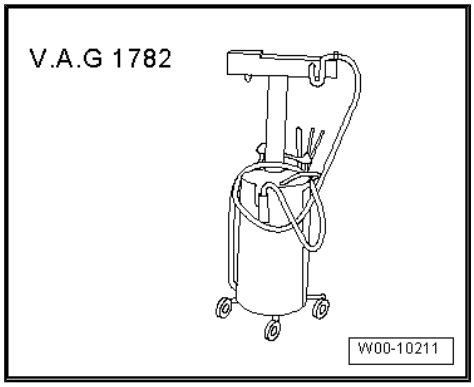
Tightening torques

Component	Nm
Oil pump to cylinder block	10
Toothed belt sprocket to crankshaft	200 + 180° 1)2)
Toothed belt tensioning roller to oil pump	22
Tensioning lever to oil pump	22
Tensioner to oil pump	10
Idler roller to oil pump	43
Spray nozzle valve	40
• 1) Renew bolt. • 2) 180° = one half turn.	

1.11 Removing and installing oil pump - “engine generation III”

Special tools and workshop equipment required

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



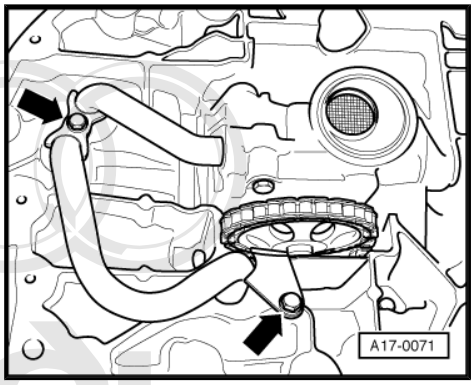
♦ TORX wrench T45

Removing

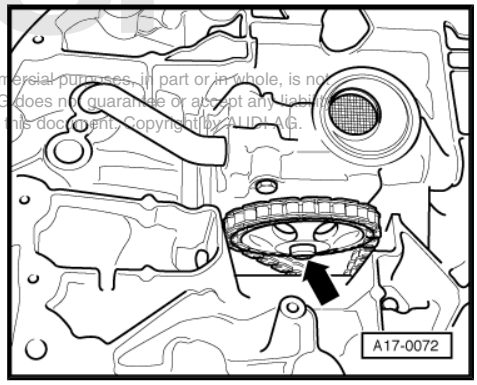
– Remove sump (bottom section) ⇒ page 124 .

– Place used oil collection and extraction unit - V.A.G 1782- under engine.

– Unbolt brackets -arrows- and pull off long oil supply pipe from below.



– Unscrew chain sprocket using TORX wrench T45 -arrow- and pull it off oil pump.



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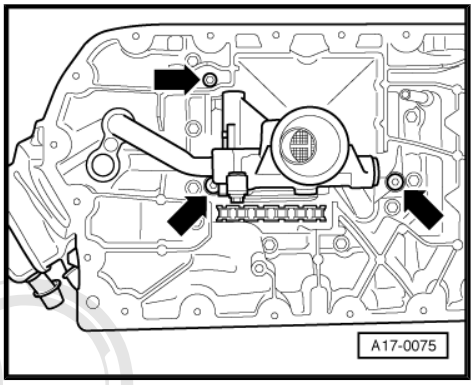
– Remove oil pump together with short oil supply pipe -arrows-.



Installing

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

- Chain sprocket can only be fitted in one position on oil pump shaft.

– Install sump (bottom section)
⇒ “1.5 Installing sump (bottom section) - engines with moulded gasket”, page 126 or
⇒ “1.6 Installing sump (bottom section) - engines with liquid gasket”, page 127 .

Tightening torques

Component	Nm
Oil pump to cylinder block	22
Chain sprocket to oil pump shaft	25
Bracket to sump (top section)	10

1.12 Checking chain tensioner - “engine generation III”

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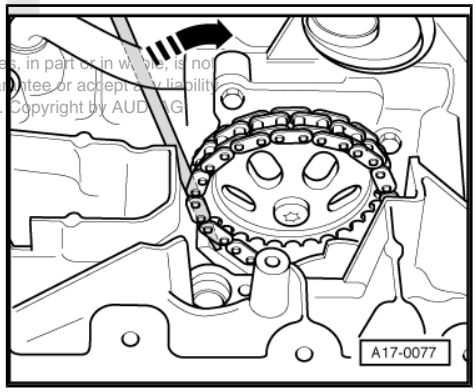
– Remove sump (bottom section) ⇒ page 124 .

– Insert screwdriver between chain and chain tensioner and lever screwdriver against tensioner in direction of -arrow-.



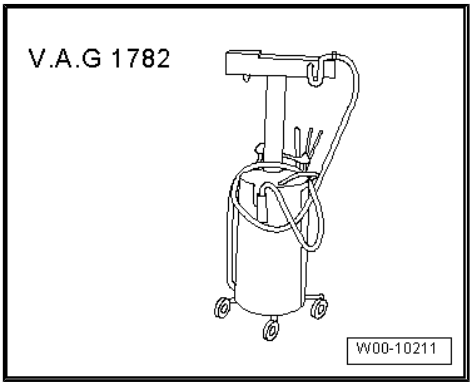
If spring tension is not felt and chain is not tensioned:

– Renew chain tensioner ⇒ page 145 .

1.13 Removing and installing chain/chain tensioner for oil pump - “engine generation III”

Special tools and workshop equipment required

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



♦ TORX wrench T45

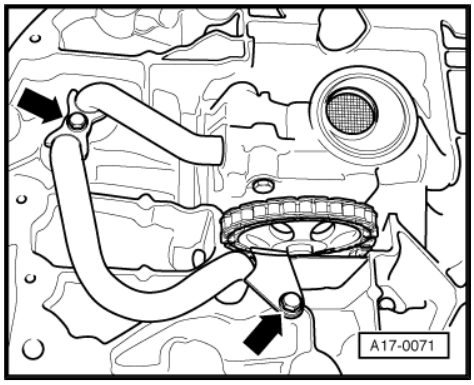
Removing

– Remove sump (bottom section) ⇒ page 124 .

– Remove sealing flange (front) ⇒ page 42 .

– Place used oil collection and extraction unit - V.A.G 1782- under engine.

– Unbolt brackets -arrows- and pull off long oil supply pipe from below.

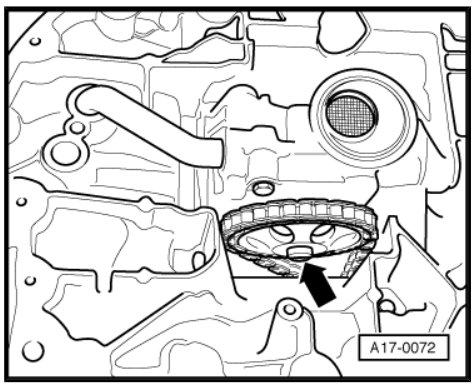


– Unscrew chain sprocket using TORX wrench T45 -arrow- and pull it off oil pump.

– Take chain sprocket out of chain.

– Pull off chain tensioner.

– Lift off chain.



Installing

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

• Chain sprocket can only be fitted in one position on oil pump shaft.

– Install sump (bottom section)
⇒ “1.5 Installing sump (bottom section) - engines with moulded gasket”, page 126 or
⇒ “1.6 Installing sump (bottom section) - engines with liquid gasket”, page 127 .

– Install sealing flange (front) ⇒ page 45 .

Tightening torques

Component	Nm
Oil pump to cylinder block	22
Chain sprocket to oil pump shaft	25
Bracket to sump (top section)	10

1.14 Renewing oil retention valves

Note

In the event of irregular valve noise which disappears after a lengthy drive but repeatedly re-occurs when travelling short distances, the oil retention valves must be renewed.

Procedure

– Remove intake manifold ⇒ page 83 .

– Unscrew cover beneath intake manifold.

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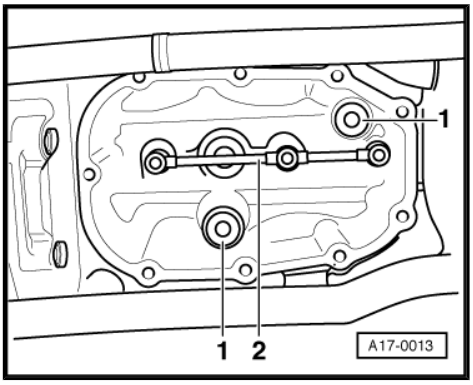
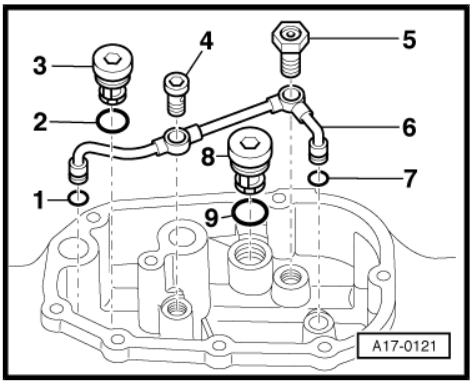
“Engine generation II”



1 - Oil retention valve, 25 Nm

2 - Oil line for spray nozzle valve for piston cooling nozzles, 15 Nm

“Engine generation III”



1 - O-ring; renew

2 - O-ring; renew

3 - Oil retention valve for cylinder head (left-side), 20 Nm

4 - Banjo bolt - 15 Nm

5 - Spray nozzle valve for piston cooling nozzles, 25 Nm

6 - Oil line

7 - O-ring; renew

8 - Oil retention valve for cylinder head (right-side), 20 Nm

9 - O-ring; renew

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

Note

Renew O-rings.

– Install intake manifold ⇒ page 83 .

Tightening torque

Component	Nm
Cover to cylinder block	10

1.15 Checking oil pressure and oil pressure switch

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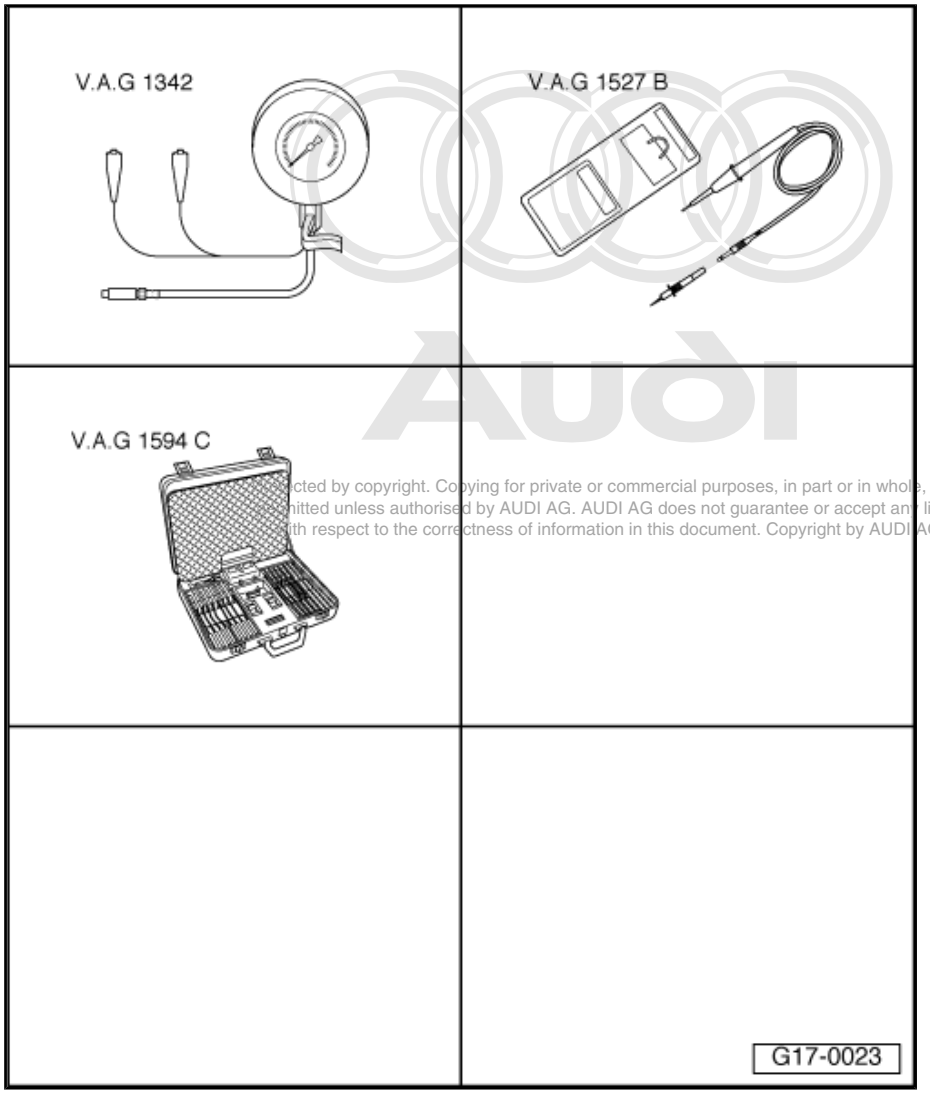
Special tools and workshop equipment required

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



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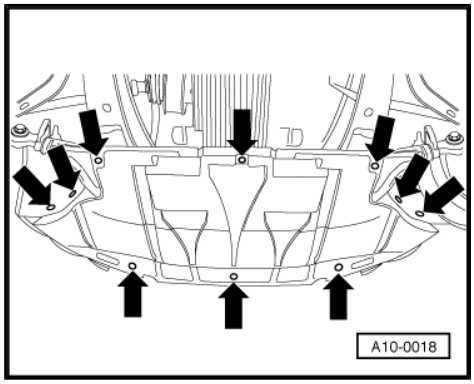
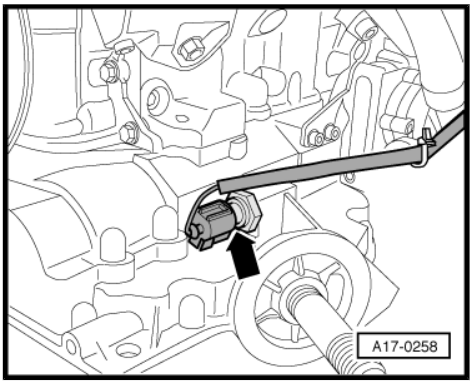
Procedure

- Oil level OK
- Engine oil temperature approx. 80 °C

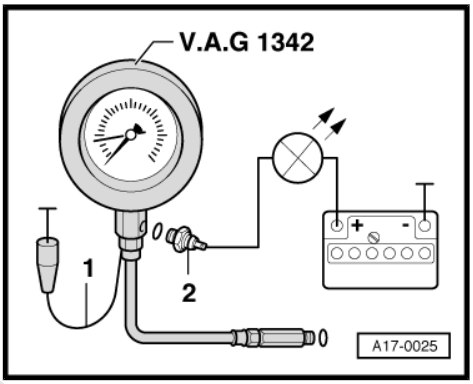
– Remove noise insulation -arrows-.



– Unplug electrical connector -arrow- at oil pressure switch.
– Unscrew oil pressure switch.



– 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 the LED lights up:

– 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.

Black oil pressure switch:

• LED should light up at 1.2 ... 1.6 bar.

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White oil pressure switch:

• LED should light up at 1.6 ... 2.0 bar.

Both types:

If LED does not light up:

– Renew oil pressure switch.

Checking oil pressure

– Start engine.

• Minimum oil pressure at idling speed: 1.5 bar.
• Minimum oil pressure at 2000 rpm: 2.5 bar.

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

– Renew oil pump ⇒ page 140 or ⇒ page 143 .

Assemble in reverse order.

1.16 Engine oil

Viscosity grades and oil specifications

⇒ Maintenance ; Booklet 802

1.17 Checking oil level

Procedure

- 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.

– 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.

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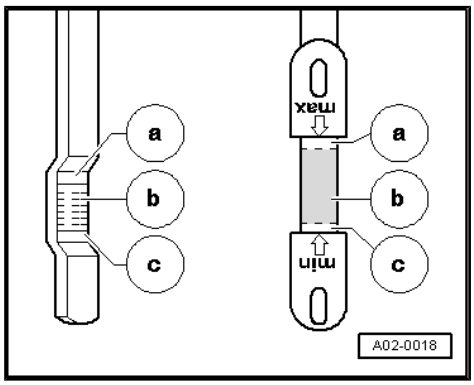
Markings on oil dipstick:

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- (grooved area on dipstick) after topping up.



Note

The oil level must not be above marking -a- on the dipstick or below marking -c-.

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.*
- *Removing and installing viscous fan ⇒ page 175 .*

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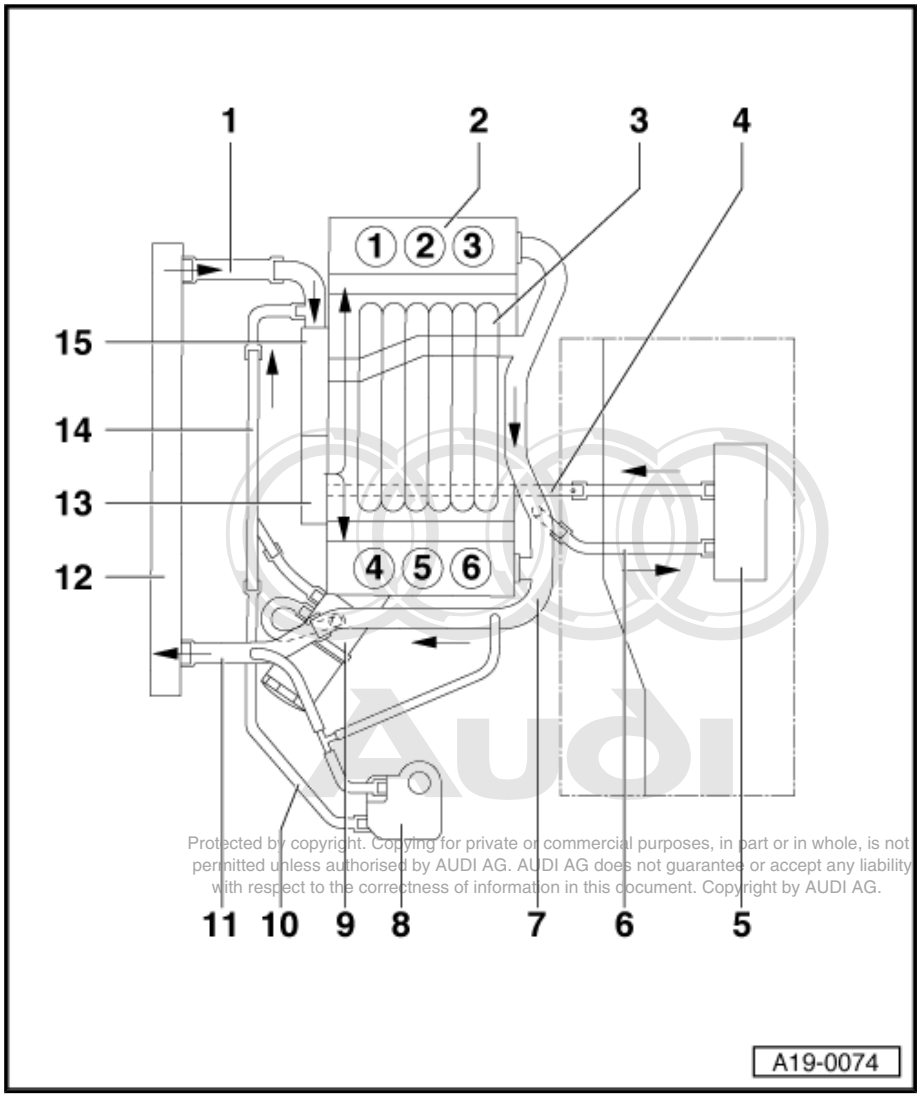
1.1 Connection diagram - coolant hoses



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1 - Coolant hose (bottom)
- ❑ From radiator to engine

2 - Cylinder head/cylinder block

3 - Intake manifold

4 - Coolant pipe
- ❑ From heat exchanger to engine block

5 - Heat exchanger
- ❑ If renewed, refill system with fresh coolant

6 - Supply hose
- ❑ To heat exchanger

7 - Coolant pipe (rear)
- ❑ Removing and installing ⇒ page 169

8 - Expansion tank
- ❑ With filler cap
- ❑ Checking pressure relief valve in filler cap ⇒ page 178

9 - Oil cooler

10 - Coolant pipe
- ❑ From expansion tank to coolant pipe (bottom)

11 - Coolant hose (top)

12 - Radiator
- ❑ Removing and installing ⇒ page 173
- ❑ If renewed, refill system with fresh coolant

13 - Coolant pump
- ❑ Removing and installing ⇒ page 161

14 - Coolant pipe (front)
- ❑ Removing and installing ⇒ page 166

15 - Thermostat
- ❑ Removing and installing ⇒ page 162
- ❑ Checking ⇒ page 165
- ❑ Installation position ⇒ page 161

1.2 Draining and filling cooling system

Special tools and workshop equipment required

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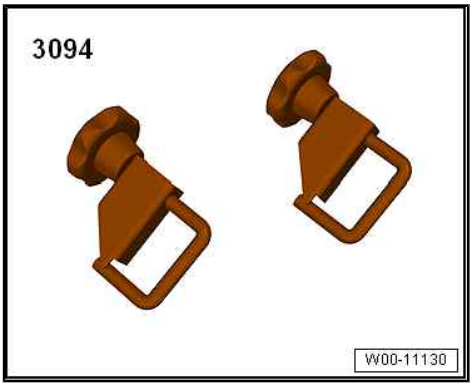
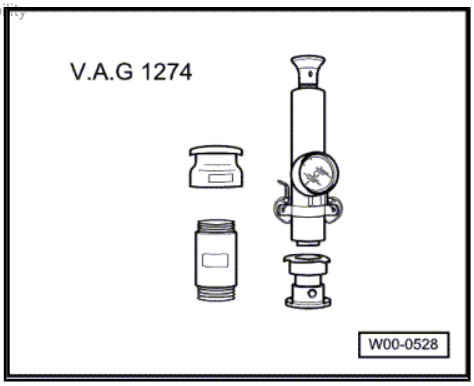
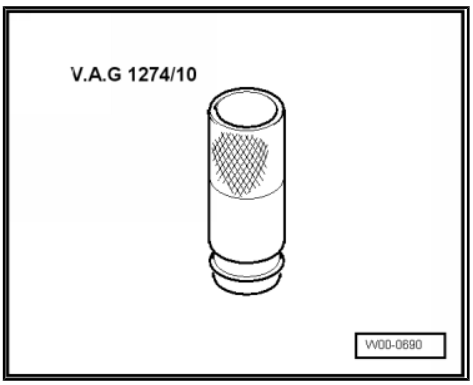
- Hose clamps up to Ø 25 mm - 3094-



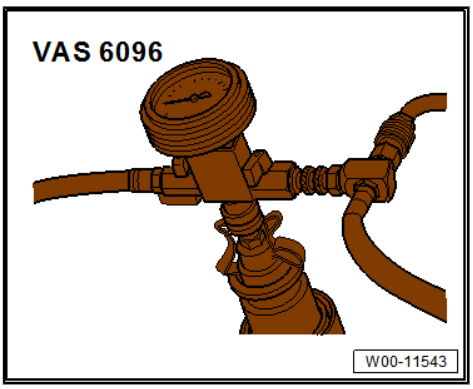
- Cooling system tester - V.A.G 1274/1- from -V.A.G 1274-



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

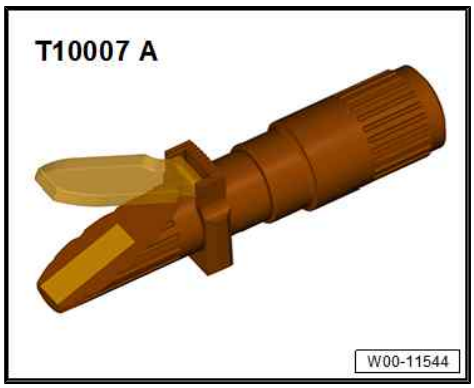


- Cooling system charge unit - VAS 6096-



♦ Drip tray for workshop hoist - VAS 6208-

♦ Refractometer - T10007 A-

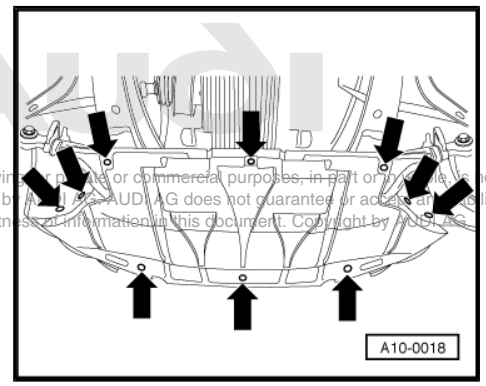


Draining

WARNING

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

– Open filler cap on coolant expansion tank.
– Remove noise insulation -arrows-.



