

Workshop Manual Audi A3 1997 ➤

**4-cylinder 1.8 ltr. 5-valve turbocharged engine
(110-132 kW), mechanics**

Engine ID	AGU	AJQ	APP	AQA	ARX	ARY	ARZ	AUM	AUQ
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Edition 12.2005



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List of Workshop Manual Repair Groups

Repair Group

- 00 - Technical data
- 10 - Removing and installing engine
- 13 - Crankshaft group
- 15 - Cylinder head, valve gear
- 17 - Lubrication
- 19 - Cooling
- 21 - Turbocharging/supercharging
- 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.

Contents

00 - Technical data	1
1 Technical data	1
1.1 Engine number	1
1.2 Engine data	1
10 - Removing and installing engine	3
1 Removing and installing engine	3
1.1 Removing engine	3
1.2 Separating engine from manual gearbox	21
1.3 Separating engine from automatic gearbox 01M	21
1.4 Separating engine from automatic gearbox 09A	23
1.5 Securing engine to assembly stand	25
1.6 Installing engine	27
2 Adjusting assembly mountings	35
2.1 Checking adjustment	35
2.2 Adjusting assembly mountings	35
13 - Crankshaft group	38
1 Servicing work on pulley end	38
1.1 Removing and installing poly V-belt	38
1.2 Removing and installing poly V-belt	39
1.3 Removing and installing vibration damper	41
1.4 Removing and installing bracket for ancillaries	42
1.5 Toothed belt - exploded view of components	45
1.6 Removing and installing toothed belt	48
1.7 Removing toothed belt from camshaft sprocket	53
1.8 Positioning crankshaft at TDC with engine removed	56
2 Removing and installing sealing flanges and dual-mass flywheel/drive plate	57
2.1 Renewing crankshaft oil seal - pulley end	58
2.2 Removing and installing sealing flange (front)	60
2.3 Removing and installing dual-mass flywheel	62
2.4 Removing and installing drive plate	64
3 Removing and installing crankshaft	66
3.1 Crankshaft - exploded view of components	66
3.2 Crankshaft dimensions	68
3.3 Removing and installing drive chain sprocket	68
4 Dismantling and assembling pistons and conrods	71
4.1 Different versions of conrods	71
4.2 Pistons and conrods - exploded view of components	71
4.3 Piston and cylinder dimensions	75
4.4 Measuring radial clearance of conrods	75
15 - Cylinder head, valve gear	77
1 Removing and installing cylinder head	77
1.1 Cylinder head - exploded view of components	77
1.2 Removing and installing cylinder head cover	79
1.3 Removing and installing cylinder head	82
1.4 Removing and installing intake manifold	87
1.5 Checking compression	91
2 Servicing valve gear	94
2.1 Valve gear - exploded view of components	94
2.2 Checking axial clearance of camshafts	97



2.3	Renewing exhaust camshaft oil seal	98
2.4	Renewing inlet camshaft oil seal	100
2.5	Removing and installing camshafts and hydraulic chain tensioner/camshaft adjuster	102
2.6	Checking hydraulic bucket tappets	108
2.7	Renewing valve stem oil seals	109
2.8	Valve dimensions	114
2.9	Checking valve guides	114
2.10	Machining valve seats	115
3	Checking variable valve timing - only on vehicles with engine code ARX, ARY, AUM, AUQ	118
3.1	Checking function of variable valve timing	118
3.2	Checking inlet camshaft control valve 1 N205	119
17	Lubrication	124
1	Removing and installing parts of lubrication system	124
1.1	Lubrication system - exploded view of components	124
1.2	Removing and installing sump	125
1.3	Removing and installing oil pump	129
1.4	Oil filter and oil cooler - exploded view of components	129
1.5	Checking oil pressure and oil pressure switch F1	131
1.6	Engine oil	132
1.7	Checking oil level	133
19	Cooling	134
1	Removing and installing parts of cooling system	134
1.1	Diagram of coolant hose connections	134
1.2	Draining and filling cooling system	136
1.3	Removing and installing coolant pump	141
1.4	Removing and installing thermostat	142
1.5	Checking thermostat	145
1.6	Removing and installing coolant pipe	145
1.7	Radiator and radiator fan - exploded view of components	148
1.8	Removing and installing radiator	149
1.9	Checking cooling system for leaks	152
21	Turbocharging/supercharging	155
1	Charge air system with turbocharger	155
1.1	Safety precautions	155
1.2	Test requirements for checking turbocharging	155
1.3	Diagram of connections for charge pressure control system	155
1.4	Effects of leaks in charge air system	159
1.5	Checking turbocharger and charge pressure regulating valve - vehicles with throttle cable	160
1.6	Checking turbocharger and charge pressure regulating valve - vehicles with electronic throttle	163
1.7	Checking mechanical air recirculation valve	169
1.8	Checking air recirculation valve for turbocharger N249 - vehicles with electronic throttle ..	170
1.9	Checking solenoid valve for charge pressure control N75	175
1.10	Checking charge pressure sender G31 - vehicles with electronic throttle	180
2	Servicing charge air system with turbocharger	184
2.1	Rules for cleanliness	184
2.2	Turbocharger - exploded view of components	184
2.3	Removing and installing turbocharger	187
2.4	Charge air cooler - exploded view of components	194
2.5	Removing and installing charge air cooler	194
26	Exhaust system	197

1	Removing and installing parts of exhaust system - vehicles with front-wheel drive	197
1.1	Exhaust system - exploded view of components	197
1.2	Separating centre and rear silencers	199
1.3	Removing and installing front exhaust pipe with catalytic converter	200
1.4	Removing and installing exhaust manifold	201
1.5	Stress-free alignment of exhaust system	204
1.6	Checking exhaust system for leaks	206
2	Removing and installing parts of exhaust system - vehicles with four-wheel drive	207
2.1	Exhaust system - exploded view of components	207
2.2	Separating centre and rear silencers	209
2.3	Removing and installing front exhaust pipe with catalytic converter	210
2.4	Removing and installing exhaust manifold	213
2.5	Stress-free alignment of exhaust system	215
2.6	Checking exhaust system for leaks	216
3	Secondary air system - not on engine code AGU, AJQ, AQA	217
3.1	Principle and function	217
3.2	Checking secondary air inlet valve N112	219
3.3	Checking secondary air pump relay J299 and secondary air pump motor V101	225
3.4	Checking combination valve for secondary air system for proper operation and leakage	230
3.5	Removing and installing combination valve for secondary air system	232
3.6	Removing and installing secondary air pump	233



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Audi A3 1997 ►

4-cylinder 1.8 ltr. 5-valve turbocharged engine (110-132 kW), mechanics - Edition 12.2005



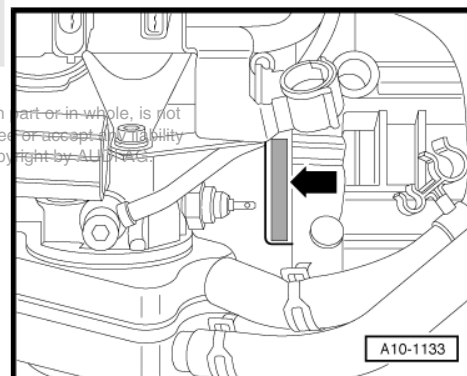
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00 – Technical data

1 Technical data

1.1 Engine number

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



1.2 Engine data

Code letters		AGU	AJQ	APP
Capacity	ltr.	1.781	1.781	1.781
Power output	kW at rpm	110/5700	132/5500	132/5500
Torque	Nm at rpm	210/1750 ... 4600	235/1950 ... 4700	235/1950 ... 4700
Bore	Ø in mm	81	81	81
Stroke	mm	86.4	86.4	86.4
Compression ratio		9.5	9.5	9.5
RON	at least	95 ¹⁾	98 ²⁾	98 ²⁾
Injection/ignition system		Motronic	Motronic	Motronic
Firing order		1-4-3-2	1-4-3-2	1-4-3-2
Emissions standard		EU2+D3	EU2+D3	EU2+D4
Turbocharging/supercharging		yes	yes	yes
Catalytic converter		yes	yes	yes
Knock control		yes	yes	yes
Charge air cooling		yes	yes	yes
Lambda control		1 probe	1 probe	2 probes
Variable valve timing		no	no	no
Secondary air system		no	no	yes

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

Code letters		AQA	ARX	ARY
Capacity	ltr.	1.781	1.781	1.781
Power output	kW at rpm	110/5700	110/5700	132/5500
Torque	Nm at rpm	210/1750 ... 4600	210/1750 ... 4600	235/1950 ... 4700
Bore	Ø in mm	81	81	81



Code letters	AQA	ARX	ARY
Stroke mm	86.4	86.4	86.4
Compression ratio	9.5	9.5	9.5
RON at least	95 ¹⁾	95 ¹⁾	98 ²⁾
Injection/ignition system	Motronic	Motronic	Motronic
Firing order	1-4-3-2	1-4-3-2	1-4-3-2
Emissions standard	EU2+D3	EU3	EU3
Turbocharging/supercharging	yes	yes	yes
Catalytic converter	yes	yes	yes
Knock control	yes	yes	yes
Charge air cooling	yes	yes	yes
Lambda control	1 probe	2 probes	2 probes
Variable valve timing	no	yes	yes
Secondary air system	no	yes	yes
¹⁾ In exceptional circumstances, fuel with not less than 91 RON can also be used, but this will cause a loss of power. ²⁾ In exceptional circumstances, fuel with not less than 95 RON can also be used, but this will cause a loss of power.			

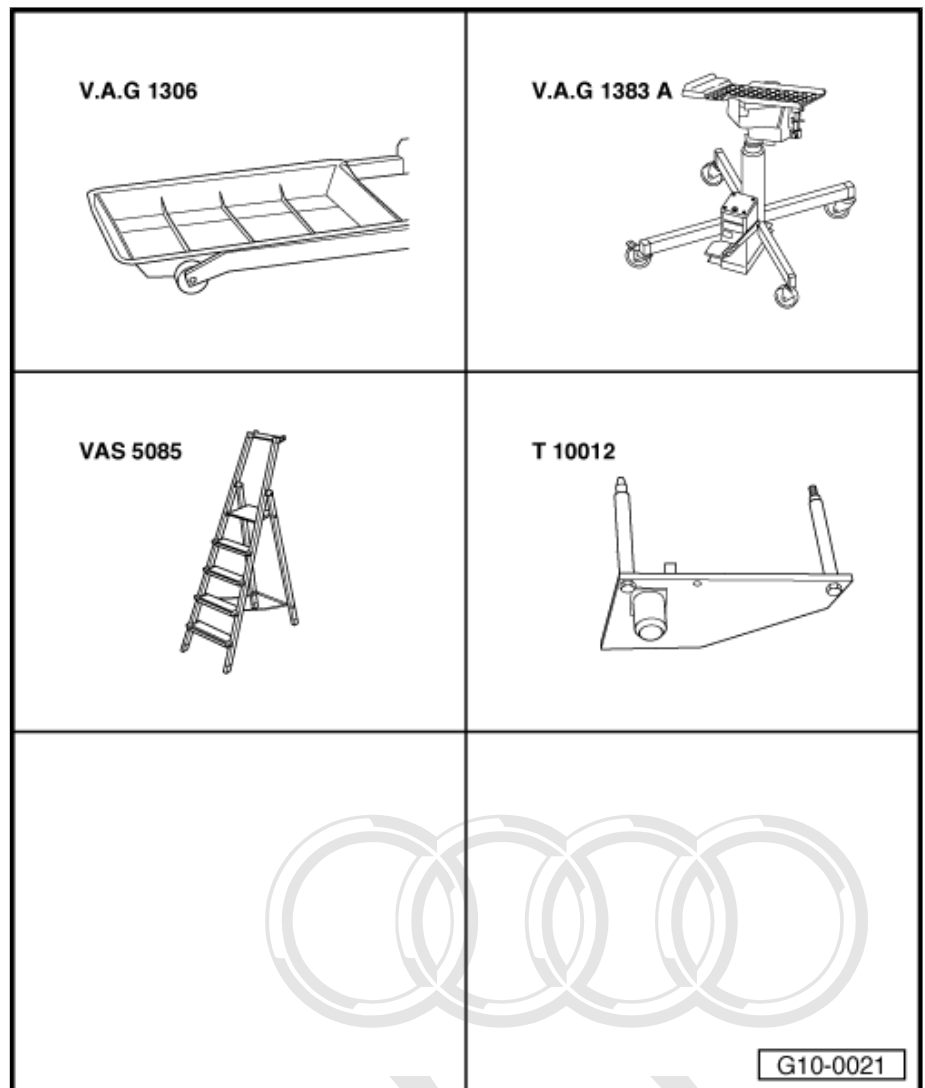
Code letters	ARZ	AUM	AUQ
Capacity ltr.	1.781	1.781	1.781
Power output kW at rpm	110/5700	110/5700	132/5500
Torque Nm at rpm	210/1750 ... 4600	210/1750 ... 4600	235/1950 ... 4700
Bore Ø in mm	81	81	81
Stroke mm	86.4	86.4	86.4
Compression ratio	9.5	9.5	9.5
RON at least	95 ¹⁾	95 ¹⁾	98 ²⁾
Injection/ignition system	Motronic	Motronic	Motronic
Firing order	1-4-3-2	1-4-3-2	1-4-3-2
Emissions standard	EU2+D4	EU4	EU4
Turbocharging/supercharging	yes	yes	yes
Catalytic converter	yes	yes	yes
Knock control	yes	yes	yes
Charge air cooling	yes	yes	yes
Lambda control	2 probes	2 probes	2 probes
Variable valve timing	no	yes	yes
Secondary air system	yes	yes	yes
¹⁾ In exceptional circumstances, fuel with not less than 91 RON can also be used, but this will cause a loss of power. ²⁾ In exceptional circumstances, fuel with not less than 95 RON can also be used, but this will cause a loss of power.			

10 – Removing and installing engine

1 Removing and installing engine

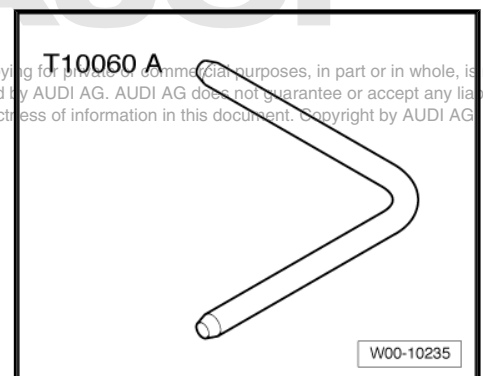
1.1 Removing engine

- ◆ Drip tray for workshop hoist -VAS 6208- or -V.A.G 1306-
- ◆ Engine and gearbox jack - V.A.G 1383 A-
- ◆ Stepladder -VAS 5085-
- ◆ Engine bracket -T10012-



- ◆ Locking pin -T10060 A-

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Procedure



Note

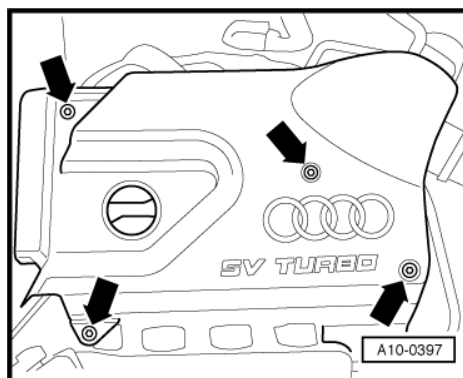
- ◆ *The engine is removed from underneath together with the gearbox.*
- ◆ *The following description corresponds to the removal and installation on vehicles with electronic throttle and secondary air system. Some operations may not be required for earlier vehicles.*
- ◆ *All cable ties which are released or cut open when removing must be fitted in the same position when installing.*
- ◆ *Collect drained coolant in a clean container for re-use or disposal.*
- Note (if necessary obtain) code on vehicles with coded radio / radio and navigation system (RNS).
- Disconnect earth wire at battery with ignition switched off.
- Turn front wheels to the right.



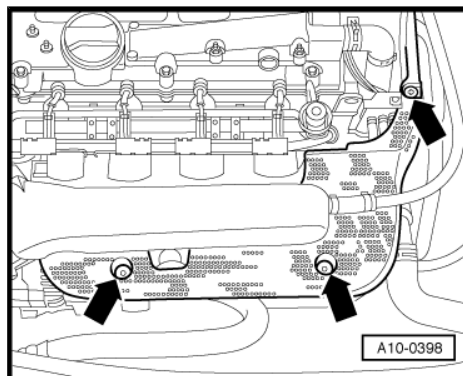
WARNING

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
- Take off engine cover panel -arrows-.

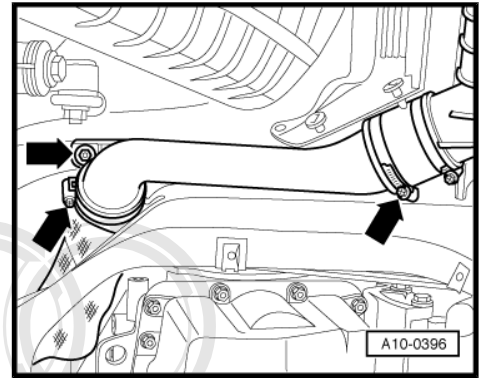


- Remove cover in front of intake manifold -arrows-.

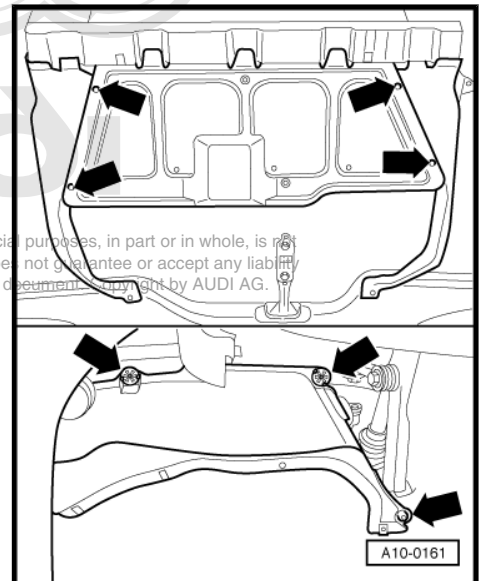


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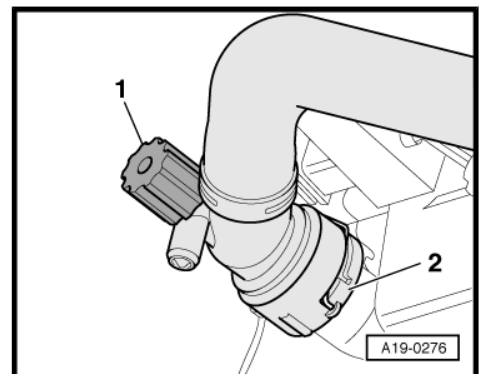
- Disconnect air pipe at bottom of right-hand longitudinal member -arrows- (air pipe leads to charge air cooler).



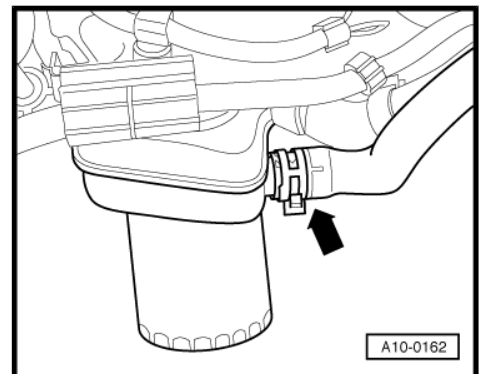
- Remove noise insulation panels (centre, left and right) -arrows-.



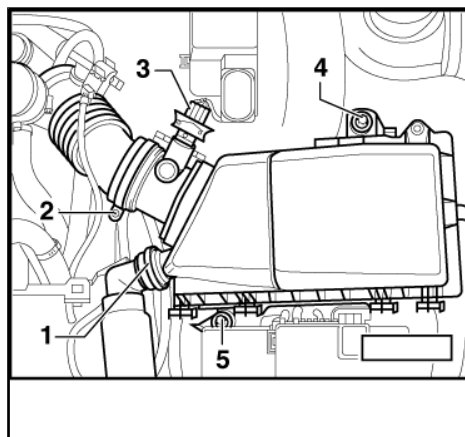
- Place drip tray for workshop hoist -VAS 6208- under engine.
- Turn drain plug -1- on radiator anti-clockwise and drain coolant (attach hose to connection if necessary).
- Pull out retaining clip -2- and remove coolant hose from radiator.



- Disconnect bottom coolant hose from oil cooler -arrow-, and drain off remaining coolant.

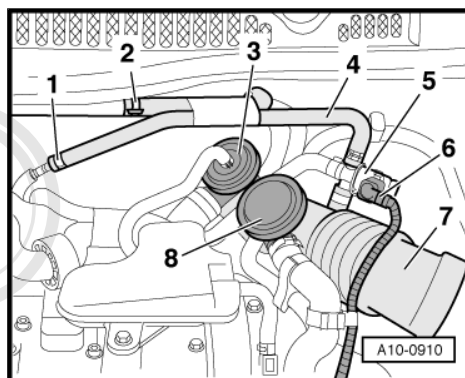


- Detach air intake hose -1- leading to secondary air pump at air cleaner housing.
- Release hose clip -2- and detach air duct from air mass meter -G70- .
- Unplug electrical connector at air mass meter -G70- -item 3-.
- Unscrew bolts -4- and -5- and remove air cleaner housing.



Vehicles with hoses routed according to version 1:

- Disconnect electrical connector -6- and hose -4- at charge pressure control solenoid valve -N75- .
- Detach charge pressure control solenoid valve -N75- -item 5-, mechanical air recirculation valve -3- and pressure control valve of crankcase breather system -8- from air duct.
- Pull locking clip out at turbocharger connection and detach air duct -7-.



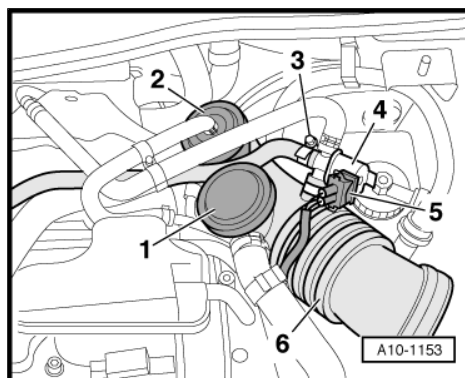
Note

Seal off opening in turbocharger intake system with a clean cloth.

- Disconnect hose -2- between coolant expansion tank and engine at bulkhead.
- Disconnect hose -1- between charge pressure control solenoid valve -N75- and turbocharger at bulkhead.

Vehicles with hoses routed according to version 2:

- Disconnect electrical connector -5- and hose -3- at charge pressure control solenoid valve -N75- .
- Detach charge pressure control solenoid valve -N75- -item 4-, mechanical air recirculation valve -1- and pressure control valve of crankcase breather system -2- from air duct.
- Pull locking clip out at turbocharger connection and remove air duct -6-.

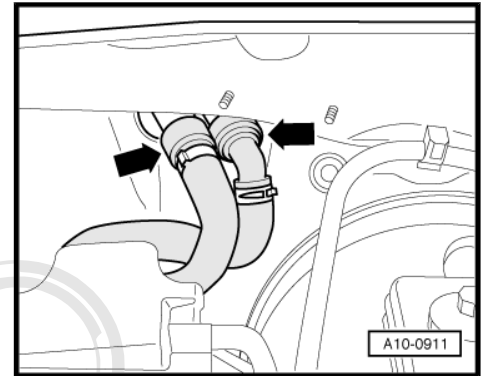


Note

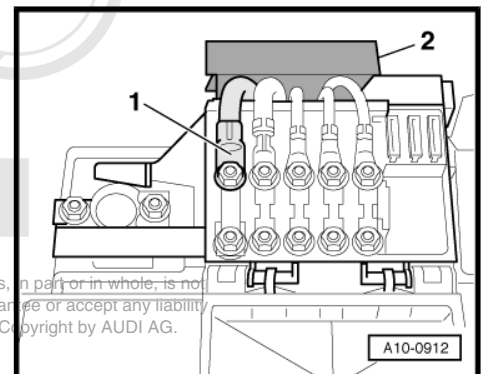
Seal off opening in turbocharger intake system with a clean cloth.

All models:

- Detach coolant hoses going to to heat exchanger at bulkhead -arrows- by releasing retaining clips.



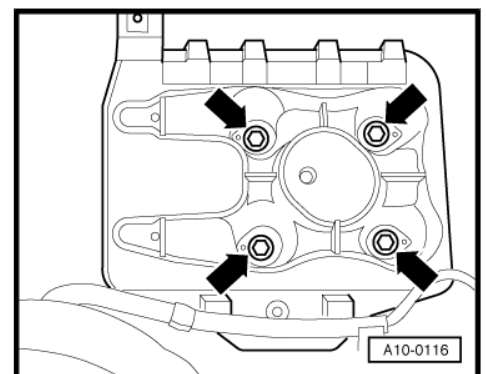
- Open cover of main fuse box.
- Unclip protective cover -2- for electrical cables.
- Unscrew black wire -1- at fuse block.
- Remove battery.



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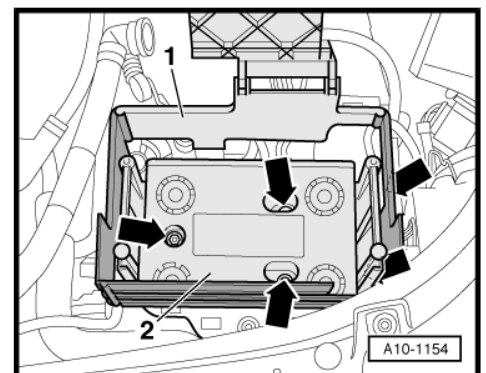
Vehicles with battery tray (version 1):

- Remove battery tray -arrows-.



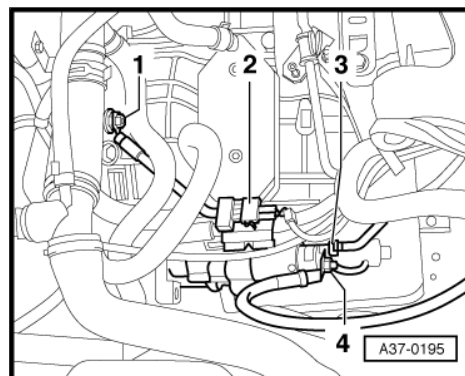
Vehicles with battery tray (version 2):

- Lift off side wall -1- together with main fuse box.
- Remove battery tray -arrows-.



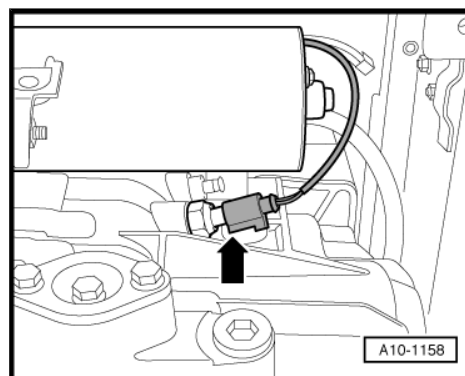
All models:

- Unscrew earth wire -1- at engine/gearbox connection.
- Detach electrical wiring -3- and -4- at starter.
- Detach electrical connector -2- from bracket and unplug.
- Disengage wiring from bracket on starter and move it clear to the side.



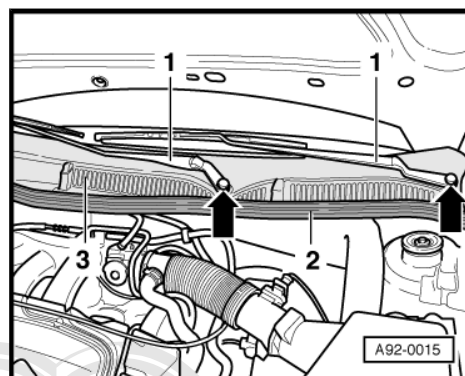
Vehicles with manual gearbox:

- Unplug electrical connector -arrow- at reversing light switch - F4- on gearbox.



All models:

- Use screwdriver to pry off caps on wiper arms -arrows- and slacken off nuts several turns.
- Loosen wiper arms -1- from wiper shafts by tilting slightly.
- Remove nuts completely and take off wiper arms.
- Detach the washer hose and electrical connectors at wind-screen washer jets.
- Lay aside plenum chamber cover (towards windscreen).

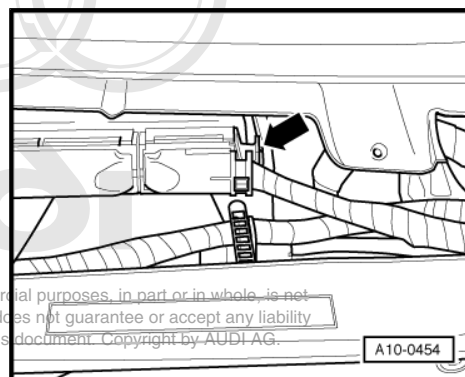


Vehicles with protective housing for engine control unit:

- Remove protective housing for engine control unit ⇒ Rep. Gr. 24 .

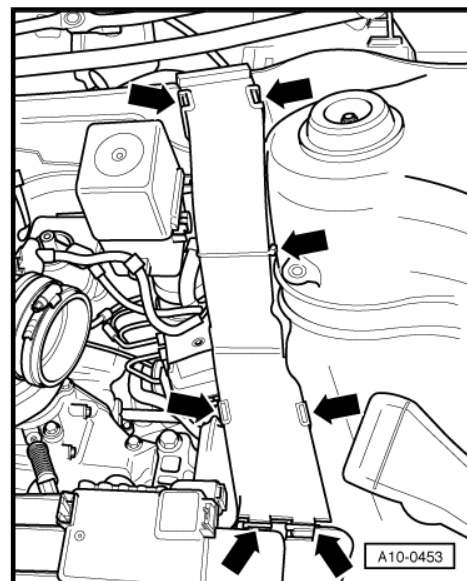
All models:

- Release retaining tab (left-side) -arrow- and unplug connector from control unit.

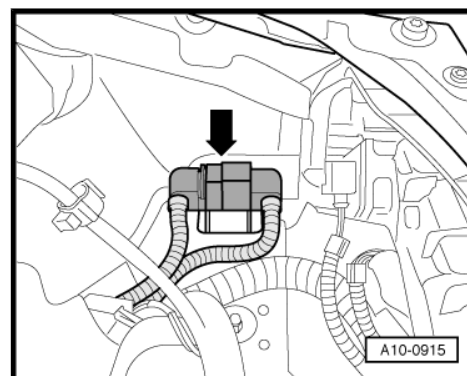


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- Open cable duct (left-side) in engine compartment -arrows-.
- Unplug electrical connector in cable duct.

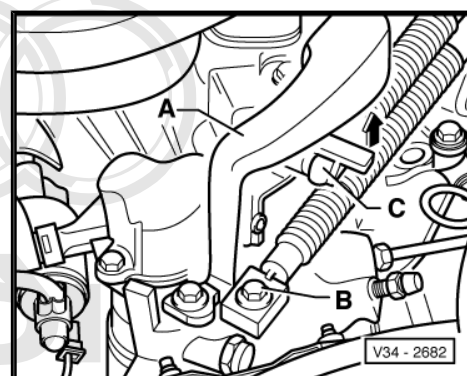


- Take electrical connector out of bracket and unplug it -arrow-.
- Set aside wiring harness leading to engine control unit.
- Place engine control unit with wiring harness on top of engine.
- Secure the engine control unit to prevent it falling.



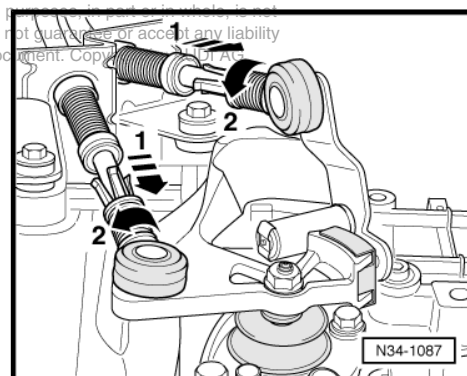
Vehicles with manual gearbox to 07.1998:

- Mark installation position of gear selector cable -B- on selector shaft lever.
- Remove damper weight -A- and gear selector cable -B- for selector shaft lever.
- Lift lug in direction of -arrow- and detach gate selector cable from relay lever -C-.



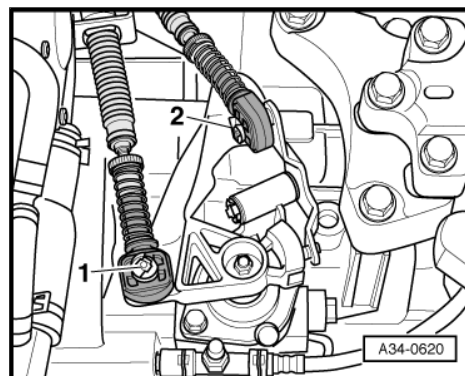
Vehicles with manual gearbox 08.1998 to 06.2001:

- Press locking sleeve in direction of -arrow 1- as far as stop and lock by turning anti-clockwise in direction of -arrow 2- to release cable end-piece for gate selector cable and gear selector cable.
- Disengage cables from cable end-piece.



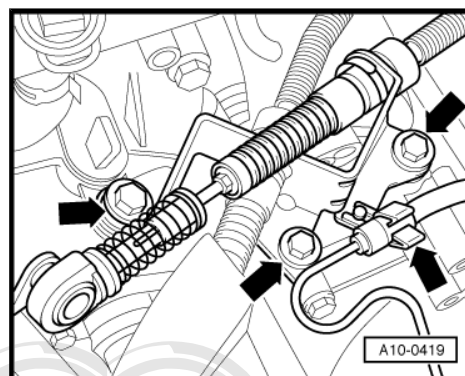
Vehicles from 07.2001:

- Unclip retaining clip -1- from gear selector cable and retaining clip -2- from gate selector cable.
- Pull selector cable end-pieces with selector cables off selector shaft lever and relay lever.



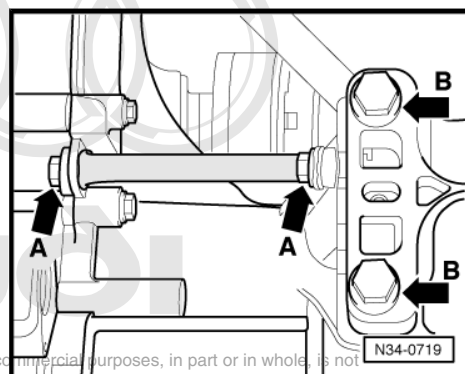
All vehicles with manual gearbox:

- Unbolt cable support bracket from gearbox and unclip hose going to clutch slave cylinder -arrows-.



Vehicles with front-wheel drive:

- Detach gearbox strut -arrows A- from gearbox.



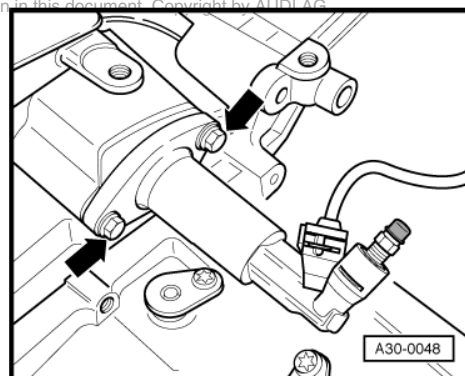
All models:

- Remove clutch slave cylinder -arrows- and use a piece of wire to secure in position (do not open pipes).