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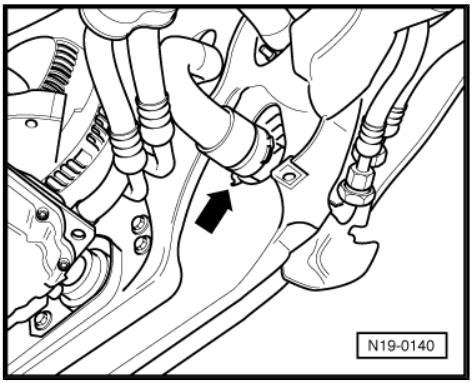
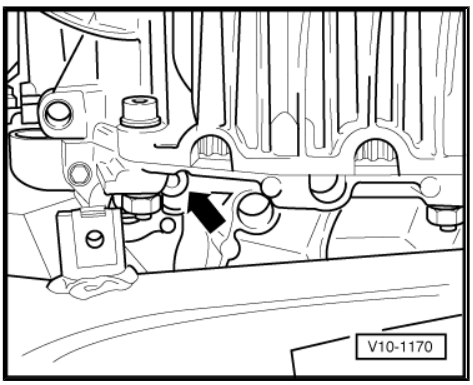
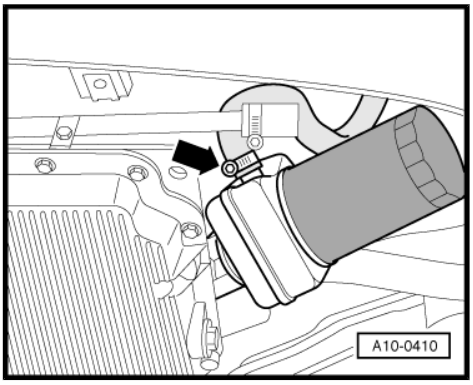
– Place drip tray for workshop hoist - VAS 6208- under engine.
– Detach coolant hose -arrow- (bottom right) from radiator by releasing retaining clip at connecting flange.



– Also open coolant drain plug on engine -arrow-.



– Also disconnect coolant hose at oil cooler -arrow-, and drain off remaining coolant.



Filling

Caution

Always use distilled water for mixing coolant additives as this ensures optimum corrosion protection.

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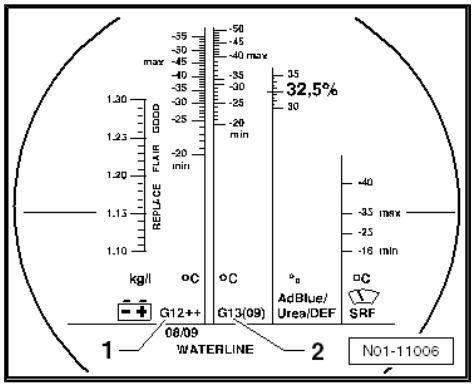

Note

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

Audi
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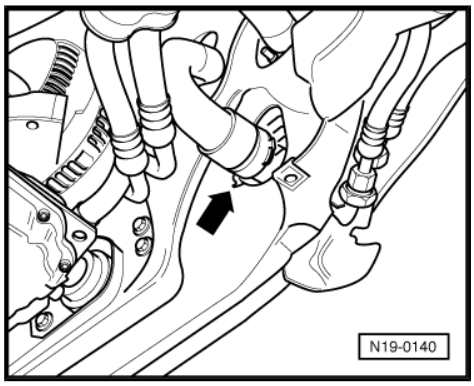
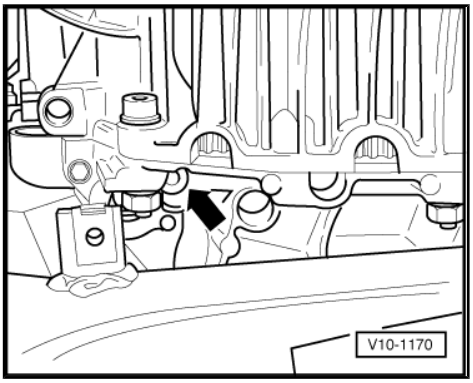
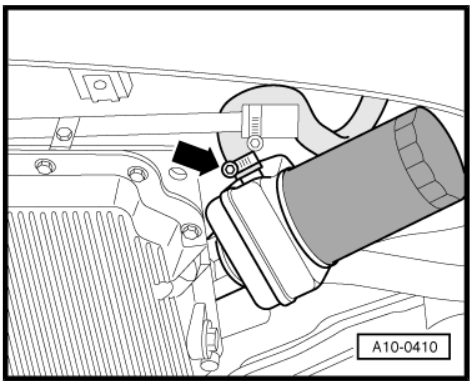
– Connect coolant hose -arrow- (bottom right) to radiator; retaining clip should engage audibly at connecting flange.



– Renew O-ring and tighten drain plug -arrow- to 20 Nm.



– Connect coolant hose to oil cooler -arrow-.



– Fill reservoir - VAS 6096/1- with at least 12 litres of premixed coolant (based on recommended ratio):

• Coolant (40 %) and water (60 %) for frost protection to -25 °C

• Coolant (50 %) and water (50 %) for frost protection to -36 °C

• Coolant ⇒ Electronic parts catalogue

– Screw adapter for cooling system tester - V.A.G 1274/1- onto coolant expansion tank.

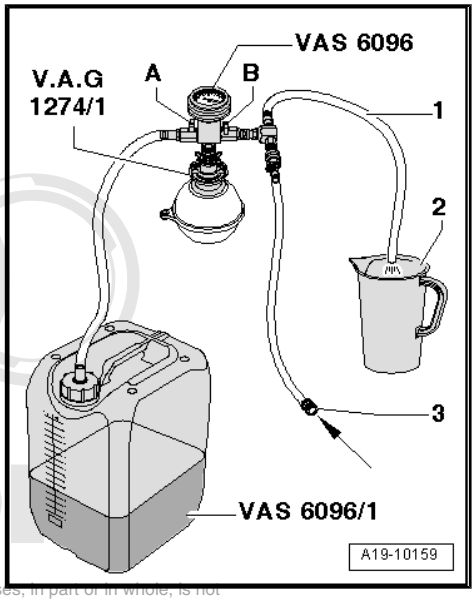
– Attach cooling system charge unit - VAS 6096- onto adapter - V.A.G 1274/1- .

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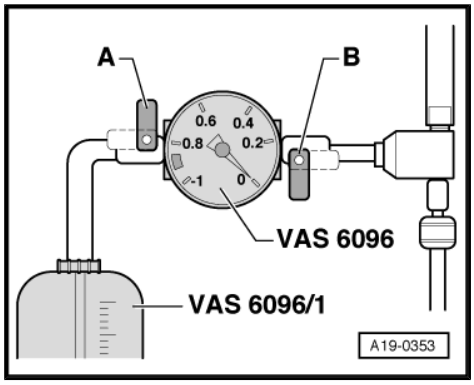
– Open valve -B- by setting lever in direction of flow.



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 - VAS 6096/1- 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.

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.

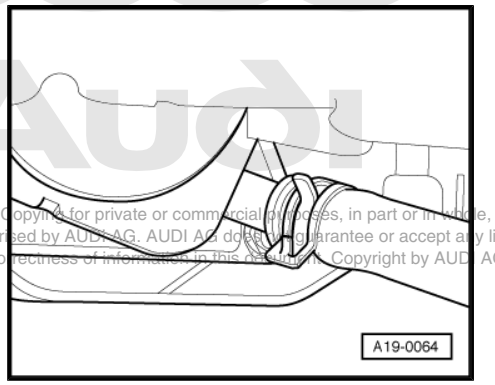
– Detach compressed air hose.

– 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 expansion tank.

– Fit pipe for cooling system tester - V.A.G 1274/10- onto adapter - V.A.G 1274/1- .



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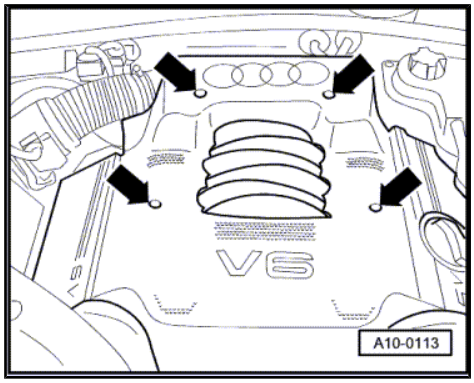
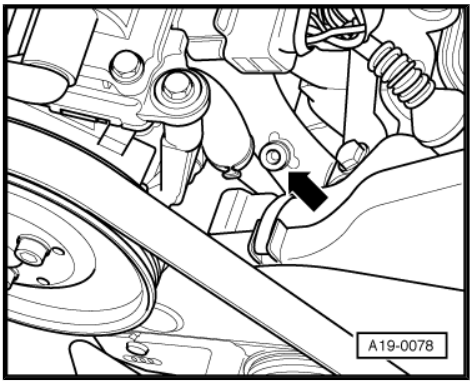
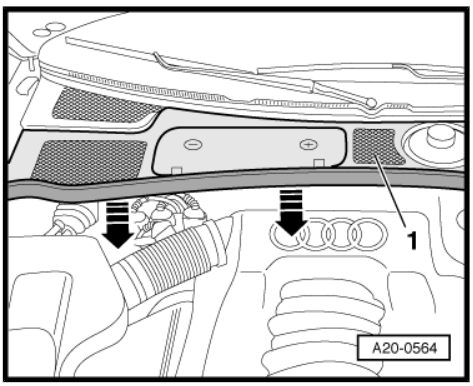
– Take off engine cover panel -arrows-.



– Open bleed screw -arrow- at front coolant pipe between power steering pump and cylinder head (left-side).
– Fill up with coolant until it emerges at bleeder hole.
– Renew seal and tighten bleed screw -arrow- to 15 Nm.



– Detach rubber seal from plenum chamber cover in direction of -arrow-.
– Detach plenum chamber cover -1- towards the front.



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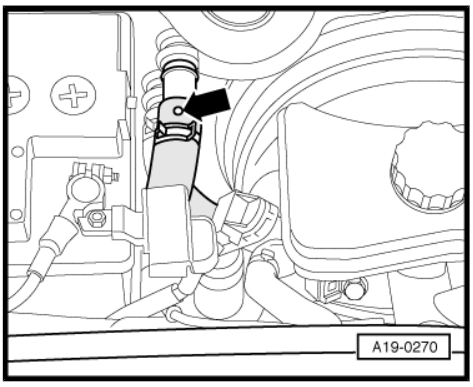
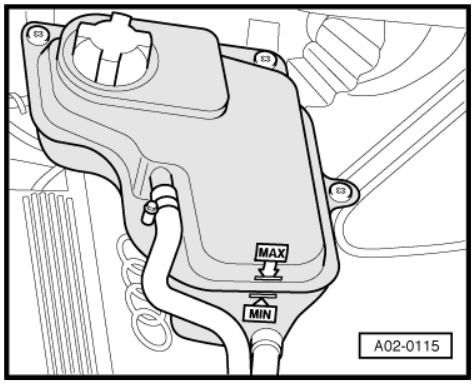
– Release coolant hose going to heat exchanger and pull back hose until bleeder hole in hose -arrow- is no longer blocked by the connection.
– Fill up with coolant until it flows out at bleeder hole in coolant hose.
– Push coolant hose onto connection and secure with hose clip.
– On vehicles with auxiliary heater, switch heater on (for about 30 seconds) and then off again.
– Tighten filler cap on expansion tank.
– Start engine.
– Set heater/air conditioner to “HI”.
– Run the engine for 3 minutes at 2000 rpm.
– Allow the engine to run at idling speed until the two large coolant hoses at main radiator become warm.
– Run the engine for 1 minute at 2000 rpm.
– Switch engine off.



– Check coolant level.

- The coolant level must be at the MAX marking when the engine is cold.
- The coolant level can be above the MAX marking when the engine is warm.

– Repeat bleeding procedure if necessary ⇒ page 158 .



Tightening torques

Component	Nm
Drain plug to cylinder block	20
Bleeder screw to coolant pipe	15

1.3 Coolant pump and thermostat - exploded view

1 - Thermostat
- ❑ Removing and installing ⇒ page 162
- ❑ Checking ⇒ page 165
- ❑ Installation position ⇒ page 161

2 - Seal
- ❑ Renew

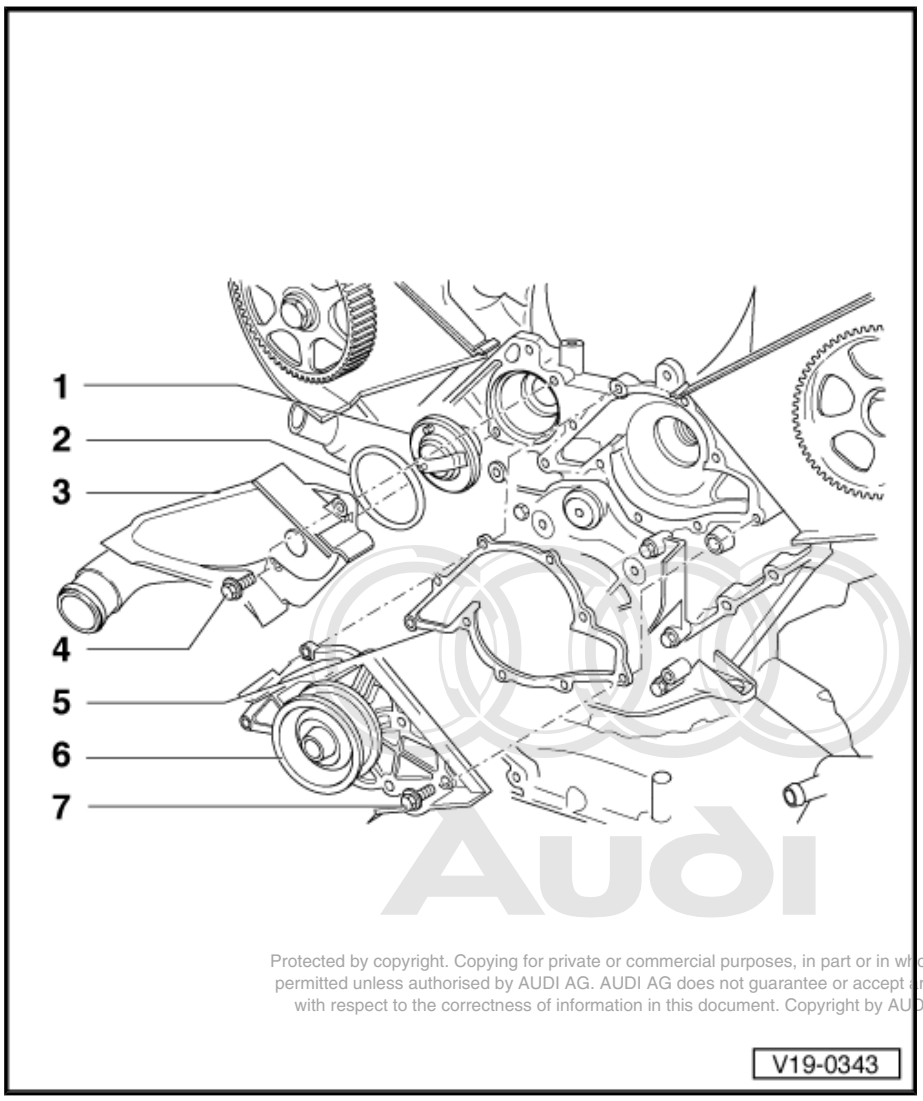
3 - Thermostat housing

4 - 10 Nm

5 - Gasket
- ❑ Renew

6 - Coolant pump
- ❑ Removing and installing ⇒ page 161

7 - 10 Nm



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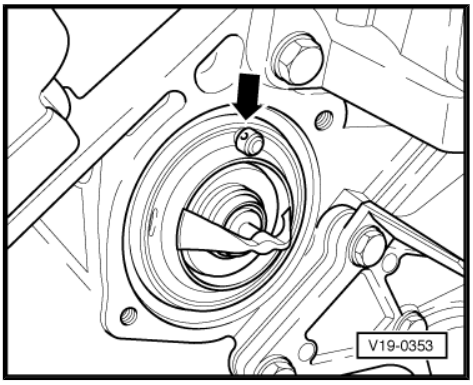
Installation position of thermostat

- Vent valve -arrow- faces upwards.
- Seal facing housing



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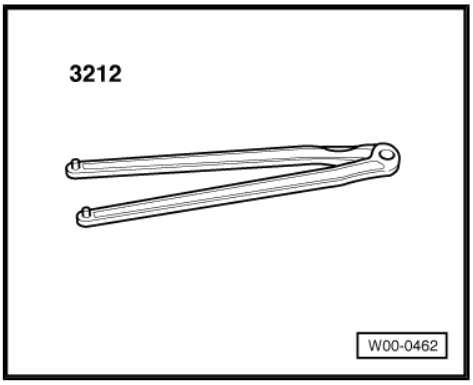
1.4 Removing and installing coolant pump

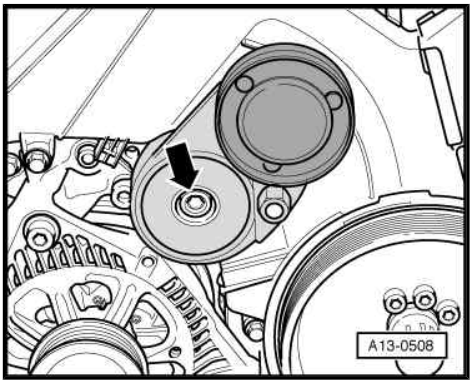
Special tools and workshop equipment required

♦ Pin wrench - 3212-

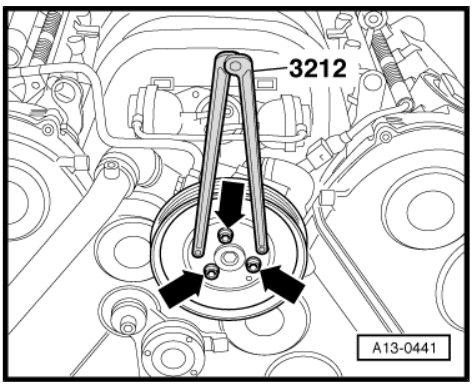


Removing

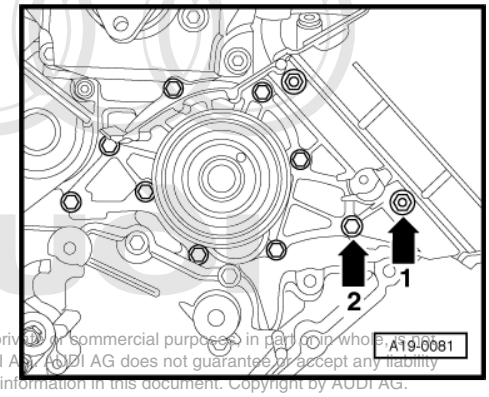
– Remove front bumper ⇒ Rep. gr. 63 .
– Move lock carrier to service position ⇒ Rep. gr. 50 .
– Remove poly V-belt ⇒ page 29 .
– Drain off coolant ⇒ page 152 .
– Unscrew bolt -arrow- and remove tensioner for poly V-belt.



– Provide support for power steering pump pulley using two-hole pin wrench - 3212- and unscrew pulley -arrows-.
– Remove toothed belt ⇒ page 34 .
– Remove tensioning roller for toothed belt.



– Unscrew nuts -arrow 1- (2x) for rear toothed belt cover.
– Unscrew bolts -arrow 2- (9x) for coolant pump and detach coolant pump.



Installing

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

Note

Renew gaskets and seals.

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– Note shim at rear when installing toothed belt tensioning roller ⇒ Item 12 (page 32) .
– Install toothed belt (adjust valve timing) ⇒ page 37 .
– Fill cooling system ⇒ page 155 .

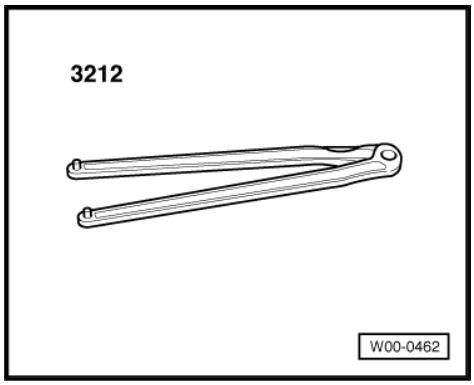
Tightening torques

Component	Nm
Coolant pump to cylinder block	10
Toothed belt cover (rear) to coolant pump	10
Toothed belt tensioning roller to oil pump/front sealing flange	22

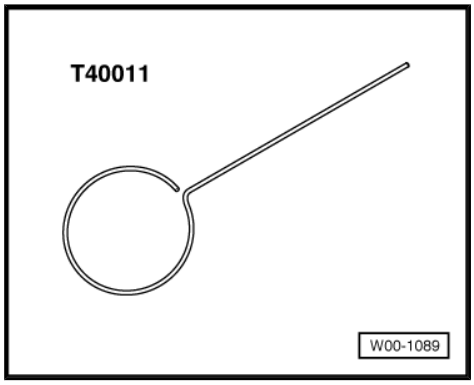
1.5 Removing, installing and checking thermostat

Special tools and workshop equipment required

♦ Pin wrench - 3212-

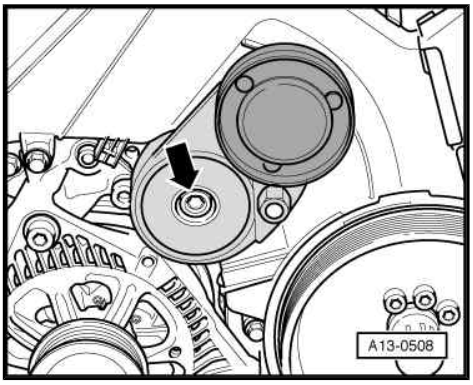


♦ Locking pin - T40011-



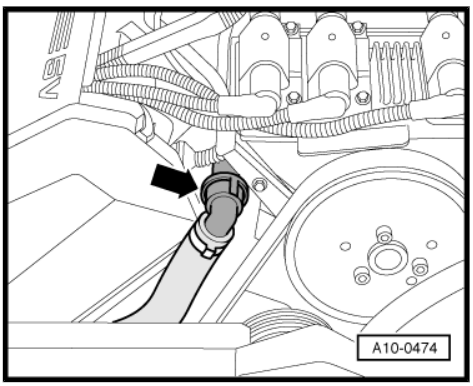
Removing

– Remove front bumper ⇒ Rep. gr. 63 .
– Move lock carrier to service position ⇒ Rep. gr. 50 .
– Drain off coolant ⇒ page 152 .
– Remove poly V-belt ⇒ page 29 .
– Unscrew bolt -arrow- and remove tensioner for poly V-belt.



Vehicles with secondary air system:

– Disconnect hose -arrow- from secondary air connecting pipe.

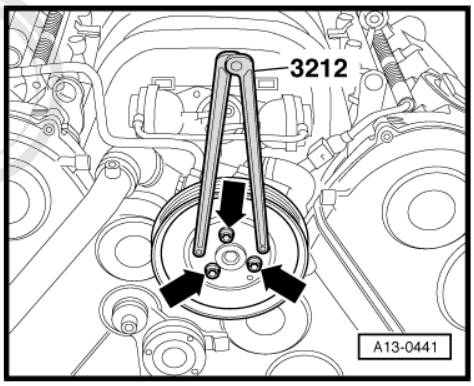


All vehicles:

– Provide support for power steering pump pulley using two-hole pin wrench - 3212- and unscrew pulley -arrows-.
– Unscrew radiator cowl for viscous fan.
– Remove right toothed belt cover (2 sections).

Vehicles with “engine generation III”:

– Remove vibration damper ⇒ page 31 .
– Remove toothed belt cover (bottom).



All vehicles:

– Disconnect coolant hoses at thermostat housing.

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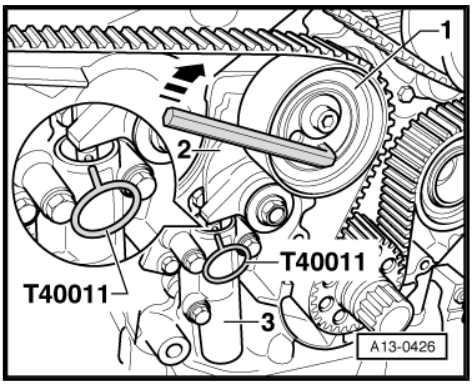
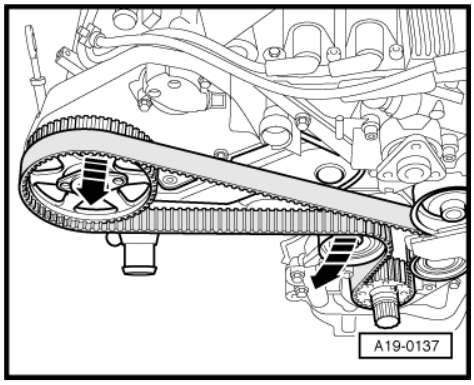
Note

The toothed belt tensioner is oil-damped and can therefore only be compressed slowly by applying constant pressure.

– Turn toothed belt tensioning roller -1- clockwise in direction of -arrow- using an 8 mm Allen key until tensioning lever -2- compresses tensioner -3- far enough for the pressure piston to be locked with locking pin - T40011- .
– Insert locking pin - T40011- and release toothed belt tensioning roller.



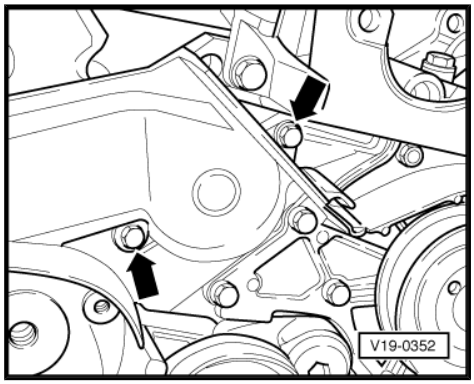
– Pull toothed belt forwards slightly on tensioning roller and right camshaft sprocket -arrows-, but do not pull off completely.



Caution

Timing must be re-adjusted if toothed belt has slipped off tensioning roller ⇒ page 37 .

– Detach thermostat housing -arrows-.



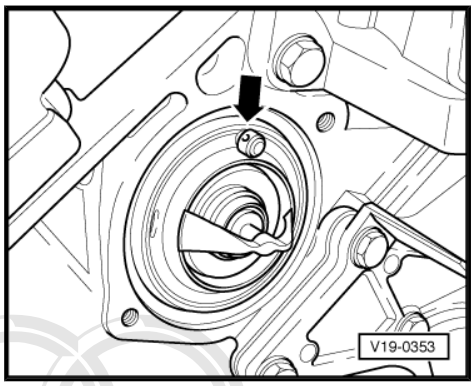
Note

Illustration shows thermostat housing with toothed belt detached.

– Remove O-ring and thermostat.

Installing

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



Note

Renew O-ring.

– Before installing, clean and smoothen sealing surface for O-ring.
– Install thermostat.

Installation position:

- Vent valve -arrow- faces upwards.
- Seal facing housing

– Install thermostat housing.

Caution

Timing must be re-adjusted if toothed belt has slipped off tensioning roller ⇒ page 37 . Follow all instructions for removing and installing toothed belt ⇒ page 34 .

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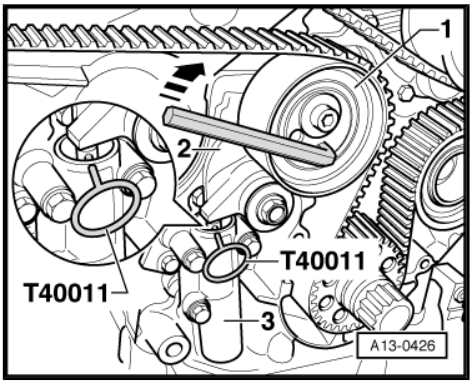
– Using an 8 mm Allen key, turn toothed belt tensioning roller -1- clockwise in direction of -arrow- until the locking pin - T40011- can be removed.



Proceed as follows to pre-tension tensioning roller before first starting engine:

– Apply torque wrench to hexagon socket of tensioning roller.

– Pre-tension tensioning roller by applying a torque of 15 Nm.

Vehicles with “engine generation III”:

– Install vibration damper ⇒ page 31 .

All vehicles:

– Install poly V-belt ⇒ page 31 .

– Fill cooling system ⇒ page 155 .

Tightening torque

Component	Nm
Thermostat housing to cylinder block	10

Checking thermostat

– Heat up the removed thermostat in hot water.

Starts to open	Fully open	Opening travel
approx. 87 °C	approx. 102 °C 1)	at least 8 mm

• 1) Cannot be tested.

1.6 Coolant pipes - exploded view

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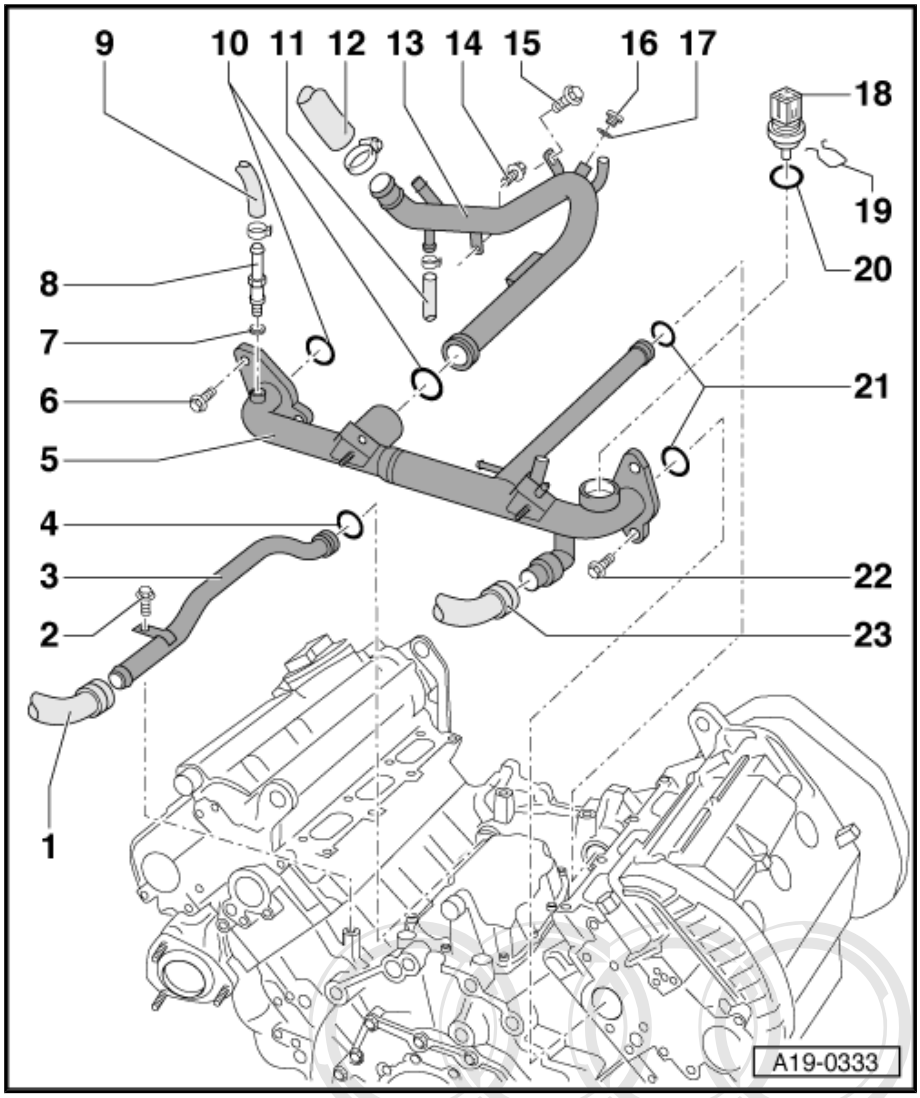

1 - Coolant hose
- ❑ To heat exchanger

2 - 10 Nm

3 - Coolant pipe (small)
- ❑ Removing and installing ⇒ page 168

4 - O-ring
- ❑ Renew

5 - Coolant pipe (rear)
- ❑ Removing and installing ⇒ page 169

6 - 10 Nm

7 - Seal
- ❑ Renew

8 - Connection, 15 Nm

9 - Coolant hose

10 - O-rings
- ❑ Renew

11 - Coolant hose
- ❑ To oil cooler

12 - Coolant hose
- ❑ To top of radiator

13 - Coolant pipe (front)
- ❑ Removing and installing ⇒ page 166

14 - 10 Nm

15 - 22 Nm

16 - Bleeder screw, 15 Nm

17 - Seal
- ❑ Renew

18 - Coolant temperature display sender - G2- / coolant temperature sender - G62-

19 - Retaining clip

20 - O-ring
- ❑ Renew

21 - O-ring
- ❑ Renew

22 - 10 Nm

23 - Coolant hose
- ❑ To heat exchanger

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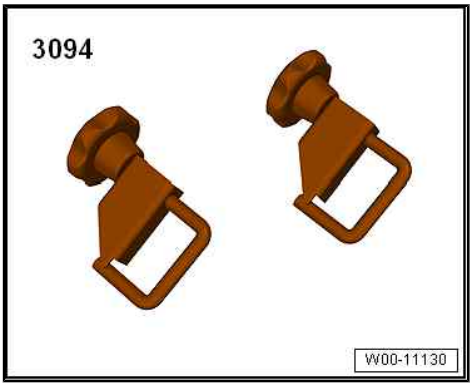
1.7 Removing and installing coolant pipe (front)

Special tools and workshop equipment required

♦ Hose clamps up to Ø 25 mm - 3094-

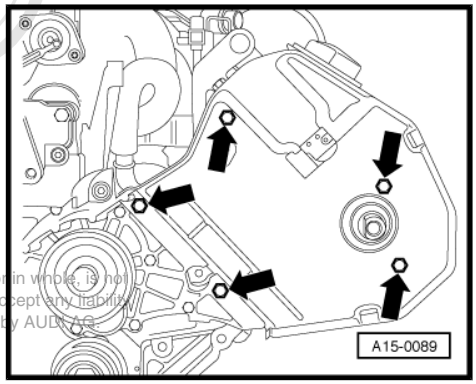


Removing

Note

All cable ties which are released or cut open when removing must be fitted in the same position when installing.

– Drain off coolant from engine ⇒ page 152 .
– Remove intake manifold ⇒ page 83 .
– Remove coolant pump ⇒ page 161 .
– Take off camshaft sprocket.
– Unbolt toothed belt cover (rear left) -arrows-.



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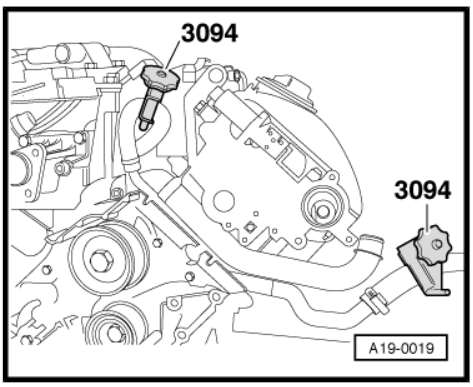
– Use hose clamps - 3094- to pinch off both hoses at hydraulic fluid supply pipe.
– Detach both hydraulic lines from intermediate pipe.

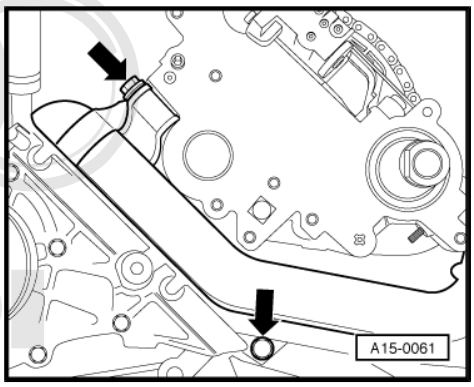


Note

Place cloth beneath pipes to be detached, as fluid escapes.

– Disconnect coolant hoses at front coolant pipe.

– Remove bolts -arrows-.
– Move wiring clear at coolant pipe.
– Pull off coolant pipe towards the front.



Installing

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

Note

- *Renew O-rings.*
- *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.*

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– Before installing, clean and smoothen sealing surface for O-ring.
– Lubricate new O-ring with »G12+« and slide onto coolant pipe.
– Slide coolant pipe into hole at rear coolant pipe.
– Install intake manifold ⇒ page 86 .
– Install coolant pump ⇒ page 162 .
– Fill cooling system ⇒ page 155 .
– Top up power steering fluid and bleed steering system ⇒ Rep. gr. 48 .

Tightening torques

Component		Nm
Front coolant pipe to cylinder head	M6	10
	M8	20
Power steering pipe bracket to cylinder head		10
Rear toothed belt cover to cylinder head		10 [1)]

• [1)] Install bolts using locking fluid; locking fluid ⇒ Parts catalogue .

1.8 Removing and installing coolant pipe (small)

Removing

– Remove coolant pipe (front) ⇒ page 166 .
– Disconnect rear coolant hose from coolant pipe (small).
– Unscrew securing bolt.
– Pull off small coolant pipe to rear.
– Take out coolant pipe from the top.

Installing

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

Note

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

– Before installing, clean and smoothen sealing surface for O-ring.
– Lubricate new O-rings with »G12« and slide onto coolant pipe.
– Slide coolant pipe into bore in cylinder block.
– Install coolant pipe (front) ⇒ page 168 .
– Fill cooling system ⇒ page 155 .

Tightening torque

Component	Nm
Coolant pipe (small) to cylinder block	10

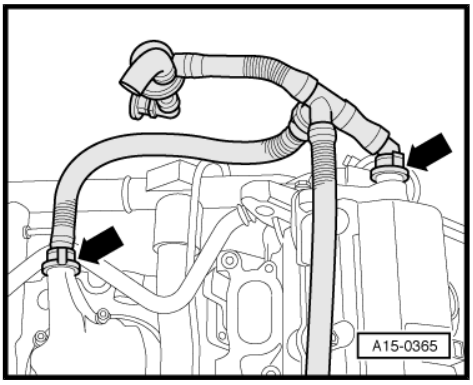
1.9 Removing and installing coolant pipe (rear)

Removing

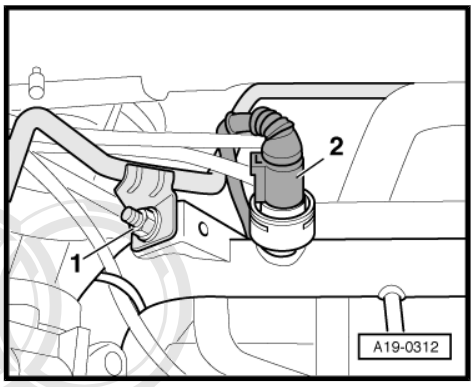
Note

All cable ties which are released or cut open when removing must be fitted in the same position when installing.

– Drain off coolant from engine ⇒ page 152 .
– Remove intake manifold ⇒ page 83 .
– Remove crankcase breather hose -arrows-.



– Unplug electrical connector -2- at coolant temperature display sender - G2- / coolant temperature sender - G62- .
– Unscrew power steering pressure pipe at coolant pipe (rear) -1-.



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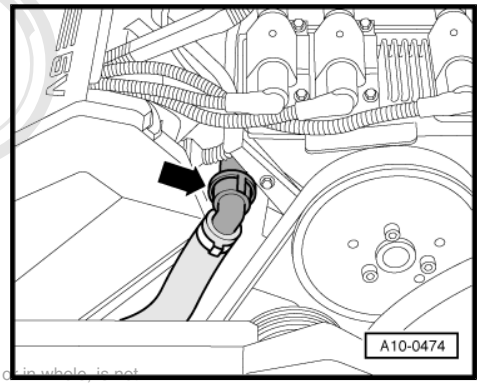
Vehicles with secondary air system:

– Disconnect hose -arrow- from secondary air connecting pipe.



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– Disconnect vacuum hose -4- at combination valve for secondary air system.

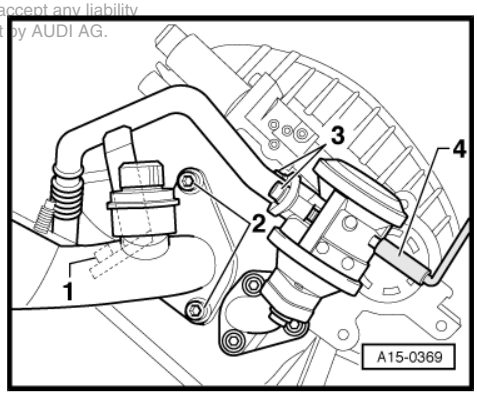
– Remove bolts -3-.

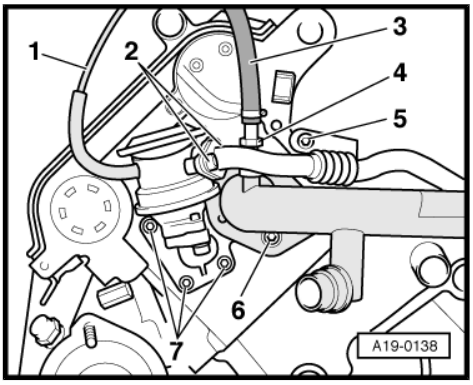
– Unscrew bolt -1- for connecting pipe bracket.

– Unscrew bolt at front right of connecting pipe.

All vehicles:

– Unscrew bolts -2- on coolant pipe.





– Detach coolant hose -3-.
– Disconnect coolant hose from rear coolant pipe (hose leads to heat exchanger for heater).

Vehicles with secondary air system:

– Disconnect vacuum hose -1- at combination valve for secondary air system.
– Unscrew hose connection -4-.
– Remove bolt -5-.
– Unscrew bolts -2- and take off connecting pipe for secondary air system.
– Unscrew bolts -7- and take off combination valve for secondary air system.