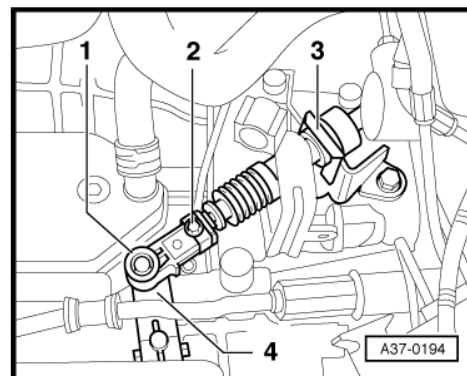
Caution

Do not operate clutch pedal with slave cylinder removed.

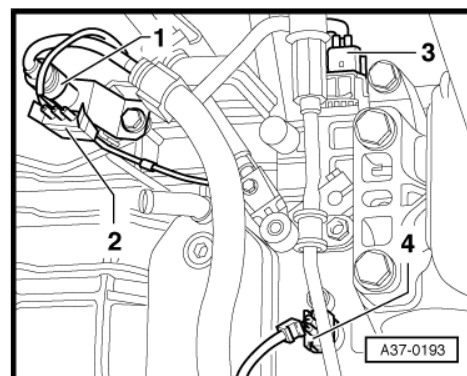


Vehicles with automatic gearbox 01M:

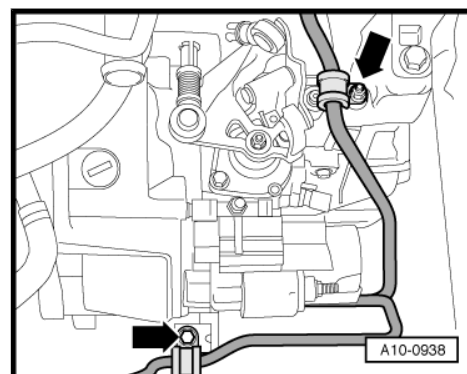
- Pry selector lever cable -1- off selector shaft lever -4- using a screwdriver and detach retaining clip -3- from support bracket.
- Detach selector lever cable and move to one side.



- Unplug electrical connectors:
 - 1 - To solenoid valves
 - 2 - To vehicle speed sender -G68-
 - 3 - At multi-function switch -F125-
 - 4 - At gearbox speed sender -G38-
- Disengage wiring harness from brackets and move clear.



- Detach power steering line from gearbox -arrows-.



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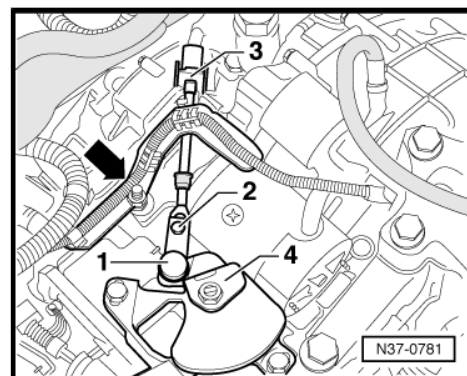
Vehicles with automatic gearbox 09A:

- Remove bracket -arrow-, if fitted.
- Move selector lever to position “P” and pry selector lever cable -1- off selector shaft lever -4- using a screwdriver.

**Note**

Do not loosen bolt -2-.

- Unclip retaining clip -3- at support bracket.
- Detach selector lever cable and move to one side.

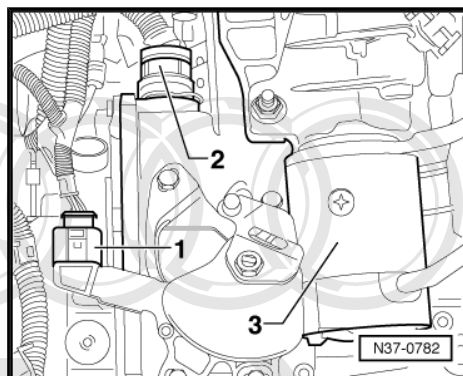


- Unplug electrical connectors:
- 1 - At multi-function switch -F125-
- 2 - At gearbox wiring harness (turn locking lever)

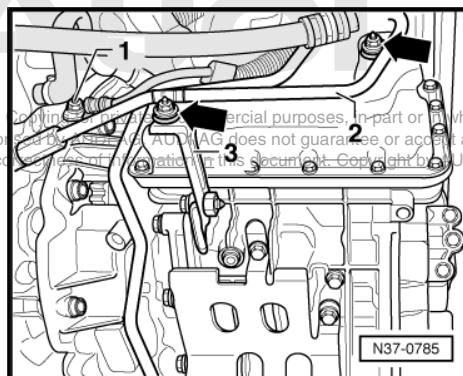


Note

Disregard -item 3-.

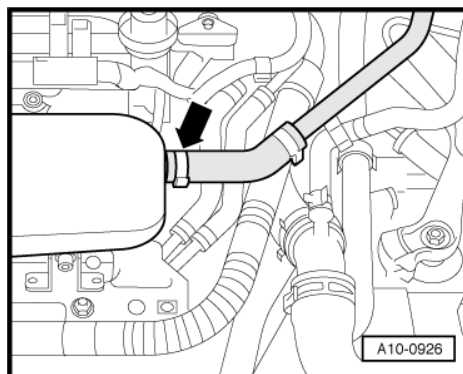


- Unscrew earth cable -1- from bracket.
- Unbolt power steering line -arrows-.
- Unscrew bracket -3-.
- Detach rear power steering line from gearbox and tie up to side.



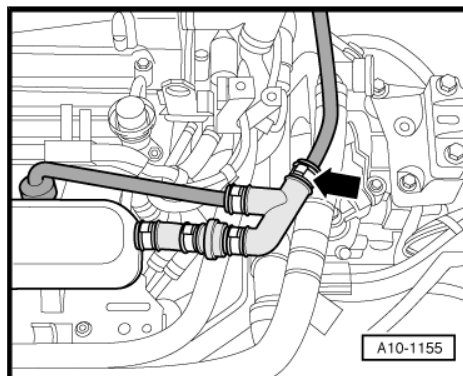
Vehicles with hoses routed according to version 1:

- Detach vacuum line -arrow- going to brake servo at intake manifold.



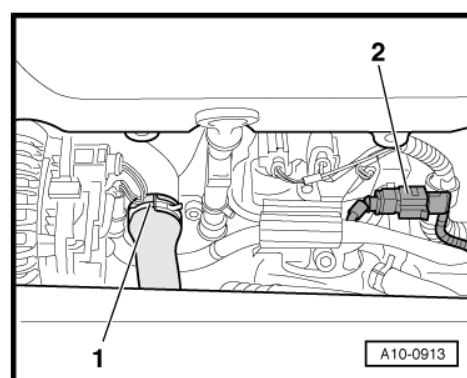
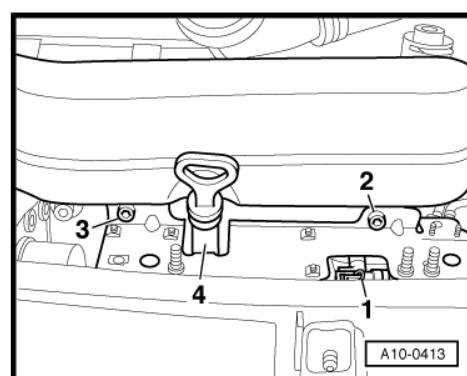
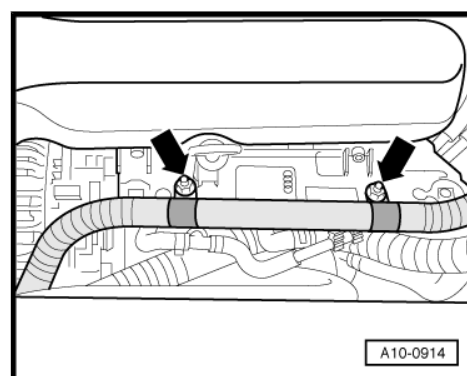
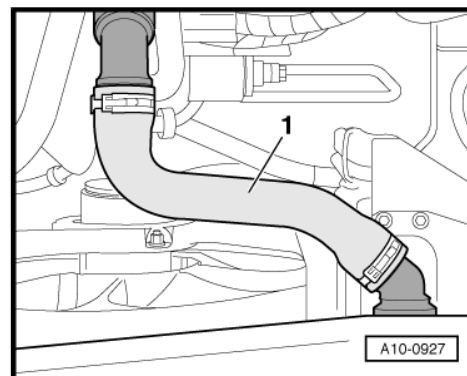
Vehicles with hoses routed according to version 2:

- Detach vacuum line -arrow- going to brake servo.



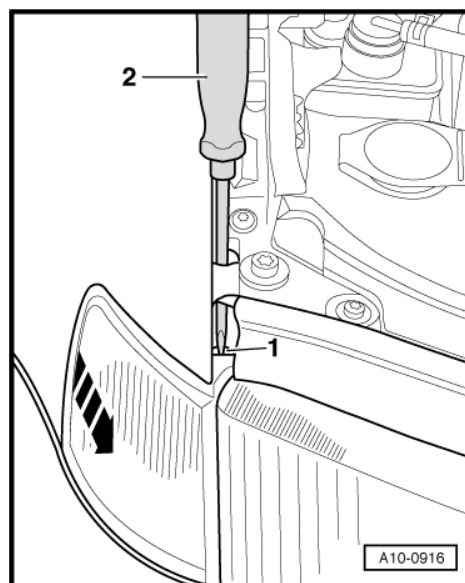
All models:

- Remove coolant hose -1- between engine and radiator.
- Detach pipe for secondary air system from brackets on engine -arrows-.
- Remove bolts -2- and -3- and detach bracket for dipstick guide tube -4-.
- Unplug connectors -1- for turbocharger air recirculation valve -N249- and secondary air inlet valve -N112- on underside of retainer for electrical change-over valves.
- Detach vacuum hose going to electrical change-over valves from intake manifold.
- Unplug electrical connector -2- and move wiring clear.
- Detach coolant hose -1- going to engine.



Vehicles with electronic throttle up to model year 2000:

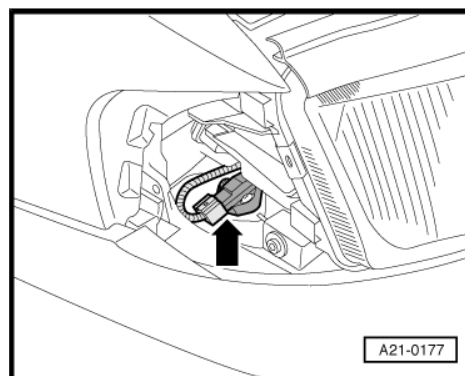
- Release catch -1- at turn signal housing with cross-head screwdriver -2- by turning 1/4 turn to left.
- Press down catch and slide turn signal housing to front -arrow- out of guide.



- Reach through opening for turn signal and unplug connector at charge pressure sender -G31- .

Vehicles from model year 2001 onwards:

- Remove washer fluid reservoir ⇒ Rep. Gr. 94 .
- Unplug electrical connector at charge pressure sender -G31- .



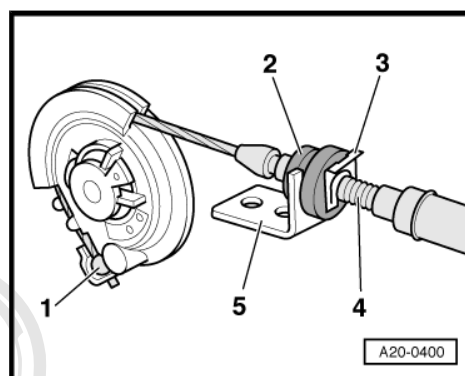
Vehicles with throttle cable:

- Disengage nipple -1- on end of throttle cable from cable cam.
- Pull grooved section of throttle cable sheath -4- out of rubber grommet -2- at support bracket -5-.



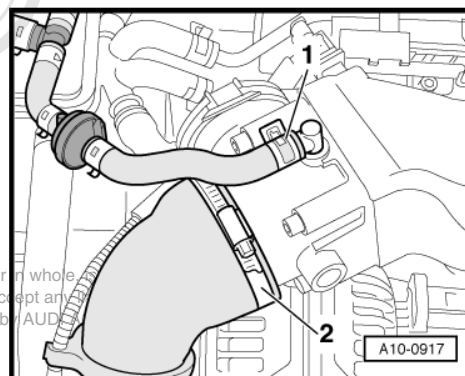
Note

Disregard -item 3-.



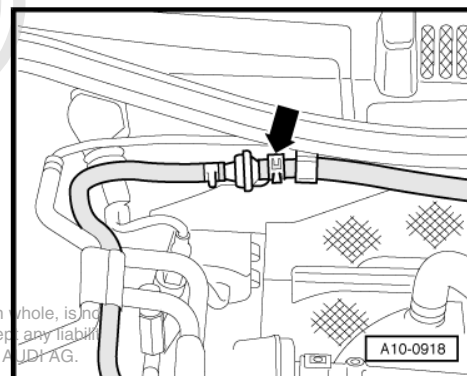
All models:

- Detach vacuum line -1- leading to activated charcoal filter from throttle valve module -J338- .
- Detach air intake hose -2- from throttle valve module -J338- .
- Unbutton heat insulation sleeve and remove.



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- Detach hose -arrow- at non-return valve.



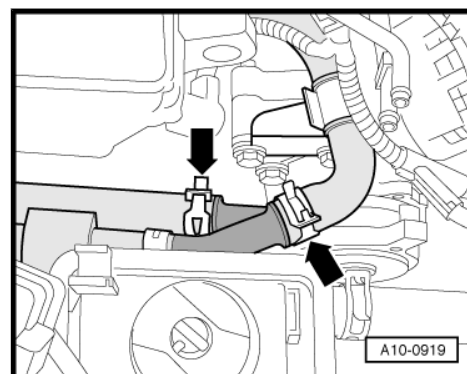
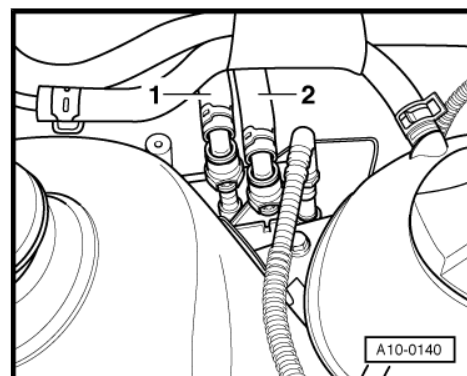
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WARNING

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

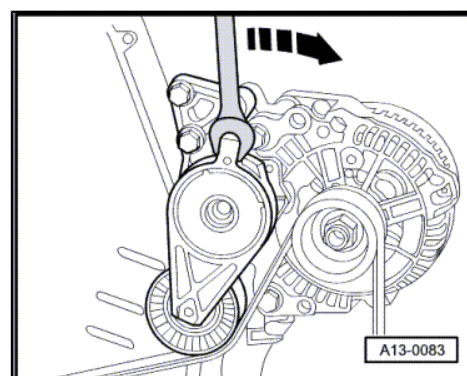
- Disconnect fuel supply pipe -1- and fuel return pipe -2- by pressing release tabs.
- Move fuel supply pipe and fuel return pipe clear.
- Detach coolant hoses (right-side) -arrows- at engine.



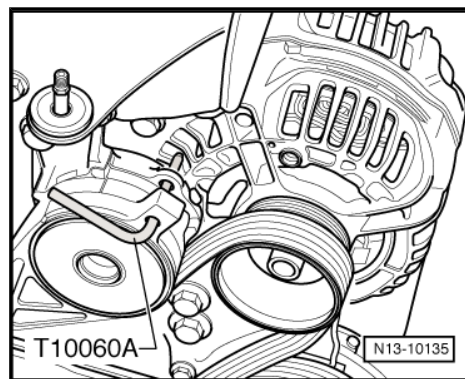
Note

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

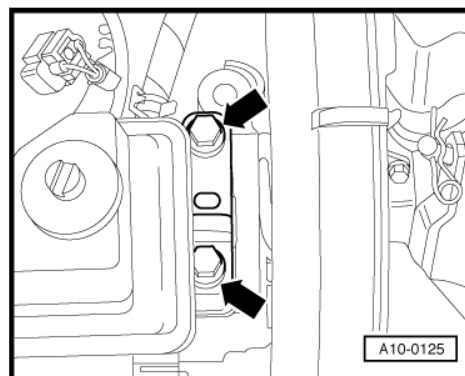
- Turn the tensioner in the direction of the -arrow- to slacken the poly V-belt.
- Remove poly V-belt.



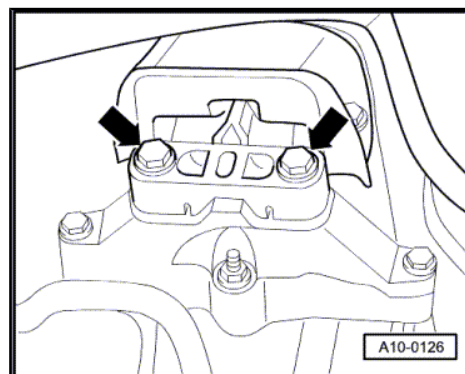
- Lock tensioner in position with locking pin -T10060 A- .



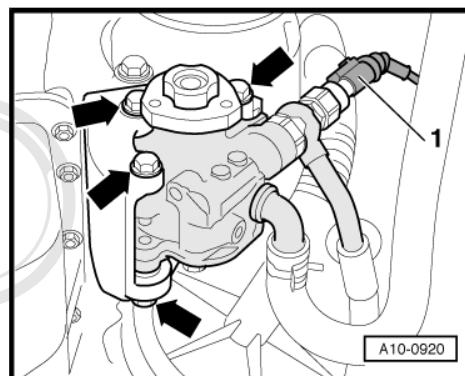
- Loosen bolts -arrows- of assembly mounting for engine approx. 2 turns.



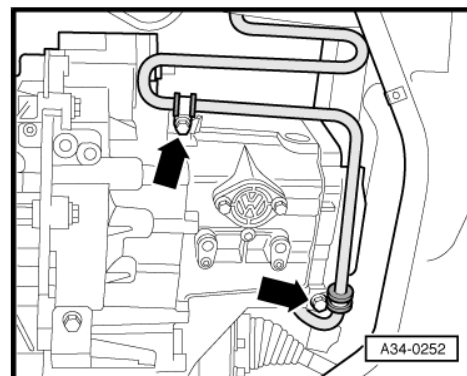
- Loosen bolts -arrows- of assembly mounting for gearbox approx. 2 turns.
- Unscrew bolts for radiator cowl which are accessible from above.



- Unbolt pulley for power steering pump.
- Unplug electrical connector -1- at power assisted steering pressure switch -F88- .
- Unbolt power steering pump -arrows-; hydraulic lines remain attached.

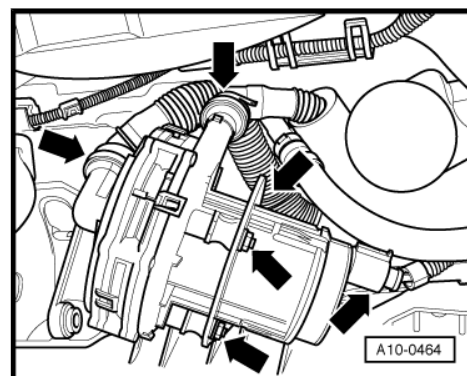


- Detach power steering cooling pipe from gearbox -arrows-.



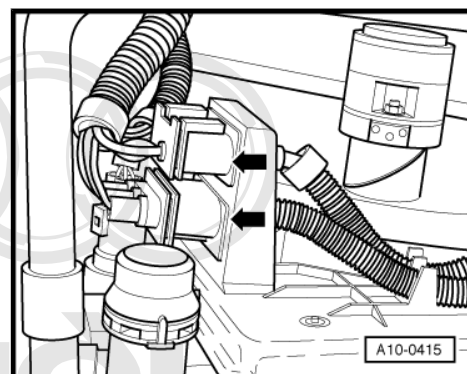
Vehicles with secondary air system:

- Unplug electrical connector at secondary air pump motor - V101- , detach hoses and remove nuts -arrows-.
- Remove secondary air pump.
- Move aside wiring harness leading to body.



All models:

- Detach electrical connectors -arrows- for radiator fan on bottom left of radiator cowl.
- Unscrew bolts on radiator cowl (accessible from below) and remove radiator cowl with both fans from below.
- Tie up power steering pump together with hydraulic line onto lock carrier on left side.



Vehicles with air conditioning:

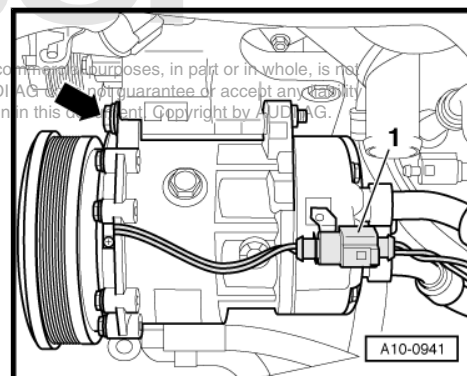
- Unplug electrical connector -1- for magnetic clutch of air conditioner compressor.



WARNING

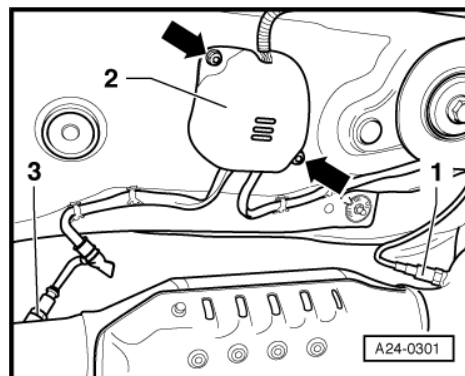
The air conditioner refrigerant circuit must not be opened.

- Unscrew bolts -arrow- for air conditioner compressor.
- Tie up air conditioner compressor together with refrigerant hoses to bonnet lock (refrigerant hoses remain connected).



All models:

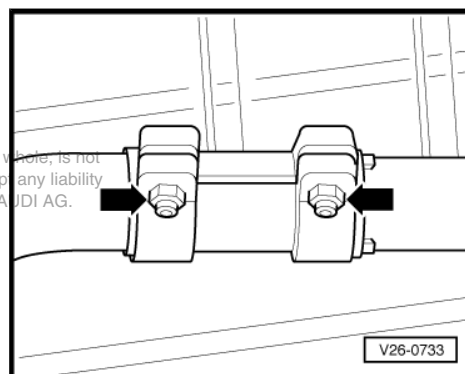
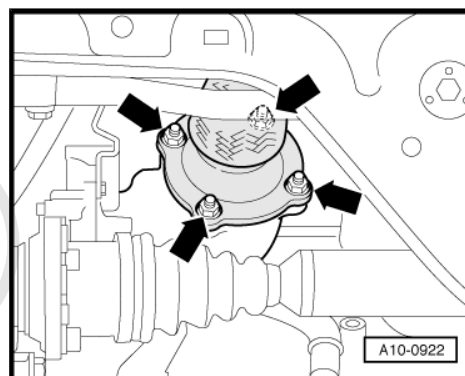
- Unbolt protective cover -2- -arrows-.
- Unplug the electrical connectors and move wiring to lambda probes -1- and -3- clear.



Note

To avoid any damage, the flexible joint in the front exhaust pipe must not be bent more than 10°.

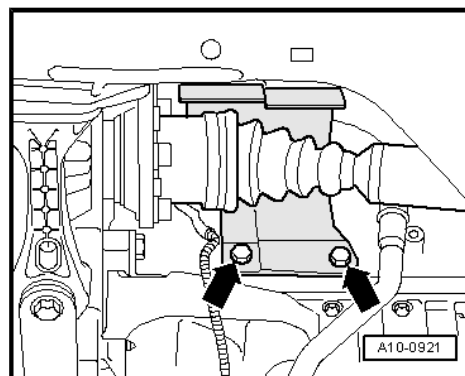
- Unscrew nuts -arrows- securing front exhaust pipe to turbo-charger.
- Separate exhaust system at clamp -arrows-.
- Push clamp back and remove front exhaust pipe with catalytic converter.



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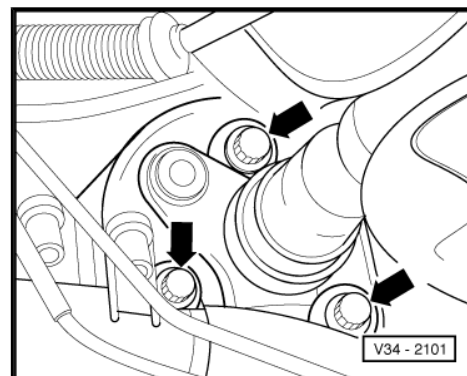
Vehicles with front-wheel drive:

- Unbolt heat shield for drive shaft (right-side) from cylinder block -arrows-.



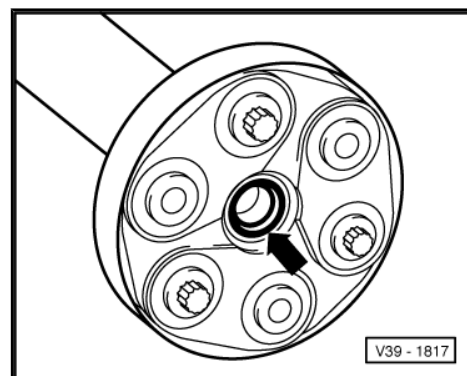
Vehicles with four-wheel drive:

- Mark position of propshaft at flexible coupling on bevel box.
- Unscrew propshaft with flexible coupling from bevel box -arrows- (counter-hold using a suitable lever at the triangular flange).

**Caution**

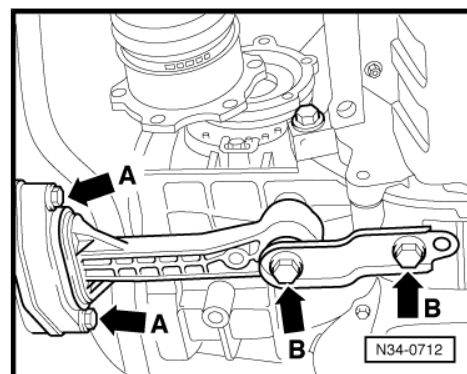
Avoid damaging the seal -arrow- in the propshaft flange when removing. If a seal is damaged the propshaft must be renewed.

- Push propshaft horizontally as far back as possible.

**All models:****Caution**

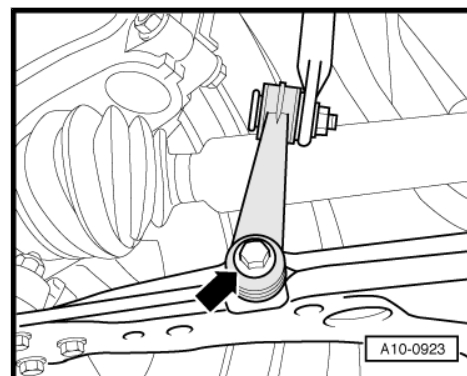
After unscrewing the bolts -A-, the engine/gearbox assembly swings slightly forward.

- First remove bolts -A-, then bolts -B- and remove pendulum support.
- Unbolt right coupling rod from wishbone -arrow-.
- Unbolt drive shafts (left and right) from gearbox flange shafts.

**Note**

Use adhesive tape to prevent bumper from being scratched.

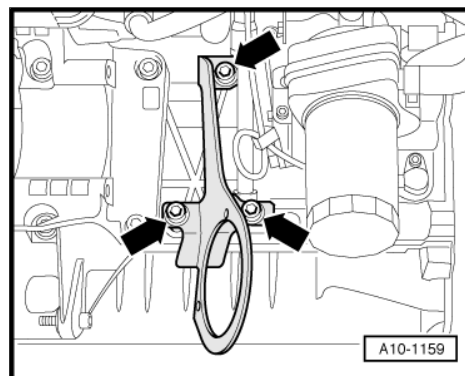
- Push engine forward. At the same time swivel right drive shaft towards front and tie up with wire.
- Suspend right drive shaft at towing eye using wire.
- Move left drive shaft towards rear and attach to anti-roll bar using wire.

**Note**

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

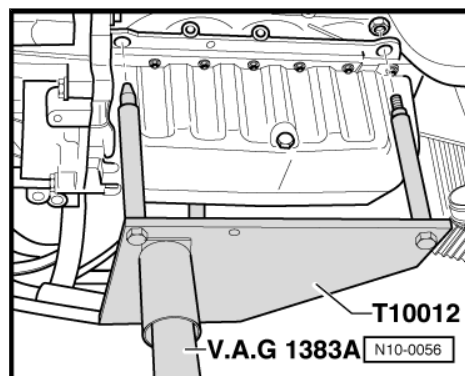
Vehicles with secondary air system:

- Remove bracket for secondary air pump -arrows-.



All models:

- Attach engine bracket -T10012- with nut and bolt to cylinder block: approx. 20 Nm.
- Insert engine and gearbox jack -V.A.G 1383 A- in engine bracket -T10012- and raise engine/gearbox assembly slightly.

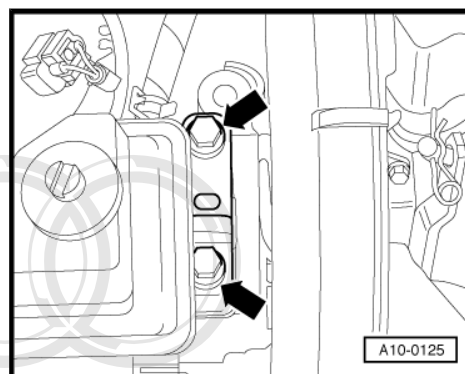


- Remove bolts -arrows- of assembly mounting on engine.



Note

To unscrew bolts for assembly mounting use stepladder -VAS 5085-.



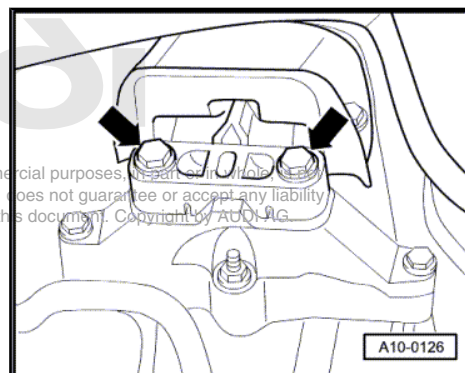
- Remove bolts -arrows- of assembly mounting on gearbox.



Note

Check that all hoses, pipes and wiring connections between engine, gearbox and body have been detached.

- Pull engine/gearbox assembly as far forward as possible, and lower gradually using engine and gearbox jack -V.A.G 1383 A-.



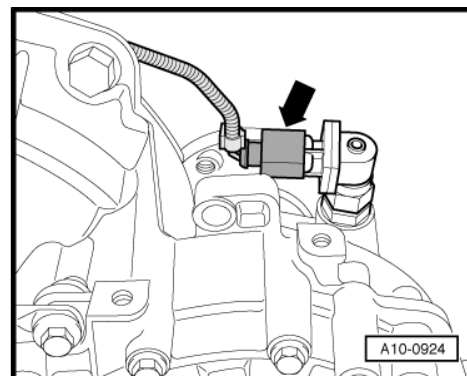
Note

- ♦ Carefully guide engine/gearbox assembly when lowering to avoid damage.
- ♦ Make sure there is sufficient clearance for vacuum unit of charge pressure control system on turbocharger.

1.2 Separating engine from manual gear-box

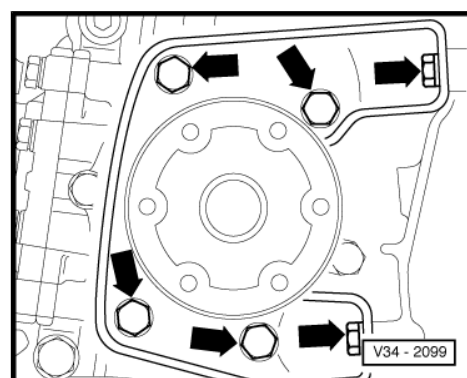
Procedure

- Engine/gearbox assembly removed and attached to engine bracket -T10012- .
- Unplug electrical connector -arrow- at speedometer sender - G22- on gearbox and move wiring clear.



Vehicles with four-wheel drive:

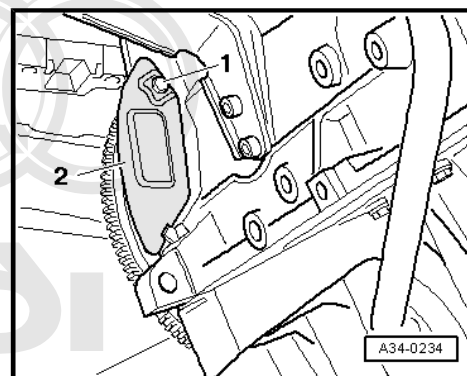
- Unbolt bracket for bevel box from engine and bevel box -arrows-.



Note

On vehicles with four-wheel drive, the small cover plate -2- for the flywheel is located behind the bevel box and is not visible with the bevel box installed. Shown in illustration with gearbox removed.

- Unscrew bolt -1- and lift out cover plate.



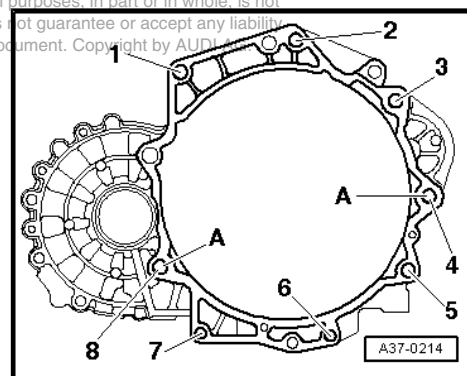
All models:

- Remove bottom engine/gearbox securing bolts -1 ... 8-.
- Separate gearbox from engine.



Note

Second mechanic is required to separate engine/gearbox assembly.

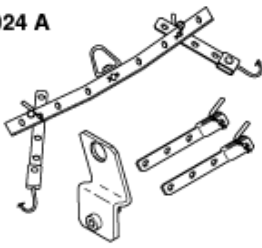
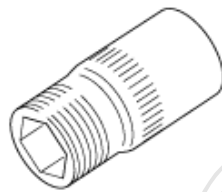


1.3 Separating engine from automatic gearbox 01M



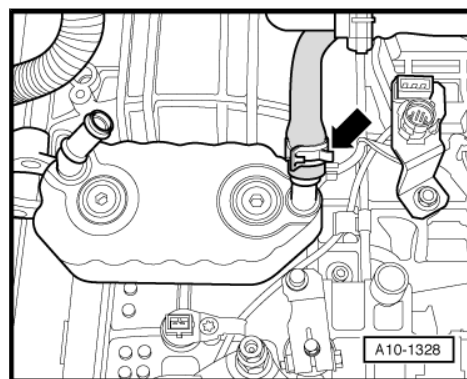
Special tools and workshop equipment required

- ◆ Lifting tackle -2024 A-
- ◆ Workshop hoist -VAS 6100-
- ◆ Socket (15 mm) -Matra V175-

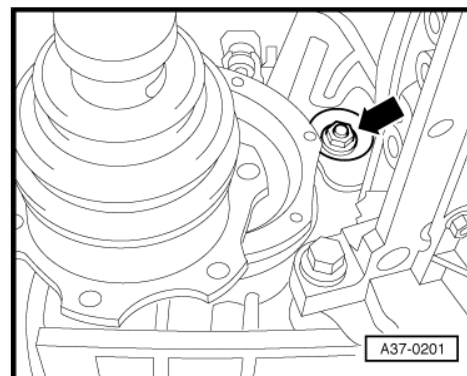
2024 A 	VAS 6100 
V/175 	
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Procedure

- Engine/gearbox assembly removed and attached to engine bracket -T10012- .
- Unplug electrical connectors on gearbox if necessary and move wiring clear.
- Disconnect coolant hose at ATF cooler -arrow-.