All vehicles:

– Move wiring clear of rear coolant pipe.
– Remove the 2 bolts -6- at rear coolant pipe and detach coolant pipe.

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Installing

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

Note

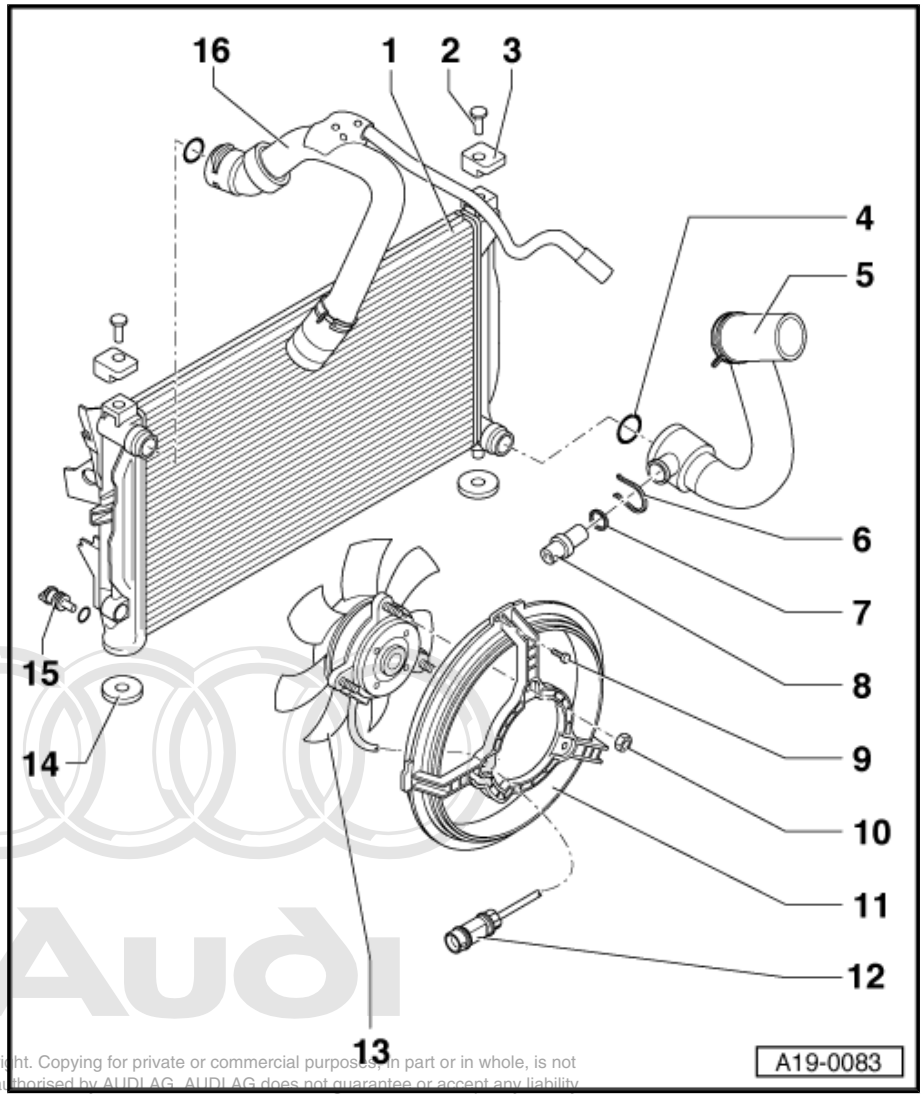
- *Renew seals and O-rings.*
- *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue .*
- *Fit all cable ties in the original positions when installing.*

– Before installing, clean and smooth down sealing surfaces for O-rings as required.
– Lubricate new O-ring with »G12+« and slide onto coolant pipe.
– Install intake manifold ⇒ page 86 .
– Fill cooling system ⇒ page 155 .

Tightening torques

Component		Nm
Coolant pipe (rear) to cylinder head		10
Combination valve to cylinder head		10
Connecting pipe to combination valve		10
Connecting pipe to cylinder head	M6	10
	M8	22
Hose connection to coolant pipe (rear)		15

1.10 Radiator and radiator fan - exploded view of components



1 - Radiator

- ❑ Removing and installing ⇒ page 173
- ❑ If renewed, change coolant in entire system
- ❑ With ATF cooler on vehicles with automatic gearbox

2 - Securing clip

3 - Rubber mounting

4 - O-ring

- ❑ Renew if damaged

5 - Coolant hose (bottom)

- ❑ Secured to radiator with retaining clip
- ❑ Check that it is securely seated
- ❑ Connection diagram - coolant hoses ⇒ page 151

6 - Retaining clip

- ❑ For thermal switch in coolant hose

7 - O-ring

- ❑ Renew if damaged

8 - Radiator fan thermal switch - F18-

- ❑ Switching temperatures: Stage 1 on: 92 ... 97 °C/ off: 84 ... 91 °C
- ❑ Switching temperatures: Stage 2 on: 99 ... 105 °C/ off: 91 ... 98 °C
- ❑ Tighten to 35 Nm

9 - Securing bolt, 2 Nm

10 - 10 Nm

11 - Fan ring

- ❑ Clipped into cowling and secured with securing bolt ⇒ Item 9 (page 172)

12 - Electrical connector

13 - Radiator fan - V7-

- ❑ Checking ⇒ page 176

14 - Rubber washer

15 - Coolant drain plug, 10 Nm

16 - Coolant hose (top)

- ❑ Secured to radiator with retaining clip
- ❑ Check that it is securely seated
- ❑ Connection diagram - coolant hoses ⇒ page 151

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1.11 Removing and installing radiator

Special tools and workshop equipment required

- Drip tray for workshop hoist - VAS 6208-

Removing

Note

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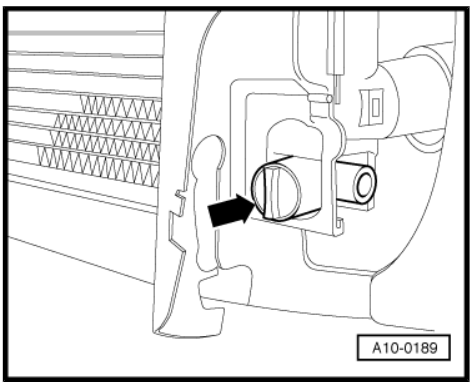
- *Collect drained coolant in a clean container for re-use or disposal.*
- *The coolant must be drained off completely if the radiator is renewed.*

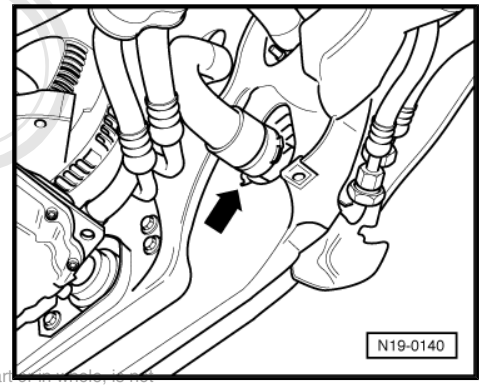
WARNING

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

– Open filler cap on coolant expansion tank.
– Remove front bumper ⇒ Rep. gr. 63 .
– Place drip tray for workshop hoist - VAS 6208- under engine.
– Turn drain plug -arrow- on radiator anti-clockwise, if necessary fit drain hose to connection.



– Detach coolant hose from radiator by releasing retaining clip at connecting flange -arrow-.



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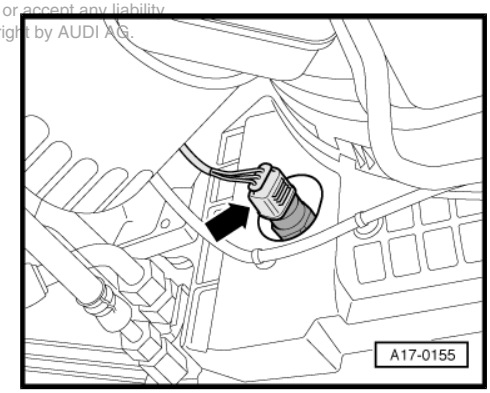
– Unplug electrical connector -arrow- at radiator fan thermal switch - F18- / -F54- at bottom left of radiator.

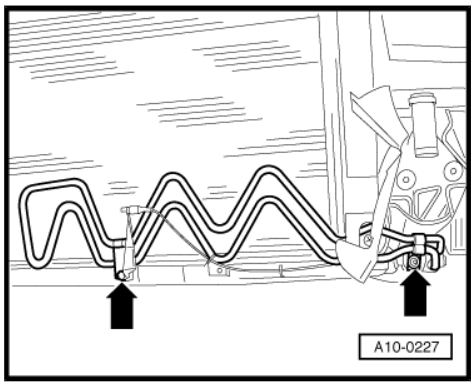


Vehicles with automatic gearbox:

– Detach ATF lines from radiator ⇒ Rep. gr. 37 .

All vehicles:

– Unscrew cooling pipe for power steering hydraulic fluid -arrows- and move clear to side; do not open hydraulic fluid circuit.



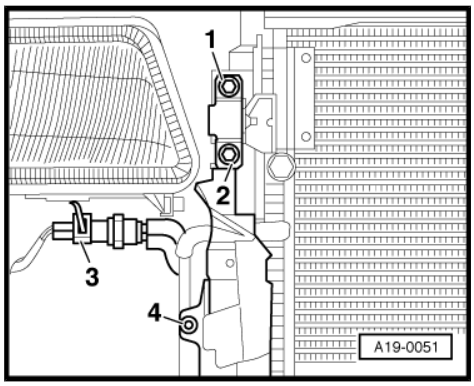
– Unbolt air ducts (left and right) at radiator -4-.

– Unplug electrical connector -3- at low pressure switch for air conditioner - F73- .

Vehicles with air conditioning:

WARNING

The air conditioner refrigerant circuit must not be opened.



Note

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

– Unscrew securing bolts -1- and -2- for condenser.

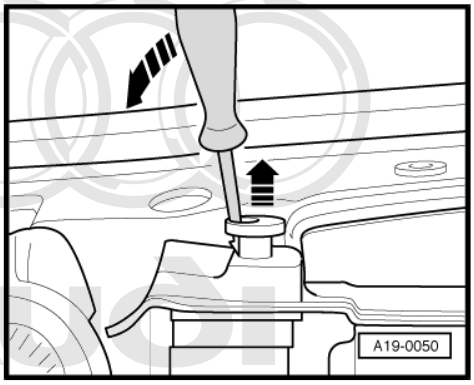
– Pull condenser up out of its bracket, pivot to side and secure to right-side front wheel with wire.

All vehicles:

– Disconnect top coolant hose at radiator.

– Release two retaining pins for radiator and pull out upwards -arrows-.

– Swivel radiator forwards by its top edge and remove upwards.



Installing

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

Note

♦ *Renew gaskets and seals.*

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

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Vehicles with automatic gearbox:

– Secure ATF lines to ATF cooler ⇒ Rep. gr. 37 .

– Check ATF level ⇒ Rep. gr. 37 .

All vehicles:

– Install front bumper ⇒ Rep. gr. 63 .

– Fill cooling system ⇒ page 155 .

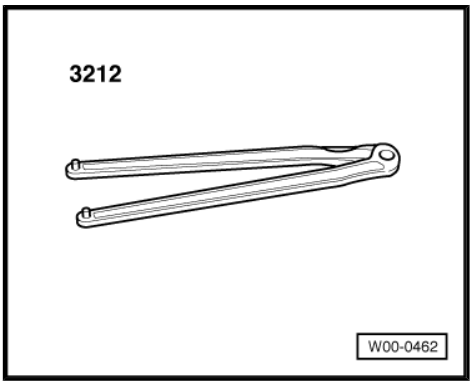
Tightening torques

Component	Nm
Condenser to radiator	10
Cooling pipe to radiator	10

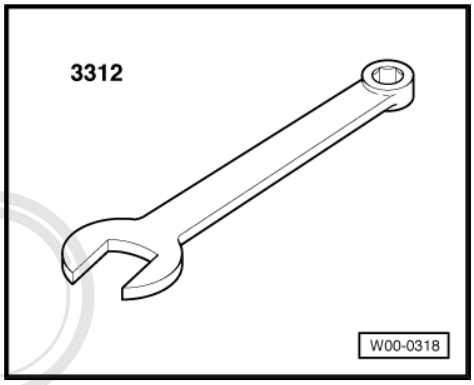
1.12 Removing and installing viscous fan

Special tools and workshop equipment required

♦ Pin wrench - 3212-



♦ Open-end spanner - 3312-



Removing

– Use 2-hole pin wrench - 3212- to support viscous fan pulley and unscrew viscous fan with open-ended wrench - 3312- -arrow- (left-hand thread).

– Lift out viscous fan.

Installing

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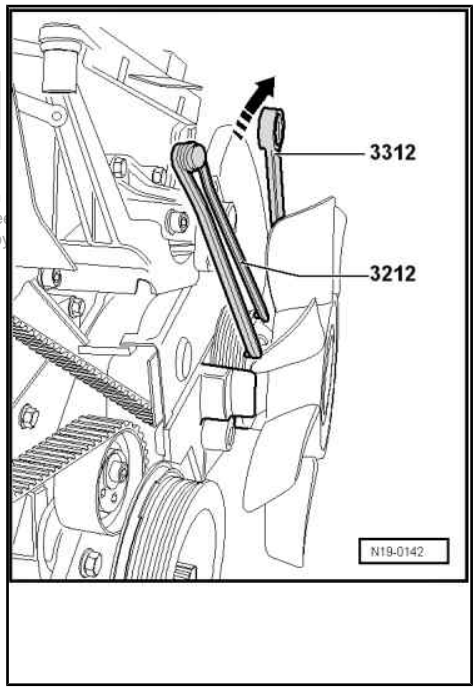
Install in reverse order.

Tightening torque

Component	Nm
Viscous fan to bearing using open-end spanner - 3312-	37



1.13 Removing and installing pulley for viscous fan

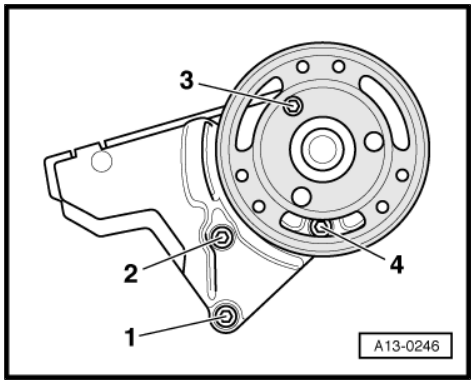
Removing

• Poly V-belt must be removed ⇒ page 29 .

– Remove bolts -1 ... 4-.

Note

Bolts -3- and -4- cannot be detached.



Installing

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

– Tighten bolt -3- (5 mm hexagon socket) to 10 Nm.

– Tighten bolts -1-, -2- and -4- (6 mm hexagon socket) to 22 Nm.

– Install poly V-belt ⇒ page 31 .

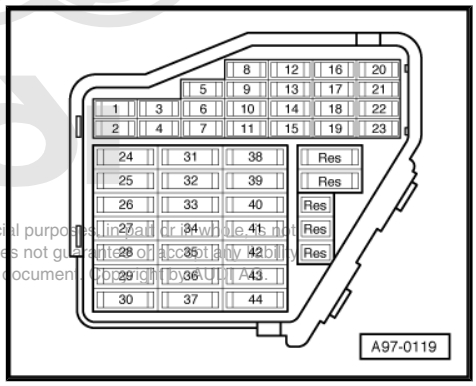
1.14 Checking radiator fan

Special tools and workshop equipment required

♦ Auxiliary measuring set - V.A.G 1594 C-

Test conditions

- Fuse -34- OK.
- Radiator fan thermal switch - F18- OK.



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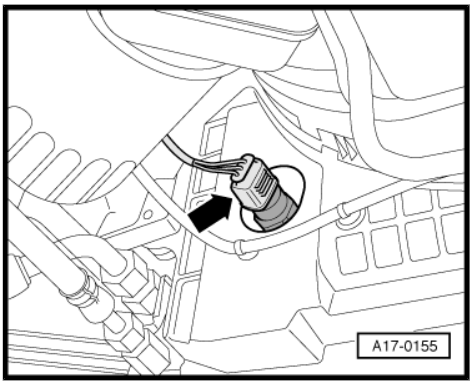
Test sequence

– Unplug electrical connector -arrow- at radiator fan thermal switch - F18- / -F54- at bottom left of radiator.

– Switch on ignition.



– Bridge contact -1- and contact -2- of connector with test leads from auxiliary measuring set - V.A.G 1594 C- .

• Stage 1 of radiator fan - V7- should start up.

– Bridge contact -1- and contact -3- of connector with test leads from auxiliary measuring set - V.A.G 1594 C- .

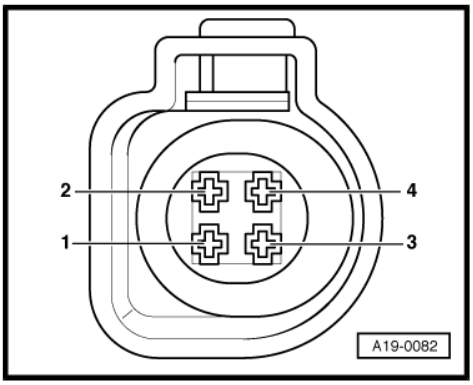
• Stage 2 of radiator fan - V7- should start up.

If 1st or 2nd fan speed does not run:

– Repair wiring connection if necessary.

If no fault in wire is detected:

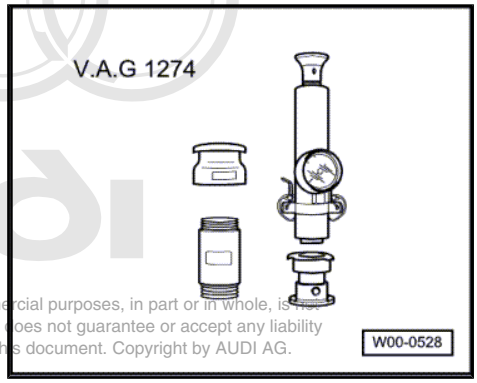
– Renew radiator fan - V7- .



1.15 Checking cooling system for leaks

Special tools and workshop equipment required

♦ Cooling system tester - V.A.G 1274- with -V.A.G 1274/8-



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Test condition

- Engine must be warm.

Test sequence

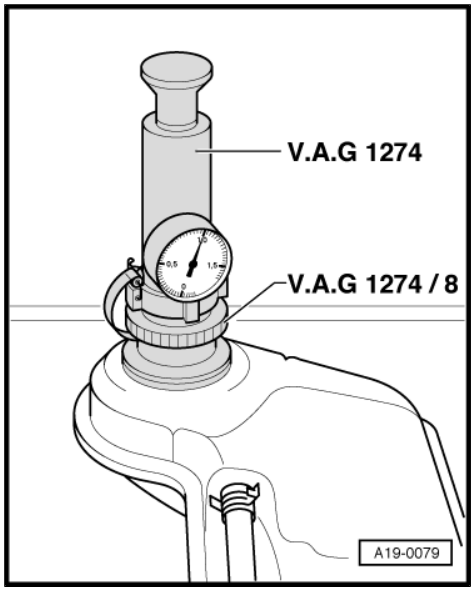
WARNING

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

– Open filler cap 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.

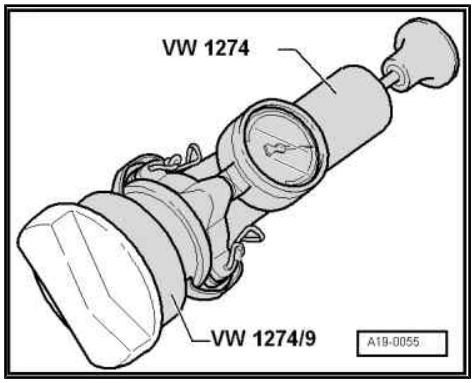


Checking pressure relief valve in filler cap

– 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 1.2 ... 1.5 bar.

If the pressure relief valve does not open as described:

– Renew filler cap.



26 – Exhaust system

1 Removing and installing parts of exhaust system

Note

- *Renew gaskets and self-locking nuts.*
- *After performing repairs on exhaust system, make sure the exhaust system is installed free of stress and there is sufficient distance between exhaust system and body. If necessary, loosen clamps and re-align silencer and exhaust pipes so that there is sufficient distance between exhaust system and body and the load on the mountings is the same on both sides.*
- *To avoid any damage, the flexible joint in the front exhaust pipe (left and right) must not be bent more than 10°.*

1.1 Exhaust system on vehicles with front-wheel drive - exploded view of components

Note

The illustration shows the exhaust system on vehicles with exhaust emissions standard "EU4".

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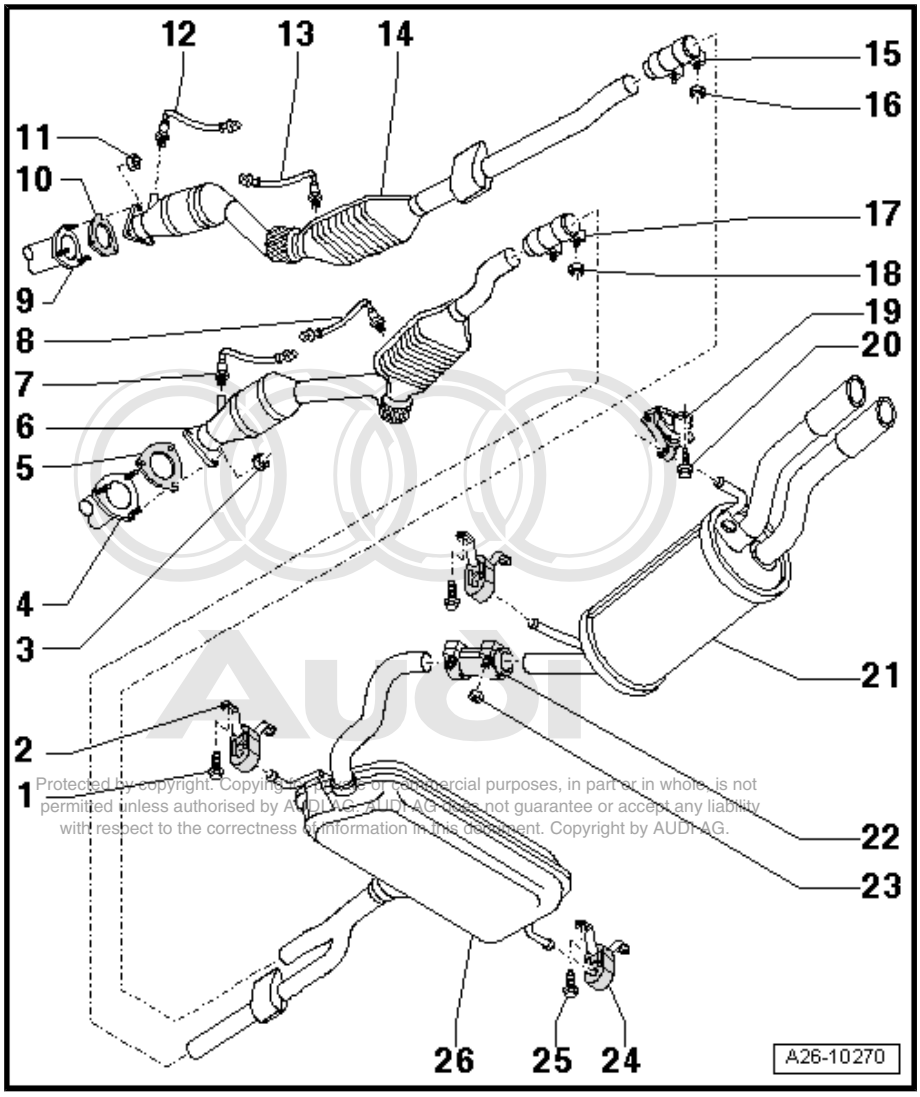

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1 - 25 Nm

2 - Mounting

- ❑ Renew if damaged

3 - 27 Nm

- ❑ Renew

4 - Exhaust manifold

- ❑ For cylinder bank 1 (right-side)

5 - Gasket

- ❑ Renew

6 - Front exhaust pipe with starter catalytic converter and main catalytic converter

- ❑ For cylinder bank 1 (right-side)
- ❑ With flexible joint
- ❑ Do not bend flexible joint more than 10° - otherwise it can be damaged
- ❑ Protect against knocks and impact
- ❑ Align exhaust system so it is free of stress ⇒ page 190
- ❑ Components of exhaust pipe mountings for vehicles with manual gearbox ⇒ page 183
- ❑ Components of exhaust pipe mountings for vehicles with automatic gearbox ⇒ page 184

7 - Lambda probe (before catalytic converter), 55 Nm

- ❑ For cylinder bank 1 (right-side)
- ❑ Threads of new Lambda probes are already greased with assembly paste; the paste must not get into the slots on the probe body
- ❑ When re-using the old Lambda probe, grease thread with high-temperature paste lubricant; the paste must not get into the slots of the probe body. High-temperature paste ⇒ Parts catalogue

8 - Lambda probe (after catalytic converter), 55 Nm

- ❑ For cylinder bank 1 (right-side)
- ❑ Threads of new Lambda probes are already greased with assembly paste; the paste must not get into the slots on the probe body
- ❑ When re-using the old Lambda probe, grease thread with high-temperature paste lubricant; the paste must not get into the slots of the probe body. High-temperature paste ⇒ Parts catalogue

9 - Exhaust manifold

- ❑ For cylinder bank 2 (left-side)

10 - Gasket

- ❑ Renew

11 - 27 Nm

- ❑ Renew

12 - Lambda probe (before catalytic converter), 55 Nm

- ❑ For cylinder bank 2 (left-side)

- ❑ Threads of new Lambda probes are already greased with assembly paste; the paste must not get into the slots on the probe body
- ❑ When re-using the old Lambda probe, grease thread with high-temperature paste lubricant; the paste must not get into the slots of the probe body. High-temperature paste ⇒ Parts catalogue

13 - Lambda probe (after catalytic converter), 55 Nm

- ❑ For cylinder bank 1 (left-side)
- ❑ Threads of new Lambda probes are already greased with assembly paste; the paste must not get into the slots on the probe body
- ❑ When re-using the old Lambda probe, grease thread with high-temperature paste lubricant; the paste must not get into the slots of the probe body. High-temperature paste ⇒ Parts catalogue

14 - Front exhaust pipe with starter catalytic converter and main catalytic converter

- ❑ For cylinder bank 2 (left-side)
- ❑ With flexible joint and front silencer
- ❑ Do not bend flexible joint more than 10° - otherwise it can be damaged
- ❑ Protect against knocks and impact
- ❑ Align exhaust system so it is free of stress ⇒ page 190
- ❑ Components of exhaust pipe mountings for vehicles with manual gearbox ⇒ page 182
- ❑ Components of exhaust pipe mountings for vehicles with automatic gearbox ⇒ page 183

15 - Clamp (front)

- ❑ Align exhaust system so it is free of stress before tightening clamp ⇒ page 190
- ❑ Installation position ⇒ page 182
- ❑ Tighten bolt connections evenly.

16 - 40 Nm

17 - Clamp (front)

- ❑ Align exhaust system so it is free of stress before tightening clamp ⇒ page 190
- ❑ Installation position ⇒ page 182
- ❑ Tighten bolt connections evenly.

18 - 40 Nm

19 - Mounting

- ❑ Renew if damaged

20 - 25 Nm

21 - Rear silencer

- ❑ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ❑ Cutting point ⇒ page 189
- ❑ Align exhaust system so it is free of stress ⇒ page 190

22 - Clamp (rear)

- ❑ For separate replacement of centre and rear silencers
- ❑ Align exhaust system so it is free of stress before tightening clamp ⇒ page 190
- ❑ Installation position ⇒ page 182
- ❑ Tighten bolt connections evenly.

23 - 40 Nm

24 - Mounting

- ❑ Renew if damaged

25 - 25 Nm

26 - Centre silencer

- ❑ With front silencer
- ❑ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes

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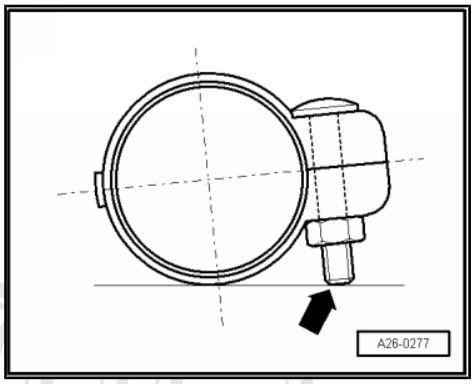
- ❑ Cutting point ⇒ page 189
- ❑ Align exhaust system so it is free of stress ⇒ page 190

Installation position of front clamps

– When fitting clamps, make sure ends of bolts do not project below bottom of clamp -arrow-.

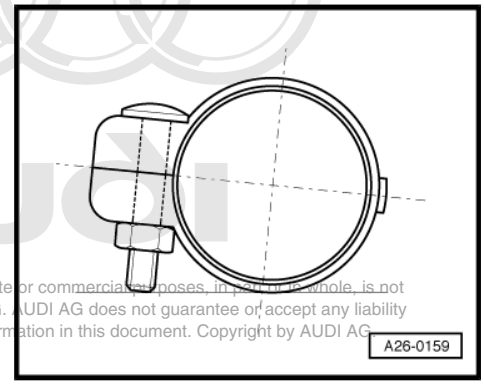
• Bolt connection faces to right.



Installation position of rear clamp

– Install clamp so that ends of bolts do not protrude beyond bottom of clamp.

• Bolt connection faces to left.



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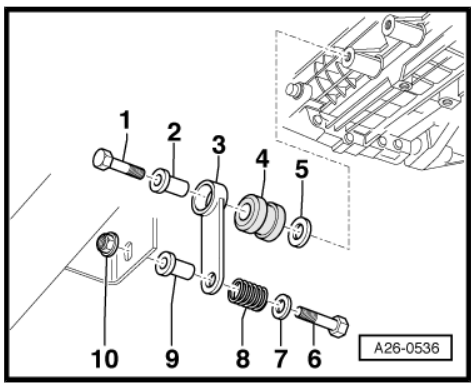
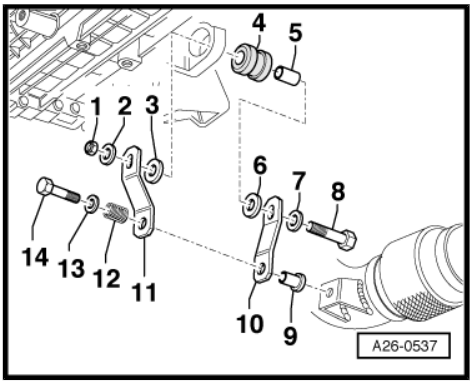
Components of exhaust pipe mountings (left-side) for vehicles with manual gearbox



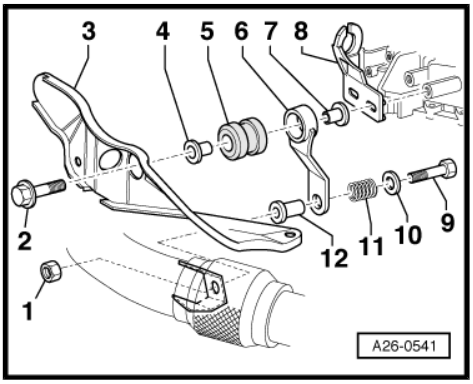
1 - Bolt, 25 Nm
2 - Spacer sleeve
3 - Bracket
4 - Buffer
5 - Washer
6 - Bolt
7 - Washer
8 - Compression spring
9 - Spacer sleeve
10 - Nut, self-locking, 25 Nm

Components of exhaust pipe mountings (right-side) for vehicles with manual gearbox



1 - Nut, self-locking, 25 Nm
2 - Washer
3 - Washer
4 - Buffer
5 - Spacer sleeve
6 - Washer
7 - Washer
8 - Bolt
9 - Spacer sleeve
10 - Bracket
11 - Bracket
12 - Compression spring
13 - Washer
14 - Bolt, 25 Nm

Components of exhaust pipe mountings (left-side) for vehicles with automatic gearbox



1 - Nut, self-locking, 25 Nm
2 - Bolt, 25 Nm
3 - Heat shield for selector lever cable
4 - Spacer sleeve
5 - Buffer
6 - Bracket
7 - Spacer sleeve
8 - Support bracket
9 - Bolt
10 - Washer
11 - Compression spring
12 - Spacer sleeve

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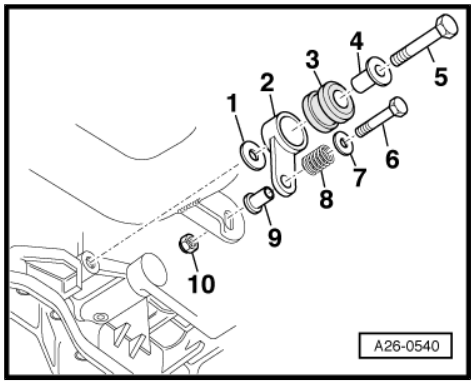
Components of exhaust pipe mountings (right-side) for vehicles with automatic gearbox



1 - Washer
2 - Bracket
3 - Buffer
4 - Spacer sleeve
5 - Bolt, 25 Nm
6 - Bolt
7 - Washer
8 - Compression spring
9 - Spacer sleeve
10 - Nut, self-locking, 25 Nm

1.2 Exhaust system on vehicles with four-wheel drive - exploded view of components

Note

The illustration shows the exhaust system on vehicles with exhaust emissions standard “EU4”.

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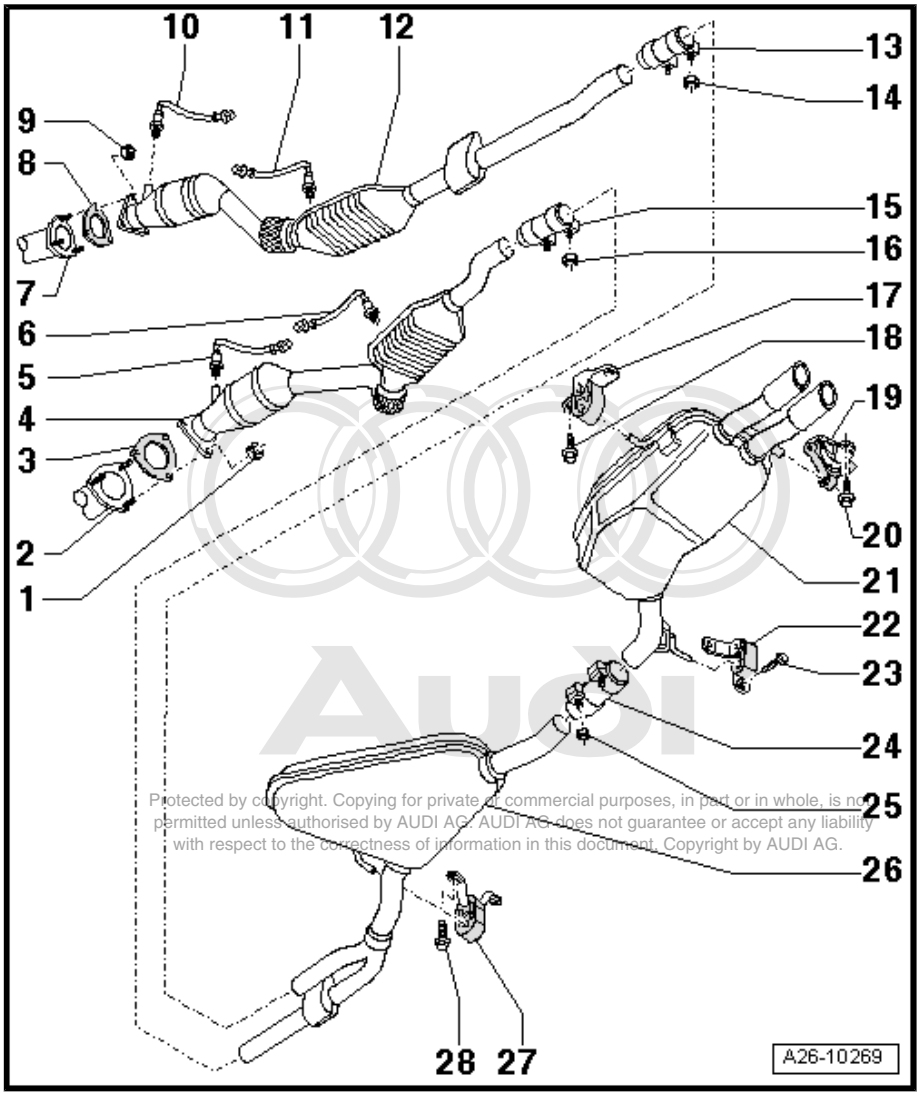

1 - 40 Nm

2 - Exhaust manifold

- ❑ For cylinder bank 1 (right-side)

3 - Gasket

- ❑ Renew

4 - Front exhaust pipe with starter catalytic converter and main catalytic converter

- ❑ For cylinder bank 1 (right-side)
- ❑ With flexible joint
- ❑ Do not bend flexible joint more than 10° - otherwise it can be damaged
- ❑ Protect against knocks and impact
- ❑ Align exhaust system so it is free of stress ⇒ page 190
- ❑ Components of exhaust pipe mountings for vehicles with manual gearbox ⇒ page 188
- ❑ Components of exhaust pipe mountings for vehicles with automatic gearbox ⇒ page 189

5 - Lambda probe (before catalytic converter), 55 Nm

- ❑ For cylinder bank 1 (right-side)
- ❑ Threads of new Lambda probes are already greased with assembly paste; the paste must not get into the slots on the probe body
- ❑ When re-using the old Lambda probe, grease thread with high-temperature paste lubricant; the paste must not get into the slots of the probe body. High-temperature paste ⇒ Parts catalogue

6 - Lambda probe (after catalytic converter), 55 Nm

- ❑ For cylinder bank 1 (right-side)
- ❑ Threads of new Lambda probes are already greased with assembly paste; the paste must not get into the slots on the probe body
- ❑ When re-using the old Lambda probe, grease thread with high-temperature paste lubricant; the paste must not get into the slots of the probe body. High-temperature paste ⇒ Parts catalogue

7 - Exhaust manifold

- ❑ For cylinder bank 2 (left-side)

8 - Gasket

- ❑ Renew

9 - 25 Nm

- ❑ Renew

10 - Lambda probe (before catalytic converter), 55 Nm

- ❑ For cylinder bank 2 (left-side)
- ❑ Threads of new Lambda probes are already greased with assembly paste; the paste must not get into the slots on the probe body
- ❑ When re-using the old Lambda probe, grease thread with high-temperature paste lubricant; the paste must not get into the slots of the probe body. High-temperature paste ⇒ Parts catalogue

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11 - Lambda probe (after catalytic converter), 55 Nm

- ❑ For cylinder bank 2 (left-side)
- ❑ Threads of new Lambda probes are already greased with assembly paste; the paste must not get into the slots on the probe body
- ❑ When re-using the old Lambda probe, grease thread with high-temperature paste lubricant; the paste must not get into the slots of the probe body. High-temperature paste ⇒ Parts catalogue

12 - Front exhaust pipe with starter catalytic converter and main catalytic converter

- ❑ For cylinder bank 2 (left-side)
- ❑ With flexible joint and front silencer
- ❑ Do not bend flexible joint more than 10° - otherwise it can be damaged
- ❑ Protect against knocks and impact
- ❑ Align exhaust system so it is free of stress ⇒ page 190
- ❑ Components of exhaust pipe mountings for vehicles with manual gearbox ⇒ page 187
- ❑ Components of exhaust pipe mountings for vehicles with automatic gearbox ⇒ page 188

13 - Clamp (front)

- ❑ Align exhaust system so it is free of stress before tightening clamp ⇒ page 190
- ❑ Installation position ⇒ page 187
- ❑ Tighten bolt connections evenly.

14 - 40 Nm

15 - Clamp (front)

- ❑ Align exhaust system so it is free of stress before tightening clamp ⇒ page 190
- ❑ Installation position ⇒ page 187
- ❑ Tighten bolt connections evenly.

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16 - 40 Nm

17 - Mounting

- ❑ Renew if damaged

18 - 25 Nm

19 - Mounting

- ❑ Renew if damaged

20 - 25 Nm

21 - Rear silencer

- ❑ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ❑ Cutting point ⇒ page 190
- ❑ Align exhaust system so it is free of stress ⇒ page 190

22 - Mounting

- ❑ Renew if damaged

23 - 25 Nm

24 - Clamp (rear)

- ❑ For separate replacement of centre and rear silencers
- ❑ Align exhaust system so it is free of stress before tightening clamp ⇒ page 190
- ❑ Installation position ⇒ page 187
- ❑ Tighten bolt connections evenly.

25 - 40 Nm

26 - Centre silencer

- ❑ With front silencer
- ❑ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes

❑ Cutting point ⇒ page 190

❑ Align exhaust system so it is free of stress ⇒ page 190

27 - Mounting

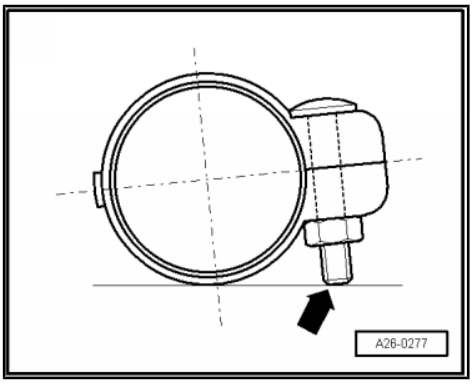
❑ Renew if damaged

28 - 25 Nm

Installation position of front clamps

– When fitting clamps, make sure ends of bolts do not project below bottom of clamp -arrow-.

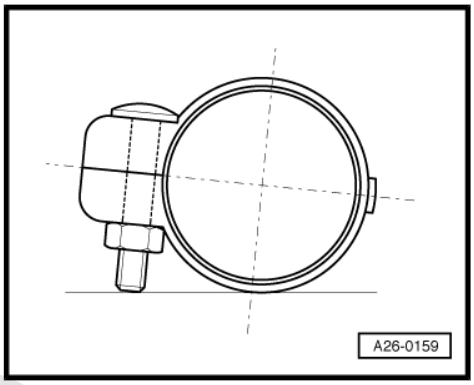
• Bolt connection faces to right.



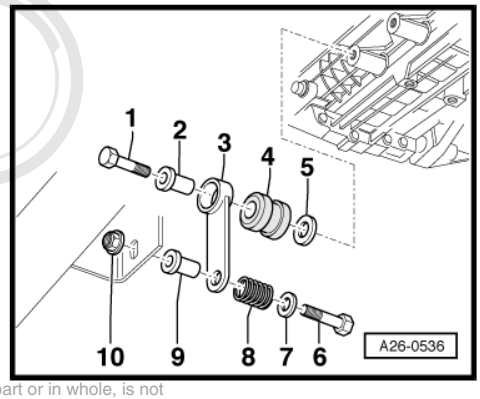
Installation position of rear clamp

– Install clamp so that ends of bolts do not protrude beyond bottom of clamp.

• Bolt connection faces to left.