- Remove plug from opening in cover plate for torque converter.
- Unscrew 3 nuts for torque converter -arrow- using socket (15 mm) -Matra V175- (turn crankshaft $\frac{1}{3}$ turn each time and counterhold at central bolt on vibration damper).



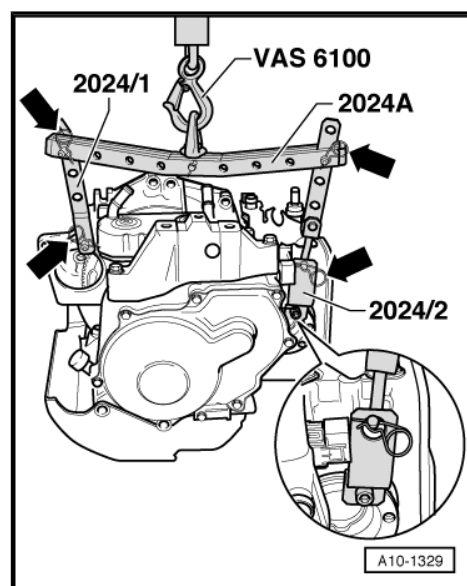
- Remove starter.
- Hook lifting tackle -2024 A- onto automatic gearbox and workshop hoist -VAS 6100-.

**Note**

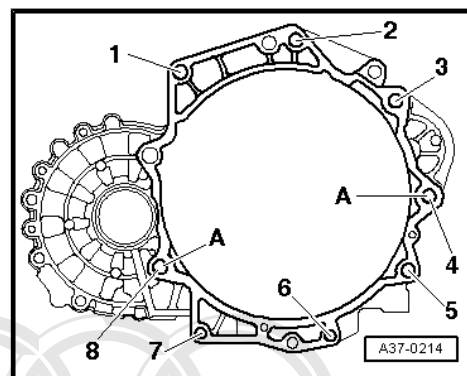
To adjust to the centre of gravity of the assembly, the perforated rails of the support hooks must be positioned as shown.

**WARNING**

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



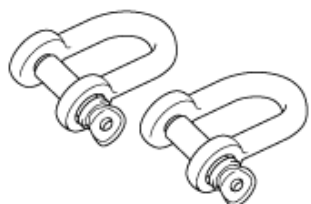
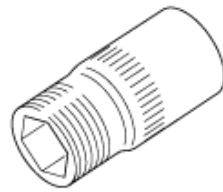
- Remove remaining engine/gearbox securing bolts.
- Separate gearbox from engine.
- Secure the torque converter in the gearbox using wire or support bridge -30-211 A- to prevent it falling out.



1.4 Separating engine from automatic gearbox 09A

Special tools and workshop equipment required

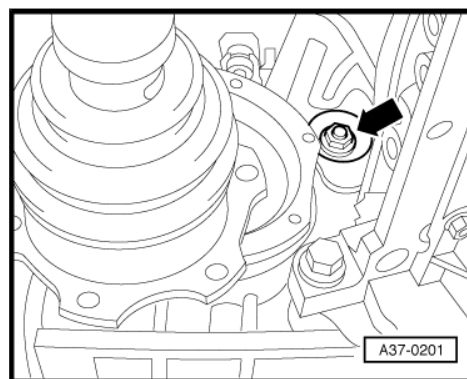
- ◆ Hooks -10-222 A/2-
- ◆ Shackle -10-222 A/12-
- ◆ Workshop hoist -VAS 6100-
- ◆ Socket (15 mm) -Matra V175-

10-222 A/2 	10-222 A/12 
VAS 6100 	V/175 
	G10-0056

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Procedure

- Engine/gearbox assembly removed and attached to engine bracket -T10012- .
- Unplug electrical connectors on gearbox if necessary and move wiring clear.
- Disconnect coolant hose at ATF cooler.
- Remove plug from opening in cover plate for torque converter.
- Unscrew 3 nuts for torque converter -arrow- using socket (15 mm) -Matra V175- (turn crankshaft $\frac{1}{3}$ turn each time and counterhold at central bolt on vibration damper).

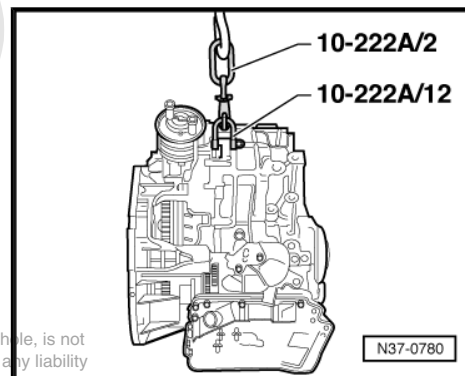


- Remove starter.
- Secure shackle -10-222 A/12- to gearbox housing and connect shackle to hook -10-222 A/2- .
- Attach hook -10-222 A/2- to workshop hoist -VAS 6100- .

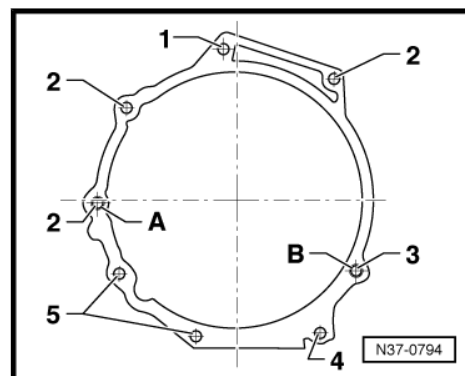
**WARNING**

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

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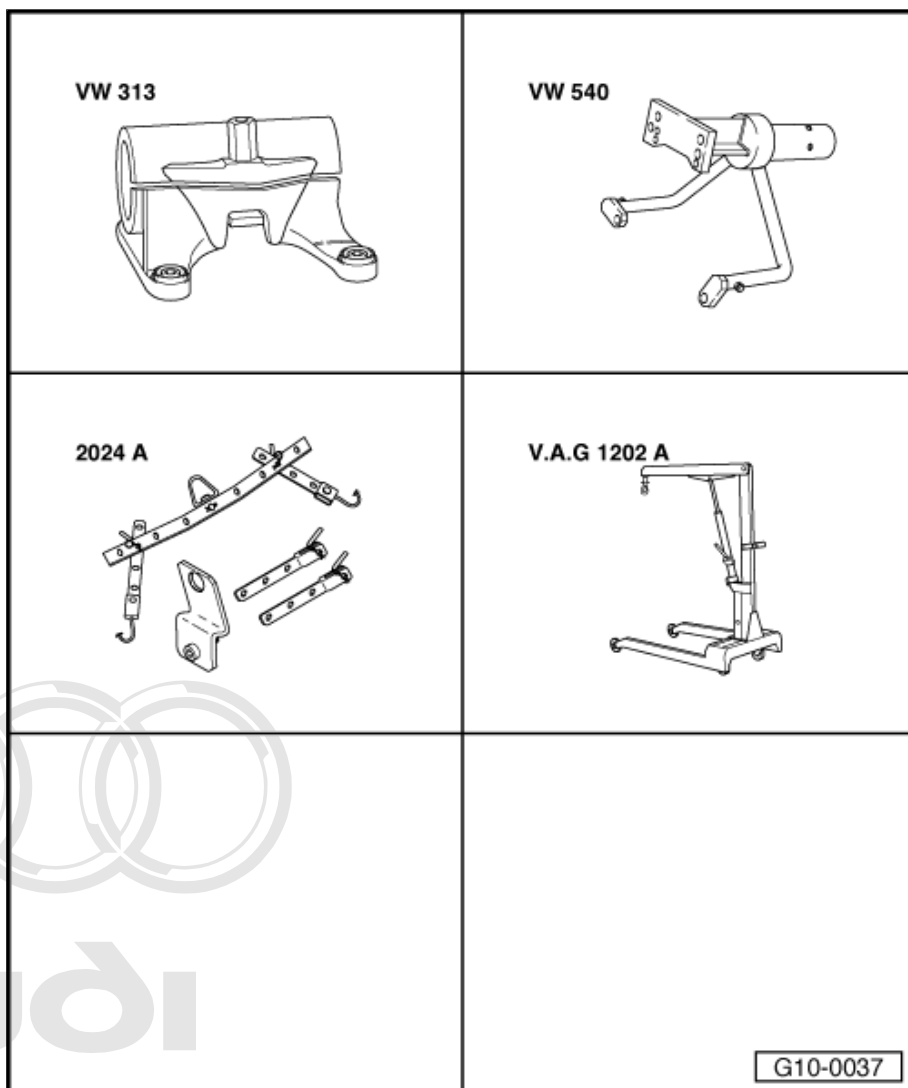
- Remove remaining engine/gearbox securing bolts.
- Separate gearbox from engine.
- Secure the torque converter in the gearbox using wire or support bridge -30-211 A- to prevent it falling out.



1.5 Securing engine to assembly stand

Special tools and workshop equipment required

- ◆ Support clamp -VW 313-
- ◆ Engine and gearbox support -VW 540-
- ◆ Lifting tackle -2024 A-
- ◆ Workshop hoist -6100- or -V.A.G 1202 A-



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Procedure

- Hook lifting tackle -2024 A- onto engine and workshop hoist -6100- .



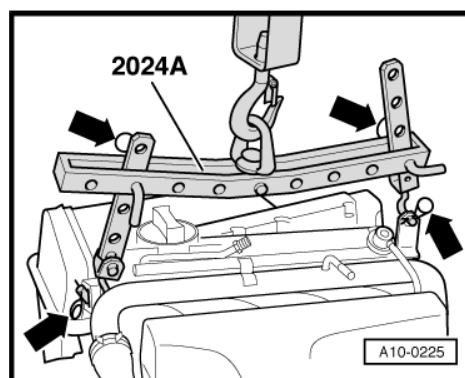
Note

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



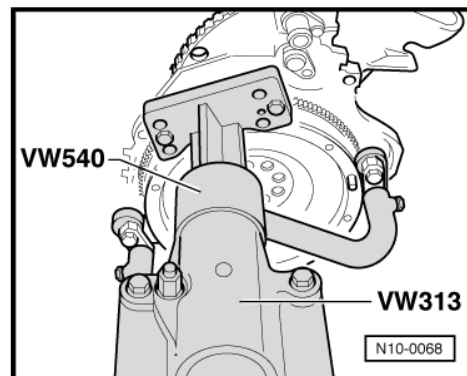
WARNING

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



- Lift engine off engine and gearbox jack -V.A.G 1383 A- using workshop hoist -6100- .

- When carrying out repairs, secure engine to assembly stand with engine and gearbox support -VW 540- .



1.6 Installing engine

Special tools and workshop equipment required

- ◆ Depth gauge for vehicles with automatic gearbox

Procedure



Note

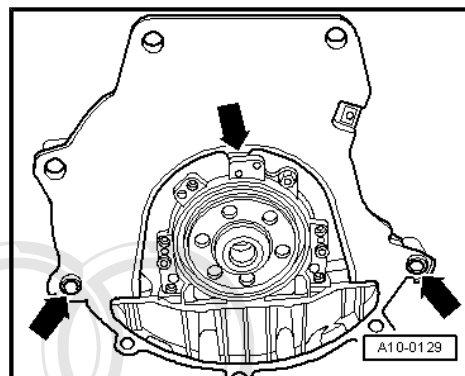
- ◆ *On assembly, renew oil seals and gaskets as well as self-locking nuts and bolts that are tightened by turning through to a specified angle.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- ◆ *Fit all heat insulation sleeves in the original position when installing.*
- ◆ *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.

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- Engage intermediate plate on sealing flange and slip onto dowel sleeves -arrows-.

Vehicles with manual gearbox:

- Check that clutch plate is correctly centred.
- Check clutch release bearing for wear, renew if necessary.
- Lightly grease clutch release bearing, release bearing guide sleeve and splines on input shaft with grease for clutch plate splines -G 000 100- .
- Bolt gearbox onto engine. Use new securing bolts on vehicles with manual gearbox 02M.



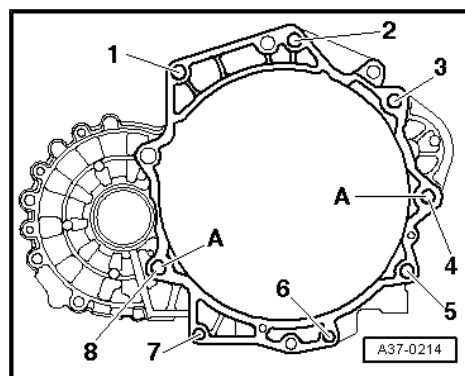
Note

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

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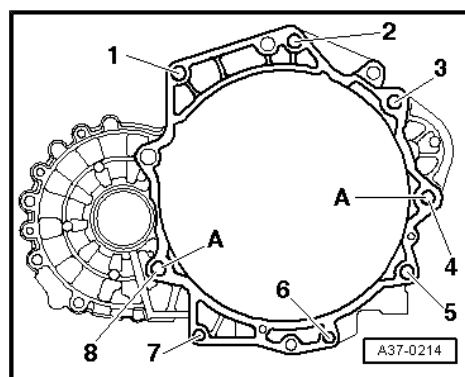
Securing engine to manual gearbox 02J

Item	Bolt	Nm
1, 2 ¹⁾ , 8	M12x55	80
3 ¹⁾ , 4	M12x150	80
5, 7	M10x50	45
6	M10x70	45
A	Dowel sleeves for centralising	
• ¹⁾ Bolt with M8 stud		



Securing engine to manual gearbox 02M

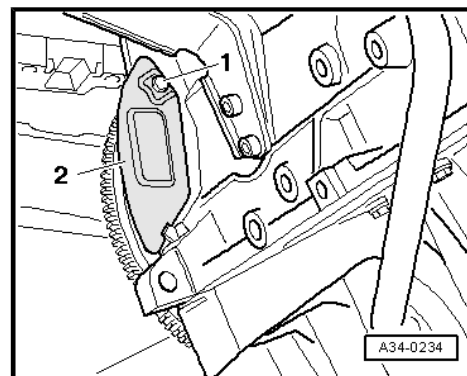
Item	Bolt ²	Nm
1, 2 ¹⁾	M12x55	80
3 ¹⁾ , 4 ¹⁾	M12x165	80
5	M10x105	40
6, 7	M10x50	40
8	M12x70	80
A	Dowel sleeves for centralising	
• ¹⁾ Bolt with M8 stud • ²⁾ Renew bolts.		



- Push in small cover plate -2- for flywheel in such a way that lug at bottom engages into the cylinder block and secure with bolt -1-.

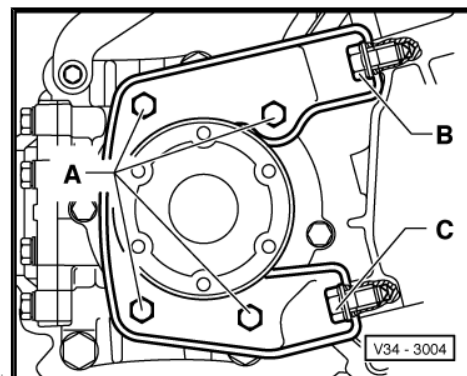
**Note**

Shown in illustration with gearbox removed.

**Vehicles with four-wheel drive:**

- Fit bolts -A ... C- of bevel box bracket. Note tightening sequence:

1. Tighten bolts -B- and -C- initially to 10 Nm.
2. Tighten bolts -A- to 25 Nm.
3. Tighten bolts -B- and -C- to 40 Nm.

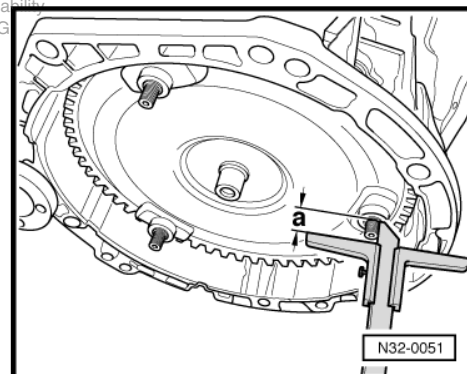
**Vehicles with automatic gearbox:**

If the torque converter is correctly installed, the depth -a- between the contact surfaces at the bottom of the studs on the torque converter and the contact surface of the torque converter bell housing is about 22 mm.

If the torque converter has not been completely inserted, this distance will be approx. 10 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.



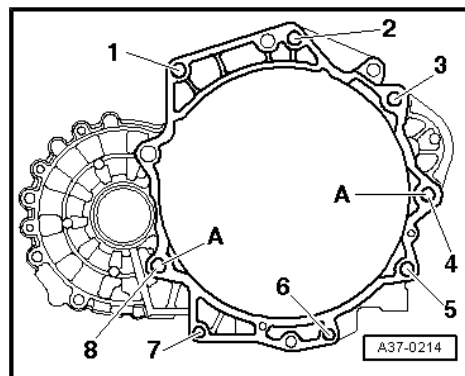
- To secure torque converter on drive plate, use only genuine nuts (same as original equipment) as specified in ⇒ Parts catalogue .
- Before installing engine, rotate torque converter and drive plate so that one hole and one stud are level with the aperture for the starter motor.
- Bolt gearbox to engine.

**Note**

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

Securing engine to automatic gearbox 01M

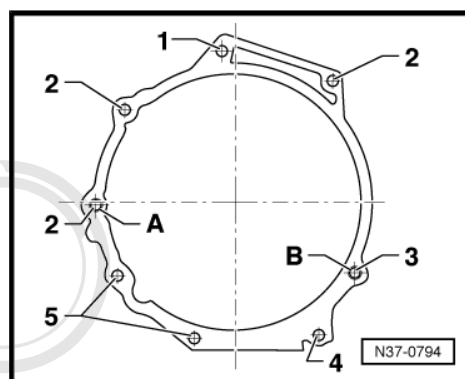
Item	Bolt	Nm
1, 2	M12x65	80
3, 4 ¹⁾	M12x180	80
5 ... 7	M10x50	45
8	M12x80	80
A	Dowel sleeves for centralising	



Securing engine to automatic gearbox 09A

Item	Bolt	Nm
1	M12x40	80
2 ¹⁾	M12x60	80
3	M12x70	80
4	M10x70	45
5	M10x55	45
A, B	Dowel sleeves for centralising	

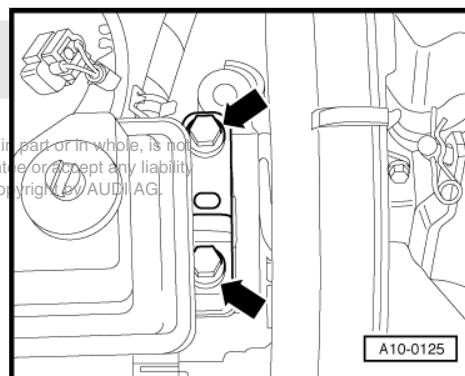
• ¹⁾ Bolts on left of illustration with M8 stud.



All models:

- Tighten bolts securing engine mounting to engine support -arrows- initially hand-tight.

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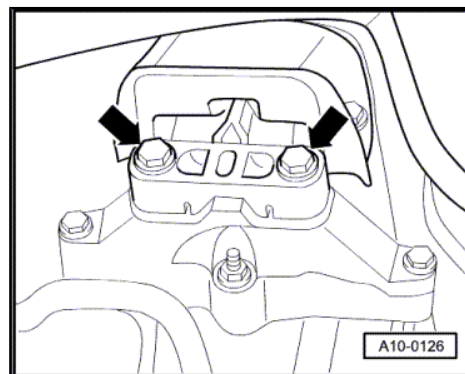


- Guide engine/gearbox assembly into the body.
- Use new bolts for securing.

i Note

The bolts are tightened to final torque only after adjusting the engine mountings ⇒ [page 35](#).

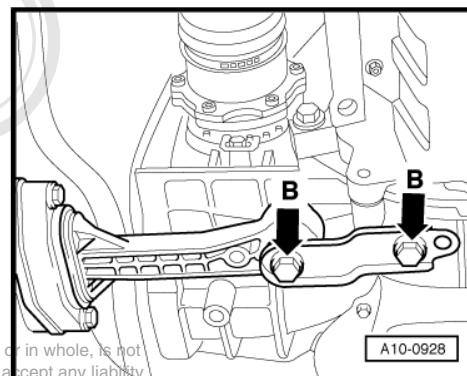
- Remove engine bracket -T10012- from engine.
- Bolt drive shafts to flange shafts of gearbox ⇒ Rep. Gr. 40.



i Note

Drive shafts must be installed prior to further assembly.

- Secure pendulum support at gearbox -arrows B-.
- Use new bolts for securing.



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Vehicles with four-wheel drive:

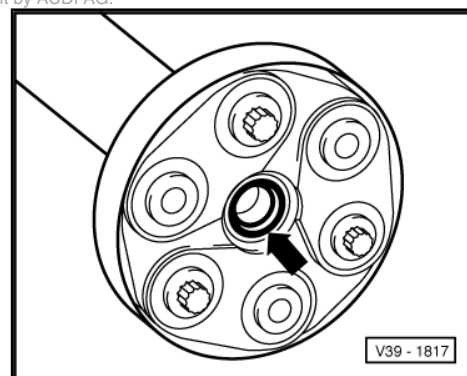
- Secure front exhaust pipe to turbocharger.



Caution

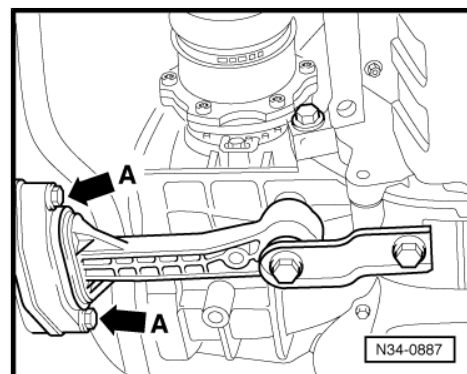
Avoid damaging the seal -arrow- in the propshaft flange when installing. If a seal is damaged the propshaft must be renewed.

- Push engine/gearbox assembly towards bulkhead; the journal of the bevel box must be simultaneously inserted horizontally and carefully into the flange of the propshaft.



All models:

- Secure pendulum support to subframe -arrows A-.
- Use new bolts for securing.

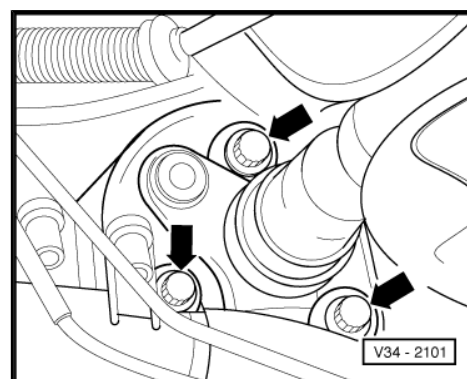


Vehicles with four-wheel drive:

- Secure propshaft with flexible coupling to bevel box -arrows-
⇒ Rep. Gr. 39 .

All models:

- Install exhaust system and align it free of stress ⇒ [page 204](#) or ⇒ [page 215](#) .
- Knock back bushes for securing bolts slightly to facilitate installation of power steering pump and air conditioner compressor.
- Install power steering pump ⇒ Rep. Gr. 48 .
- Install secondary air pump ⇒ [page 233](#) .
- Install air conditioner compressor ⇒ Rep. Gr. 87 .





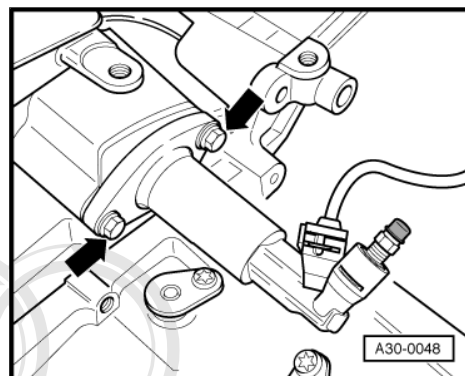
Vehicles with manual gearbox:



Caution

The clutch pedal must not be operated before installing slave cylinder.

- Install clutch slave cylinder -arrows- ⇒ Rep. Gr. 30 .



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- Install gearbox strut -arrows A-.
- Install cable support bracket and selector cables ⇒ Rep. Gr. 34 .
- Adjust selector cables ⇒ Rep. Gr. 34 .

All models:

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

- Install poly V-belt ⇒ [page 39](#) .
- Adjust assembly mountings ⇒ [page 35](#) .

Vehicles with throttle cable:

- Adjust throttle cable ⇒ Rep. Gr. 20 .

All models:

- Connect vacuum hoses ⇒ [page 155](#) .
- Electrical connections and routing ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

Vehicles from model year 2001 onwards:

- Install washer fluid reservoir ⇒ Rep. Gr. 94 .

All models:**Note**

- ◆ *When the battery is reconnected, please ensure that the vehicle equipment (e.g. radio, radio/navigation system, clock, electric window lifters) is activated as described in the operating instructions.*
- ◆ *For further operations after reconnecting power supply, refer to ⇒ Rep. Gr. 24 .*

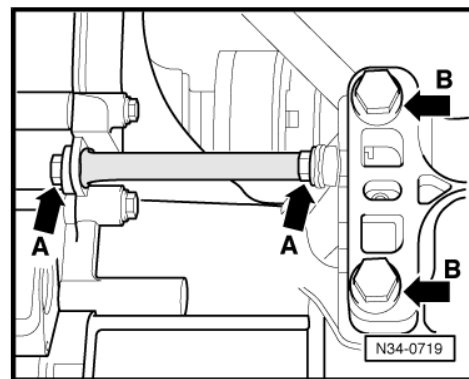
- Install and adjust wiper arms ⇒ Rep. Gr. 92 .
- Check oil level ⇒ [page 133](#) .
- Fill cooling system ⇒ [page 138](#) .

**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.*

**WARNING**

Never use battery charging equipment for boost starting. There is danger of damaging the vehicle's control units.



**Tightening torques**

Component		Nm
Bolts/nuts	M6	10
	M8	20
	M10	45
	M12	65
Except for the following:		
Torque converter to drive plate		57
Front exhaust pipe to turbocharger		40
Radiator cowl to radiator		10
Pendulum support to:	Gearbox	40 + 90° ¹⁾²⁾
	Subframe	20 + 90° ¹⁾²⁾
Catalytic converter to front exhaust pipe		40
Drive shaft heat shield to cylinder block		35
Gearbox strut		25
Hose clips for coolant hoses		2
Hose clips for air hoses		3.5
• ¹⁾ Renew bolts. • ²⁾ 90° = one quarter turn.		



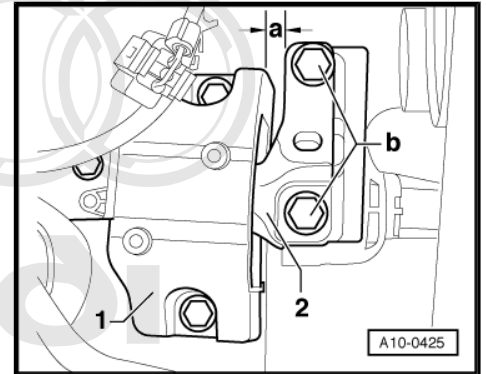
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2 Adjusting assembly mountings

2.1 Checking adjustment

Procedure

- Detach power steering reservoir above engine mounting (right-side) and move to side.
- Both bolt heads -b- must be flush with the edge of the support arm -2-.
- The distance -a- between engine mounting -1- and support arm -2- must be 13 mm.
- Check gap -a- with 12 mm iron bar (or support bridge -2011-).
- The bar must be easy to insert.

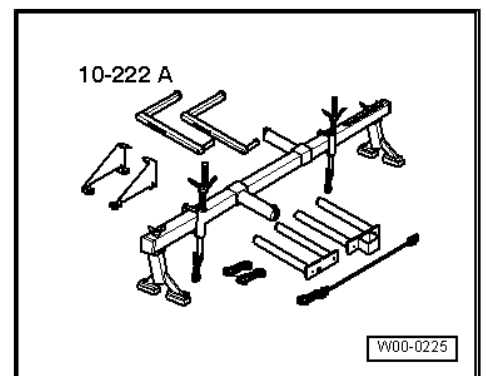


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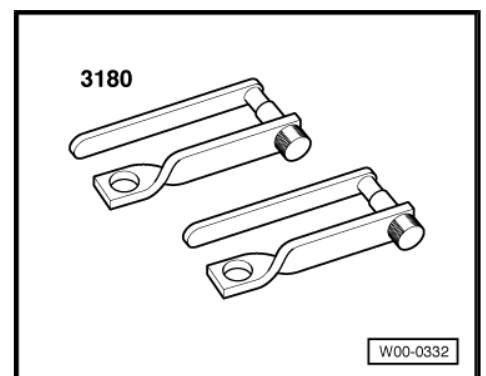
2.2 Adjusting assembly mountings

Special tools and workshop equipment required

- ◆ Support bracket -10-222 A-



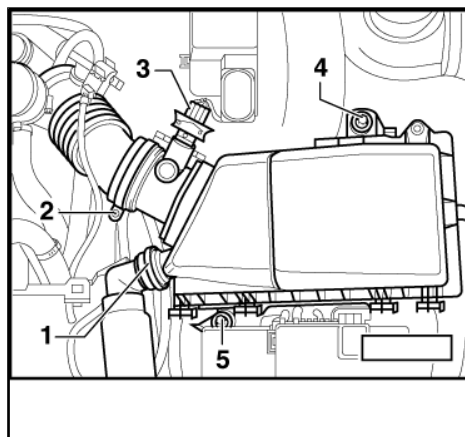
- ◆ Retainer -3180-



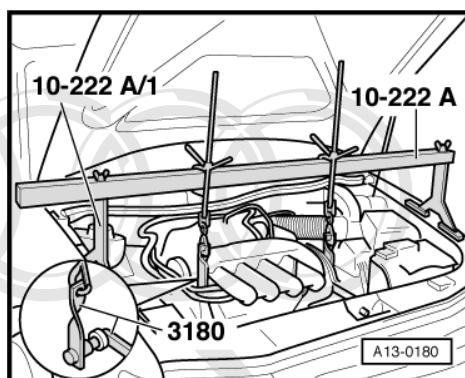
Procedure

If the distance measured is too small or too great, proceed as follows:

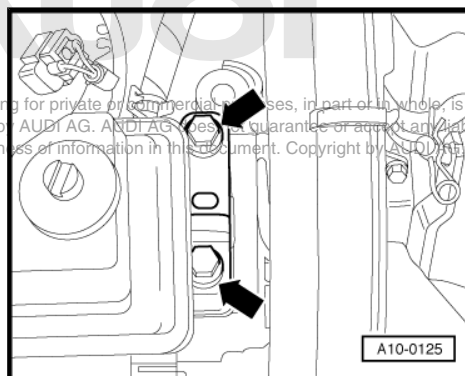
- Detach air intake hose -1- leading to secondary air pump at air cleaner housing.
- Release hose clip -2- and detach air duct from air mass meter -G70- .
- Unplug electrical connector at air mass meter -G70- -item 3-.
- Unscrew bolts -4- and -5- and remove air cleaner housing.



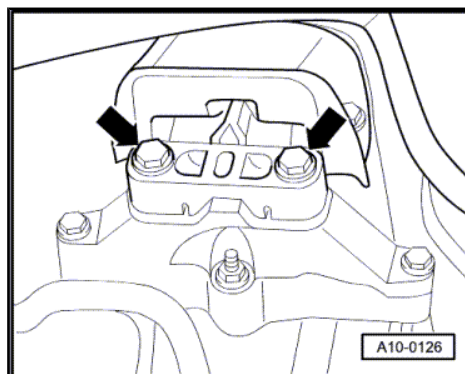
- Set up support bracket -10-222 A- in front of gas-filled strut on wing panel flanges.
 - The spindles face forwards.
- Secure retainer -3180- to engine lifting eye (right-side) and engage in hook on spindle (right-side).
- Attach hook on spindle (left-side) to lifting eye (left-side).
- Lift the engine evenly a short distance with both spindles.



- Remove bolts -arrows- of assembly mounting on engine.

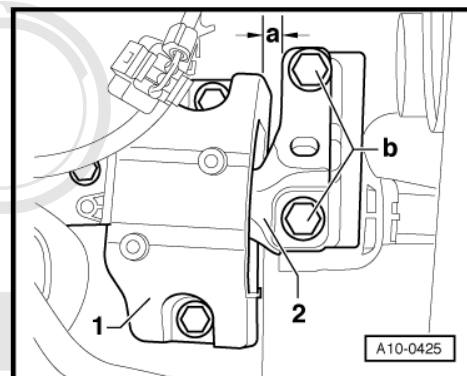


- Remove bolts -arrows- of assembly mounting on gearbox.
- Renew all 4 bolts one after the other and hand-tighten.



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- Loosen bolts -b- for support arms on right and left sides approx. 2 turns.
- Use lever to adjust engine until distance -a- between engine mounting -1- and support arm -2- is 13 mm.
- It should be possible to insert the 12 mm iron bar (or support bridge -2011-) easily.
- Both bolt heads -b- must be flush with the edge of the support arm.
- Tighten the bolts -b- for engine assembly mounting.



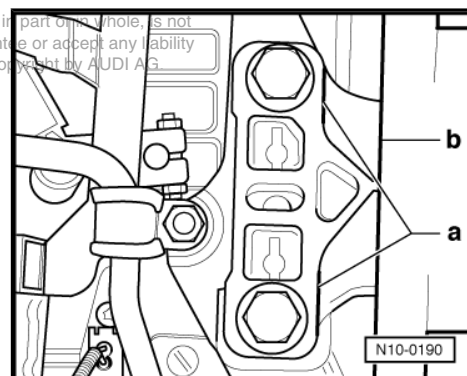
- Ensure that the edges of the support arm (on the gearbox assembly mounting) -a- and gearbox mounting -b- are parallel.
- Tighten the bolts for gearbox assembly mounting.

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



Note

Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.



Tightening torques

Component		Nm
Support arm to:	Gearbox support	60 + 90° ¹⁾²⁾
	Engine support	60 + 90° ¹⁾²⁾
Hose clips for air hoses		3.5
• ¹⁾ Renew bolts. • ²⁾ 90° = one quarter turn.		

13 – Crankshaft group

1 Servicing work on pulley end

1.1 Removing and installing poly V-belt



Note

The illustration shows the poly V-belt drive on vehicles with air conditioner.

1 - Poly V-belt

- ☐ Routing of belt on vehicles without air conditioner ⇒ [page 39](#)
- ☐ Routing of belt on vehicles with air conditioner ⇒ [page 39](#)
- ☐ Double-sided poly V-belt on vehicles with air conditioner
- ☐ Before removing, mark direction of rotation with chalk or felt-tipped pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage.
- ☐ Check for wear
- ☐ Do not kink
- ☐ Removing and installing ⇒ [page 39](#)

2 - 23 Nm

3 - Poly V-belt tensioner

- ☐ Turn with open-end spanner to slacken poly V-belt ⇒ [page 40](#)

4 - Vibration damper

- ☐ With pulley for poly V-belt
- ☐ Removing and installing ⇒ [page 41](#)

5 - 45 Nm

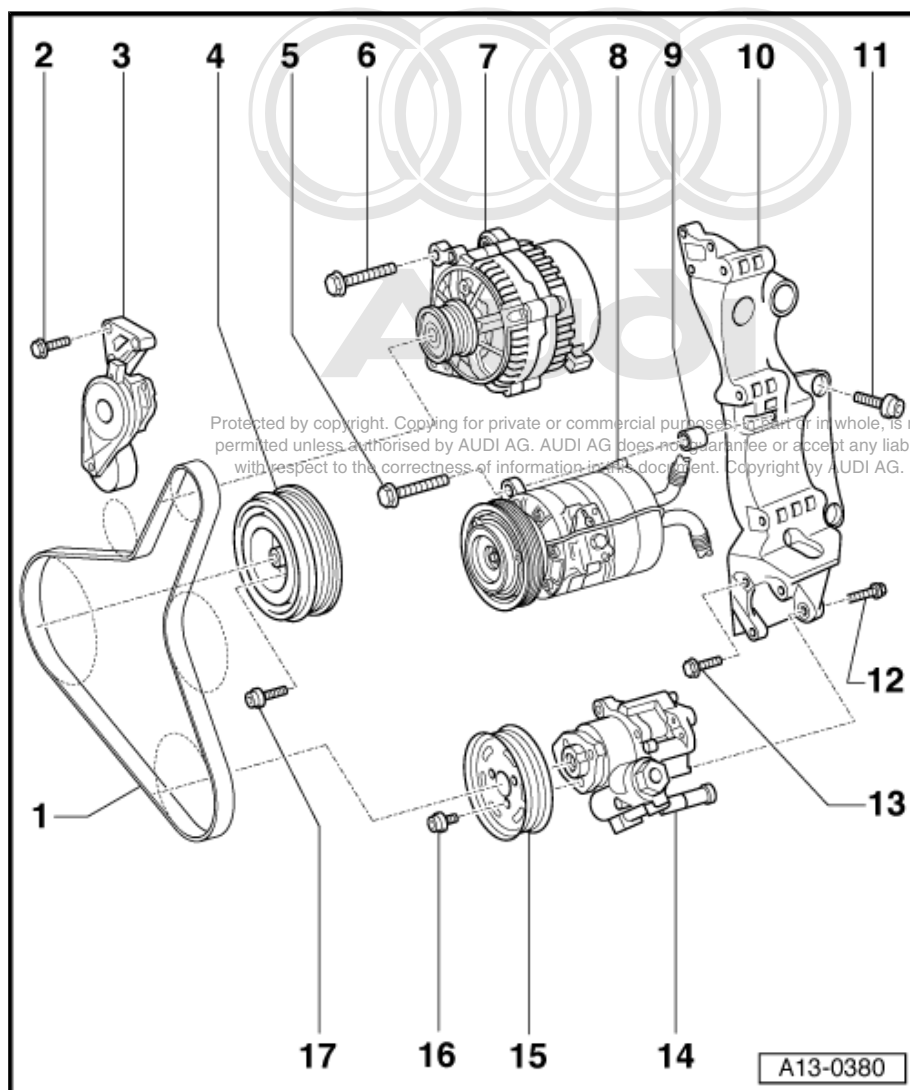
6 - 23 Nm

7 - Alternator

- ☐ Removing and installing ⇒ Rep. Gr. 27
- ☐ To facilitate attachment of alternator, knock back threaded bushes for alternator securing bolts slightly

8 - Air conditioner compressor

- ☐ Removing and installing ⇒ Rep. Gr. 87
- ☐ After detaching, secure compressor to lock carrier using wire or similar. Do not leave it suspended from refrigerant pipes.
- ☐ Do not unscrew or disconnect refrigerant hoses or pipes.



- ☐ To facilitate attachment of air conditioner, knock back threaded bushes for securing bolts slightly

9 - Spacer bush

10 - Bracket for ancillaries

- ☐ Removing and installing ⇒ [page 42](#)

11 - 45 Nm

12 - 23 Nm

13 - 23 Nm

14 - Power steering pump

- ☐ Removing and installing ⇒ Rep. Gr. 48
- ☐ To facilitate positioning of power steering pump, drive back threaded bush for securing bolt slightly at bracket

15 - Pulley for power steering pump

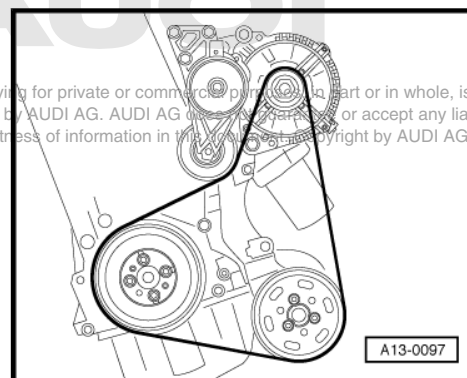
16 - 23 Nm

17 - Special bolt

- ☐ Allocation ⇒ Parts catalogue
- ☐ If bolt strength is 8.8, renew and tighten to 10 Nm + 90° further
- ☐ If bolt strength is 10.9, tighten to 40 Nm

Poly V-belt on vehicles without air conditioner

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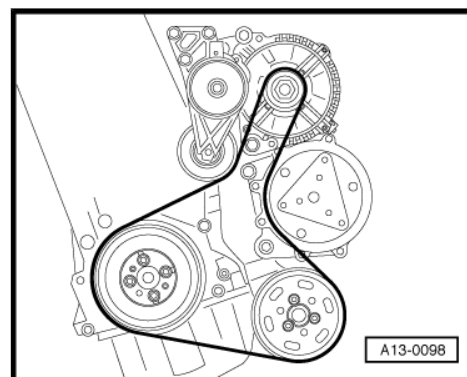


Poly V-belt on vehicles with air conditioner



Note

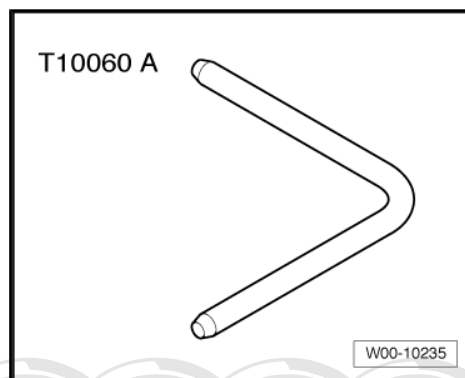
Engines with an air conditioner compressor are fitted with a double-sided poly V-belt.



1.2 Removing and installing poly V-belt

Special tools and workshop equipment required

♦ Locking pin -T10060 A-



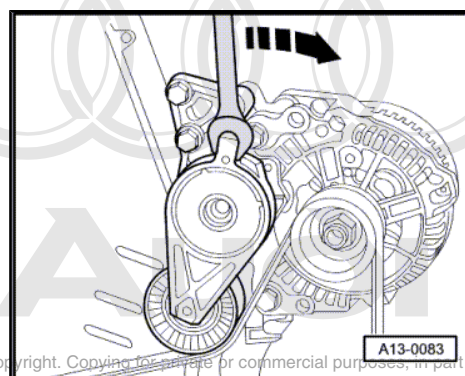
Removing



Note

Before removing, mark direction of rotation of poly V-belt with chalk or felt-tipped 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- to slacken the poly V-belt.
- Remove poly V-belt.



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- Lock tensioner in position with locking pin -T10060 A- .

Installing

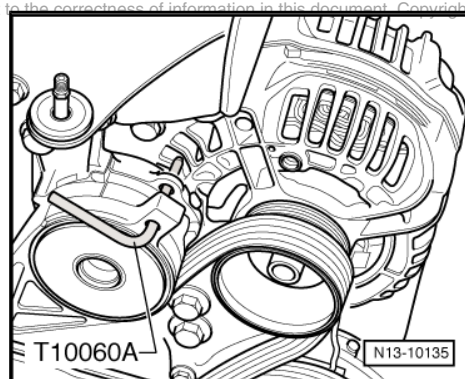
Installation is carried out in the reverse order; note the following:



Note

Before fitting poly V-belt, make sure all mechanical units (alternator, air conditioner compressor, power steering pump) are firmly in position.

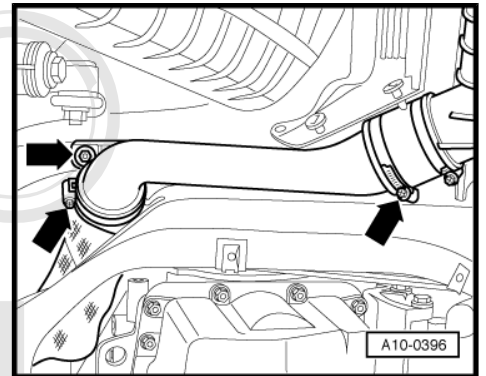
- Fit poly V-belt onto crankshaft pulley, power steering pump pulley and then onto alternator pulley.
- Release pressure from the tensioner and remove locking pin -T10060 A- .
- Check poly V-belt for proper seating.
- Routing of poly V-belt on vehicles without air conditioner
⇒ [page 39](#) .
- Routing of poly V-belt on vehicles with air conditioner
⇒ [page 39](#) .
- Start engine and check that belt runs properly.



1.3 Removing and installing vibration damper

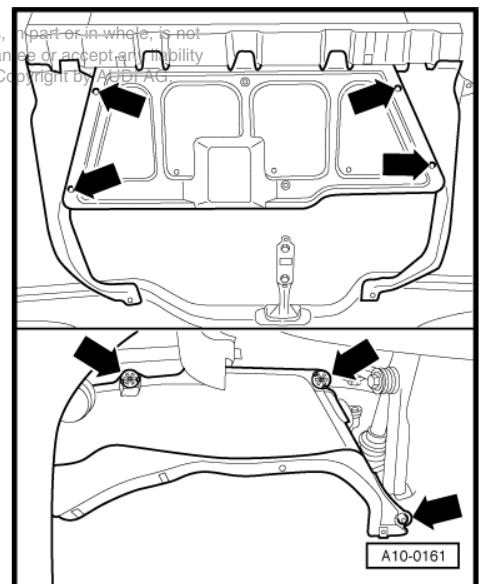
Removing

- Remove poly V-belt ⇒ [page 39](#) .
- Disconnect air pipe at bottom of right-hand longitudinal member -arrows- (air pipe leads to charge air cooler).

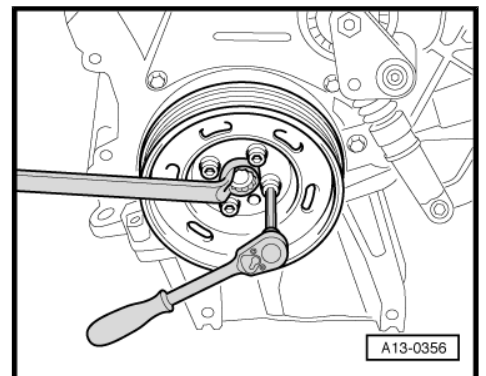


- Remove noise insulation panels (centre and right) -arrows-

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



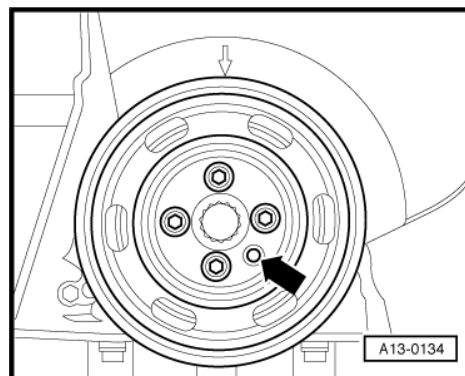
Installing

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

- When installing the vibration damper, use only genuine bolts (same as original equipment): ⇒ Parts catalogue .
- The vibration damper can only be installed in one position. The hole -arrow- in the vibration damper must be located over the projection on the toothed belt sprocket.

Tightening torque

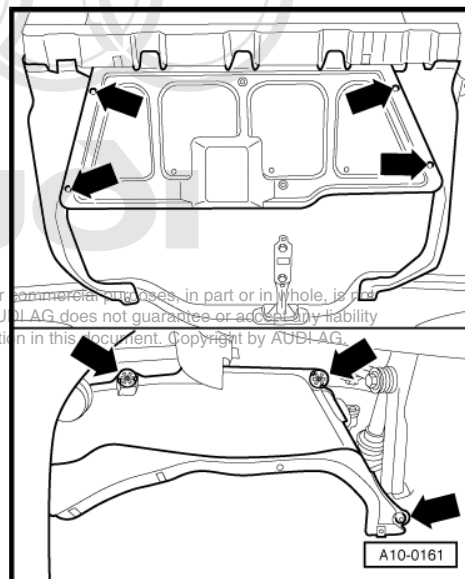
Component		Nm
Vibration damper to crankshaft	Bolt strength rating 8.8	10 + 90° 1)2)
	Bolt strength rating 10.9	40
• 1) Renew bolts. • 90° = one quarter turn.		



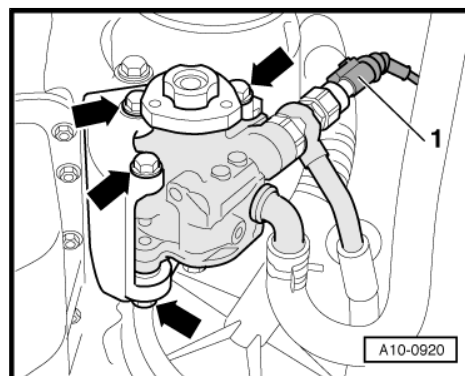
1.4 Removing and installing bracket for ancillaries

Removing

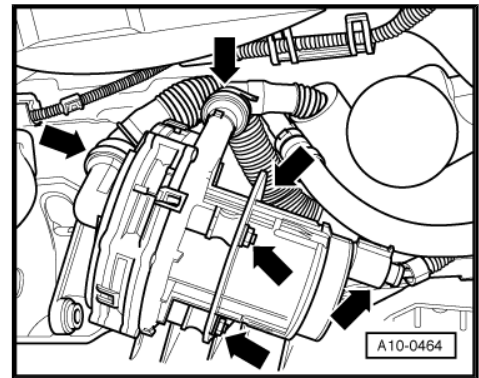
- Note (if necessary obtain) code on vehicles with coded radio / radio and navigation system (RNS).
- Disconnect earth wire at battery with ignition switched off.
- Remove poly V-belt ⇒ [page 39](#) .
- Remove noise insulation panels (centre and right) -arrows-.



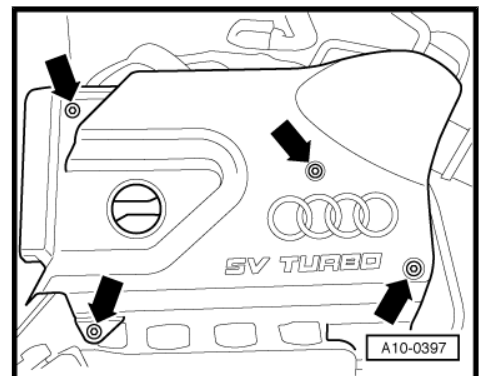
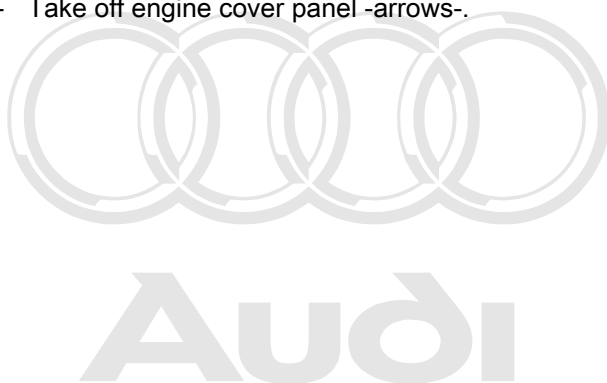
- Unbolt pulley for power steering pump.
- Unplug electrical connector -1- at power assisted steering pressure switch -F88- .
- Detach power steering pump from bracket for ancillaries -arrows-.
- Tie up power steering pump to one side; hydraulic lines remain attached.



- Unplug electrical connector at secondary air pump motor - V101- , detach hoses and remove nuts -arrows-.

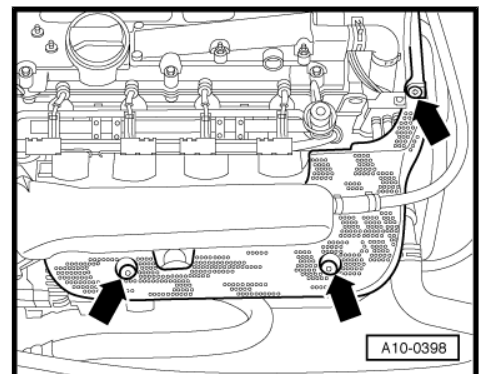


- Take off engine cover panel -arrows-.

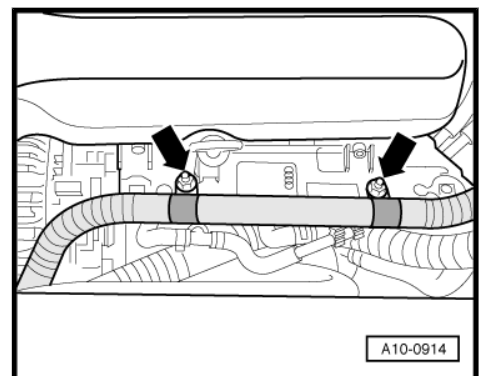


- Remove cover in front of intake manifold -arrows-.

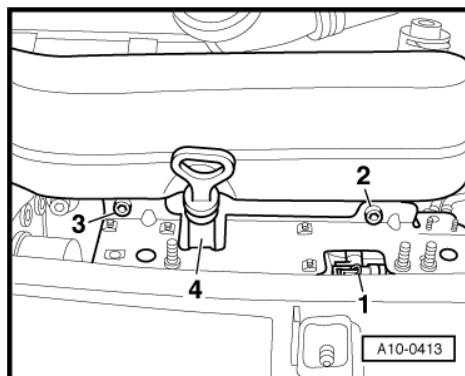
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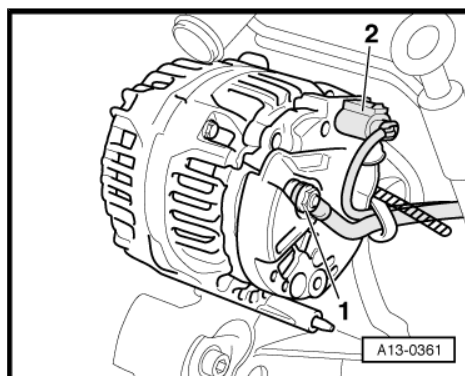
- Detach pipe for secondary air system from brackets on engine -arrows-.



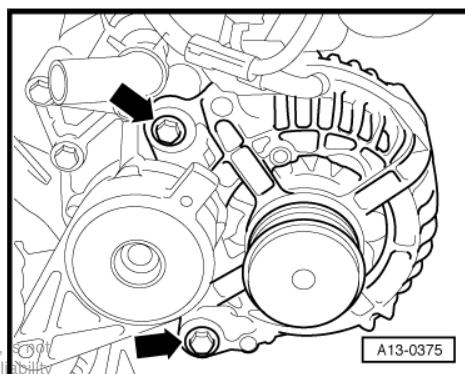
- Remove bolts -2- and -3- and detach bracket for dipstick guide tube -4-.
- Unplug connectors -1- for turbocharger air recirculation valve -N249- and secondary air inlet valve -N112- on underside of retainer for electrical change-over valves.
- Disconnect vacuum hose going to electrical change-over valves at intake manifold and lay aside bracket with hoses connected.



- Unplug electrical connector -2-.
- Unscrew electrical wire -1- from alternator.
- Unscrew clamp and move electrical wiring clear.



- Unscrew bolts -arrows-.
- Detach alternator and guide it towards left out of engine compartment.
- Unscrew radiator fan (right-side) from radiator cowl, take out downwards and tie up to body (wiring remains connected).



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Vehicles with air conditioning:

- Unplug electrical connector -1- for magnetic clutch of air conditioner compressor.



WARNING

The air conditioner refrigerant circuit must not be opened.

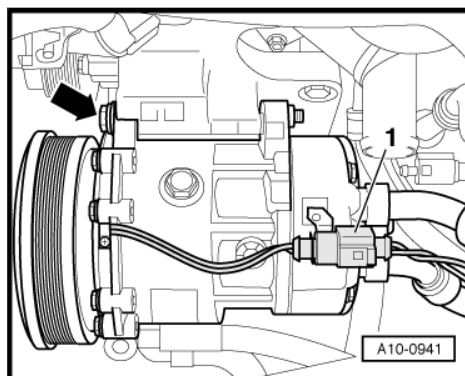
- Unscrew bolts -arrow- for air conditioner compressor.



Note

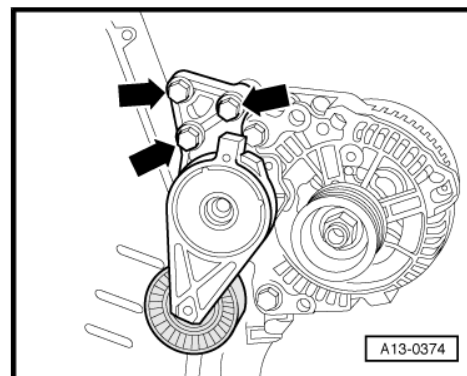
To prevent damage to the refrigerant lines, ensure that the pipes and hoses are not stretched, kinked or bent.

- Lower air conditioner compressor and tie up to lock carrier using wire.



All models:

- Remove poly V-belt tensioner -arrows-.

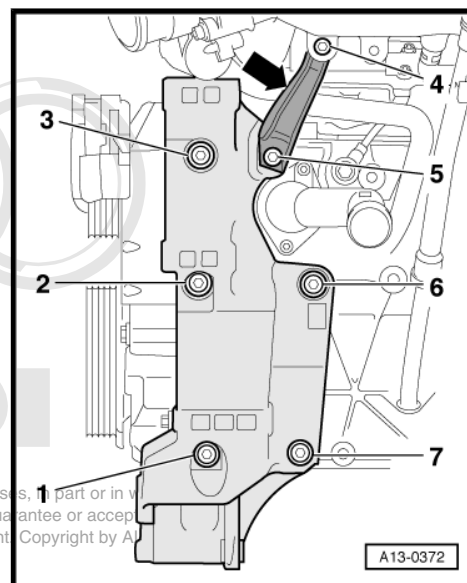


- Unscrew bolts -1 ... 7-.
- Take out support for intake manifold -arrow- and bracket for ancillaries.

Installing

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

- Drive back the respective bushes for securing bolts slightly to facilitate installation of alternator, power steering pump and air conditioner compressor.
- Install power steering pump ⇒ Rep. Gr. 48 .
- Install air conditioner compressor ⇒ Rep. Gr. 87 .
- Install alternator ⇒ Rep. Gr. 27 .
- Install poly V-belt ⇒ [page 39](#) .

**Note**

- ◆ *When the battery is reconnected, please ensure that the vehicle equipment (e.g. radio, radio/navigation system, clock, electric window lifters) is activated as described in the operating instructions.*
- ◆ *For further operations after reconnecting power supply, refer to ⇒ Rep. Gr. 24 .*

Tightening torques

Component	Nm
Bracket for ancillaries to cylinder block	45
Support for intake manifold to:	Intake manifold
	Bracket for ancillaries
Radiator fan to radiator cowl	10
Tensioner for poly V-belt to bracket for ancillaries	23
Pulley to power steering pump	23
Front cross piece to longitudinal member	20

1.5 Toothed belt - exploded view of components

1 - Engine support

2 - 45 Nm

3 - Toothed belt cover (top)

- ☐ Engage carefully in centre toothed belt cover when installing

4 - Toothed belt

- ☐ Before removing, mark direction of rotation with chalk or felt-tipped pen. If the belt runs in the opposite direction when it is refitted, this can cause breakage
- ☐ Check for wear
- ☐ Removing ⇒ [page 48](#)
- ☐ Installing (adjusting valve timing) ⇒ [page 52](#)

5 - Idler roller

6 - 27 Nm

7 - 65 Nm

- ☐ Use counterhold tool -3036- when loosening and tightening ⇒ [page 47](#)

8 - Camshaft sprocket for exhaust camshaft

- ☐ Remove toothed belt prior to removing and installing ⇒ [page 48](#)
- ☐ Installation position ⇒ [page 47](#)

9 - Tensioning roller

10 - Washer

11 - Tensioner for toothed belt

12 - O-ring

- ☐ Renew
- ☐ Lubricate with coolant additive Plus -G 012 A8F A1- prior to installing

13 - Coolant pump

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

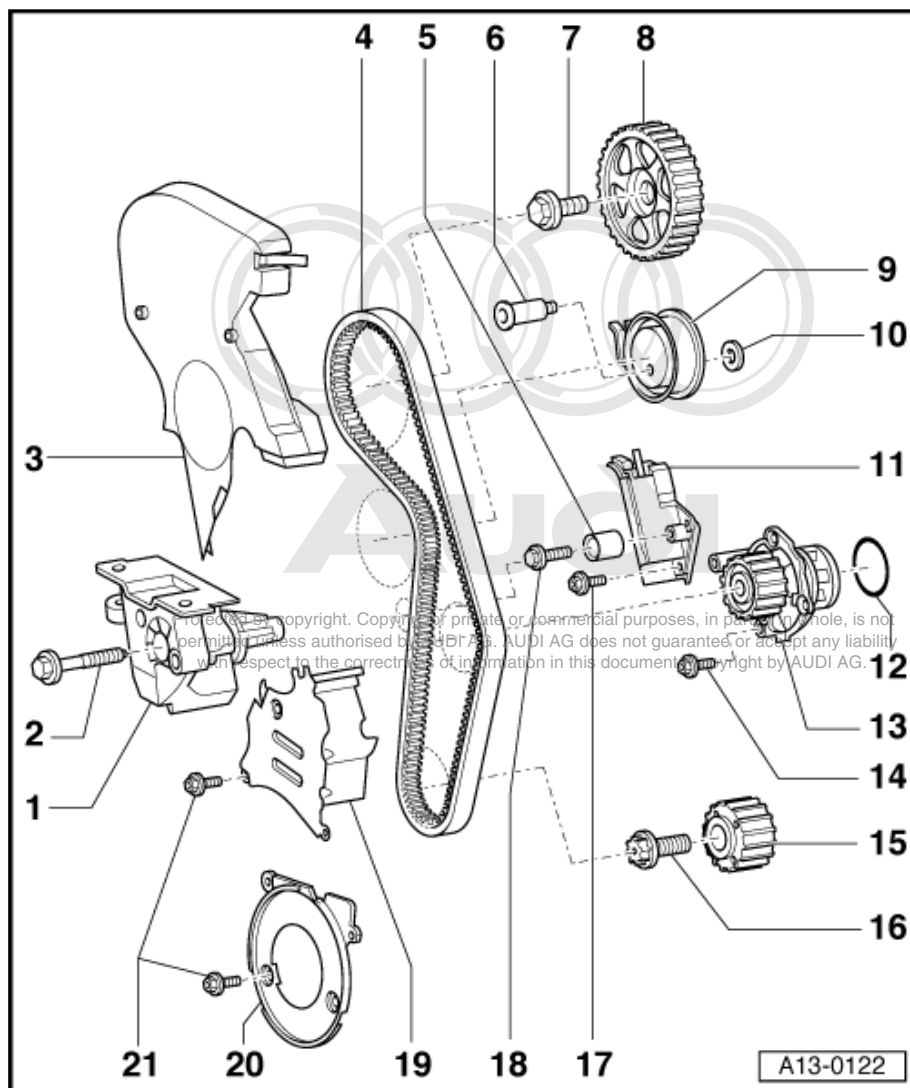
14 - 15 Nm

15 - Crankshaft sprocket

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

16 - 90 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ Do not lubricate with oil
- ☐ Use counterhold tool -3415- when loosening and tightening ⇒ [page 47](#)



17 - 15 Nm

18 - 25 Nm

19 - Toothed belt cover (centre)

20 - Toothed belt cover (bottom)

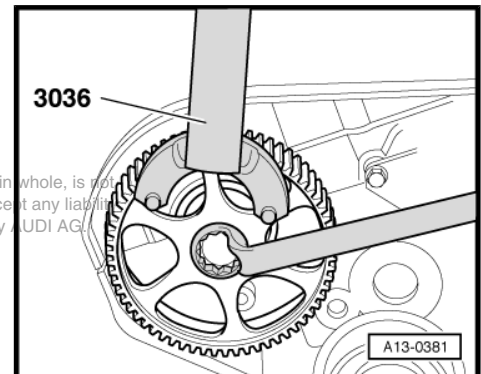
21 - 10 Nm

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

Loosening and tightening bolt for camshaft sprocket

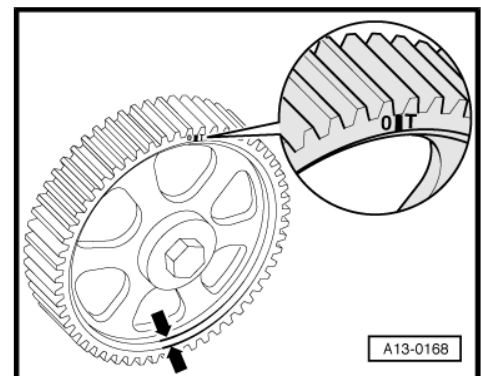
- Use counterhold tool -3036- when loosening and tightening central bolt.

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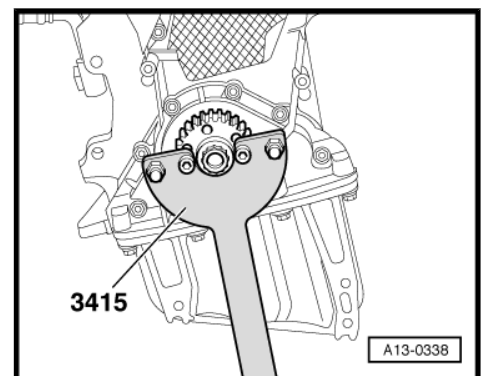
Installation position of camshaft sprocket

- The thinner web of the camshaft sprocket faces outwards -arrows- and the marking "OT" for TDC is visible from the front.



Removing and installing crankshaft sprocket

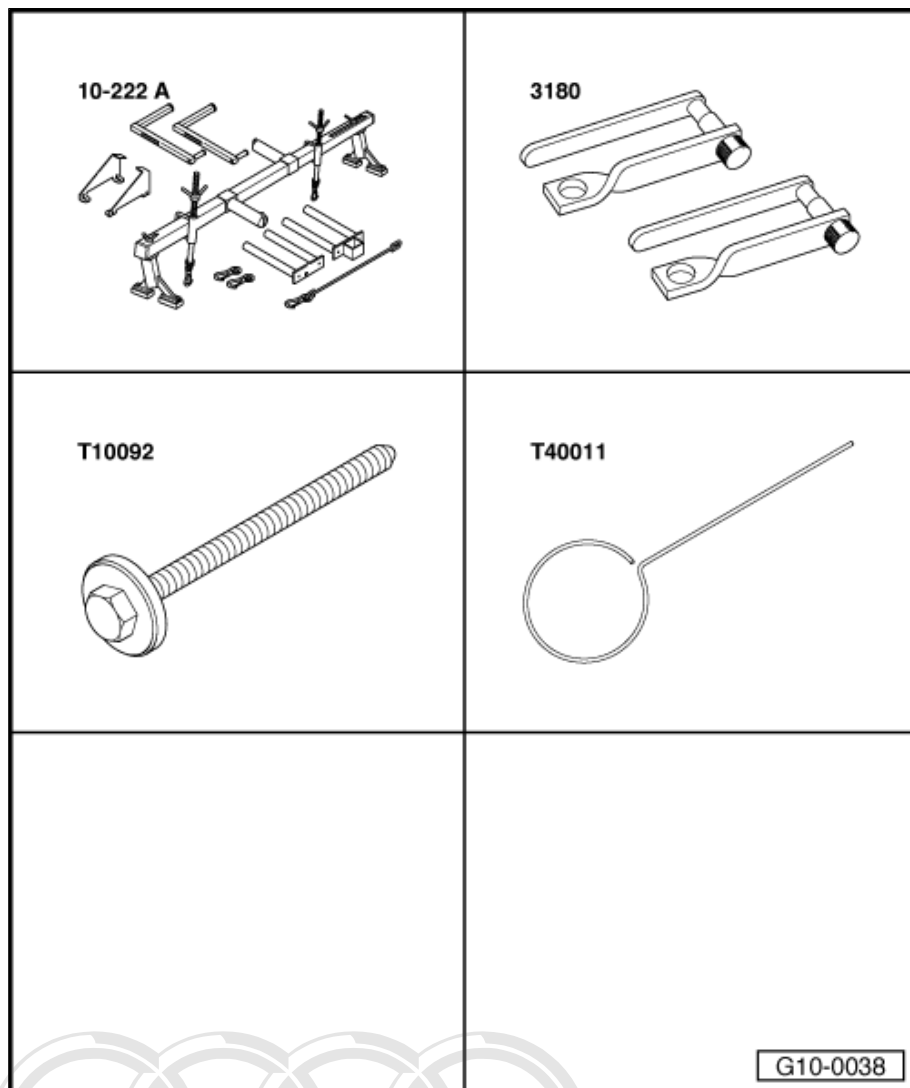
- Use counterhold tool -3415- when loosening and tightening central bolt.



1.6 Removing and installing toothed belt

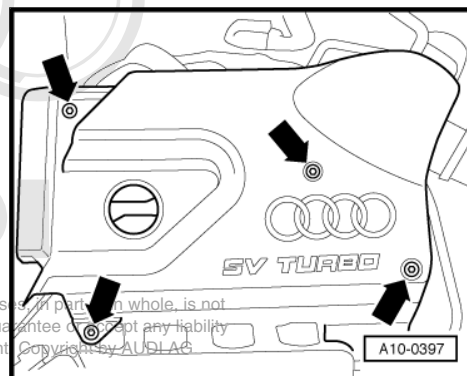
Special tools and workshop equipment required

- ◆ Support bracket -10-222 A-
- ◆ Retainer -3180-
- ◆ Tensioning bolt -T10092-
- ◆ Locking pin -T40011-



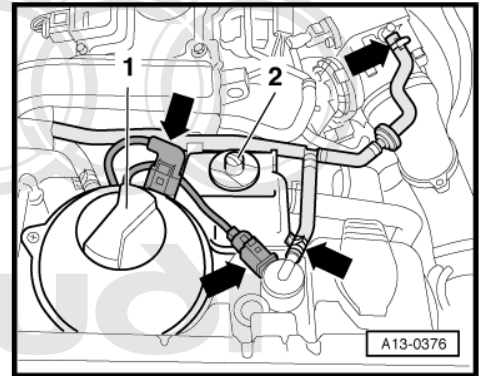
Removing

- Take off engine cover panel -arrows-.



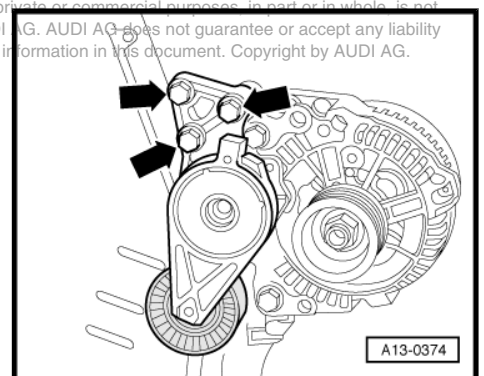
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- Unplug electrical connectors and disconnect hoses -arrows-.
- Detach coolant expansion tank -1- and power steering reservoir -2-. Hoses remain connected.
- Remove poly V-belt ⇒ [page 39](#) .

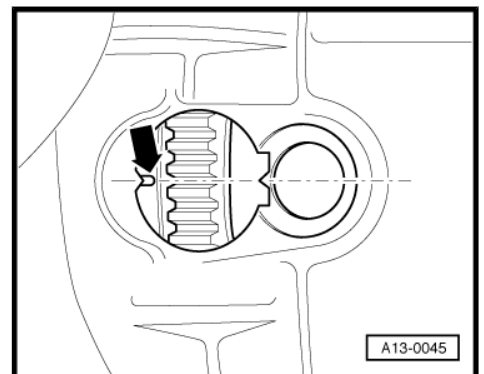


- Remove poly V-belt tensioner -arrows-.
- Remove toothed belt cover (top).
- Mark the rotation direction of toothed belt with chalk or a felt-tipped pen.