Components of exhaust pipe mountings (left-side) for vehicles with manual gearbox



1 - Bolt, 25 Nm
2 - Spacer sleeve
3 - Bracket
4 - Buffer
5 - Washer
6 - Bolt
7 - Washer
8 - Compression spring
9 - Spacer sleeve
10 - Nut, self-locking, 25 Nm

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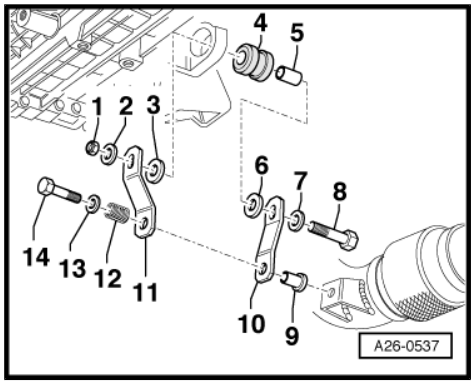
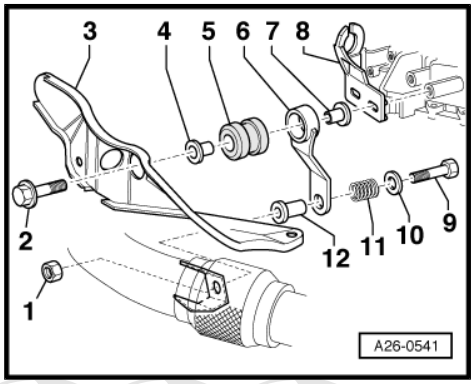
Components of exhaust pipe mountings (right-side) for vehicles with manual gearbox



1 - Nut, self-locking, 25 Nm
2 - Washer
3 - Washer
4 - Buffer
5 - Spacer sleeve
6 - Washer
7 - Washer
8 - Bolt
9 - Spacer sleeve
10 - Bracket
11 - Bracket
12 - Compression spring
13 - Washer
14 - Bolt, 25 Nm

Components of exhaust pipe mountings (left-side) for vehicles with automatic gearbox



1 - Nut, self-locking, 25 Nm
2 - Bolt, 25 Nm
3 - Heat shield for selector lever cable
4 - Spacer sleeve
5 - Buffer
6 - Bracket
7 - Spacer sleeve
8 - Support bracket
9 - Bolt
10 - Washer
11 - Compression spring
12 - Spacer sleeve

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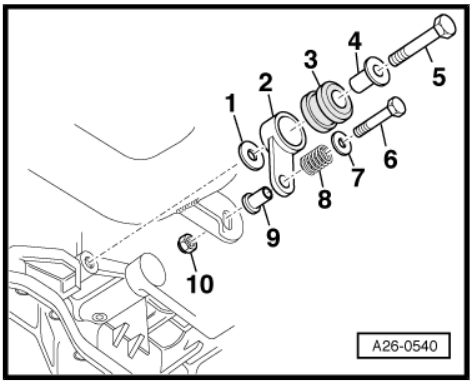
Components of exhaust pipe mountings (right-side) for vehicles with automatic gearbox

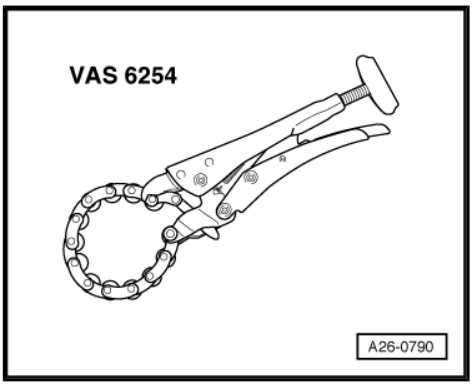


1 - Washer
2 - Bracket
3 - Buffer
4 - Spacer sleeve
5 - Bolt, 25 Nm
6 - Bolt
7 - Washer
8 - Compression spring
9 - Spacer sleeve
10 - Nut, self-locking, 25 Nm

1.3 Separating centre and rear silencers

Special tools and workshop equipment required

- Chain pipe cutter - VAS 6254-



The connecting pipe can be cut through at the cutting point provided in order to renew the centre and rear silencers separately.

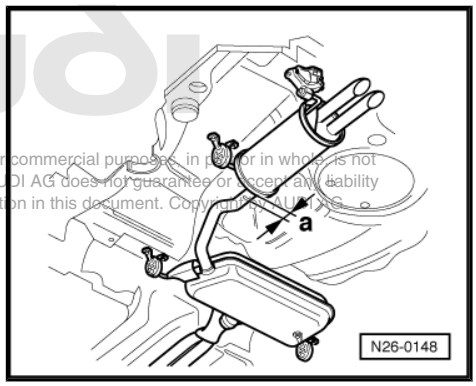
Note

Cutting location is also marked by an indentation on circumference of exhaust pipe.

Procedure - vehicles with front-wheel drive:

– Cut through exhaust pipe at a right angle at cutting point using chain-type pipe cutter - VAS 6254- .

• Dimension -a- = approx. 182 mm.



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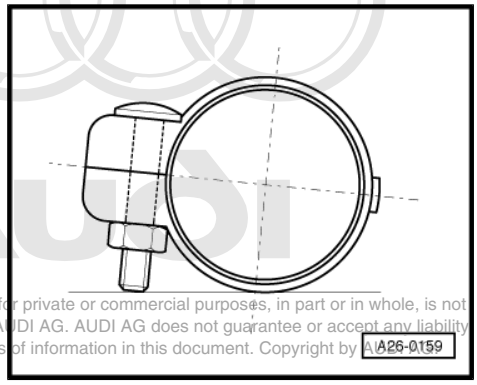
– When reassembling, position the clamp centrally over the cutting points.
– Install clamp so that ends of bolts do not protrude beyond bottom of clamp.
• Bolt connection faces to left.
– Align exhaust system so it is free of stress ⇒ page 190 .



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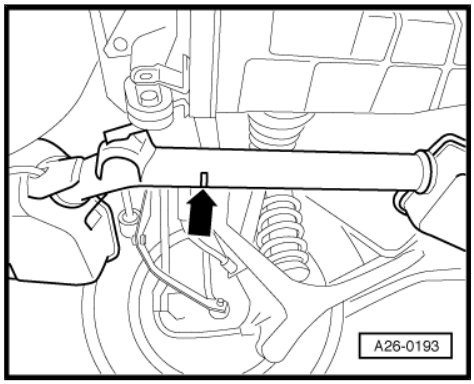
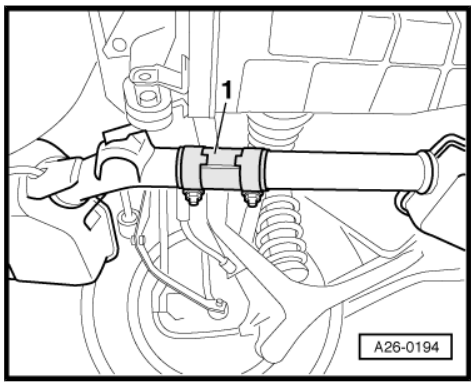
Procedure - vehicles with four-wheel drive:

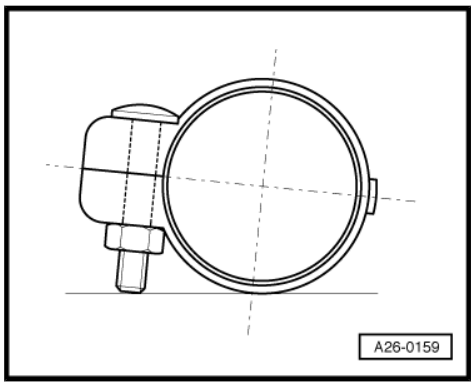
– Cut through exhaust pipe at a right angle at cutting point -arrow- using chain pipe cutter - VAS 6254- .



– When reassembling, position the clamp -1- centrally over the cutting point.



– Install clamp so that ends of bolts do not protrude beyond bottom of clamp.
• Bolt connection faces to left.
– Align exhaust system so it is free of stress ⇒ page 190 .

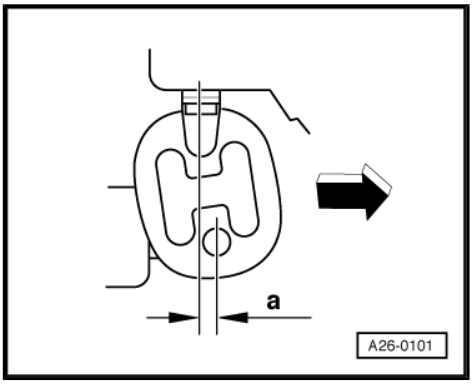


1.4 Stress-free alignment of exhaust system

Note

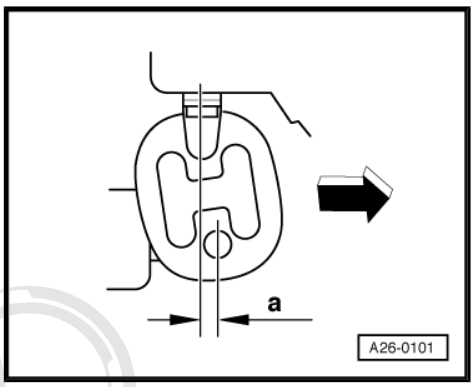
The exhaust system must be aligned when it is cool.

Vehicles with front-wheel drive without clamp between centre silencer and rear silencer



- Loosen bolts of front clamps ⇒ Item 15 (page 181) and ⇒ Item 17 (page 181) .
- Push exhaust system towards front of vehicle -arrow-, so that mounting for centre silencer is preloaded by -a- = 7 ... 9 mm.
- Tighten bolt connections of clamps evenly to 40 Nm.
- Align tailpipes ⇒ page 192 .

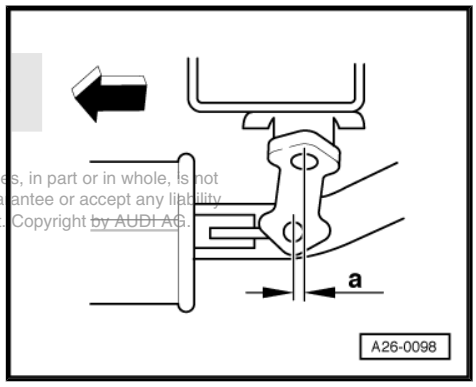
On vehicles with front-wheel drive with clamp between centre silencer and rear silencer



Note

On vehicles with clamp fitted between centre silencer and rear silencer, it is also necessary to align the rear silencer.

- Loosen bolts for front clamps ⇒ Item 15 (page 181) , ⇒ Item 17 (page 181) and rear clamp ⇒ Item 22 (page 181) .
- Push front section of exhaust system towards front of vehicle -arrow- so that mounting for centre silencer is preloaded by -a- = 7 ... 9 mm.
- Tighten bolts on front clamps ⇒ Item 15 (page 181) and ⇒ Item 17 (page 181) evenly to 40 Nm.
- Push rear section of exhaust system towards front of vehicle -arrow- until rear mountings for rear silencer are preloaded by -a- = 7 ... 9 mm.
- Align rear silencer so it is horizontal.
- Tighten bolt connections for clamps (rear) ⇒ Item 22 (page 181) evenly to 40 Nm.
- Align tailpipes ⇒ page 192 .



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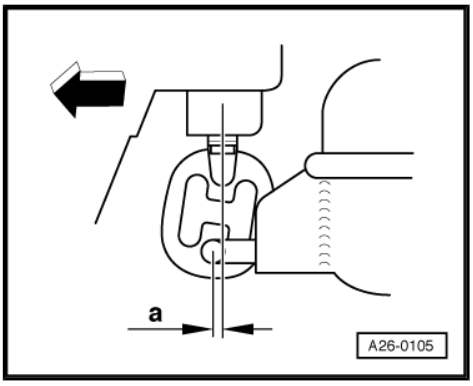
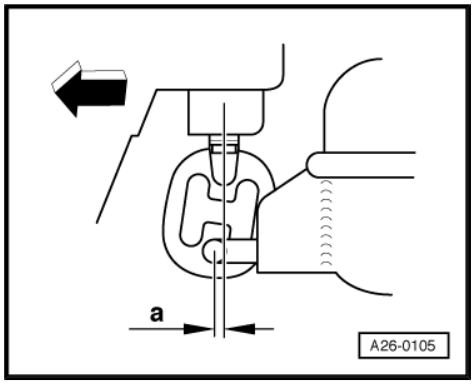
Vehicles with four-wheel drive without clamp between centre silencer and rear silencer



- Loosen bolts of front clamps ⇒ Item 13 (page 186) and ⇒ Item 15 (page 186) .
- Push exhaust system towards front of vehicle -arrow-, so that mounting for centre silencer is preloaded by -a- = 7 ... 9 mm.
- Tighten bolt connections of clamps evenly to 40 Nm.
- Align tailpipes ⇒ page 192 .

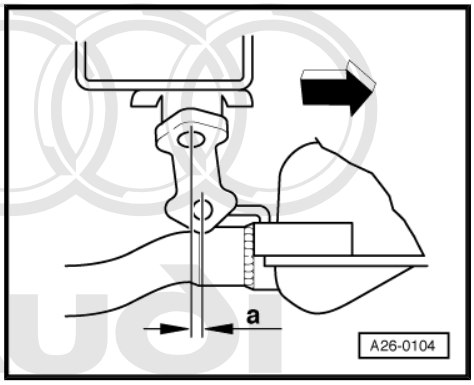
On vehicles with four-wheel drive with clamp between centre silencer and rear silencer



Note

On vehicles with clamp fitted between centre silencer and rear silencer, it is also necessary to align the rear silencer.

- Loosen bolts for front clamps ⇒ Item 13 (page 186) , ⇒ Item 15 (page 186) and rear clamp ⇒ Item 24 (page 186) .
- Push front section of exhaust system towards front of vehicle -arrow- so that mounting for centre silencer is preloaded by -a- = 7 ... 9 mm.
- Tighten bolts on front clamps ⇒ Item 13 (page 186) and ⇒ Item 15 (page 186) evenly to 40 Nm.



- Push rear section of exhaust system towards front of vehicle -arrow- until rear mountings for rear silencer are preloaded by -a- = 9 ... 11 mm.
- Align rear silencer so it is horizontal.
- Tighten bolt connections for clamps (rear) ⇒ Item 24 (page 186) evenly to 40 Nm.
- Align tailpipes ⇒ page 192 .

Aligning tailpipes

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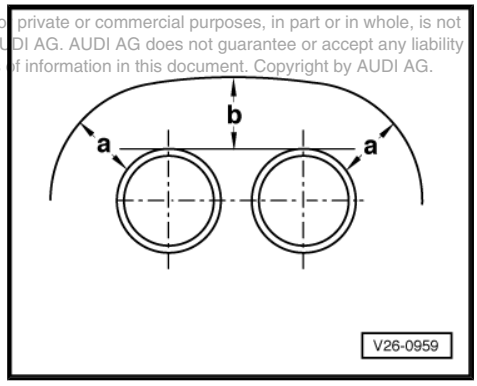


- Align tailpipes so that distance -a- (left-side) is the same as distance -a- (right-side).
- At the same time, distance -b- must be obtained between bumper cut-out and top of tailpipes.

• Dimension -b- = min. 24 mm.

1.5 Checking exhaust system for leaks

- Start engine and run at idling speed.
- Plug tailpipes during leak test (e.g. with cloth or plug).
- Listen for noise at connection points (cylinder head/exhaust manifold, exhaust manifold/front exhaust pipe, etc.) to locate any leaks.
- Repair any leaks that are found.

2 Secondary air system - vehicles with engine code AHA, ALF, ALG, AML, AMM, AQD, ARJ, ATQ

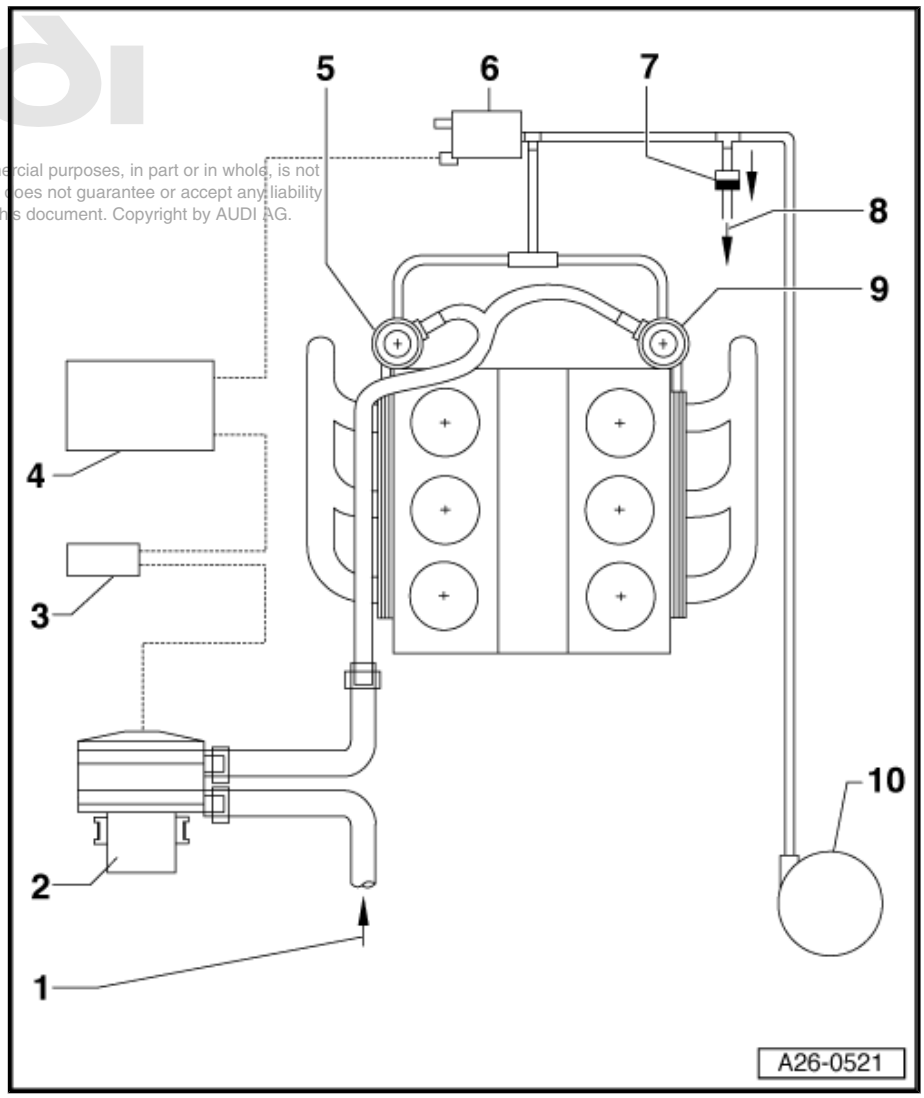
The secondary air system is designed to enable the catalytic converter to heat up and reach its operating temperature more quickly after a cold start.

2.1 Principle and function

Principle

Because of the over-enrichment of the mixture in the cold start phase, the proportion of unburned hydrocarbons in the exhaust gas is higher. The secondary air system improves the afterburning (oxidation) process in the catalytic converter, and thus reduces toxic emissions. The heat generated by oxidisation accelerates the "light off" of the catalytic converter and significantly improves exhaust gas quality during warm-up.

Function



1 - From air cleaner housing

2 - Secondary air pump motor - V101-

- ❑ Fitting location ⇒ page 194
- ❑ Removing and installing ⇒ page 207

3 - Secondary air pump relay - J299- or -J316- .

- ❑ Fitting location ⇒ page 194

4 - Motronic control unit - J220-

5 - Combination valve for secondary air system (right-side)

- ❑ Fitting location ⇒ page 196

6 - Secondary air inlet valve - N112-

- ❑ Fitting location ⇒ page 196

7 - Non-return valve

- ❑ Installation position (light side/dark side) as shown in illustration. Arrow indicates direction of flow.

8 - To intake manifold

9 - Combination valve for secondary air system (left-side)

- ❑ Fitting location ⇒ page 196

10 - Vacuum reservoir

- ❑ Fitting location: in front left wheel housing beneath liner

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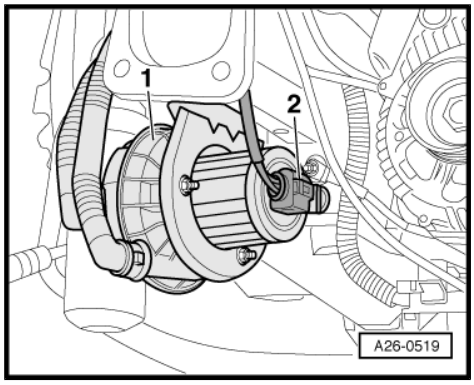
Fitting location of secondary air pump motor - V101-

- At front right of engine compartment, below longitudinal member.

1 - Secondary air pump motor - V101-

2 - Electrical connector for secondary air pump motor - V101-



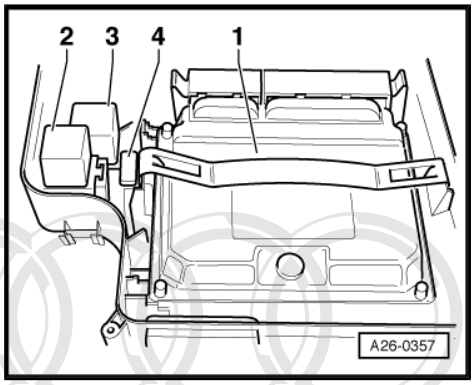
Fitting location of secondary air pump relay - J299- or -J316- .

- In electronics box (plenum chamber)

1 - Motronic control unit - J220-

2 - Secondary air pump relay - J299- or -J316- .