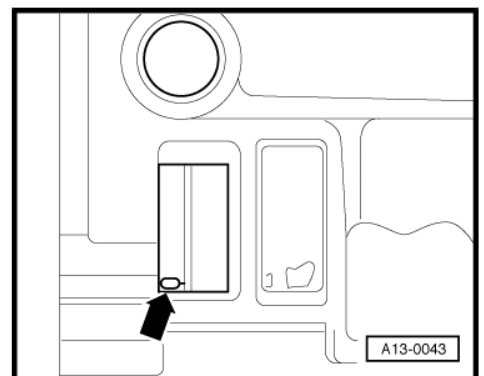
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- Pull out sealing plug at gearbox.
- Turn crankshaft at central bolt on crankshaft sprocket in direction of engine rotation to TDC mark.
- Vehicles with manual gearbox



- Vehicles with automatic gearbox



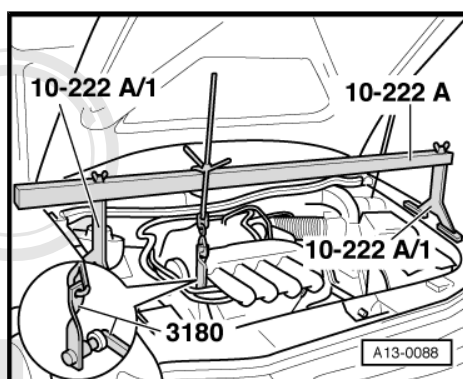
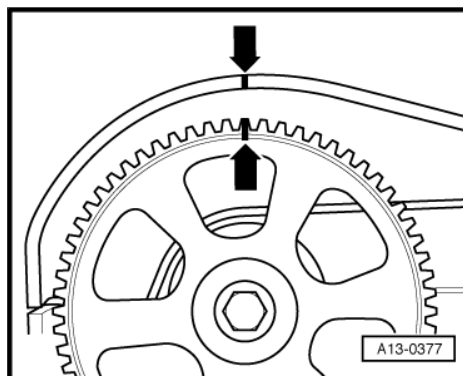
- At the same time the marking on the front of the camshaft sprocket must align with the marking on the cylinder head cover -arrows-.
- Rotate crankshaft one turn further if necessary.



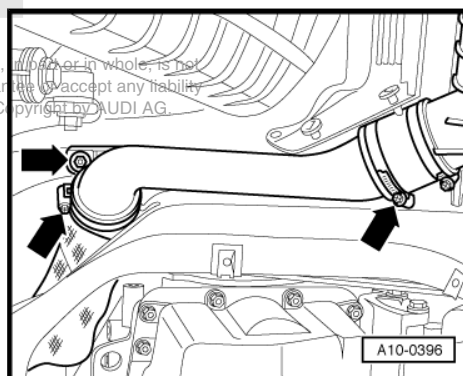
Note

Positioning crankshaft at "TDC" with engine removed
⇒ [page 56](#).

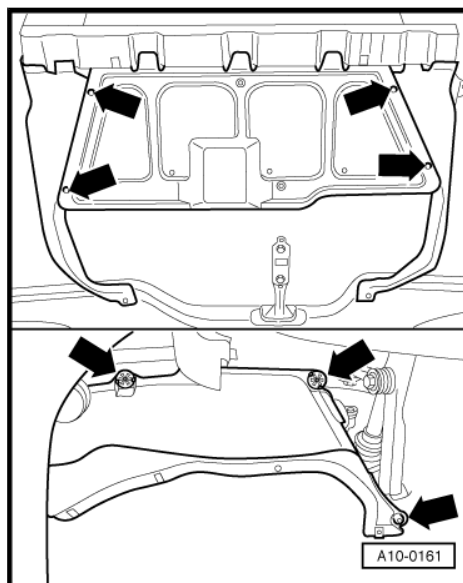
- Set up support bracket -10-222 A- in front of gas-filled strut on wing panel flanges.
- The spindle is located at the front.
- Secure retainer -3180- to engine lifting eye (right-side) and engage in hook on spindle.
- Lift engine slightly with spindle of support bracket -10-222 A-.
- Lift coolant expansion tank and power assisted steering reservoir and tie them in place on the engine support bracket.



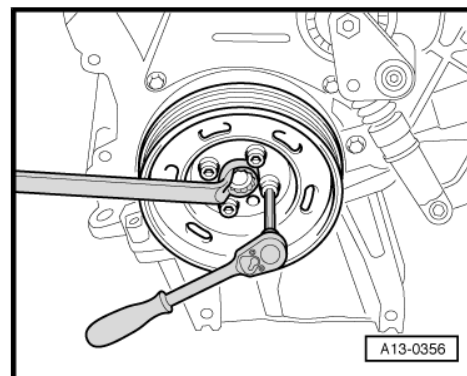
- Disconnect air pipe at bottom of right-hand longitudinal member -arrows- (air pipe leads to charge air cooler).



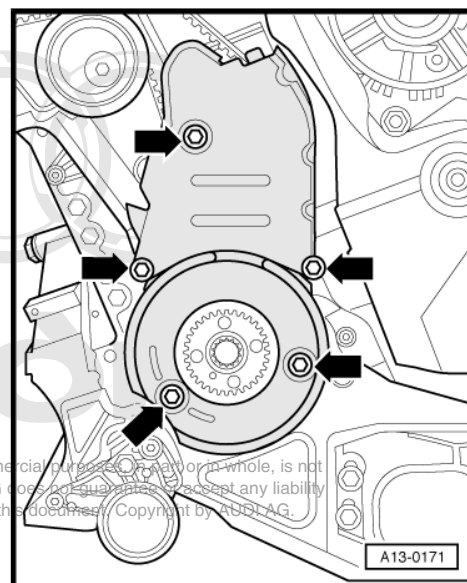
- Remove noise insulation panels (centre and right) -arrows-.



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

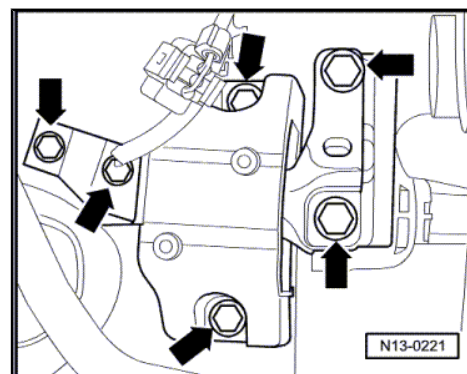


- Unbolt lower and centre toothed belt covers -arrows-.



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- Unbolt engine mounting and connecting bracket from body and from engine support -arrows-.
- Remove engine mounting.

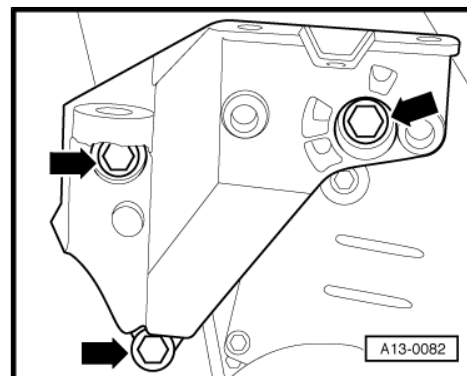


- Remove bolts for engine support -arrows- but do not take out the engine support.



Note

To remove the bolts for the engine support, raise or lower the engine slightly as necessary via the spindle on support bracket -10-222 A-.



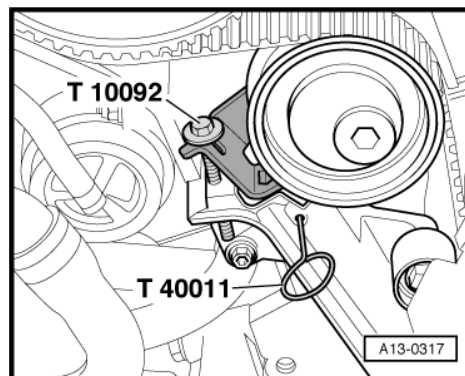
- Screw tensioning bolt -T10092- into toothed belt tensioner.
- Compress piston of tensioner just far enough so that the piston can be locked with locking pin -T40011- .



Note

Bend locking pin -T40011- approx. 90° so it can be inserted more easily.

- Pull out toothed belt through space between engine support and cylinder block.



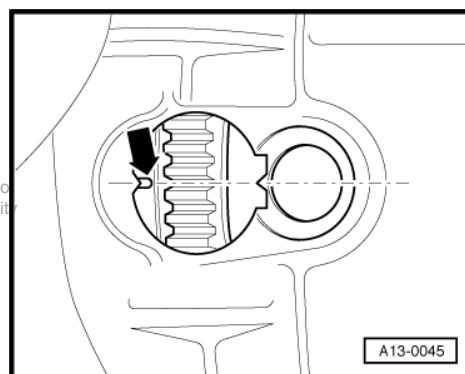
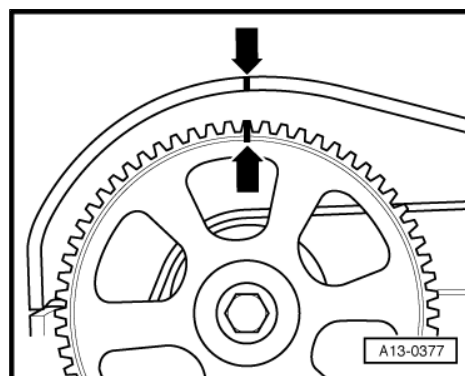
Installing (adjusting valve timing)



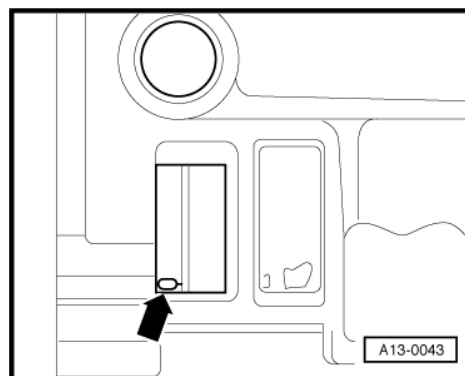
Caution

When turning the camshaft, the crankshaft must not be at "TDC". Otherwise, there is a risk of damage to valves and piston crowns.

- Check that marking on camshaft sprocket is aligned with marking on cylinder head cover -arrows-.
- Check again whether the crankshaft is positioned at TDC -arrow-.
- Vehicles with manual gearbox



- Vehicles with automatic gearbox
- Fit toothed belt onto crankshaft sprocket, noting direction of rotation.
- Fit toothed belt onto remaining sprockets in the sequence: coolant pump, tensioning roller, camshaft sprocket.



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- Remove tensioning bolt -T10092- .
- Remove locking pin -T40011- from tensioner.
- Piston of toothed belt tensioner is released.
- Turn crankshaft at central bolt on toothed belt sprocket two revolutions in direction of engine rotation and check whether camshaft and crankshaft markings align with their respective reference points.
- Install toothed belt cover.

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

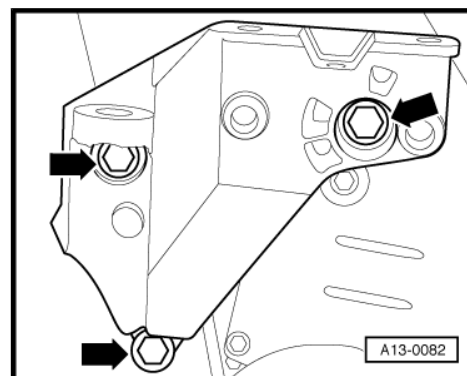
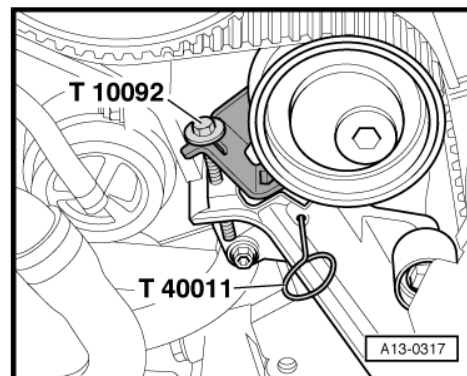


Note

- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- Install vibration damper ⇒ [page 41](#) .
- Install engine support -arrows-.
- Adjust assembly mountings ⇒ [page 35](#) .
- Install poly V-belt ⇒ [page 39](#) .
- Install coolant expansion tank and power steering reservoir.

Tightening torques

Component	Nm
Toothed belt cover (bottom) to cylinder block	10 ¹⁾
Toothed belt cover (centre) to cylinder block	10 ¹⁾
Engine support to cylinder block	45
Connecting bracket to body/engine mounting	25
Engine mounting to body	40 + 90° ²⁾³⁾
Tensioner for poly V-belt to bracket for ancillaries	23
• ¹⁾ Install using locking fluid; locking fluid ⇒ Parts catalogue . • ²⁾ Renew bolts. • ³⁾ 90° = one quarter turn.	



1.7 Removing toothed belt from camshaft sprocket

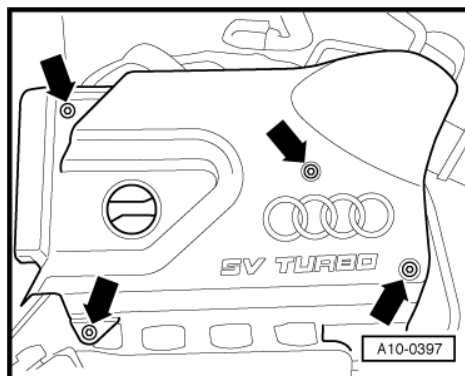
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Special tools and workshop equipment required

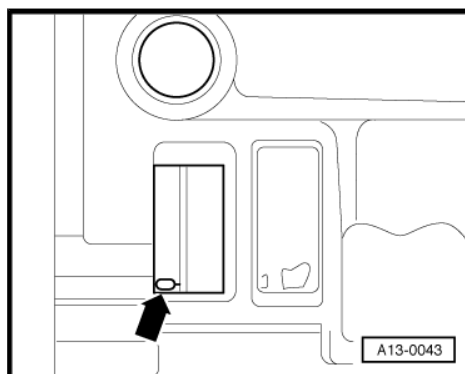
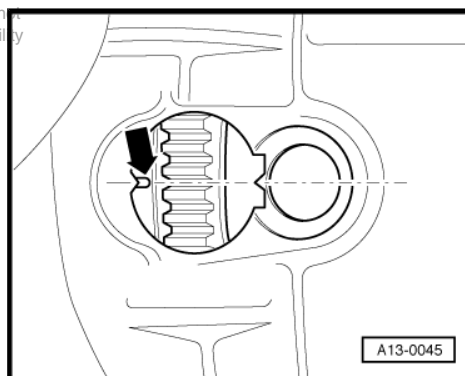
- ◆ Stud M5x55, nut and large washer

Removing

- Take off engine cover panel -arrows-.
- Remove toothed belt cover (top).



- Pull out sealing plug at gearbox.
- Turn crankshaft at central bolt on crankshaft sprocket in direction of engine rotation to TDC mark.
- Vehicles with manual gearbox

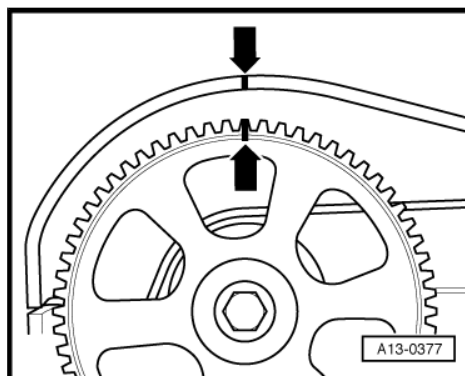


- Vehicles with automatic gearbox
- At the same time the marking on the front of the camshaft sprocket must align with the marking on the cylinder head cover -arrows-.
- Rotate crankshaft one turn further if necessary.



Note

Positioning crankshaft at "TDC" with engine removed
⇒ [page 56](#).



- Screw stud M5x55 -item 1- into toothed belt tensioner.
- Screw nut -3- with large washer -2- onto stud.
- Carefully tension piston of tensioner until it is just possible to detach toothed belt from camshaft sprocket.

**Note**

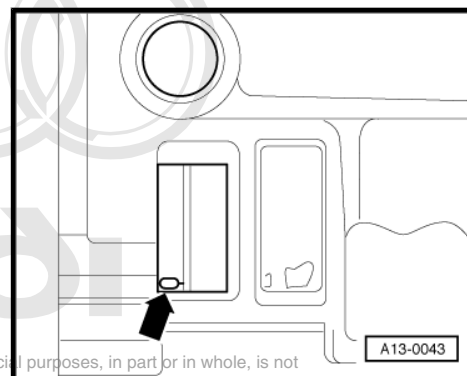
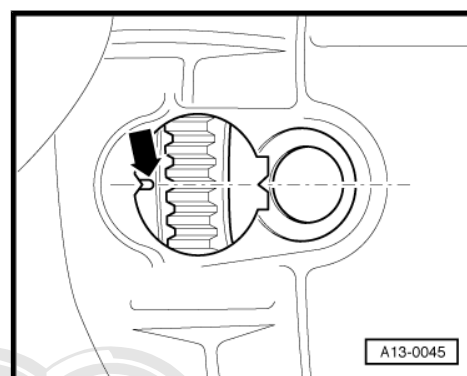
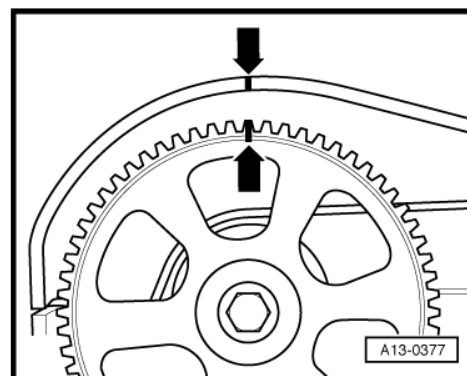
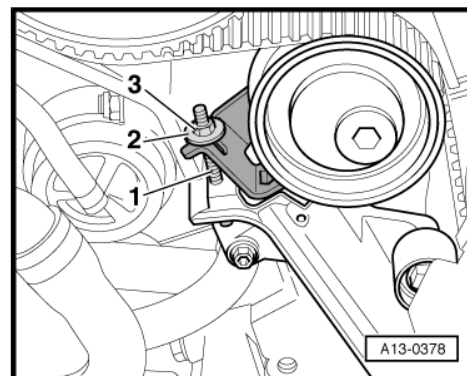
Take care not to compress tensioner too far.

- Remove toothed belt from camshaft sprocket.

Fitting (adjusting valve timing)**Caution**

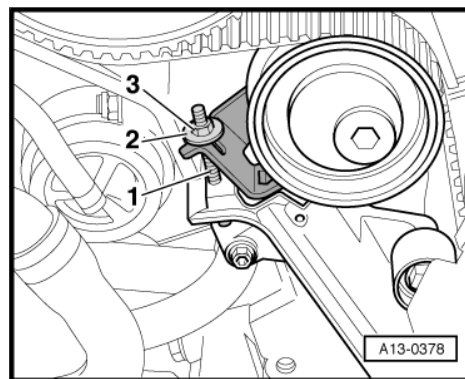
When turning the camshaft, the crankshaft must not be at "TDC". Otherwise, there is a risk of damage to valves and piston crowns.

- Check that marking on camshaft sprocket is aligned with marking on cylinder head cover -arrows-.
- Check again whether the crankshaft is positioned at TDC -arrow-.
- Vehicles with manual gearbox
- Vehicles with automatic gearbox



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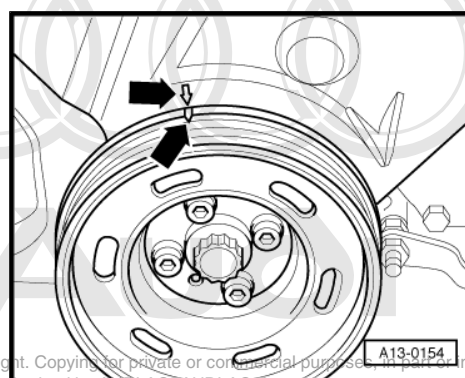
- Fit toothed belt onto camshaft sprocket.
- Release piston of toothed belt tensioner and unscrew stud -1-.
- Turn crankshaft at central bolt on toothed belt sprocket two revolutions in direction of engine rotation and check whether camshaft and crankshaft markings align with their respective reference points.



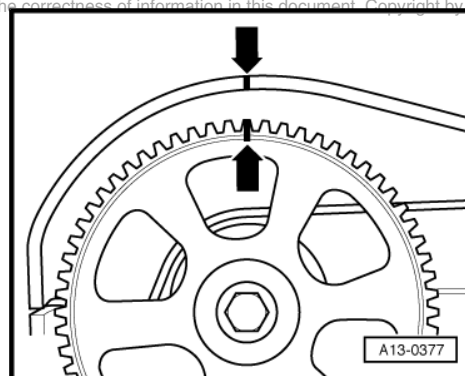
1.8 Positioning crankshaft at TDC with engine removed

Procedure

- Toothed belt cover (top section) removed
- Turn crankshaft at central bolt on crankshaft sprocket in direction of engine rotation to TDC mark.
- At the same time the marking on the front of the camshaft sprocket must align with the marking on the cylinder head cover -arrows-.
- Rotate crankshaft one turn further if necessary.



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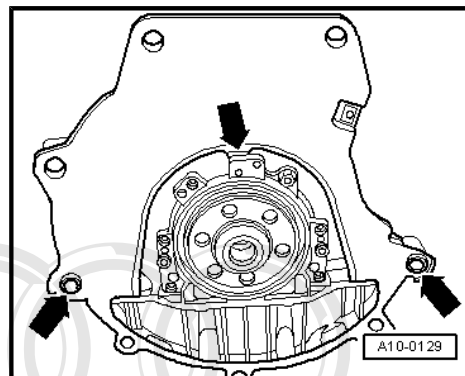


10 - Sealing flange (rear) with oil seal

- ☐ With gasket for cylinder block
- ☐ Do not lubricate with oil
- ☐ Take care not to fold over or damage sealing lip of oil seal when fitting
- ☐ Remove sump prior to removing ⇒ [page 125](#)
- ☐ To install, push guide sleeve from installation kit onto crankshaft.

Installing intermediate plate

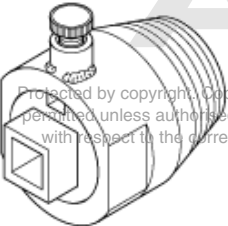
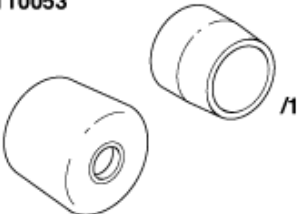
- Engage intermediate plate on sealing flange and slip onto dowel sleeves -arrows-.



2.1 Renewing crankshaft oil seal - pulley end

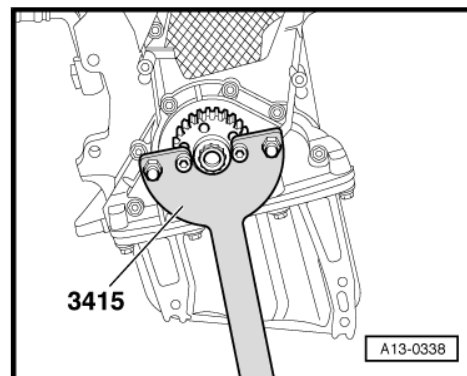
Special tools and workshop equipment required

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

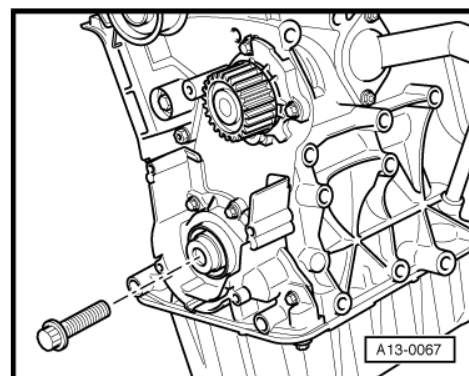
3203 	3415 
T10053 	
	G13-0017

Procedure

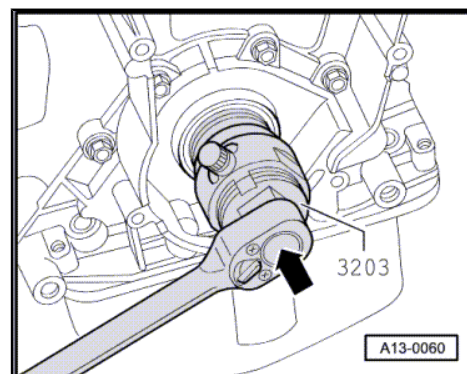
- Engine in vehicle.
- Remove toothed belt ⇒ [page 48](#) .
- Remove crankshaft sprocket; use counterhold tool -3415- to lock sprocket in place.



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



- Unscrew inner section of oil seal extractor -3203- one turn 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 section of oil seal extractor against crankshaft until oil seal is pulled out.
- Clamp flats of oil seal extractor in vice and use pliers to remove seal.
- Clean running surface and sealing surface.



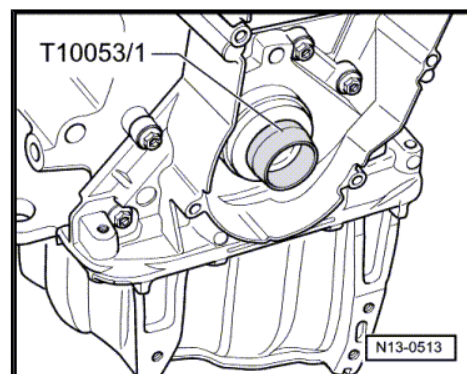
- Place guide sleeve -T10053/1- onto crankshaft journal.



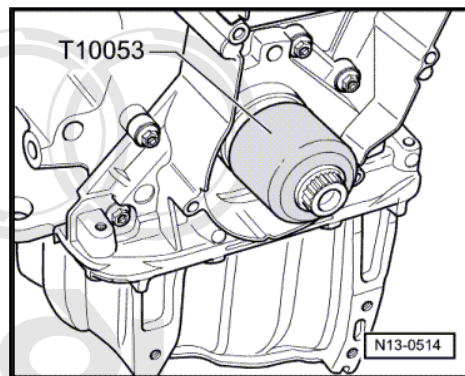
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Do not lubricate sealing lip and outer rim of oil seal before pressing in.

- Slide oil seal over guide sleeve.



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



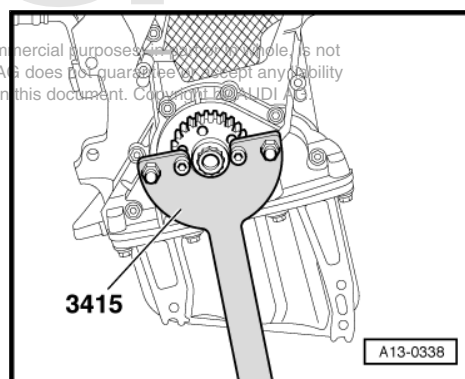
- Renew centre bolt for crankshaft sprocket.



Note

- ◆ *Contact surface between toothed belt sprocket and crankshaft must be free of oil.*
- ◆ *Do not lubricate bolt for crankshaft sprocket.*
- Install crankshaft sprocket; use counterhold tool -3415- to lock sprocket in place.
- Install toothed belt (adjust valve timing) ⇒ [page 52](#) .
- Install poly V-belt ⇒ [page 39](#) .

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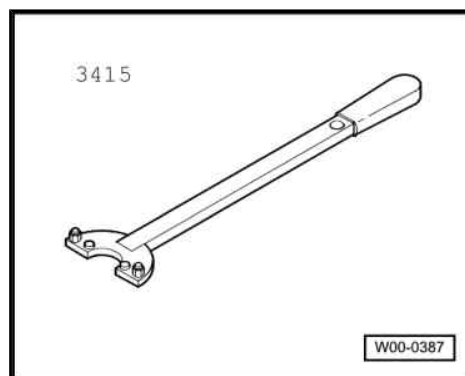
Tightening torque

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

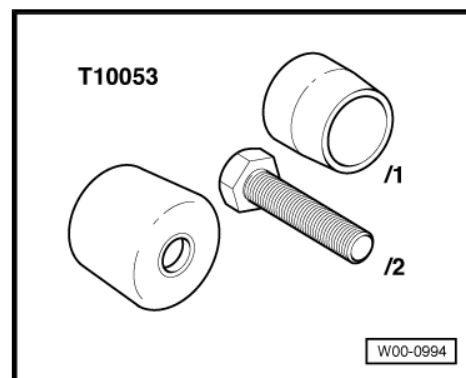
2.2 Removing and installing sealing flange (front)

Special tools and workshop equipment required

- ◆ Counterhold tool -3415-



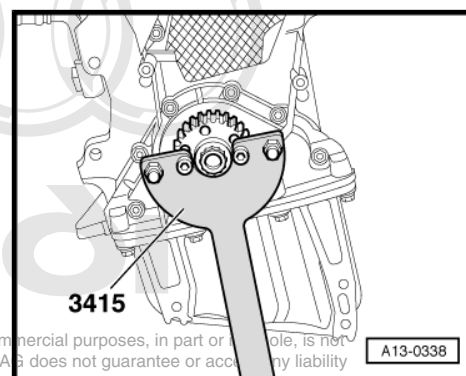
◆ Assembly tool -T10053-



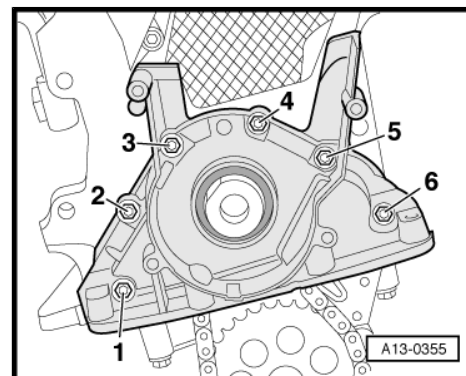
- ◆ Electric drill with plastic brush attachment
- ◆ Safety goggles
- ◆ Sealant ⇒ Parts catalogue

Removing

- Engine in vehicle.
- Remove toothed belt ⇒ [page 48](#) .
- Remove crankshaft sprocket; use counterhold tool -3415- to lock sprocket in place.
- Remove sump ⇒ [page 125](#) .



- Unscrew bolts -1 ... 6-.
- Lever off sealing flange and remove.

**Installing**

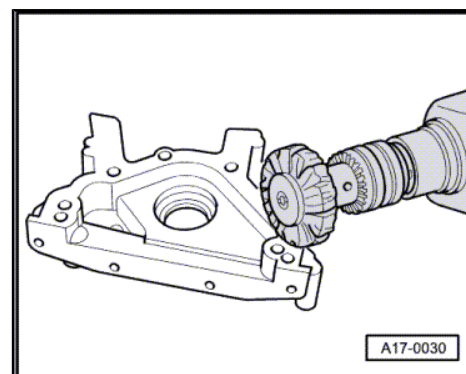
Installation is carried out in the reverse order; note the following:

- Carefully remove sealant residue from cylinder block.

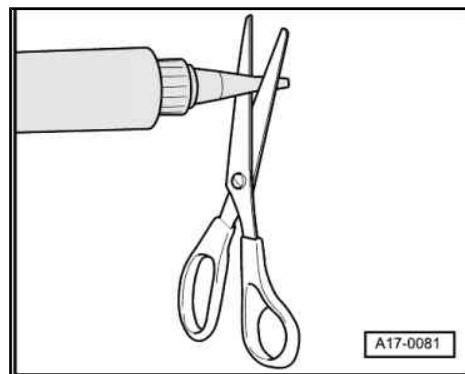
**WARNING**

Wear safety goggles.

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



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

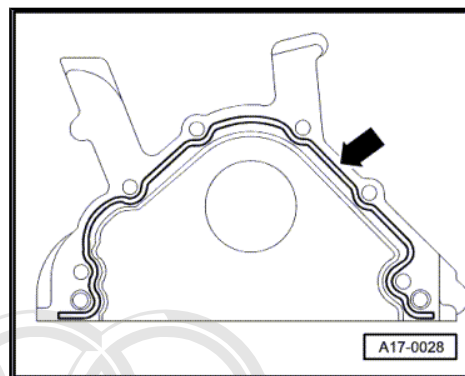


- Apply the bead of sealant onto the clean sealing surface of the sealing flange as illustrated -arrow-.
- Thickness of sealant bead: 2 ... 3 mm



Note

- ♦ *The bead of sealant must not be thicker than specified, otherwise excess sealant can enter the sump and obstruct the strainer in the oil intake pipe.*
- ♦ *The sealing flange must be installed within 5 minutes after applying sealant.*



- Fit sealing flange and tighten bolts hand-tight.



Note

Use guide sleeve -T10053/1- to attach sealing flange with oil seal fitted.

- Tighten bolts for sealing flange in diagonal sequence.
- Install sump ⇒ [page 127](#) .

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Note

After installing, allow sealant to dry for approx. 30 minutes Then (and only then) fill the engine with engine oil.

- Install crankshaft oil seal (pulley end) ⇒ [page 58](#) .
- Install toothed belt (adjust valve timing) ⇒ [page 52](#) .

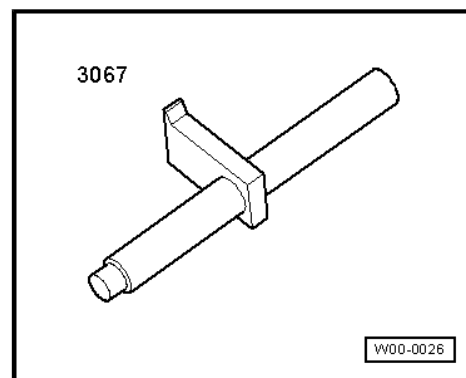
Tightening torque

Component	Nm
Sealing flange to cylinder block	15

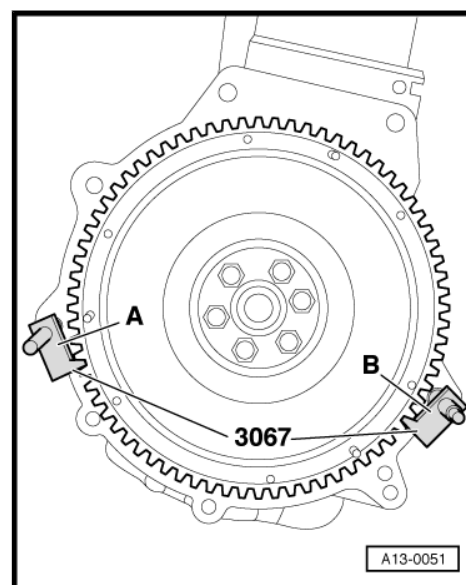
2.3 Removing and installing dual-mass fly-wheel

Special tools and workshop equipment required

◆ Counterhold tool -3067-

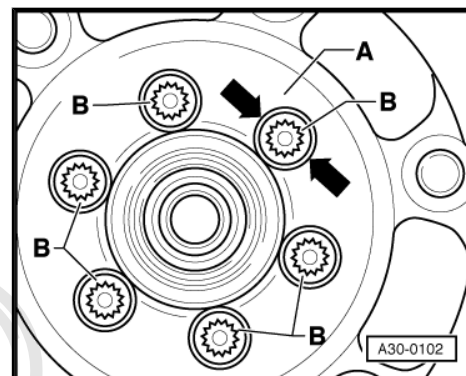
**Removing**

- Insert counterhold tool -3067- as illustrated to slacken bolts.
- A - Installation position for counterhold tool when tightening bolts
- B - Installation position for counterhold tool when loosening bolts
- Mark installation position of dual-mass flywheel on crankshaft.

**Note**

To prevent damage to the dual-mass flywheel when removing, the bolts -B- must not be removed with an impact wrench or similar. The bolts may only be removed by hand using conventional tools.

- Rotate the dual-mass flywheel -A- so that the bolts align with the holes -arrows-.
- When unscrewing the bolts, make sure that the bolt heads do not come into contact with the dual-mass flywheel; the flywheel will otherwise be damaged as the bolts are screwed out.

**Installing**

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

- Use new bolts for securing.

Tightening torque

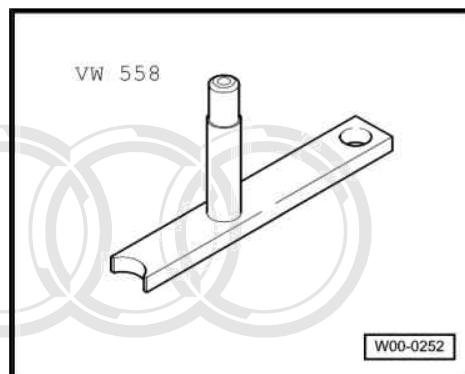
Component	Nm
Dual-mass flywheel to crankshaft	60 + 90° 1)2)
• 1) Renew bolt. • 2) 90° = one quarter turn.	

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2.4 Removing and installing drive plate

Special tools and workshop equipment required

- ◆ Counterhold tool -VW 558-



- ◆ Depth gauge
- ◆ Hexagon bolt M8x45 and hexagon nut M10 (2x)

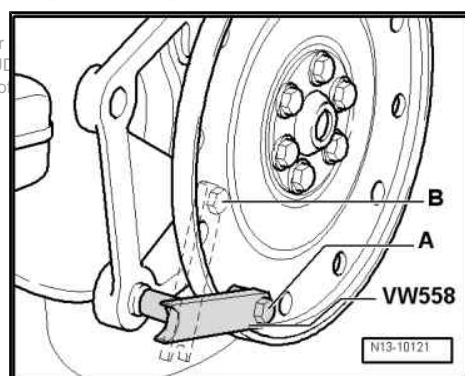
Removing

- Insert counterhold tool -VW 558- in hole on cylinder block and use hexagon bolt M8x45 to secure to drive plate (fit two M10 nuts between counterhold tool and drive plate).

A - Installation position for counterhold tool when loosening bolts

B - Installation position for counterhold tool when tightening bolts

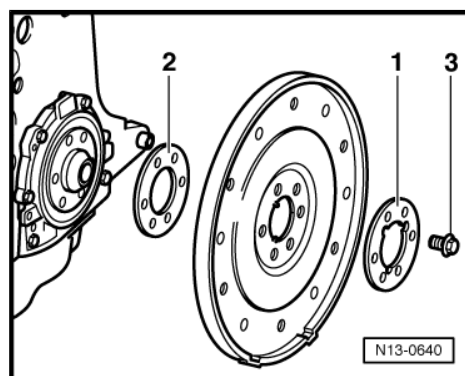
- Mark installation position of drive plate on crankshaft.
- Unbolt drive plate.



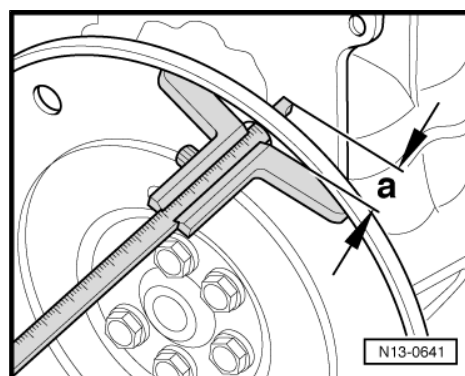
Installing

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

- Fit drive plate using washer with notches -1-.
- Use new bolts for securing.
- Tighten bolts to 30 Nm.



- Measure depth -a- at three points (measurement is taken through the hole in the drive plate to the machined surface of the cylinder block).
- Calculate average value.
- Specification: 19.5 ... 21.1 mm.



If the value is below specification:

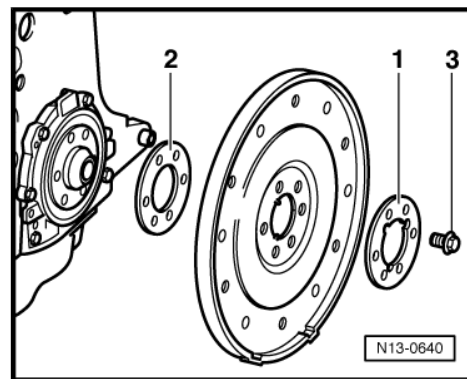
- Remove drive plate again and re-fit with shim -2-.
- Tighten bolts to 30 Nm.
- Repeat measurement.

If the specification is obtained:

- Tighten bolts for drive plate.

Tightening torque

Component	Nm
Drive plate to crankshaft	60 + 90° 1)2)
• 1) Renew bolt. • 2) 90° = one quarter turn.	



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3 Removing and installing crankshaft



Note

- ◆ When carrying out repairs, secure engine to assembly stand with engine and gearbox support -VW 540- ➔ [page 25](#) .
- ◆ From approx. 05.2000 onwards, bearing shells of the correct thickness are matched to the bearings in the cylinder block at the factory. Coloured dots are used to identify the thickness of the bearing shells ➔ [page 68](#) .

3.1 Crankshaft - exploded view of components

1 - Bearing shell

- ☐ For cylinder block (with oil groove)
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ From approx. 05.2000 onwards: install new bearing shells for the cylinder block with the correct coloured markings ➔ [page 68](#)

2 - Drive chain sprocket

- ☐ For oil pump chain
- ☐ Renewing ➔ [page 68](#)

3 - Bearing shell

- ☐ For bearing cap (without oil groove)
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ From approx. 05.2000 onwards: the crankshaft bearing shells in the bearing caps are only supplied as spare parts with "yellow" colour-coding.

4 - Thrust washers

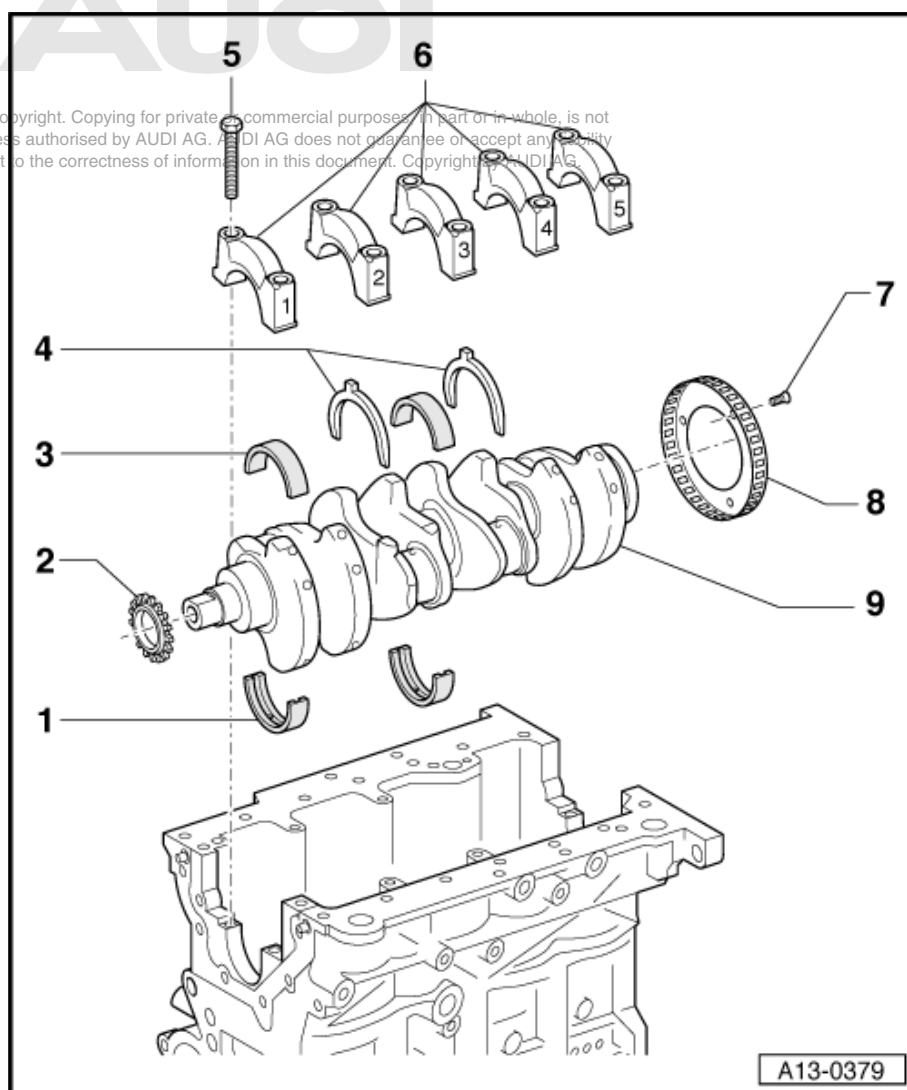
- ☐ For bearing No. 3
- ☐ Note location

5 - 65 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ For measuring radial clearance of crankshaft tighten to 65 Nm, but not further

6 - Bearing cap

- ☐ Bearing cap 1: Pulley end
- ☐ Bearing cap 3 with recesses for thrust washers
- ☐ Bearing shell retaining lugs (cylinder block/bearing cap) must be on the same side



7 - 10 Nm + 90° (1/4 turn) further

- ☐ Renew
- ☐ Sender wheel must be renewed if bolts are loosened ⇒ [page 67](#)

8 - Sender wheel

- ☐ For engine speed sender -G28-
- ☐ Can only be installed in one position (holes are off-set)
- ☐ Sender wheel must be renewed if bolts are loosened
- ☐ Removing and installing ⇒ [page 67](#)

9 - Crankshaft

- ☐ Axial clearance (new): 0.07 ... 0.23 mm
- ☐ Axial clearance: wear limit: 0.30 mm
- ☐ Check radial clearance with Plastigage
- ☐ Radial clearance (new): 0.02 ... 0.04 mm
- ☐ Radial clearance: wear limit: 0.15 mm
- ☐ Do not rotate the crankshaft when checking the radial clearance
- ☐ Crankshaft dimensions ⇒ [page 68](#)

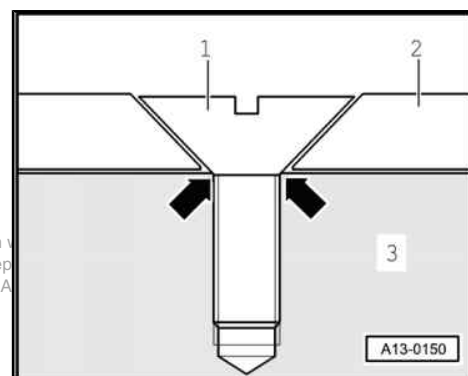
Removing and installing sender wheel

- Sender wheel -2- must always be renewed after slackening off bolts -1-.



Note

- ◆ *If the countersunk bolts are tightened a second time, the seats for the bolt heads in the sender wheel will be deformed to such an extent that the bolt heads make contact with the crankshaft -3- -arrows- and the sender wheel beneath the bolts will be loose.*
- ◆ *Sender wheel can only be fitted in one position (holes are off-set).*



Tightening torque

Component	Nm
Sender wheel to crankshaft	10 + 90° 1)2)
• 1) Renew bolts. • 2) 90° = one quarter turn.	

From approx. 05.2000 onwards: allocation of crankshaft bearing shells for cylinder block

From approx. 05.2000 onwards, bearing shells of the correct thickness are matched to the bearings in the cylinder block at the factory. Coloured dots are used to identify the thickness of the bearing shells.

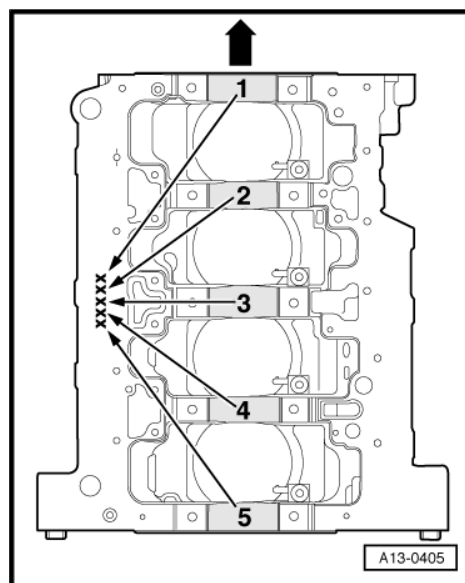


Note

The -arrow- points to pulley end.

Letter codes on lower sealing surface of cylinder block indicate which bearing shell is to be fitted at each location.

Letter on cylinder block	Colour coding of bearing
S =	Black
R =	Red
G =	Yellow



Note

The crankshaft bearing shells in the bearing caps are only supplied as spare parts with "yellow" coloured markings.

3.2 Crankshaft dimensions

To approx. 05.2000

Honing dimension (in mm)	Crankshaft main bearing journal Ø	Conrod bearing journal Ø
Basic dimension	54.00 -0.022 -0.042	50.90 -0.022 -0.042
1st undersize	53.75 -0.022 -0.042	50.65 -0.022 -0.042
2nd undersize	53.50 -0.022 -0.042	50.40 -0.022 -0.042
3rd undersize	53.25 -0.022 -0.042	50.15 -0.022 -0.042

From approx. 05.2000

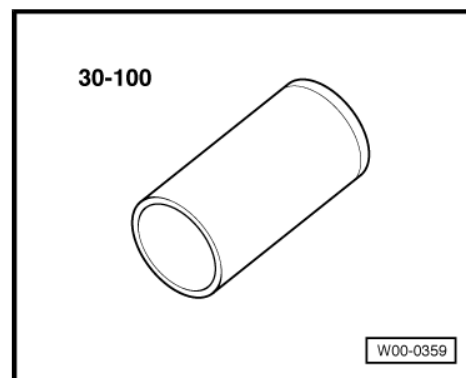
Honing dimension (in mm)	Crankshaft main bearing journal Ø	Conrod bearing journal Ø
Basic dimension	54.00 -0.017 -0.037	50.90 -0.022 -0.042
1st undersize	53.75 -0.017 -0.037	50.65 -0.022 -0.042
2nd undersize	53.50 -0.017 -0.037	50.40 -0.022 -0.042
3rd undersize	53.25 -0.017 -0.037	50.15 -0.022 -0.042

3.3 Removing and installing drive chain sprocket

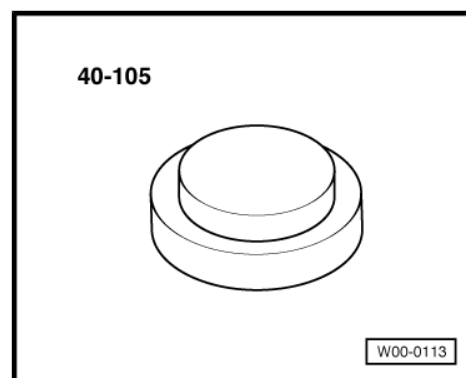
Special tools and workshop equipment required

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◆ Drift sleeve -30-100-



◆ Thrust plate -40-105-



◆ Claw-type puller -Kukko 44-1-

◆ Protective gloves

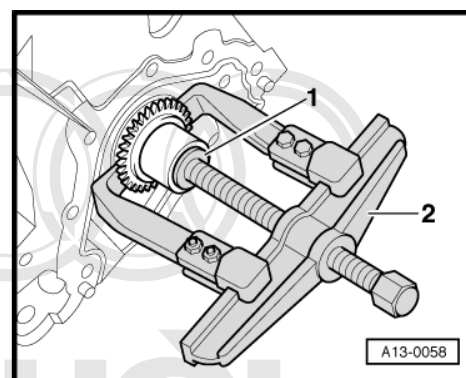
Removing

- Remove sump ⇒ [page 125](#) .
- Remove sealing flange (front) ⇒ [page 60](#) .
- Remove oil pump chain sprocket, chain tensioner and chain ⇒ [Item 2 \(page 124\)](#) .
- Pull off crankshaft drive chain sprocket using e.g. claw-type puller -Kukko 44-1- -item 2- (protect end of crankshaft with thrust plate -40-105- -item 1-).

Installing**WARNING**

Wear protective gloves.

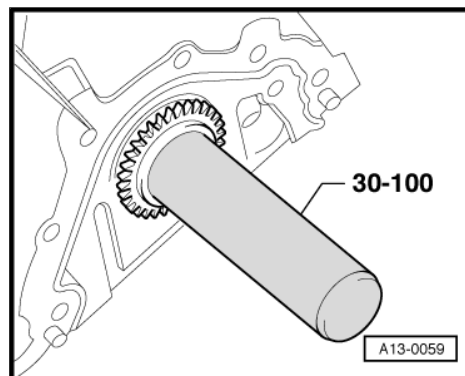
- Heat drive chain sprocket in an oven for approx. 15 minutes to 220 °C.



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- Using pliers, locate drive chain sprocket on end of crankshaft.
- Wider collar on drive chain sprocket faces engine.
- Push drive chain sprocket onto crankshaft as far as the stop using drift sleeve -30-100- .
- Install oil pump chain sprocket, chain tensioner and chain
⇒ [Item 2 \(page 124\)](#) .
- Install sealing flange (front) ⇒ [page 60](#) .
- Install sump ⇒ [page 127](#) .



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4 Dismantling and assembling pistons and conrods

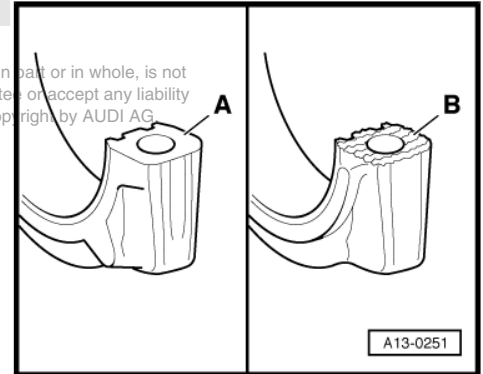
4.1 Different versions of conrods

- ◆ Gradual introduction of cracked instead of sawn conrods (from approx. 05.2000 onwards)

- ◆ Distinguishing feature

A - Sawn conrods = smooth mating surface

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



4.2 Pistons and conrods - exploded view of components



Note

Oil spray jet and pressure relief valve ⇒ [page 75](#)

Pistons and sawn conrods

1 - Piston rings

- ☐ Offset gaps by 120°
- ☐ Remove and install using piston ring clamp
- ☐ "TOP" must face towards piston crown
- ☐ Checking ring gap ⇒ [page 74](#)
- ☐ Checking ring-to-groove clearance ⇒ [page 74](#)

2 - Piston

- ☐ Checking ⇒ [page 74](#)
- ☐ Mark installation position and cylinder allocation
- ☐ Arrow on piston crown points to pulley end
- ☐ Install using piston ring clamp
- ☐ Piston and cylinder dimensions ⇒ [page 75](#)

3 - Conrod

- ☐ Only renew as a complete set
- ☐ Mark cylinder allocation -B-
- ☐ Installation position: Markings -A- face towards pulley side
- ☐ With oil passage for piston pin lubrication

4 - Conrod bearing cap

- ☐ Mark cylinder allocation -B-
- ☐ Installation position: Markings -A- face towards pulley side

5 - 30 Nm + 90° (1/4 turn) further

- ☐ Renew conrod bolt ⇒ [Item 8 \(page 72\)](#)
- ☐ Lubricate threads and contact surface
- ☐ To measure radial clearance, tighten to 30 Nm but do not turn further

6 - Bearing shell

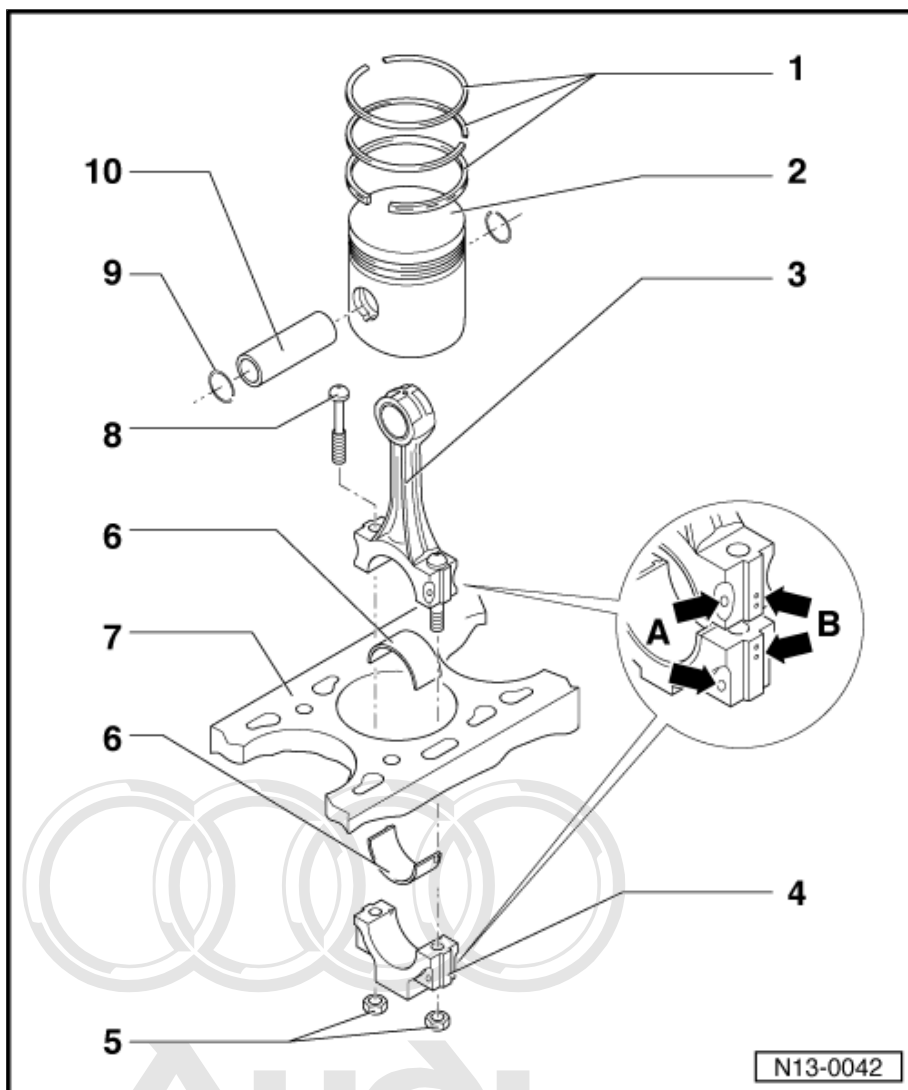
- ☐ Upper bearing shell with oil hole for piston pin lubrication
- ☐ Note installation position
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Ensure tight fit in retaining lugs
- ☐ Axial clearance (new): 0.10 ... 0.35 mm
- ☐ Axial clearance: wear limit: 0.40 mm
- ☐ Measuring radial clearance ⇒ [page 75](#)

7 - Cylinder block

- ☐ Checking cylinder bore ⇒ [page 75](#)
- ☐ Piston and cylinder dimensions ⇒ [page 75](#)

8 - Conrod bolt

- ☐ Renew



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9 - Circlip**10 - Piston pin**

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

Pistons and cracked conrods**1 - Conrod bolt, 30 Nm + 90° (1/4 turn) further**

- ☐ Renew
- ☐ Lubricate threads and contact surface
- ☐ Use old bolt for measuring radial clearance
- ☐ To measure radial clearance, tighten to 30 Nm but not further

2 - Conrod bearing cap

- ☐ Mark cylinder allocation -B-
- ☐ Installation position: Markings -A- face towards pulley side

3 - Bearing shells

- ☐ Upper bearing shell with oil hole for piston pin lubrication
- ☐ Installation position [⇒ page 75](#)
- ☐ Do not interchange used bearing shells (mark positions)
- ☐ Axial clearance (new): 0.10 ... 0.35 mm
- ☐ Axial clearance: wear limit: 0.40 mm
- ☐ Measuring radial clearance [⇒ page 75](#)

4 - Conrod

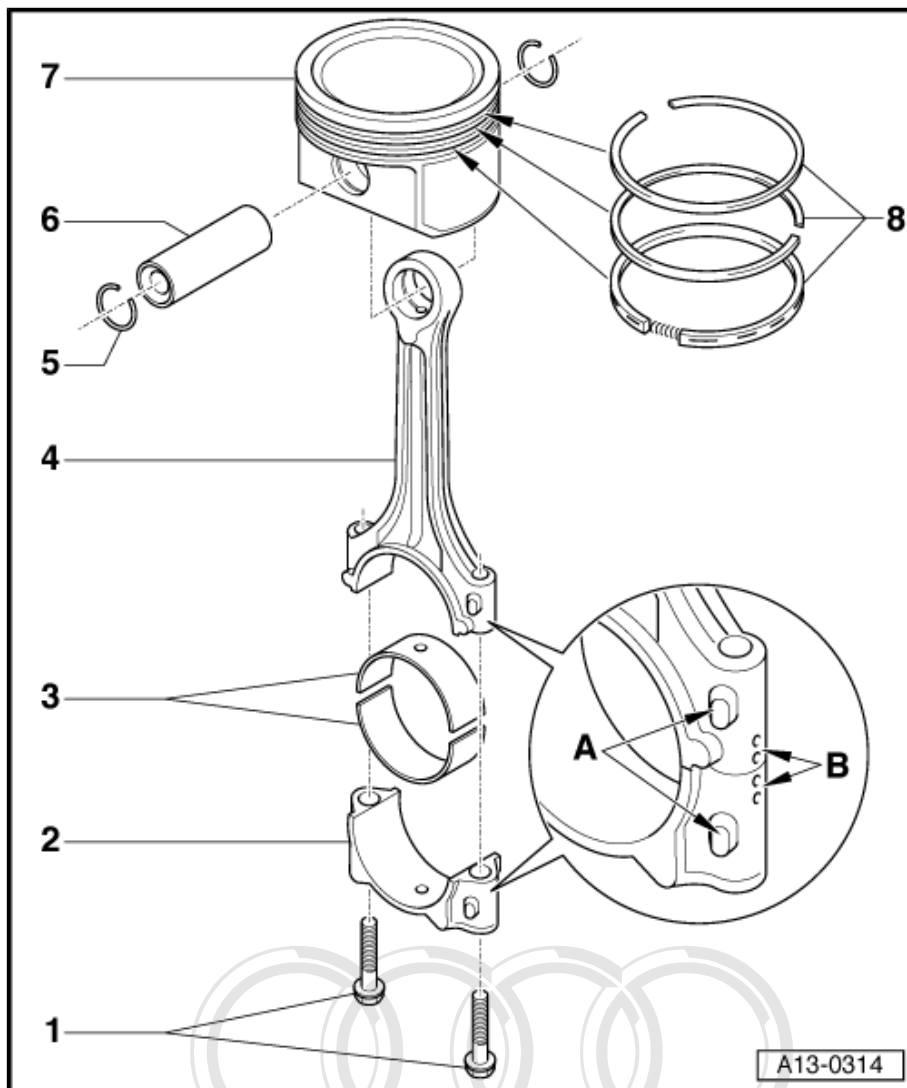
- ☐ Only renew as a complete set
- ☐ Mark cylinder allocation -B-
- ☐ Installation position: Markings -A- face towards pulley side
- ☐ With oil passage for piston pin lubrication

5 - Circlip**6 - Piston pin**

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

7 - Piston

- ☐ Checking [⇒ page 74](#)
- ☐ Mark installation position and cylinder allocation
- ☐ Arrow on piston crown points to pulley end



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- ☐ Install using piston ring clamp
- ☐ Piston and cylinder dimensions ➔ [page 75](#)

8 - Piston rings

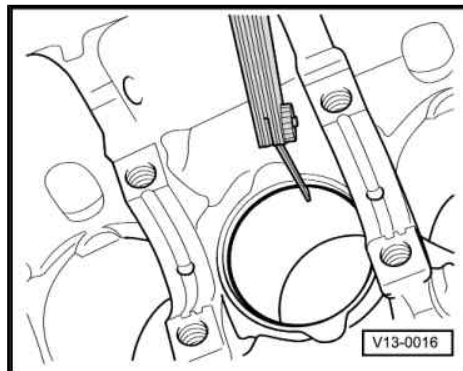
- ☐ Offset gaps by 120°
- ☐ Remove and install using piston ring clamp
- ☐ "TOP" must face towards piston crown
- ☐ Checking ring gap ➔ [page 74](#)
- ☐ Checking ring-to-groove clearance ➔ [page 74](#)

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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. To do so, use a piston without rings.

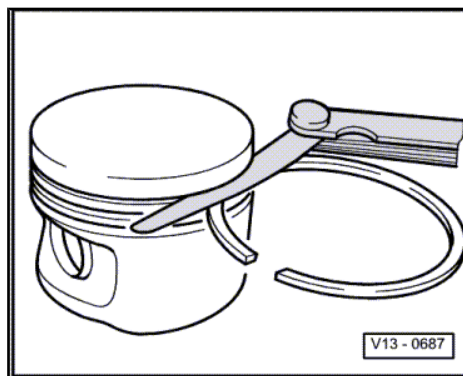
Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.20 ... 0.40	0.80
2nd compression ring	0.20 ... 0.40	0.80
Oil scraper ring	0.25 ... 0.50	0.80



Checking ring-to-groove clearance

- Clean groove in piston before checking clearance.

Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.06 ... 0.09	0.20
2nd compression ring	0.05 ... 0.08	0.20
Oil scraper ring	0.03 ... 0.06	0.15

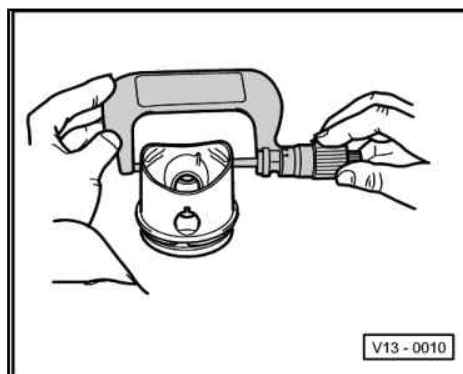


Checking piston

- Measure approx. 10 mm from the bottom edge, perpendicular to the piston pin axis.
- Maximum deviation from nominal dimension: 0.04 mm.

Nominal dimension

➔ ["4.3 Piston and cylinder dimensions", page 75](#).

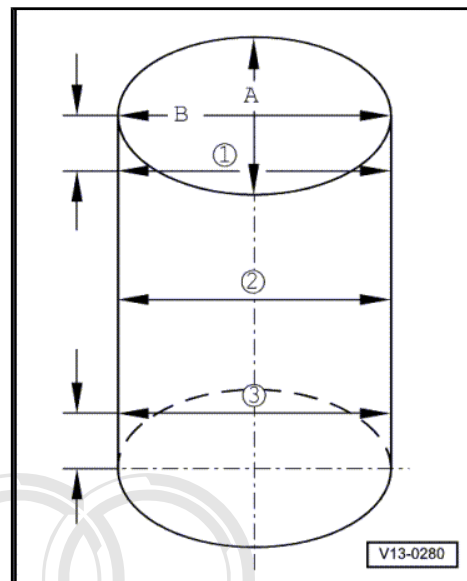


Checking cylinder bore

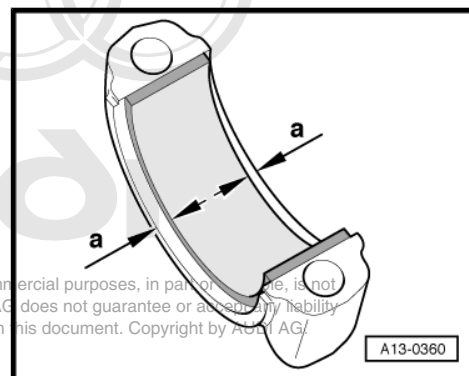
- Use 50 ... 100 mm internal dial gauge to take measurements at 3 points in transverse direction -A- and longitudinal direction -B-.
- Maximum deviation from nominal dimension: 0.08 mm.

Nominal dimension

⇒ [“4.3 Piston and cylinder dimensions”, page 75](#).

**Installation position of bearing shell with cracked conrods**

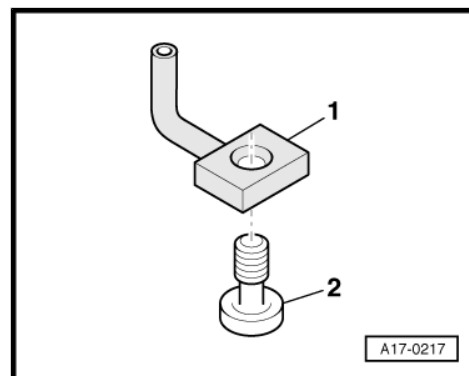
- Insert bearing shells in centre of conrod/conrod bearing cap.
- Dimension -a- = 3.0 mm.



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Oil spray jet and pressure relief valve

- 1 - Oil spray jet (for cooling of pistons)
 - 2 - Bolt with pressure relief valve, 27 Nm
- Engines with sawn conrods: opening pressure 2.5 ... 3.2 bar.
 - Engines with cracked conrods: opening pressure 1.3 ... 1.6 bar.

**4.3 Piston and cylinder dimensions**

Honing dimension (in mm)	Piston Ø	Cylinder bore Ø
Basic dimension	80.95 ¹⁾	81.01
Repair oversize	81.45 ¹⁾	81.51
¹⁾ Dimension not including graphite coating (thickness 0.02 mm). The graphite coating wears down in service.		

4.4 Measuring radial clearance of conrods**Special tools and workshop equipment required**

- ◆ Plastigage



Procedure

- Remove conrod bearing caps.
- Clean bearing caps and bearing journals.
- Place Plastigage onto bearing journal or into bearing shells corresponding to width of bearing.
- Fit conrod bearing cap and tighten to 30 Nm. Do not rotate crankshaft.
- Remove conrod bearing caps once more.
- Compare width of Plastigage with measurement scale:

Radial clearance:

- New: 0.01 ... 0.05 mm.
- Wear limit: 0.12 mm.
- Renew bolts for conrod bearings.