4 - Secondary air pump fuse - S130-



2.2 Secondary air system - exploded view

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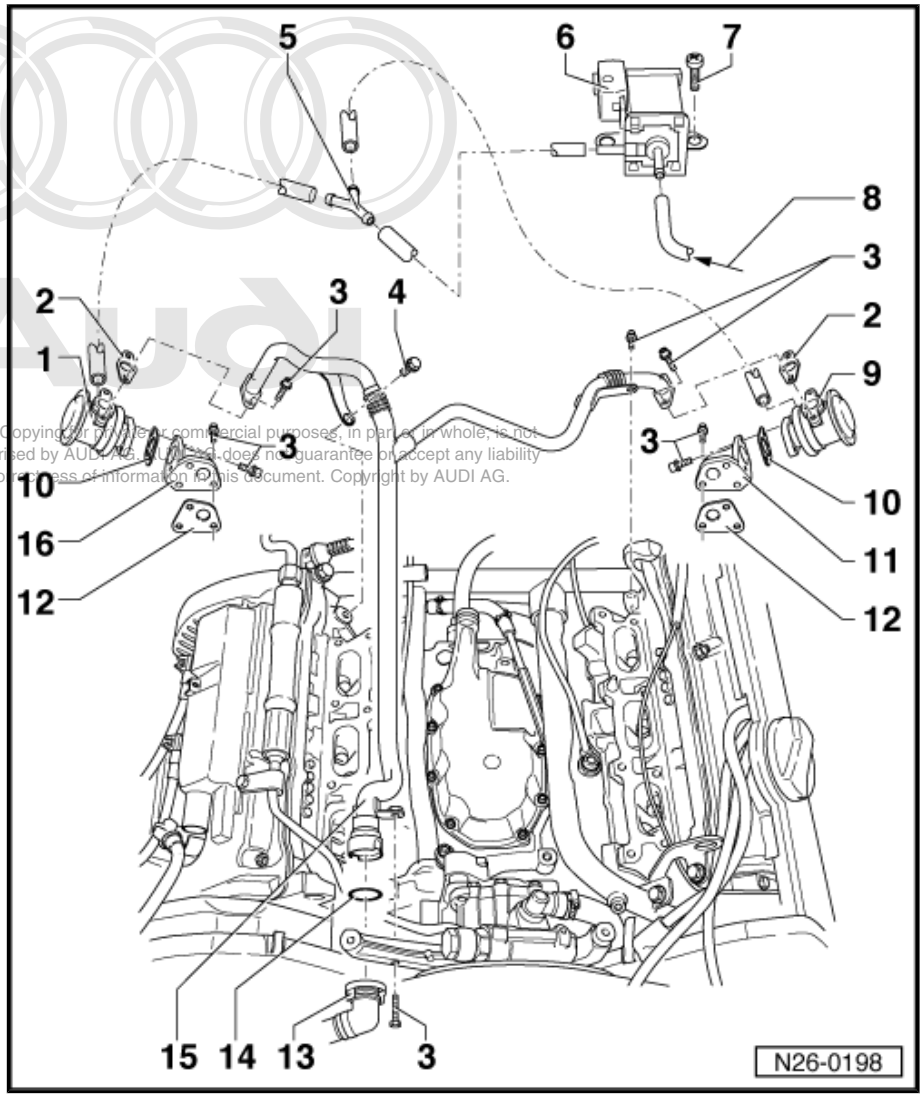

1 - Combination valve for secondary air system (right-side)

- ❑ Fitting location ⇒ page 196
- ❑ Checking ⇒ page 205
- ❑ Removing and installing ⇒ page 209

2 - Seal

- ❑ Renew

3 - 10 Nm

4 - 22 Nm

5 - Y-piece

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6 - Secondary air inlet valve - N112-

- ❑ Fitting location ⇒ page 196
- ❑ Checking ⇒ page 196

7 - 6 Nm

8 - From vacuum reservoir

- ❑ Fitting location: in front left wheel housing beneath liner

9 - Combination valve for secondary air system (left-side)

- ❑ Fitting location ⇒ page 196
- ❑ Checking ⇒ page 205
- ❑ Removing and installing ⇒ page 208

10 - Gasket

- ❑ Renew

11 - Connection

12 - Gasket

- ❑ Renew

13 - Pressure hose

- ❑ Check that it is securely seated
- ❑ Press together at front to release

14 - O-ring

- ❑ Renew

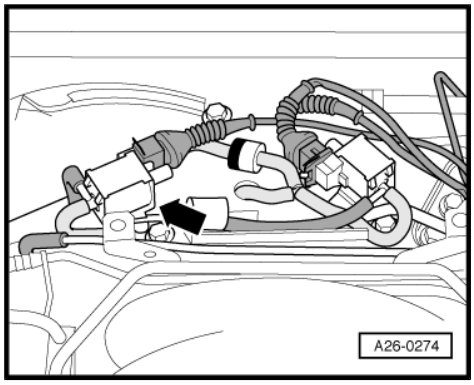
15 - Connecting pipe

- ❑ To combination valves for secondary air inlet
- ❑ Removal and installation involve taking out intake manifold ⇒ page 83

16 - Connection

Fitting location of secondary air inlet valve - N112-

- Bolted to retainer plate for solenoid valves at rear of engine -arrow-.

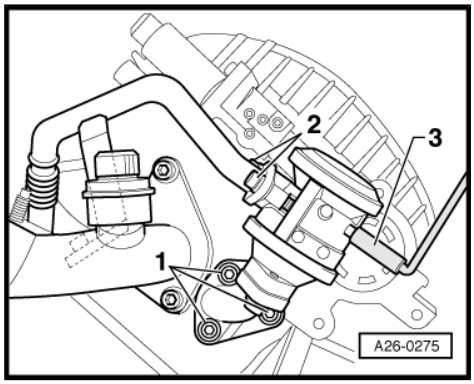


Fitting location of combination valve for secondary air system

- At rear of cylinder heads.

Note

Illustration shows valve on right side.



2.3 Checking secondary air inlet valve - N112-

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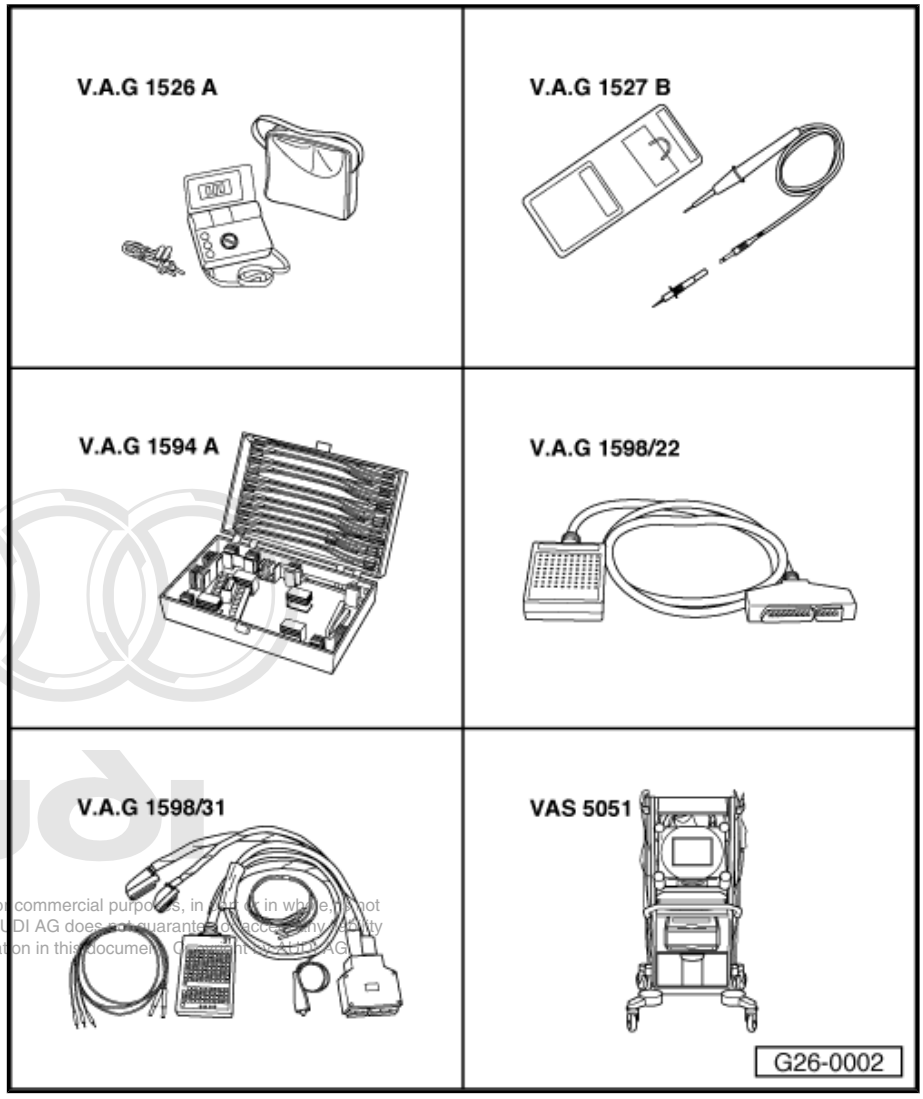
Special tools and workshop equipment required

- Hand-held multimeter - V.A.G 1526 A- or -V.A.G 1526 B-
- Voltage tester - V.A.G 1527 B-
- Auxiliary measuring set - V.A.G 1594 A- or -V.A.G 1594 C-
- Test box - V.A.G 1598/22- (vehicles with throttle cable)
- Test box - V.A.G 1598/31- (vehicles with electronic throttle)
- Vehicle diagnostic, testing and information system - VAS 5051- with diagnosis lead - VAS 5051/1-



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Test conditions

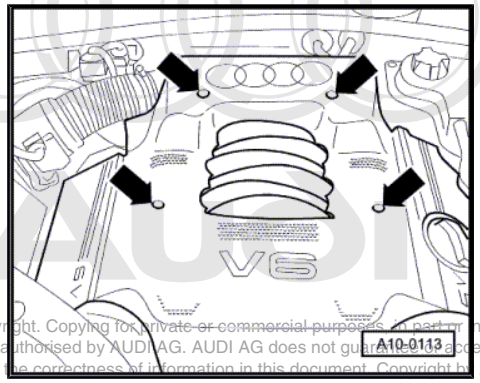
- Vehicle diagnostic, testing and information system - VAS 5051- with diagnosis lead - VAS 5051/1- is connected; vehicle self-diagnosis and vehicle system “01 - Engine electronics” is selected. When doing this, the ignition must be switched on.
- Fault memory of engine control unit interrogated.

Note

The secondary air inlet valve - N112- and the wiring connections are monitored by the engine control unit.

Test sequence

– Take off engine cover panel -arrows-.



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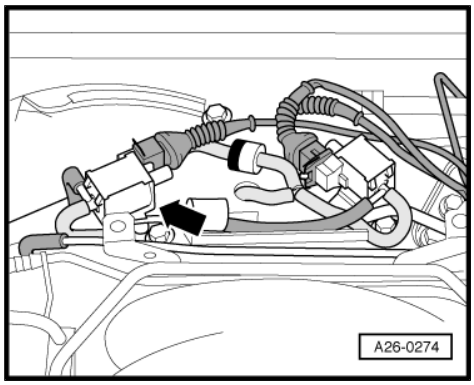
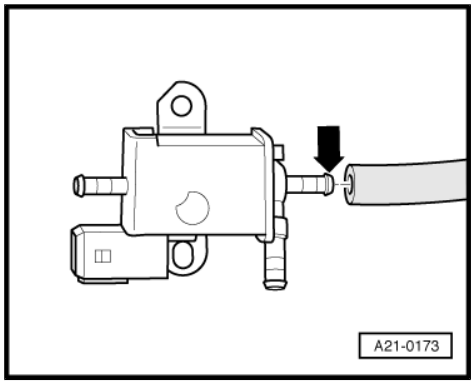
– Disconnect hoses from secondary air inlet valve - N112- -arrow-; leave electrical connector attached.



– Connect test hose to the valve connector marked with an -arrow-.



Display on -VAS 5051- :

– From the menu -1- select the diagnostic function “03 - Final control diagnosis”.

– Press the → key repeatedly until the secondary air inlet valve - N112- is activated.

• The valve should click and open and close (check by blowing into the test hose).

– Exit function “03 - Final control diagnosis” by pressing the ← key, and switch off the ignition.

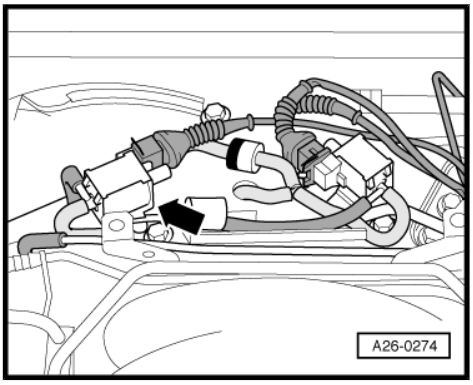
If valve does not open or close correctly:

– Renew secondary air inlet valve - N112- .

If valve does not click during final control diagnosis:

Checking internal resistance

– Unplug electrical connector at secondary air inlet valve - N112- -arrow-.



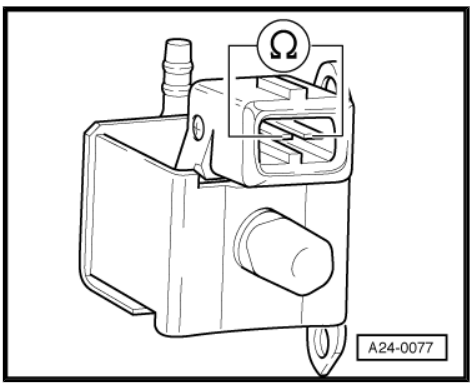
– Connect multimeter (resistance measuring range) to valve.

• Specification: 25 ... 35 Ω.

If the specification is not attained:

– Renew secondary air inlet valve - N112- .

If specification is obtained:



Checking voltage supply

• Fuse for secondary air inlet valve OK.

• Fuel pump relay - J17- OK.

Note

The secondary air inlet valve - N112- is supplied with power via the fuel pump relay.

– Connect voltage tester - V.A.G 1527 B- between contact -1- and earth.

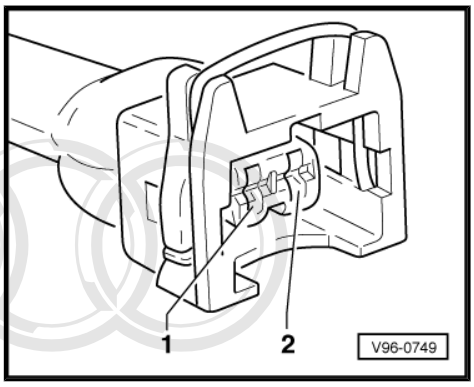
– Operate the starter briefly.

• The LED should light up.

If LED does not light up:

– Repair wiring from contact -1- of connector, via fuse, to fuel pump relay (refer to current flow diagram).

If the LED lights up:



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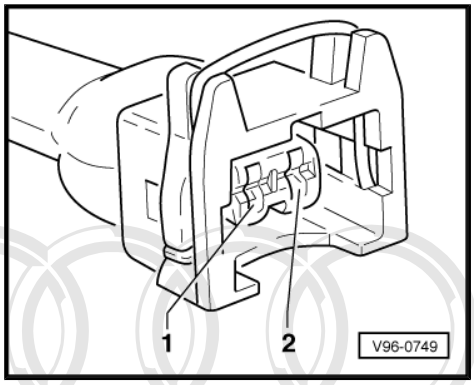
Checking activation



– Connect voltage tester - V.A.G 1527 B- between contacts -1- and -2-.
– Repeat function “03 - Final control diagnosis”.
– Press the → key repeatedly until the secondary air inlet valve - N112- is activated.
• The LED should flash.
– Exit function “03 - Final control diagnosis” by pressing the ← key, and switch off the ignition.

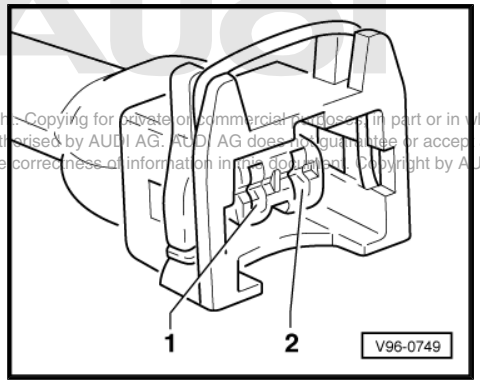
If the LED does not flash:

– Connect test box - V.A.G 1598/22- or -V.A.G 1598/31- to wiring harness for engine control unit, but do not connect the engine control unit itself ⇒ Rep. gr. 24 .

– Check for open circuit and short to positive or earth in the following wiring:

Vehicles with throttle cable:

Connector Contact	Test box - V.A.G 1598/22- Socket
-2-	33



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Vehicles with electronic throttle:

Connector Contact	Test box - V.A.G 1598/31- Socket
-2-	44

All vehicles:

– Repair wiring connection if necessary.

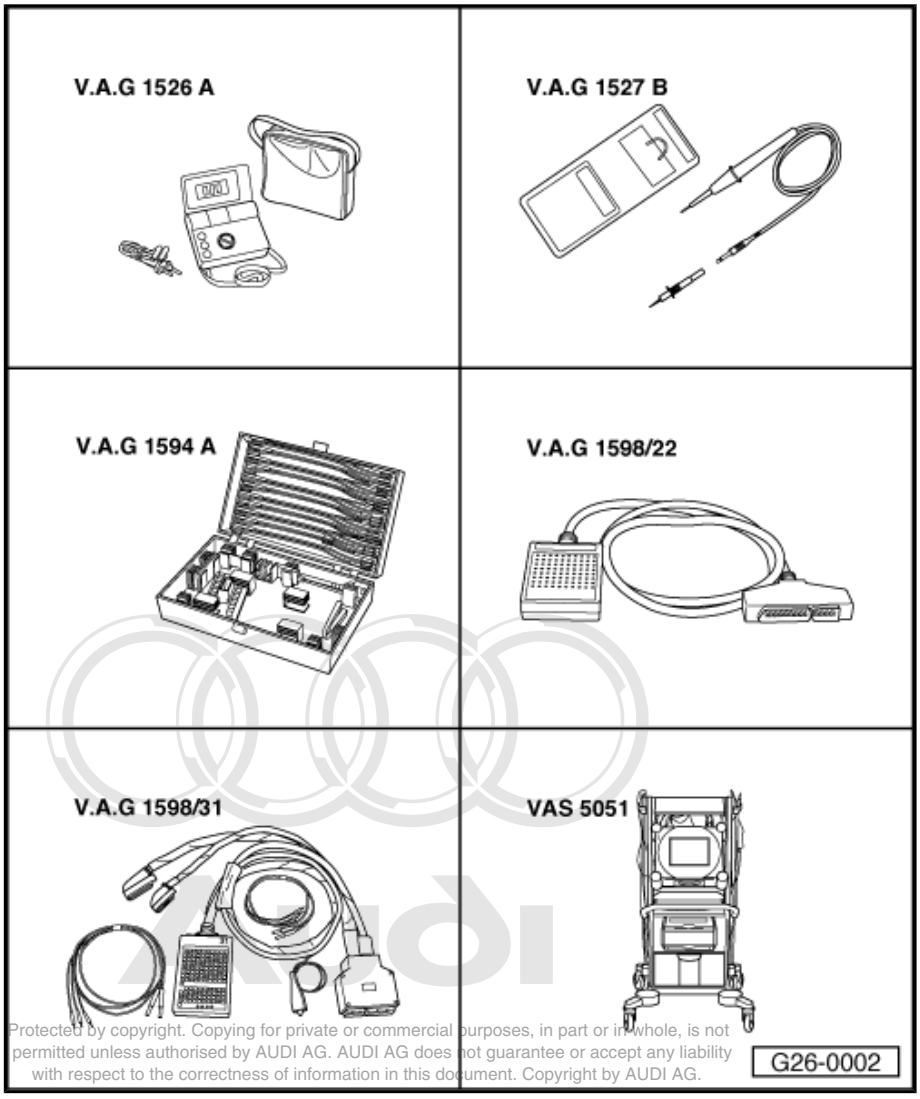
If no fault in wire is detected:

– Renew engine control unit.

2.4 Checking secondary air pump relay - J299- or -J316- and activation

Special tools and workshop equipment required

- Hand-held multimeter - V.A.G 1526 A- or -V.A.G 1526 B-
- Voltage tester - V.A.G 1527 B-
- Auxiliary measuring set - V.A.G 1594 A- or -V.A.G 1594 C-
- Test box - V.A.G 1598/22- (vehicles with throttle cable)
- Test box - V.A.G 1598/31- (vehicles with electronic throttle)
- Vehicle diagnostic, testing and information system - VAS 5051- with diagnosis lead - VAS 5051/1-



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Test conditions

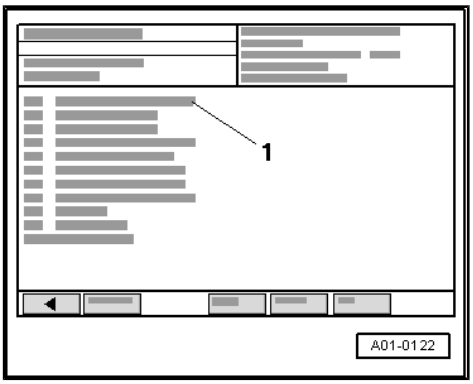
- Vehicle diagnostic, testing and information system - VAS 5051- with diagnosis lead - VAS 5051/1- is connected; vehicle self-diagnosis and vehicle system “01 - Engine electronics” is selected. When doing this, the ignition must be switched on.
- Fault memory of engine control unit interrogated.

Test sequence

Display on -VAS 5051-

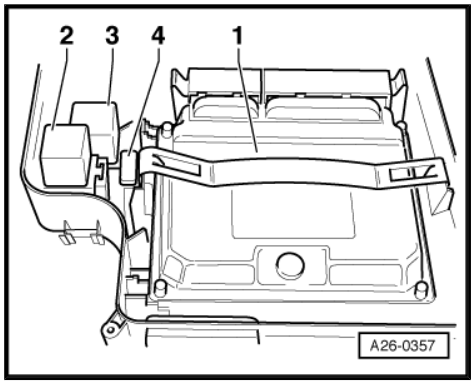
– From the menu -1- select the diagnostic function “03 - Final control diagnosis”.

– Tap the → key repeatedly until the secondary air pump relay - J299- or -J316- is activated.



- The secondary air pump relay - J299- or -J316- -item 2- (located in electronics box in plenum chamber) should pick up and the secondary air pump motor - V101- should start up intermittently.

– Exit function “03 - Final control diagnosis” by pressing the ⏎ key, and switch off the ignition.



A - If the relay does not pick up:

– Check voltage supply of secondary air pump relay - J299- or -J316- ⇒ page 202 .

– Check activation of secondary air pump relay - J299- or -J316- ⇒ page 203 .

B - If the relay picks up but the secondary air pump motor - V101- does not run:

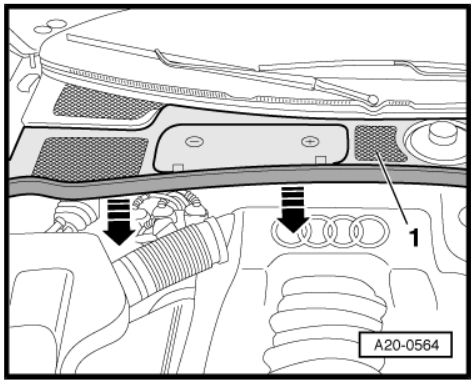
– Check voltage supply for secondary air pump motor - V101- ⇒ page 204 .