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15 – Cylinder head, valve gear

1 Removing and installing cylinder head

1.1 Cylinder head - exploded view of components

1 - Cylinder head

- ☐ Removing and installing
⇒ [page 82](#)
- ☐ Checking for distortion
⇒ [page 78](#),
⇒ [page 78](#)
- ☐ Machining limit
⇒ [page 78](#),
⇒ [page 78](#)
- ☐ If renewed, refill system
with fresh coolant

2 - Oil deflector

- ☐ Note installation position

3 - Cylinder head bolt

- ☐ Renew

- ☐ Note correct sequence
when loosening
⇒ [page 84](#)
- ☐ Note correct sequence
when tightening
⇒ [page 86](#)

4 - Gaskets for cylinder head cover

- ☐ Renew if damaged or
leaking
- ☐ Before fitting, apply
sealant at sealing points
⇒ [page 79](#) and
⇒ [page 79](#)

5 - Cylinder head cover

- ☐ Removing and installing
⇒ [page 79](#)

6 - Gasket

- ☐ For ignition coil bolted onto cylinder head cover
- ☐ Renew if damaged

7 - Ignition coil

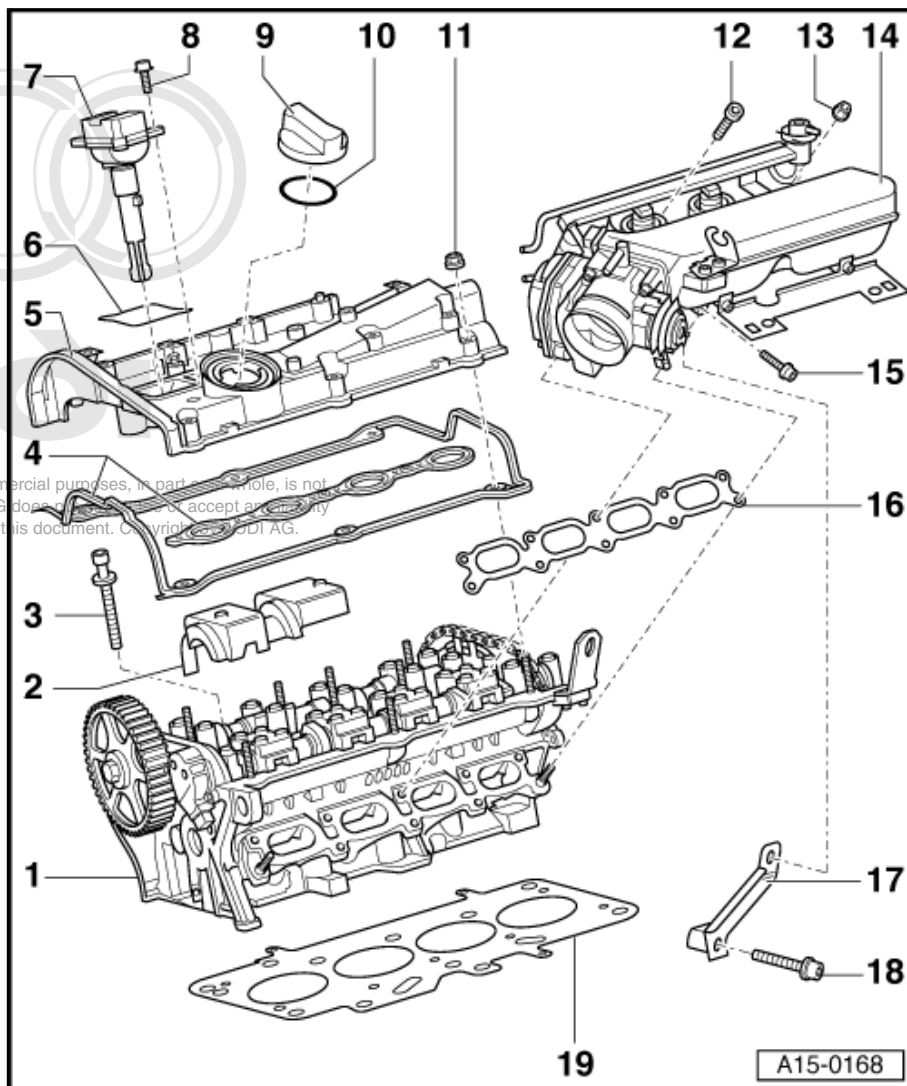
8 - 10 Nm

- ☐ For ignition coil bolted onto cylinder head cover

9 - Filler cap

10 - Seal

- ☐ Renew if damaged or leaking



11 - 10 Nm

- ☐ First tighten inner nuts
- ☐ Tighten outer nuts in diagonal sequence

12 - 10 Nm

13 - 10 Nm

14 - Intake manifold

- ☐ Removing and installing ⇒ [page 87](#)

15 - 20 Nm

16 - Gasket

- ☐ Renew

17 - Support for intake manifold

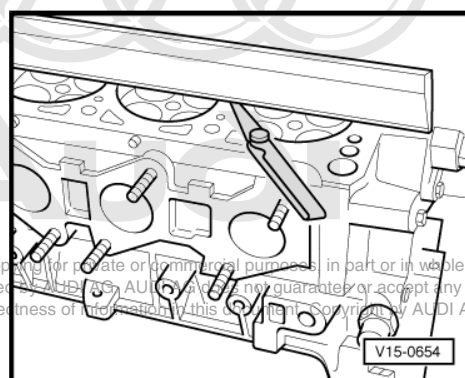
18 - 45 Nm

19 - Cylinder head gasket

- ☐ Renewing ⇒ [“1.3 Removing and installing cylinder head”, page 82](#)
- ☐ Installation position: Part No. towards cylinder head
- ☐ If renewed, change coolant in entire system

Checking cylinder head for distortion

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

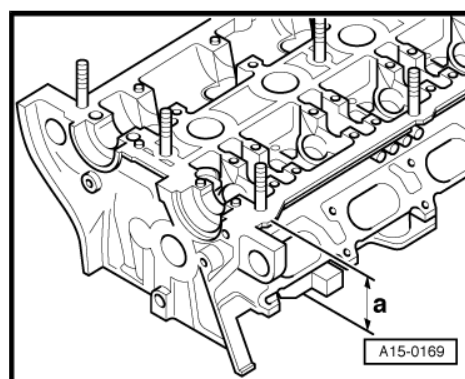


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Cylinder head machining limit

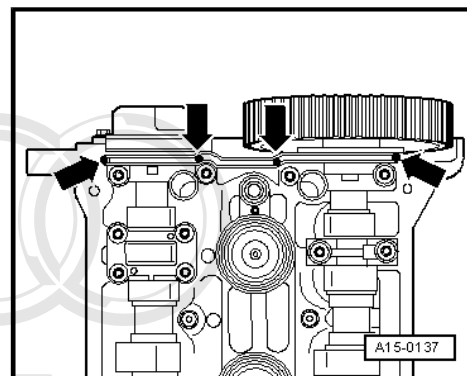
Machining of the cylinder head (surface grinding) is only permissible down to the minimum dimension -a-.

- Minimum dimension: -a- = 139.20 mm



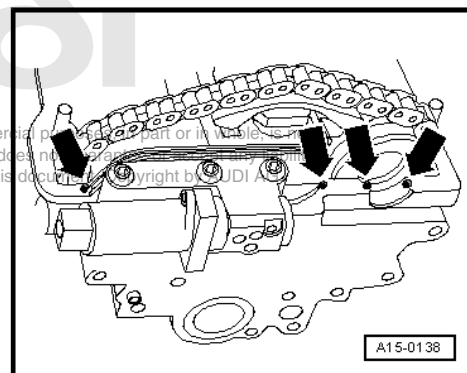
Sealing points on double bearing cap/cylinder head

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



Sealing points: hydraulic chain tensioner/cylinder head and camshaft adjuster/cylinder head

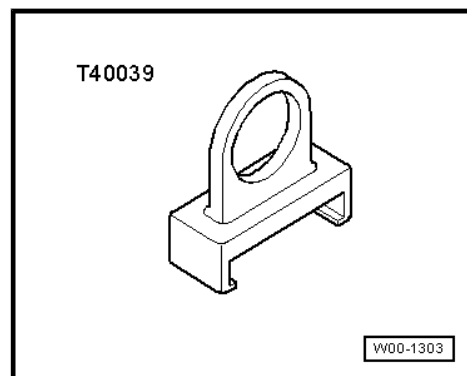
- Apply small quantity of sealant to transitions -arrows- at top sealing surface on cylinder head; sealant ⇒ Parts catalogue .



1.2 Removing and installing cylinder head cover

Special tools and workshop equipment required

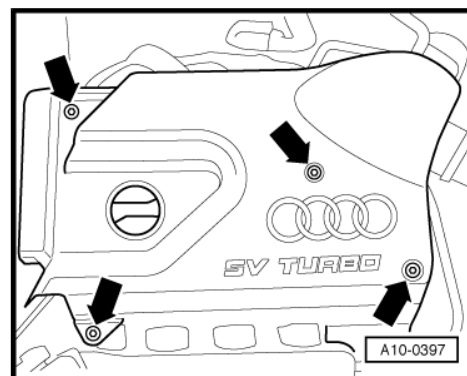
- ◆ Puller -T40039- for vehicles with push-fitted ignition coils



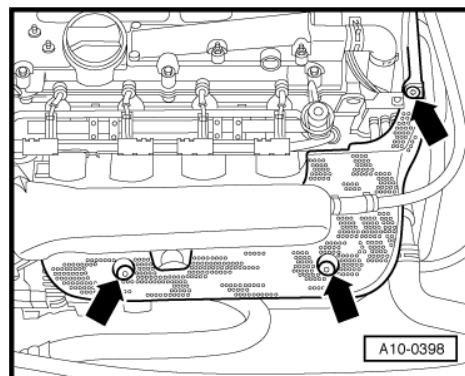
- ◆ Sealant ⇒ Parts catalogue

Removing

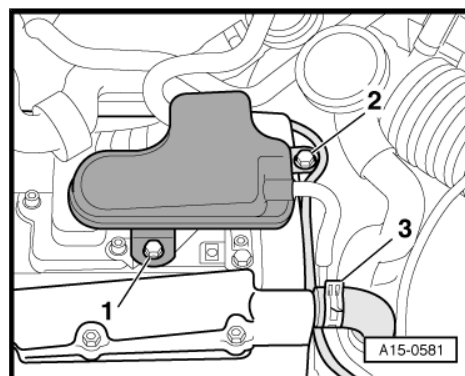
- Take off engine cover panel -arrows-.



- Remove cover in front of intake manifold -arrows-.



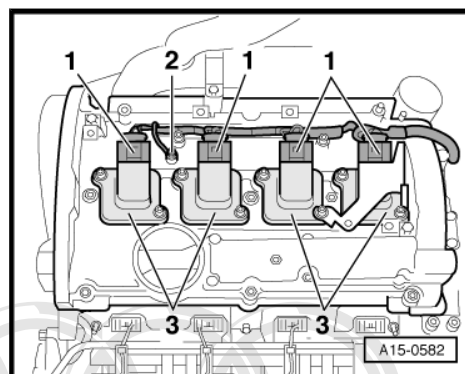
- Disconnect crankcase breather hose -3- at cylinder head cover.
- Unscrew vacuum reservoir -1-, disengage and move clear to one side.
- Unbolt wiring bracket -2- from cylinder head cover.



- Disconnect earth cable -2-.
- Detach electrical connectors -1-.
- Move wiring clear.

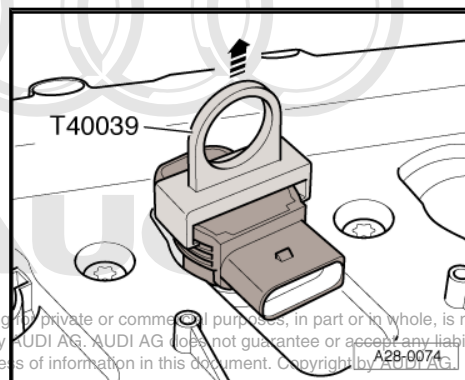
Vehicles with bolted on ignition coils:

- Unbolt ignition coils -3-.



Vehicles with push-fitted ignition coils:

- Pull ignition coils out with puller -T40039-.



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All models:

- Remove toothed belt cover (top).
- Unscrew nuts -arrows- 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.*
- ◆ *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 on cylinder head; sealant ⇒ Parts catalogue .

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

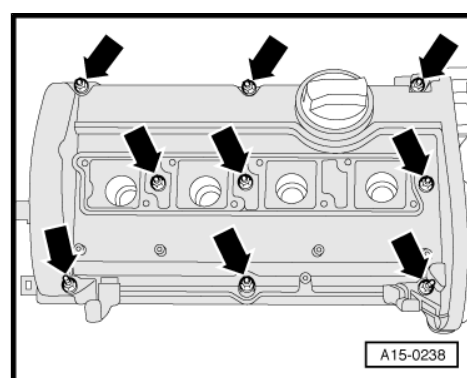
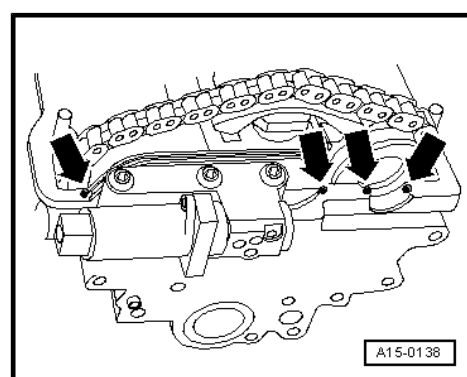
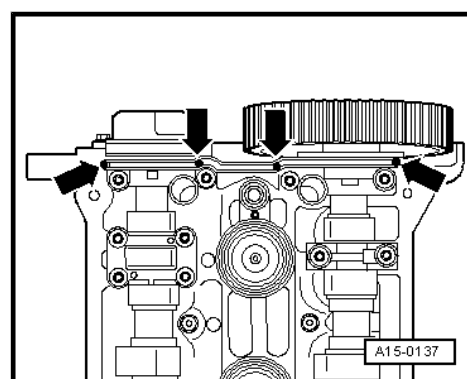
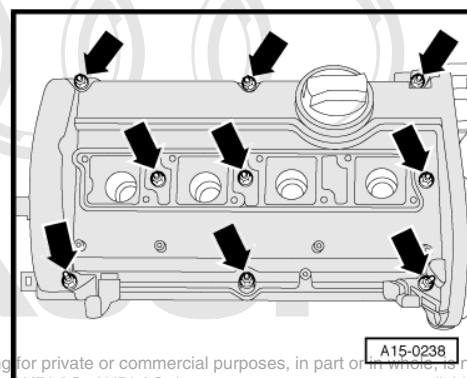
- First tighten inner cylinder head cover nuts, then tighten outer nuts in diagonal sequence.
- Make sure toothed belt cover (top) is correctly fitted.
- Install ignition coils ⇒ Rep. Gr. 28 .

**Note**

Renew gaskets for bolted on ignition coils if damaged.

Tightening torques

Component	Nm
Cylinder head cover to cylinder head	10
Vacuum reservoir to cylinder head	10



1.3 Removing and installing cylinder head

Removing

- Engine in vehicle.



Note

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

- Drain off coolant ⇒ [page 136](#) .
- Remove air intake hose -1- between top air pipe and bottom air pipe.
- Unbolt bracket -2- or retaining clip (depending on version) for top air pipe.

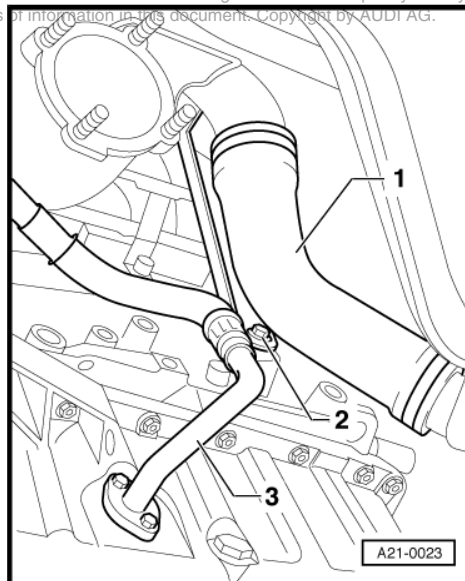


Note

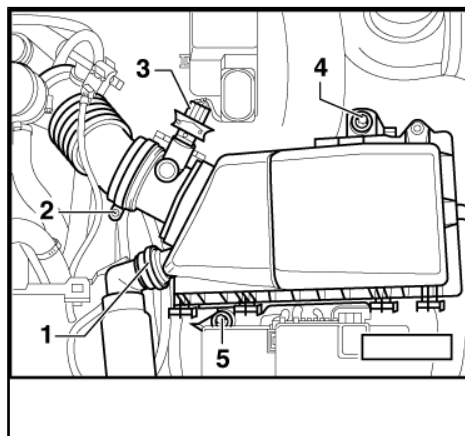
Disregard -item 3-.

- Remove intake manifold ⇒ [page 87](#) .

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- Detach air intake hose -1- leading to secondary air pump at air cleaner housing.
- Release hose clip -2- and detach air duct from air mass meter -G70- .
- Unplug electrical connector at air mass meter -G70- -item 3-.
- Unscrew bolts -4- and -5- and remove air cleaner housing.



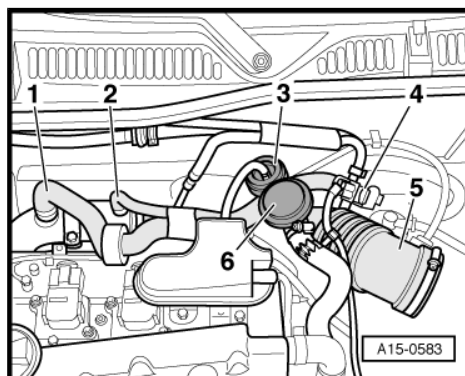
- Detach mechanical air recirculation valve -3-, pressure control valve for crankcase breather -6- and charge pressure control solenoid valve -N75- -item 4- from air duct.
- Pull locking clip out at turbocharger connection and detach air duct -5-.



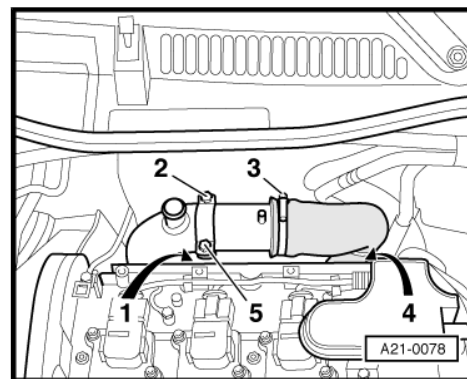
Note

Seal off opening in turbocharger intake system with a clean cloth.

- Detach hoses -1- and -2- from top air pipe.



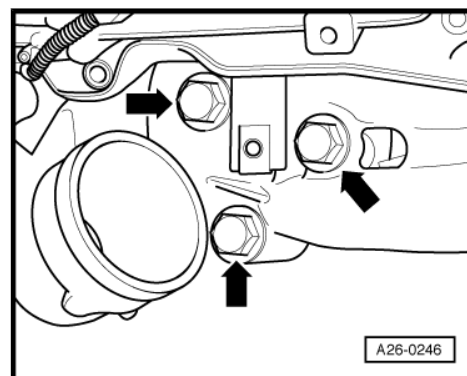
- Disconnect air intake hose -3- leading to turbocharger from top air pipe.
- Unscrew bolts -2- and -5- on retaining clip for top air pipe.
- Unscrew bolts -1- and -4- for heat shield at back of cylinder head.
- Remove top air pipe and heat shield.



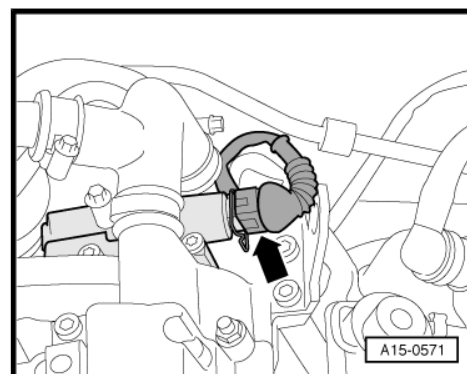
- Unbolt turbocharger from exhaust manifold -arrows-.

**Note**

Seal off opening in turbocharger intake system with a clean cloth.

**Vehicles with variable valve timing:**

- Unplug electrical connector -arrow- at inlet camshaft control valve 1 -N205-.

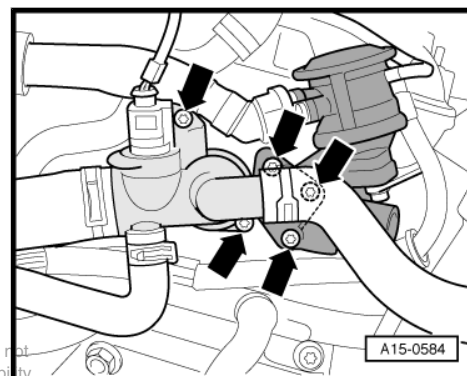
**All models:**

- First unscrew coolant flange and then flange for combination valve for secondary air system at cylinder head -arrows-.

**Note**

The electrical connectors and hoses remain attached.

- Remove toothed belt from camshaft sprocket ⇒ [page 53](#).
- Remove cylinder head cover ⇒ [page 79](#).



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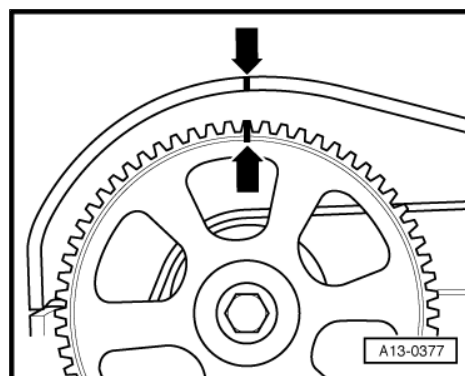
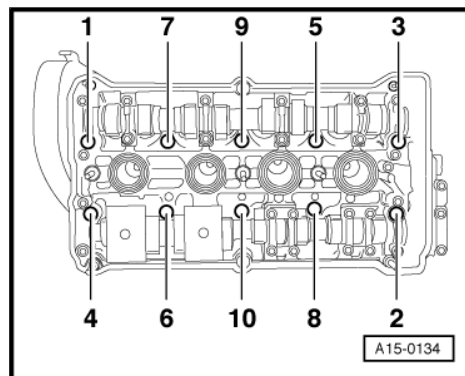
- Slacken cylinder head bolts in the sequence: -1 ... 10-.
- Remove cylinder head bolts and detach cylinder head.

Installing

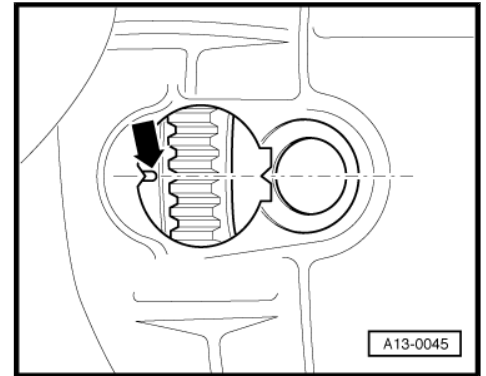


Note

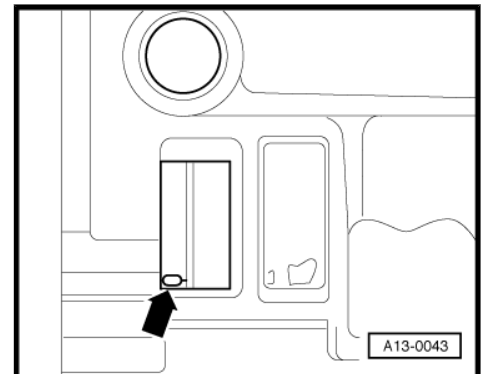
- ◆ *Renew the cylinder head bolts.*
 - ◆ *Renew self-locking nuts and bolts when performing assembly work.*
 - ◆ *Renew bolts which are tightened to a specified angle as well as oil seals and gaskets.*
 - ◆ *Carefully remove any sealant residue from the cylinder head and cylinder block. Ensure that 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.*
 - ◆ *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 fitted camshafts, the contact surfaces between the bucket tappets and cams must be oiled after installing the cylinder head.*
 - ◆ *The plastic protectors fitted to protect the open valves must only be removed immediately before fitting the cylinder head.*
 - ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
 - ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
 - ◆ *Fit all cable ties in the original positions when installing.*
 - ◆ *When fitting a new cylinder head or cylinder head gasket, drain off all the old coolant and refill with new coolant.*
- Set camshaft to “TDC for No. 1 cylinder” before fitting cylinder head -arrows-.



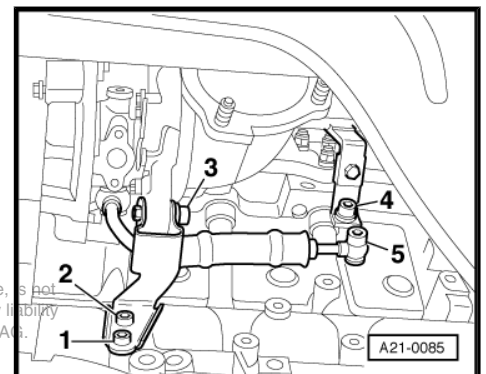
- Check again whether the crankshaft is positioned at TDC -arrow-.
- Vehicles with manual gearbox



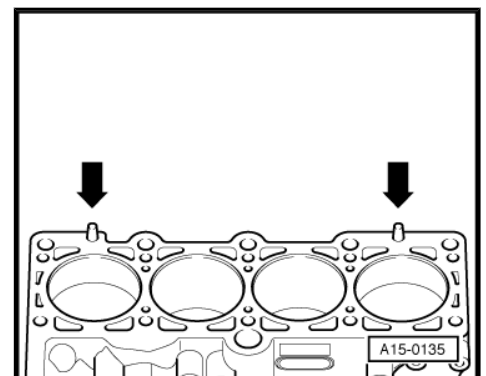
- Vehicles with automatic gearbox



- Unscrew bolts -1 ... 3- on turbocharger bracket (about 2 full turns each) to avoid stressing when installing the cylinder head.



- Fit cylinder head gasket.
- Note position of centering pins -arrows- in cylinder block.
- The Part No. should be legible from inlet side.
- Fit the cylinder head.
- Fit cylinder head bolts and tighten hand-tight.



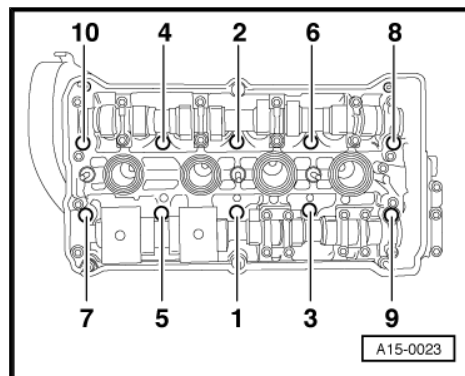
– Tighten cylinder head bolts as follows in the sequence shown:

1. Tighten with torque wrench to 40 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.



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

- Secure turbocharger with new gasket to exhaust manifold and secure bracket to cylinder block.
- Install cylinder head cover ⇒ [page 79](#) .
- Install toothed belt (adjust valve timing) ⇒ [page 52](#) .
- Install intake manifold ⇒ [page 87](#) .
- Check oil level ⇒ [page 133](#) .



Note

If engine oil is contaminated, perform oil change ⇒ Maintenance ; Booklet 806 .

- Fill cooling system with fresh coolant ⇒ [page 138](#) .



Note

- ◆ *When the battery is reconnected, please ensure that the vehicle equipment (e.g. radio, radio/navigation system, clock, electric window lifters) is activated as described in the operating instructions.*
- ◆ *For further operations after reconnecting power supply, refer to ⇒ Rep. Gr. 24 .*

Tightening torques

Component	Nm
Turbocharger to exhaust manifold	35 ¹⁾²⁾
Bracket for turbocharger to	45
Cylinder block	25
Bracket for air pipe to cylinder block	25
Flange for coolant to cylinder head	10
Flange for combination valve for secondary air system to cylinder head	10
Hose clips for air hoses	3.5
• ¹⁾ Renew bolts. • ²⁾ Coat threads and contact surface of bolt heads with high-temperature paste; for high-temperature paste refer to ⇒ Parts catalogue .	

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1.4 Removing and installing intake manifold

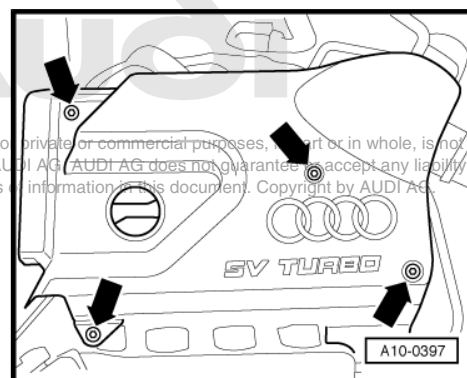
Removing



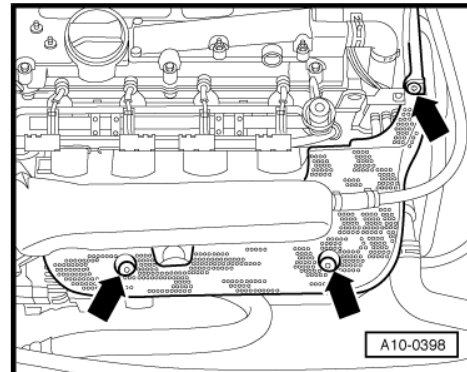
Note

- ◆ *The following description is for removal and installation on vehicles with secondary air system. Some operations may not be required for earlier vehicles.*
- ◆ *All cable ties which are released or cut open when removing must be fitted in the same position when installing.*
- Note (if necessary obtain) code on vehicles with coded radio / radio and navigation system (RNS).
- Disconnect earth wire at battery with ignition switched off.
- Take off engine cover panel -arrows-.

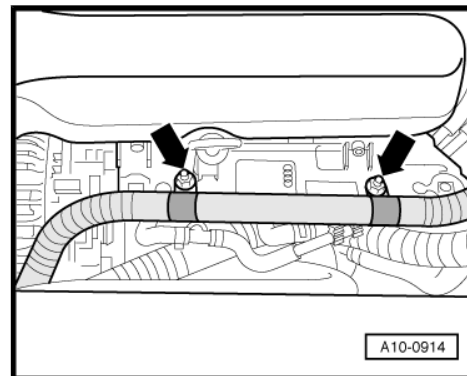
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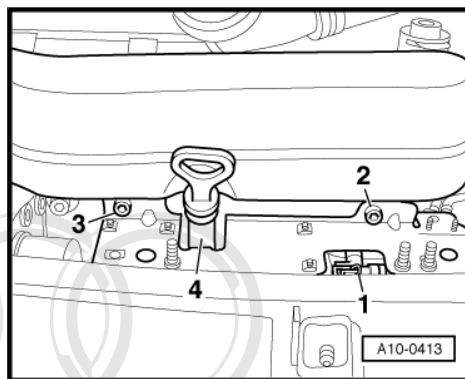
- Remove cover in front of intake manifold -arrows-.



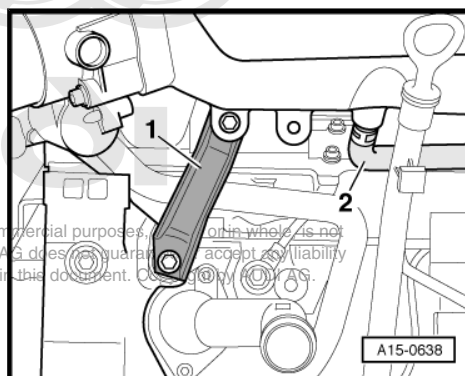
- Detach pipe for secondary air system from brackets on engine -arrows-.



- Remove bolts -2- and -3- and detach bracket for dipstick guide tube -4-.
- Unplug connectors -1- for turbocharger air recirculation valve -N249- and secondary air inlet valve -N112- on underside of retainer for electrical change-over valves.
- Detach vacuum hose going to electrical change-over valves from intake manifold.



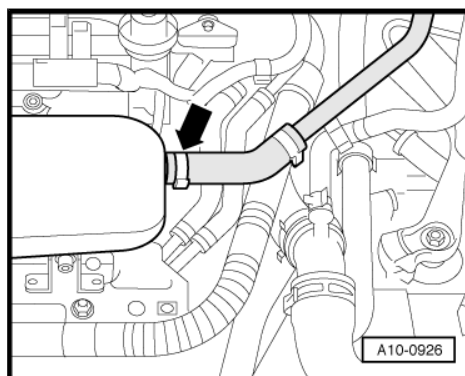
- Unbolt support -1- for intake manifold from intake manifold.
- Detach vacuum hose -2-.



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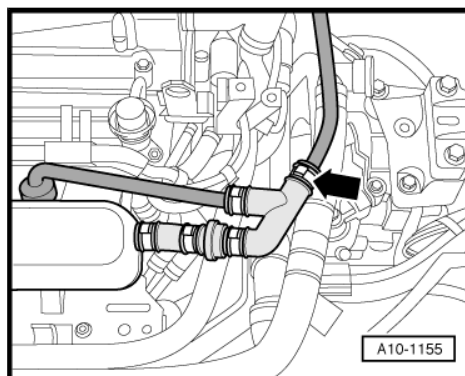
Vehicles with hoses routed according to version 1:

- Detach vacuum line -arrow- going to brake servo at intake manifold.



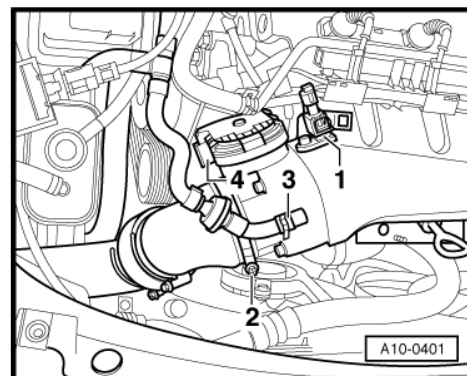
Vehicles with hoses routed according to version 2:

- Detach vacuum line -arrow- going to brake servo.



All models:

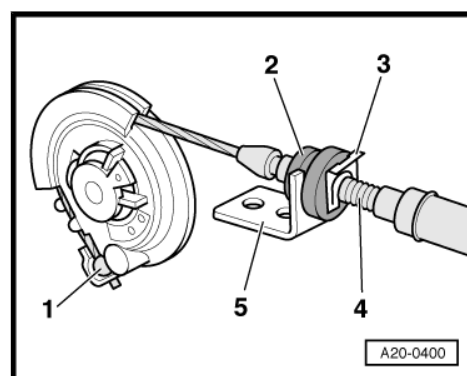
- Unplug electrical connectors -1- at intake air temperature sender -G42- and -4- at throttle valve module -J338- (bottom).
- Detach vacuum line -3- leading to activated charcoal filter and air intake hose -2- from throttle valve module -J338- .

**Vehicles with throttle cable:**

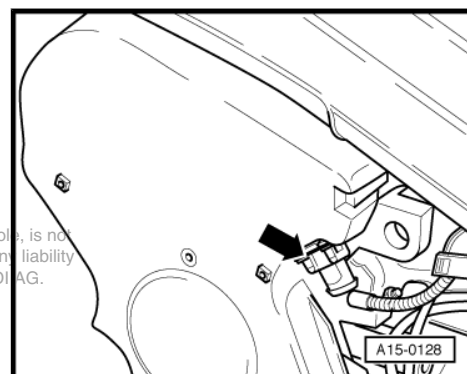
- Disengage nipple -1- on end of throttle cable from cable cam.
- Pull grooved section of throttle cable sheath -4- out of rubber grommet -2- at support bracket -5-.

**Note**

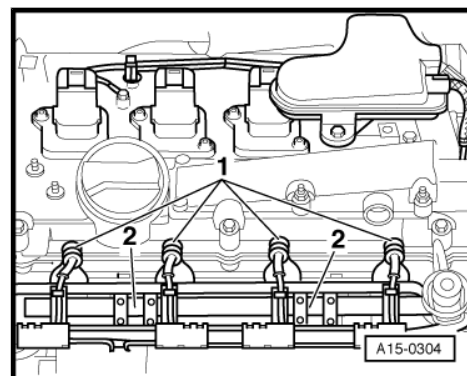
Retaining clip -3- remains connected.

**All models:**

- Unplug electrical connector -arrow- at Hall sender -G40- .



- Unplug electrical connectors -1- on injectors.
- Unclip retaining strip from fuel rail -2-.



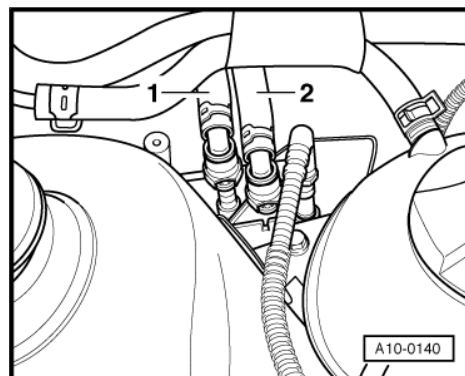
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WARNING

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

- Disconnect fuel supply pipe -1- and fuel return pipe -2- by pressing release tabs.
- Move fuel supply pipe and fuel return pipe clear.
- Disconnect crankcase breather hose from T-piece.
- Pull out oil dipstick.
- Unbolt and remove intake manifold from cylinder head.