Checking voltage supply of secondary air pump relay - J299- or -J316-

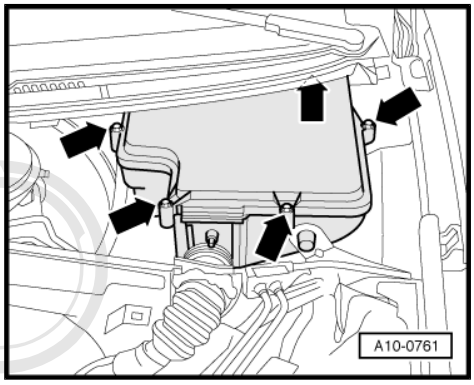
– Run windscreen wipers to the vertical position.

– Detach rubber seal from plenum chamber cover in direction of -arrow-.

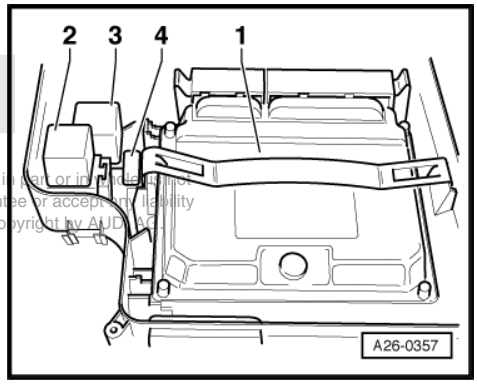
– Detach plenum chamber cover -1- towards the front.



– Remove cover for electronics box in plenum chamber -arrows-.



– Disconnect secondary air pump relay - J299- or -J316- -item 2-.



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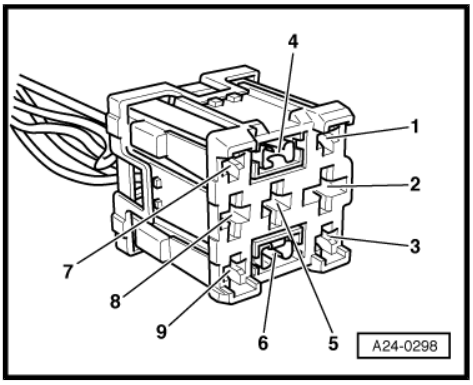
– Connect multimeter (voltage measuring range) between relay socket, contact -8- and earth.

• Specification: approx. battery voltage



If specification is not obtained:

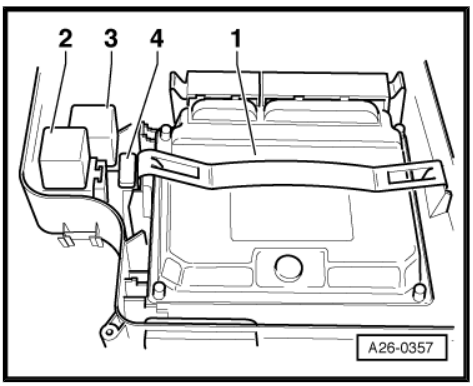
– Check secondary air pump fuse - S130- in position -4- on relay and fuse holder in electronics box (plenum chamber).

– Use current flow diagram to check for open circuit in wiring from battery + (terminal 30), via secondary air pump fuse - S130- in position -4-, to secondary air pump relay - J299- or -J316- -item 2- in electronics box (plenum chamber).

– Connect multimeter (voltage measuring range) between relay socket, contact 4 and earth.

– Operate the starter briefly.

• Specification: approx. battery voltage



If specification is not obtained:

– Repair wiring harness according to current flow diagram.

Checking activation of secondary air pump relay - J299- or -J316-

– Switch off ignition.

– Disconnect secondary air pump relay - J299- or -J316- .

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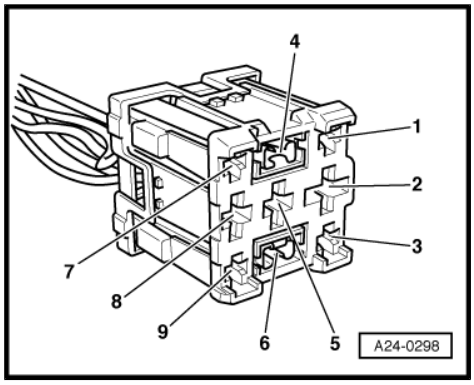
– Connect up voltage tester - V.A.G 1527 B- between relay socket contact -6- and battery positive.

– Repeat function “03 - Final control diagnosis”.

– Tap the ⇨ key repeatedly until the secondary air pump relay - J299- or -J316- is activated.

• The LED should flash.

– Exit function “03 - Final control diagnosis” by pressing the ⇦ key, and switch off the ignition.



If the LED does not flash:

– Connect test box - V.A.G 1598/22- or -V.A.G 1598/31- to wiring harness leading to engine control unit, but do not connect engine control unit itself ⇒ Rep. gr. 24 .

– Check for open circuit and short to positive or earth in the following wiring:

Vehicles with throttle cable:

Relay socket contact	Test box - V.A.G 1598/22- Socket
-6-	30

Vehicles with electronic throttle:

Relay socket contact	Test box - V.A.G 1598/31- Socket
-6-	46

All vehicles:

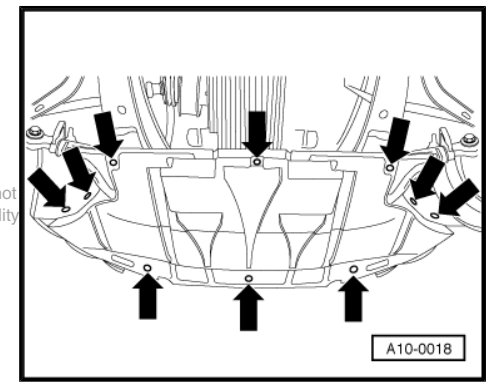
– Repair wiring connection if necessary.

If no fault in wire is detected:

– Renew secondary air pump relay - J299- or -J316- .

Checking voltage supply for secondary air pump motor - V101-

– Remove noise insulation -arrows-.



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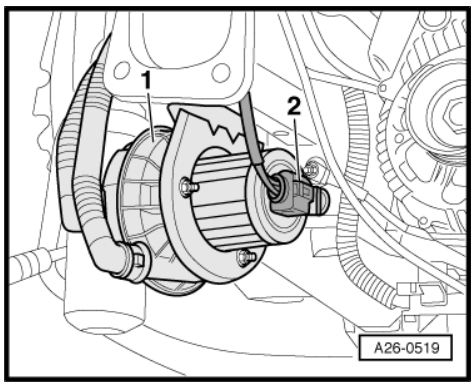
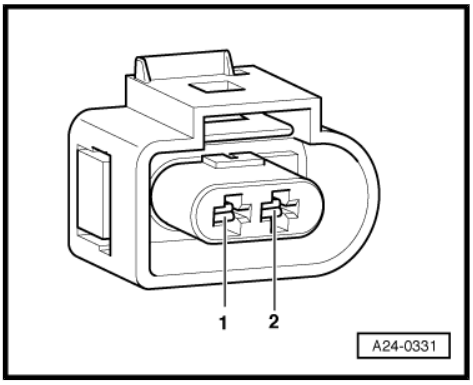
– Unplug electrical connector -2- at secondary air pump motor - V101- -item 1-.



– Connect voltage tester - V.A.G 1527 B- between contacts -1- and -2-.
– Repeat function “03 - Final control diagnosis”.
– Tap the → key repeatedly until the secondary air pump relay - J299- or -J316- is activated.

• The LED should flash.

– Exit function “03 - Final control diagnosis” by pressing the ← key, and switch off the ignition.

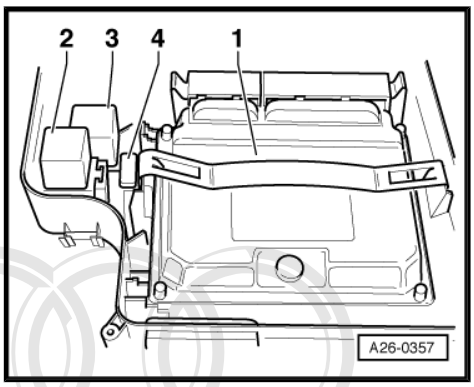


If the LED does not flash:

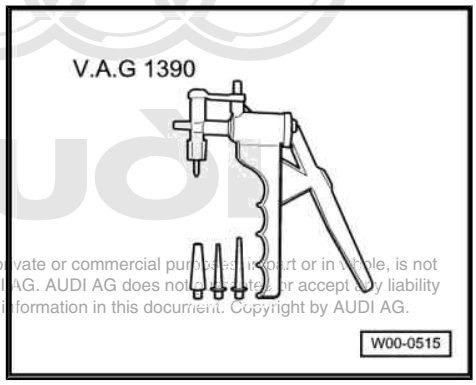
– Use current flow diagram to check for open circuit in wiring between connector at secondary air pump motor - V101- and secondary air pump relay - J299- or -J316- , -item 2- (in electronics box in plenum chamber).
– Use current flow diagram to check for open circuit in wiring between connector at secondary air pump motor - V101- and earth.

If no fault is found:

– Renew secondary air pump.



2.5 Checking combination valve for secondary air system for proper operation and leakage



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Special tools and workshop equipment required

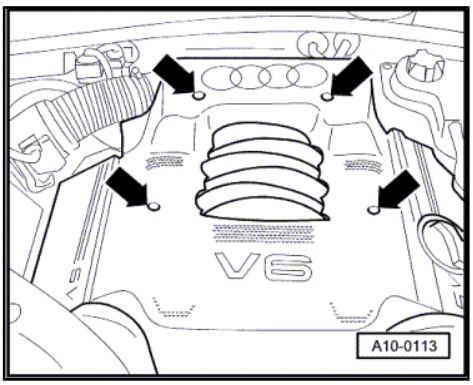
♦ Hand vacuum pump with accessories - V.A.G 1390-

Test conditions

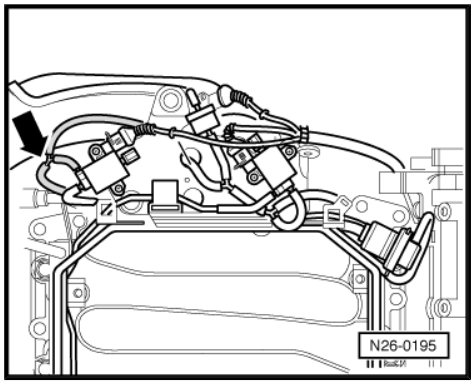
• Vacuum hoses and hose connections do not leak.
• Vacuum hoses are not clogged.

Test sequence

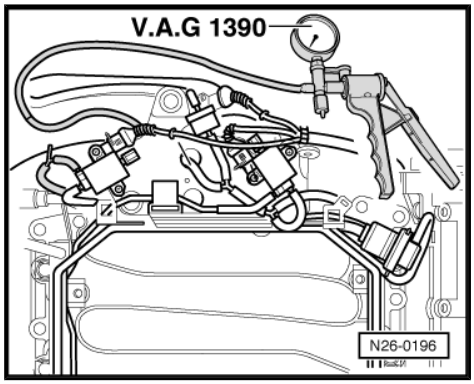
– Remove engine cover panel -arrows-.



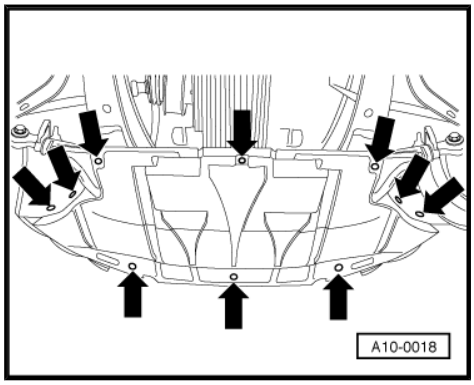
– Pull vacuum hose off Y-piece -arrow- of combination valve you want to check.



– Connect the hand vacuum pump - V.A.G 1390- to vacuum hose of combination valve you want to check.



– Remove noise insulation -arrows-.

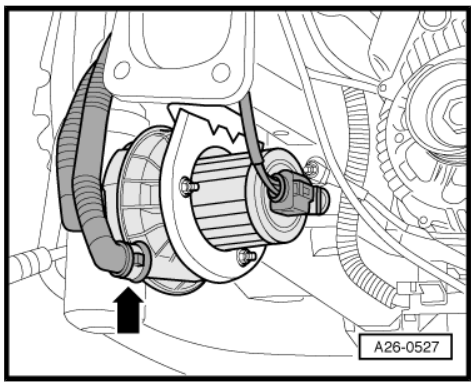


– Detach pressure hose -arrow- from secondary air pump motor and blow into it with light pressure (do not use compressed air).

• Both combination valves must be closed and it must not be possible to blow through the hose.

– Use hand vacuum pump to generate vacuum.

• The combination valve should open; it should now be possible to blow through the hose.



If the relevant combination valve does not open:

– Renew combination valve: left-side ⇒ page 208 , right-side ⇒ page 209 .

Assembly is performed in the reverse sequence:

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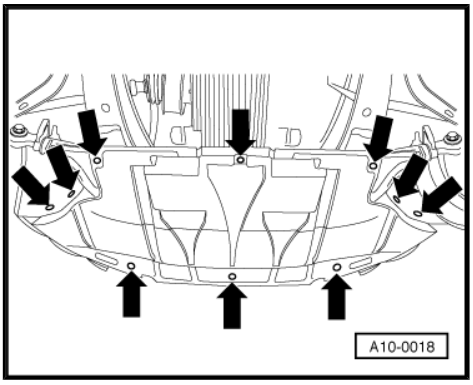
2.6 Removing and installing secondary air pump

Removing

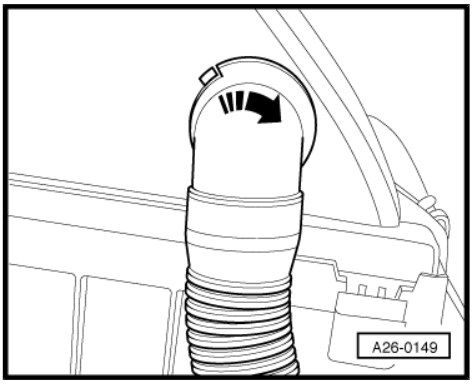
– Remove noise insulation -arrows-.

– Remove front bumper ⇒ Rep. gr. 63 .

– Move lock carrier to service position ⇒ Rep. gr. 50 .



– Turn connecting pipe for secondary air system through 45° to the right -arrow- and detach from air cleaner housing.



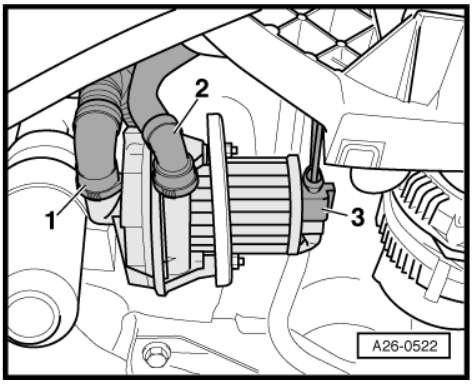
– Remove air duct going to alternator at radiator cowl (front).

– Unplug electrical connector -3-.

– Detach air hoses -1- and -2-.

– Unscrew bolts for secondary air pump motor - V101- .

– Remove secondary air pump motor - V101- .



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Installing

Install in reverse order.

– Install lock carrier ⇒ Rep. gr. 50 .

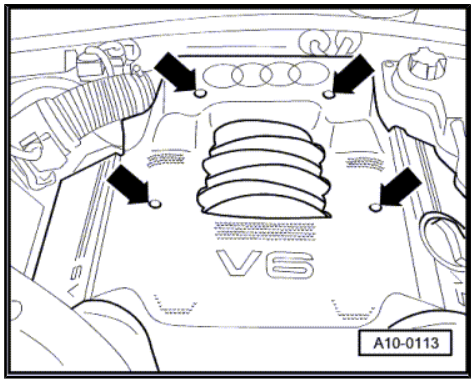
Tightening torque

Component	Nm
Secondary air pump motor - V101- to bracket	10

2.7 Removing and installing combination valve for secondary air system (left-side)

Removing

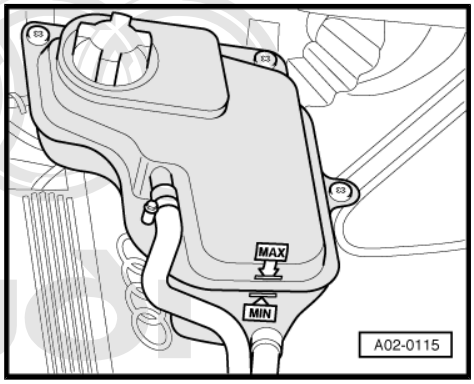
– Remove engine cover panel -arrows-.



– Unbolt coolant expansion tank.

– Detach electrical connector at coolant shortage indicator switch - F66- on coolant expansion tank (bottom).

– Lay aside coolant expansion tank with coolant hoses connected.



– Remove cover panel for cylinder head cover (left-side) -arrows-.

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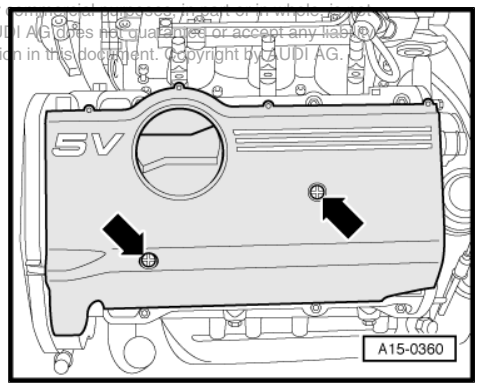
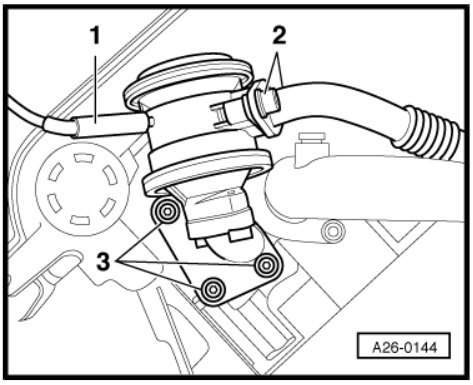


– Detach vacuum hose -1-.
– Remove bolts -3- accessible from underneath at secondary air combination valve.
– Unscrew bolts -2- and take off combination valve for secondary air system.



Note

Illustration shows engine removed.

Installing

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

Note

Renew gaskets and seals.

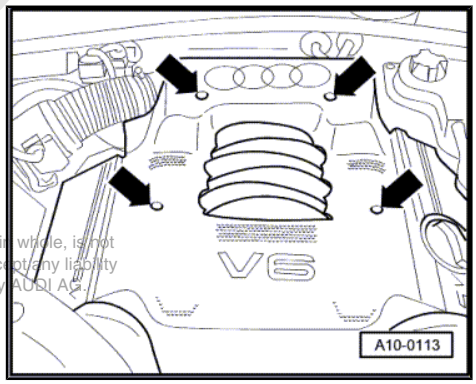
Tightening torques

Component	Nm
Combination valve for secondary air system to cylinder head	10
Connecting pipe to cylinder head	10

2.8 Removing and installing combination valve for secondary air system (right-side)

Removing

– Take off engine cover panel -arrows-.



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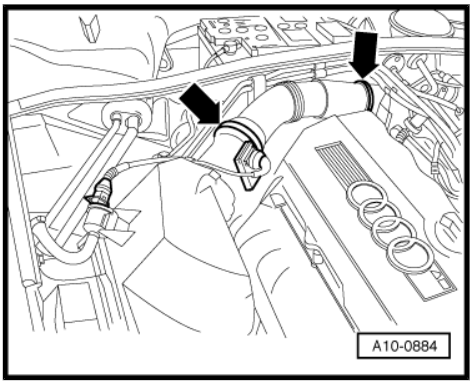
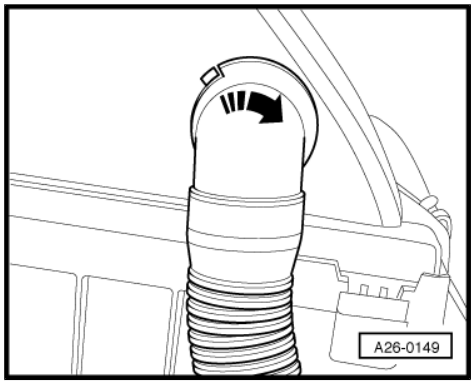
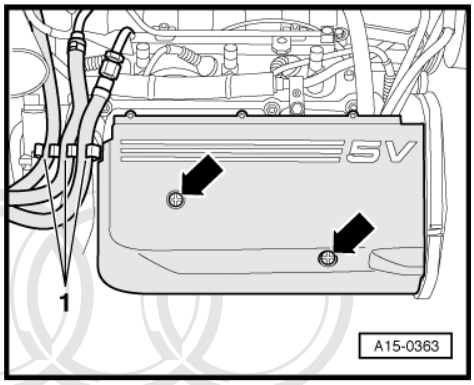
– Remove air intake hose between air mass meter - G70- and intake manifold -arrows-.
– Unplug electrical connectors at solenoid valve 1 for activated charcoal filter system - N80- and air mass meter - G70- .
– Detach solenoid valve 1 for activated charcoal filter - N80- from bracket.



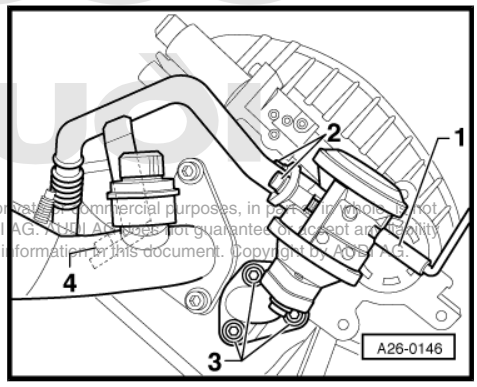
– Turn connecting pipe through 45° to the right -arrow- and detach from air cleaner housing.
– Unscrew and remove air cleaner housing.



– Remove cover panel for cylinder head cover (right-side) -arrows-.



– Detach vacuum hose -1-.
– Remove bolts -3- and -4-.
– Unscrew bolts -2- and take off combination valve for secondary air system.



Installing

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

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Note

Renew seals and gaskets.

Tightening torques

Component	Nm
Combination valve for secondary air system to cylinder head	10
Connecting pipe to cylinder head	10