Note

Block off intake ports in cylinder head with clean cloths.

Installing

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



Note

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

Vehicles with throttle cable:

- Adjust throttle cable.

All models:



Note

- ◆ *When the battery is reconnected, please ensure that the vehicle equipment (e.g. radio, radio/navigation system, clock, electric window lifters) is activated as described in the operating instructions.*
- ◆ *For further operations after reconnecting power supply, refer to ⇒ Rep. Gr. 24.*

Tightening torques

Component	Nm
Intake manifold to cylinder head	10
Support for intake manifold to: Intake manifold	20
Bracket	45
Fuel rail to intake manifold	10
Hose clips for air hoses	3.5

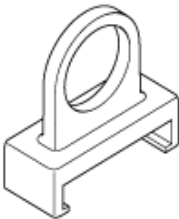
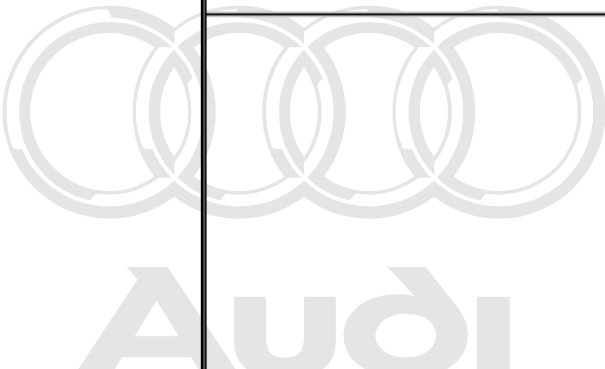
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1.5 Checking compression

1.5.1 Special tools and workshop equipment required

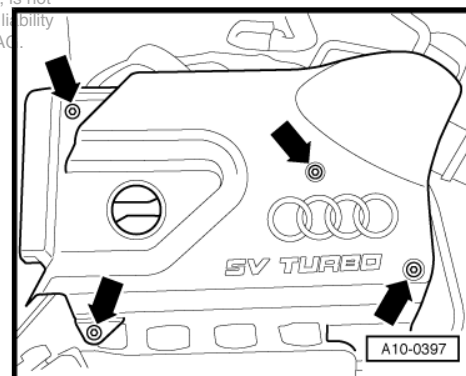
Special tools and workshop equipment required

- ◆ Spark plug socket and extension -3122 B-
- ◆ Compression tester -V.A.G 1763-
- ◆ Puller -T40039- for vehicles with push-fitted ignition coils

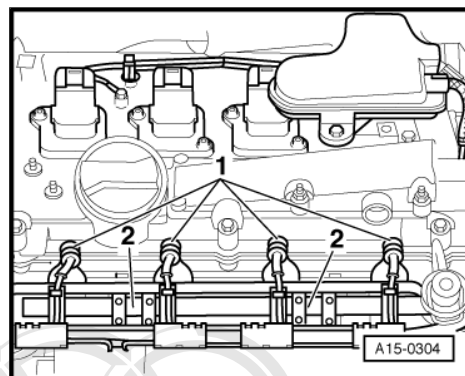
3122 B 	V.A.G 1763 
T40039 	
	G15-0070

Procedure

- Engine oil temperature at least 30 °C.
- Battery voltage at least 12.5 V.
- Take off engine cover panel -arrows-.



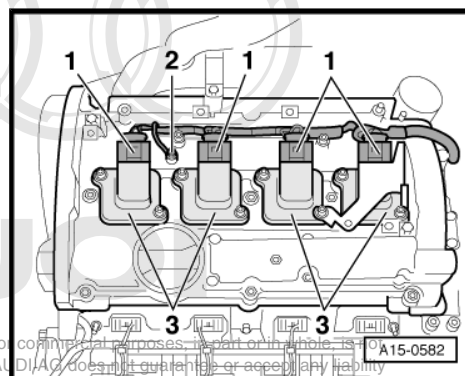
- Unplug electrical connectors -1- on injectors.
- Unscrew vacuum reservoir, disengage and move clear to one side.



- Disconnect earth cable -2-.
- Detach electrical connectors -1-.

Vehicles with bolted on ignition coils:

- Unbolt ignition coils -3-.



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Vehicles with push-fitted ignition coils:

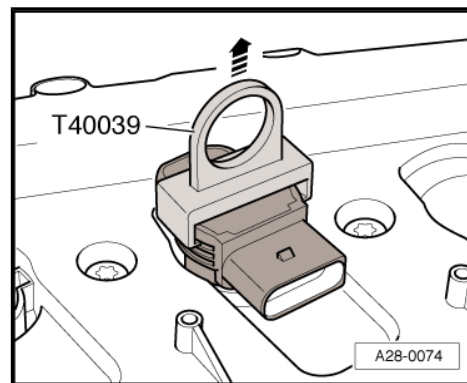
- Pull ignition coils out with puller -T40039- .

All models:

- Remove spark plugs with spark plug socket -3122 B- .
- Test the compression pressure with the compression tester - V.A.G 1763- .

**Note**

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	10.0 ... 13.0
Wear limit	7.0
Difference between cylinders	max. 3.0

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

- Install spark plugs and ignition coils ⇒ Rep. Gr. 28 .

**Note**

Renew gaskets for bolted on ignition coils if damaged.

- Interrogate and erase the fault memory for engine control unit, as faults are stored when the electrical connectors are unplugged ⇒ Vehicle diagnosis, testing and information system VAS 5051.

Tightening torque

Component	Nm
Vacuum reservoir to cylinder head	10

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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 to ensure that none of the valves make contact when the starter is operated.*

2.1 Valve gear - exploded view of components

1 - 65 Nm

- ❑ Use counterhold tool -3036- when loosening and tightening
⇒ [page 47](#)

2 - Camshaft sprocket for exhaust camshaft

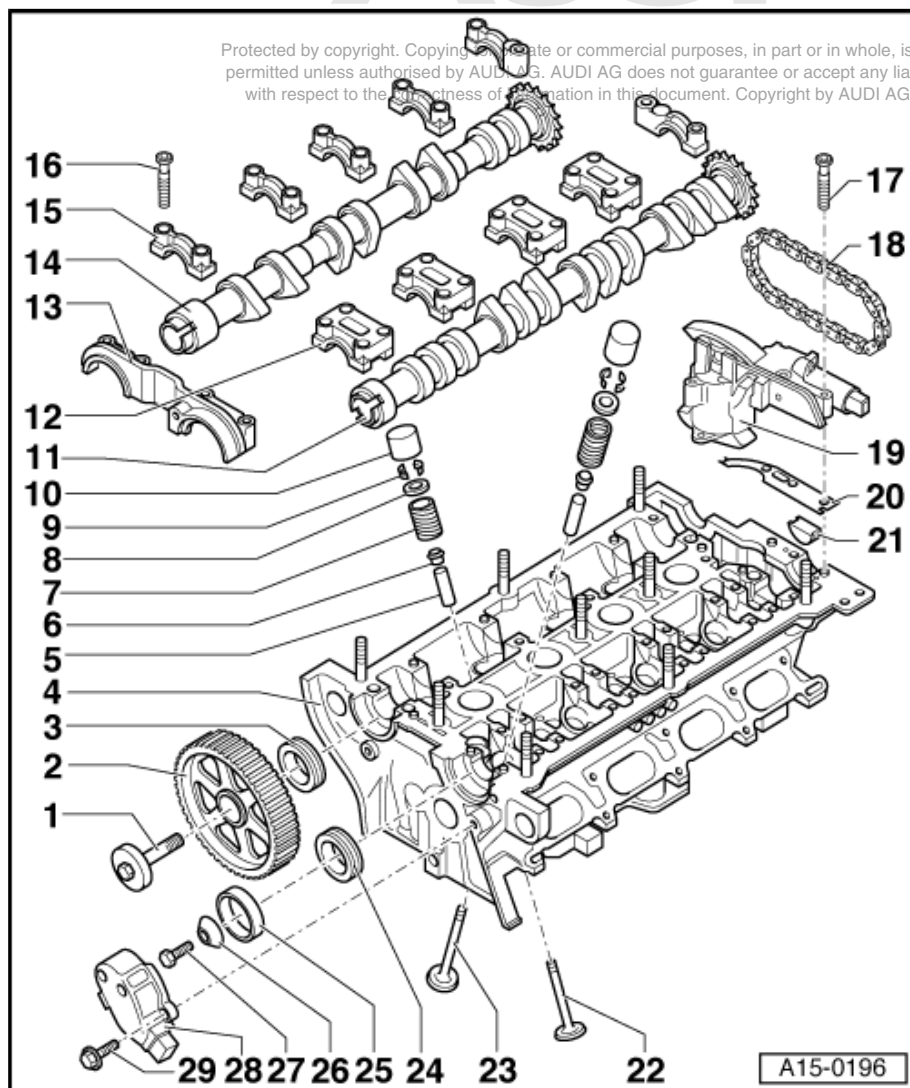
- ❑ Installation position:
The camshaft sprocket is installed with the smaller web facing out and the "TDC" marking is visible from the front
⇒ [page 100](#)

3 - Oil seal

- ❑ For exhaust camshaft
- ❑ Renewing ⇒ [page 98](#)

4 - Cylinder head

- ❑ See note ⇒ [page 94](#)
- ❑ Checking valve guides
⇒ [page 114](#)
- ❑ Machining valve seats
⇒ [page 115](#)
- ❑ Dowel sleeves for bearing caps must be positioned in cylinder head
- ❑ Sealing points
⇒ [page 79](#) and



⇒ [page 79](#)

5 - Valve guide

- ☐ Checking ⇒ [page 114](#)

6 - Valve stem oil seal

- ☐ Renewing ⇒ [page 109](#)

7 - Valve spring

- ☐ Removing and installing ⇒ [“2.7 Renewing valve stem oil seals”, page 109](#)

8 - Valve spring plate

9 - Valve cotters

10 - Hydraulic bucket tappet

- ☐ Checking ⇒ [page 108](#)
- ☐ Removing and installing ⇒ [“2.7 Renewing valve stem oil seals”, page 109](#)
- ☐ Do not interchange
- ☐ Place down with contact surface facing downwards
- ☐ Before installing, check camshaft axial clearance ⇒ [page 97](#)
- ☐ Lubricate contact surface

11 - Inlet camshaft

- ☐ Check radial clearance with Plastigage (bucket tappets removed)
- ☐ Radial clearance: wear limit: 0.1 mm
- ☐ Runout: max. 0.035 mm
- ☐ Checking axial clearance ⇒ [page 97](#)
- ☐ Removing and installing camshafts ⇒ [page 102](#)

12 - Bearing cap for inlet camshaft

- ☐ Must be positioned on dowel sleeves
- ☐ Dowel sleeves must be positioned in cylinder head
- ☐ Note installation position
- ☐ Installation sequence ⇒ [page 107](#)

13 - Double bearing cap

- ☐ Must be positioned on dowel sleeves
- ☐ Dowel sleeves must be positioned in cylinder head
- ☐ Before installing, apply small quantity of sealant to sealing surface ⇒ [page 107](#)
- ☐ Sealing points between double bearing cap/cylinder head ⇒ [page 79](#)

14 - Exhaust camshaft

- ☐ Check radial clearance with Plastigage (bucket tappets removed)
- ☐ Radial clearance: wear limit: 0.1 mm
- ☐ Runout: max. 0.035 mm
- ☐ Checking axial clearance ⇒ [page 97](#)
- ☐ Removing and installing camshafts ⇒ [page 102](#)

15 - Bearing cap for exhaust camshaft

- ☐ Must be positioned on dowel sleeves
- ☐ Dowel sleeves must be positioned in cylinder head
- ☐ Note installation position
- ☐ Installation sequence ⇒ [page 107](#)

16 - 10 Nm

17 - 10 Nm

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18 - Drive chain

- ☐ Check for wear
- ☐ Before removing mark rotation direction (installation position) ⇒ [page 105](#)
- ☐ Removing and installing
⇒ ["2.5 Removing and installing camshafts and hydraulic chain tensioner/camshaft adjuster", page 102](#)

19 - Hydraulic chain tensioner

- ☐ Not on vehicles with engine code ARX, ARY, AUM, AUQ
- ☐ Before removing, lock in position with chain tensioner retainer -3366-
- ☐ Removing and installing ⇒ [page 102](#)
- ☐ Sealing points: hydraulic chain tensioner/cylinder head ⇒ [page 79](#)

19 - Camshaft adjuster

- ☐ Only on vehicles with engine code ARX, ARY, AUM, AUQ
- ☐ With inlet camshaft control valve 1 -N205-
- ☐ Checking function of variable valve timing ⇒ [page 118](#)
- ☐ Before removing, lock in position with chain tensioner retainer -3366-
- ☐ Removing and installing ⇒ [page 102](#)
- ☐ Sealing points between camshaft adjuster and cylinder head ⇒ [page 79](#)

20 - Rubber/metal gasket

- ☐ Apply sealant before installing ⇒ [page 105](#)

21 - Seal

- ☐ Renew

22 - Exhaust valve

- ☐ With sodium filling
- ☐ Note safety precautions when disposing of valves with sodium filling ⇒ [page 114](#)
- ☐ Must not be machined; only grinding-in is permissible
- ☐ Valve dimensions ⇒ [page 114](#)
- ☐ Checking valve guides ⇒ [page 114](#)
- ☐ Machining valve seats ⇒ [page 115](#)

23 - Inlet valve

- ☐ Must not be machined; only grinding-in is permissible
- ☐ Valve dimensions ⇒ [page 114](#)
- ☐ Checking valve guides ⇒ [page 114](#)
- ☐ Machining valve seats ⇒ [page 115](#)

24 - Oil seal

- ☐ For inlet camshaft
- ☐ Renewing ⇒ [page 100](#)

25 - Rotor for Hall sender

- ☐ Installation position: insert lug into notch on camshaft

26 - Washer

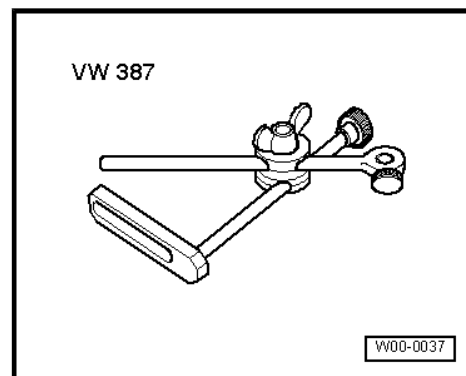
- ☐ With taper
- ☐ Note installation position

27 - 25 Nm**28 - Hall sender -G40- housing****29 - 10 Nm**

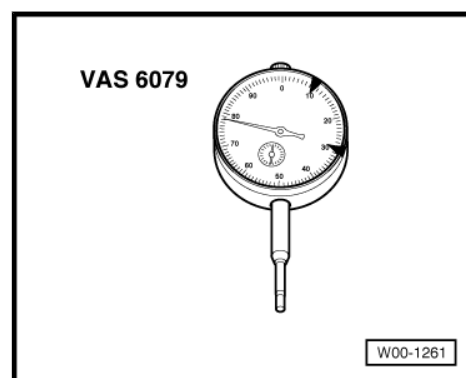
2.2 Checking axial clearance of camshafts

Special tools and workshop equipment required

- ◆ Universal dial gauge bracket -VW 387-



- ◆ Dial gauge -VAS 6079-



Procedure

- Remove camshafts ⇒ [page 102](#) .

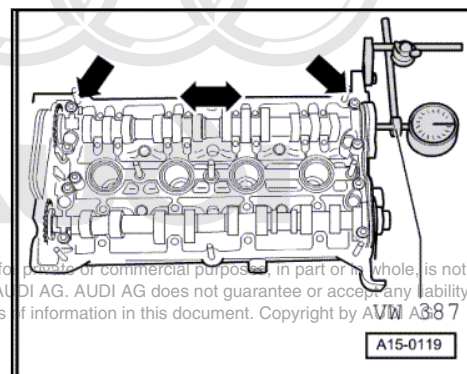


Note

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

- Take bucket tappets out of guides and set them down with contact surface facing downwards.
- Fit camshafts in cylinder head and install bearing caps at chain sprocket end and double bearing cap.
- Secure universal dial gauge bracket -VW 387- with dial gauge -VAS 6079- to cylinder head:

Inlet camshaft



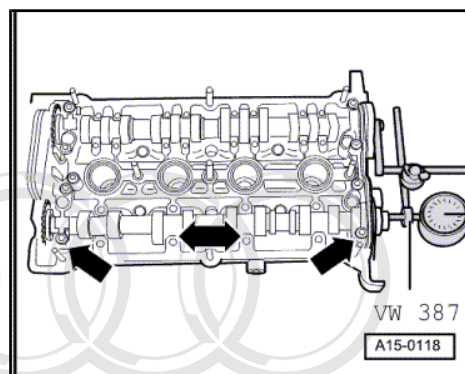
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Exhaust camshaft

- Press relevant camshaft against dial gauge by hand.
- Set dial gauge to “0”.
- Push camshaft away from dial gauge and read off value.

Axial clearance for inlet and exhaust camshaft:

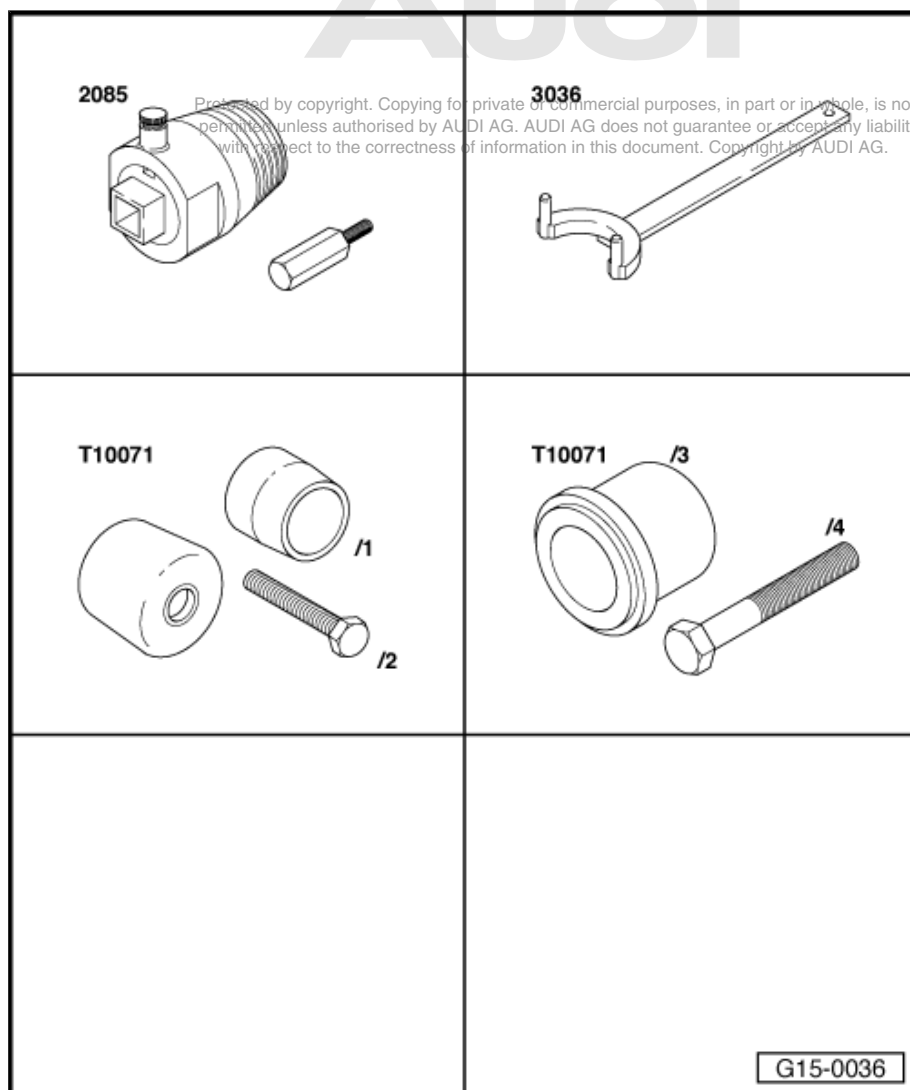
- Wear limit: 0.20 mm.



2.3 Renewing exhaust camshaft oil seal

Special tools and workshop equipment required

- ◆ Oil seal extractor -2085-
- ◆ Counterhold tool -3036-
- ◆ Assembly tool -T10071-



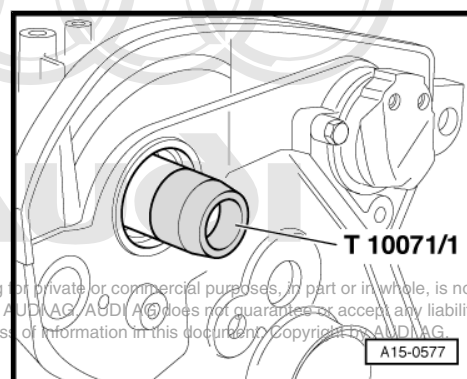
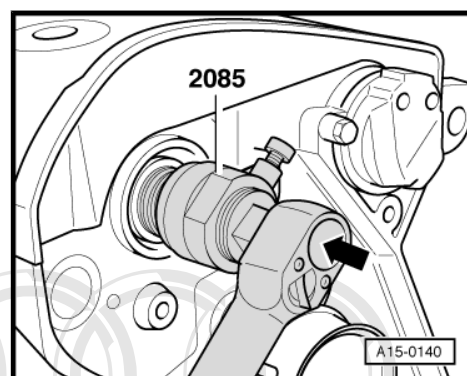
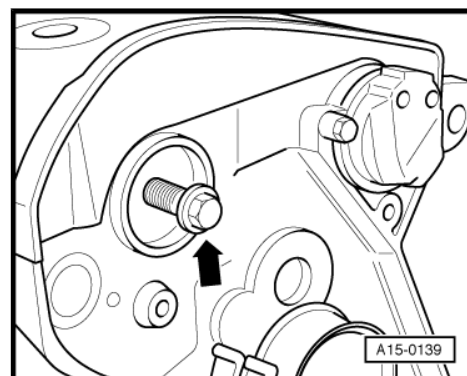
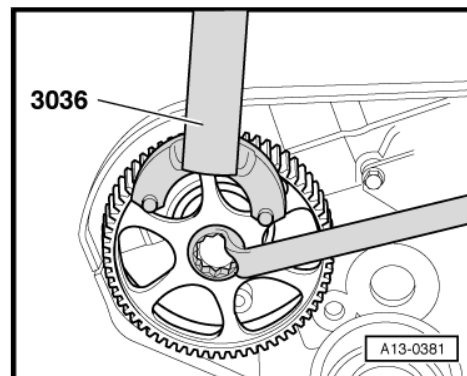
Procedure

- Cylinder head installed
- Remove toothed belt from camshaft sprocket ⇒ [page 53](#) .
- Loosen camshaft sprocket using counterhold tool -3036- .
- Detach camshaft sprocket.
- To guide oil seal extractor, screw bolt for camshaft sprocket -arrow- into camshaft as far as it will go until hand-tight.
- Unscrew inner section of oil seal extractor -2085- two turns (approx. 3 mm) out of outer section and lock inner section 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 of oil seal extractor against camshaft until the oil seal is pulled out.
- Clamp flats of oil seal extractor in vice and use pliers to remove seal.
- Clean running surface and sealing surface.
- Place guide sleeve -T10071/1- onto camshaft journal.

**Note**

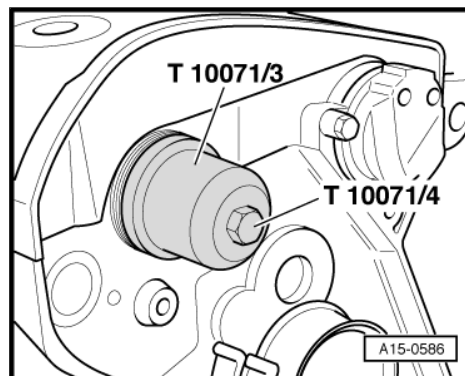
Do not lubricate sealing lip of oil seal.

- Slide oil seal over guide sleeve onto camshaft journal.
- Detach guide sleeve.

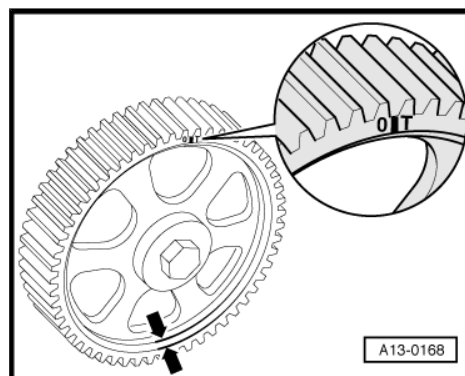


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- Press oil seal in as far as the stop using press sleeve - T10071/3- and bolt -T10071/4- .



- Install camshaft sprocket.
- The thinner web of the camshaft sprocket faces outwards -arrows- and the marking for TDC is visible.



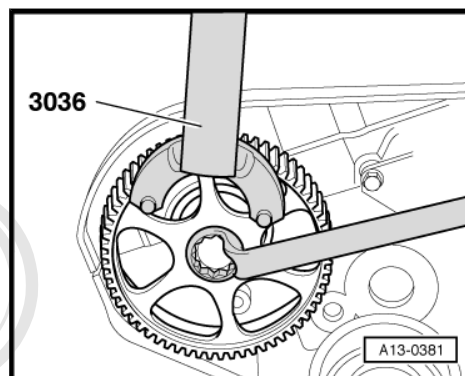
Caution

If a piston is at "TDC" the valves could strike the piston when turning the camshaft. Pistons must therefore not be at "TDC" This could otherwise result in damage to valves and pistons.

- Tighten securing bolt of camshaft sprocket (use counterhold tool -3036-).
- Install toothed belt (adjust valve timing) ⇒ [page 52](#) .

Tightening torque

Component	Nm
Camshaft sprocket to camshaft	65

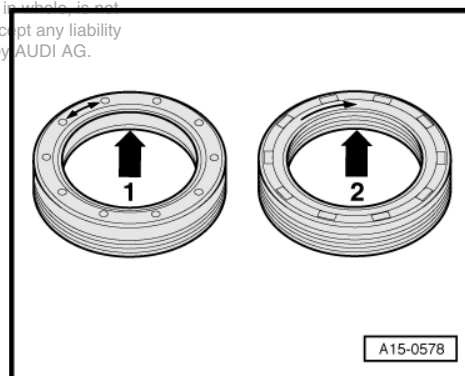


2.4 Renewing inlet camshaft oil seal



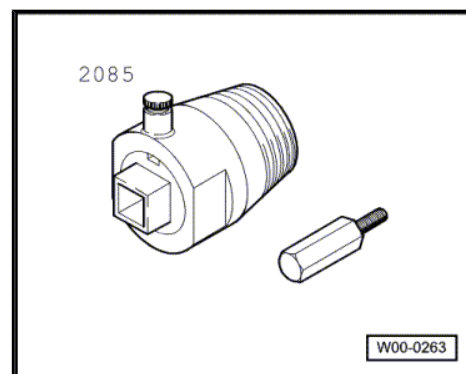
Note

- ◆ Depending on version, radial type oil seals with a spring-ring or PTFE oil seals are used.
- ◆ Distinguishing feature: the old-type radial oil seal has only one sealing lip -arrow 1- (the spring ring exerts pressure on the sealing lip). The PTFE oil seal has a thread-like sealing surface -arrow 2- and no spring ring.
- ◆ Do not stretch sealing surface of PTFE oil seal when installing.
- ◆ 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.

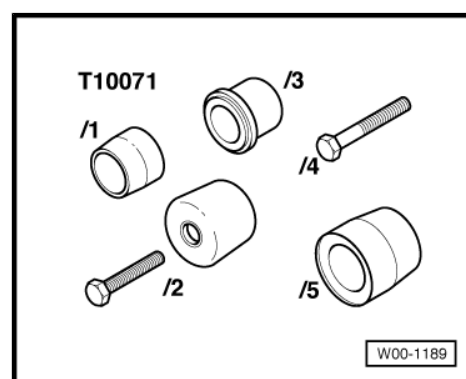


Special tools and workshop equipment required

- ◆ Oil seal extractor -2085-

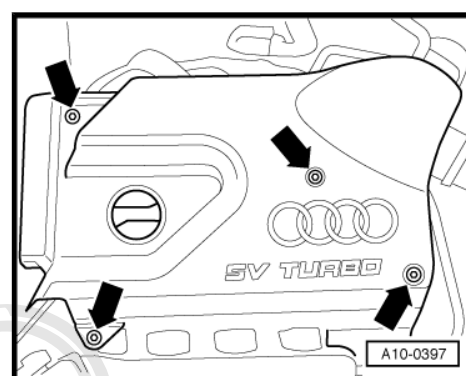


- ◆ Assembly tool -T10071- with bolt M8x60

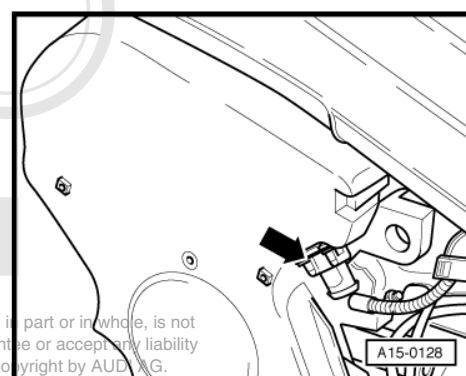


Procedure

- Cylinder head installed.
- Take off engine cover panel -arrows-.

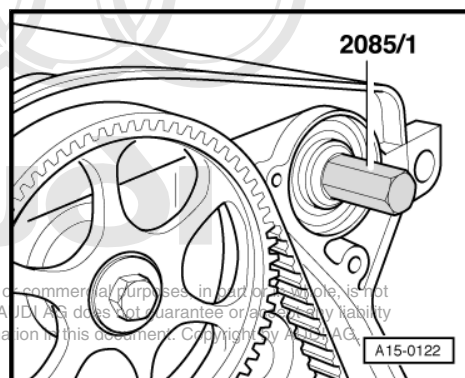


- Unplug electrical connector -arrow- at Hall sender -G40- .
- Remove toothed belt cover (top).
- Remove Hall sender ⇒ [Item 25 \(page 96\)](#) ,
⇒ [Item 26 \(page 96\)](#) and ⇒ [Item 28 \(page 96\)](#) .

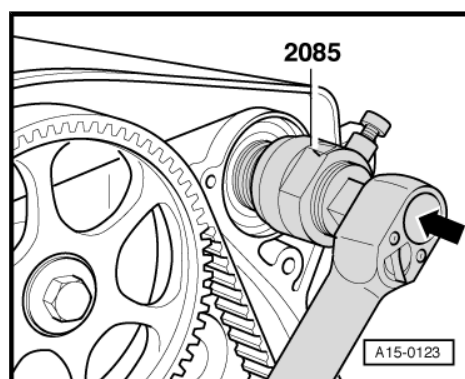


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- To guide oil seal extractor, screw bolt -2085/1- into camshaft as far as it will go until hand-tight.
- Unscrew inner section of oil seal extractor -2085- two turns (approx. 3 mm) out of outer section and lock inner section with knurled screw.



- 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 of oil seal extractor against camshaft until the oil seal is pulled out.
- Clamp flats of oil seal extractor in vice and use pliers to remove seal.
- Clean running surface and sealing surface.



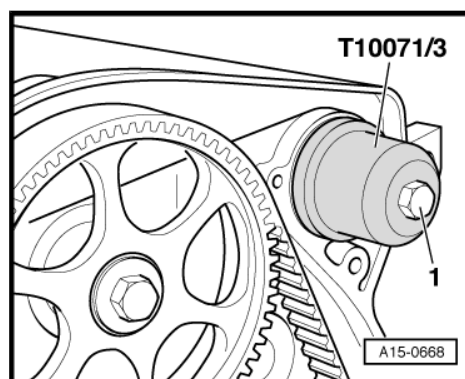
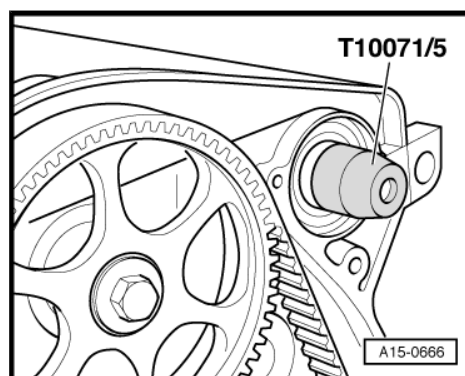
- Place guide sleeve -T10071/5- onto camshaft journal.



Note

Do not lubricate sealing lip of oil seal.

- Slide oil seal over guide sleeve onto camshaft journal.
- Detach guide sleeve.
- Press oil seal in as far as the stop using press sleeve - T10071/3- and bolt M8x60.
- Install Hall sender ⇒ [Item 25 \(page 96\)](#) , ⇒ [Item 26 \(page 96\)](#) and ⇒ [Item 28 \(page 96\)](#) .
- Fit toothed belt cover (top section).



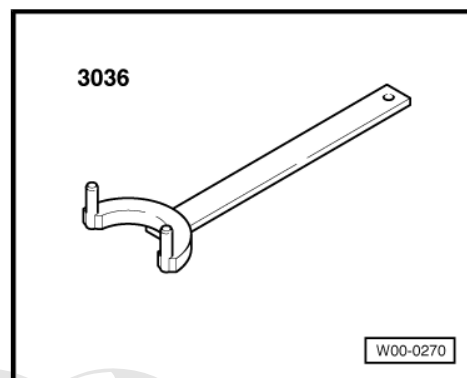
Tightening torques

Component	Nm
Hall sender rotor to camshaft	25
Hall sender housing to cylinder head	10

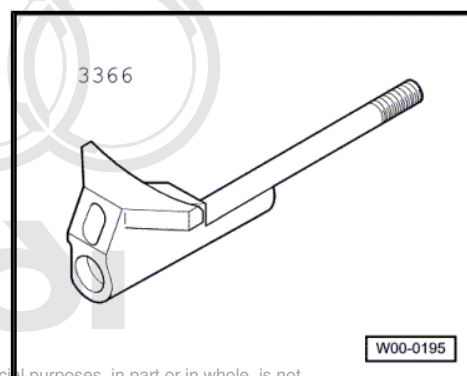
2.5 Removing and installing camshafts and hydraulic chain tensioner/camshaft adjuster

Special tools and workshop equipment required

◆ Counterhold tool -3036-



◆ Chain tensioner retainer -3366-



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◆ Sealant ⇒ Parts catalogue

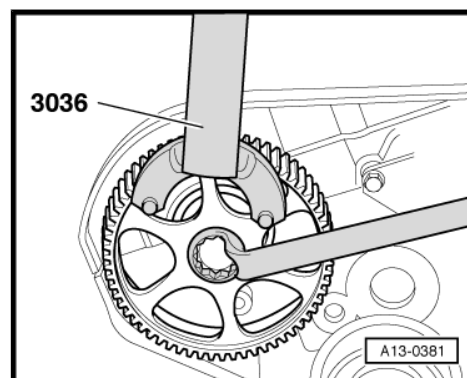
Removing

- Cylinder head installed.
- Remove toothed belt from camshaft sprocket ⇒ [page 53](#).

**Caution**

If a piston is at "TDC" the valves could strike the piston when turning the camshaft. Pistons must therefore not be at "TDC" This could otherwise result in damage to valves and pistons.

- Turn the crankshaft approx. 45° anti-clockwise at the toothed belt sprocket bolt so that all pistons are clear of "TDC" position.
- Loosen camshaft sprocket using counterhold tool -3036-.
- Detach camshaft sprocket.

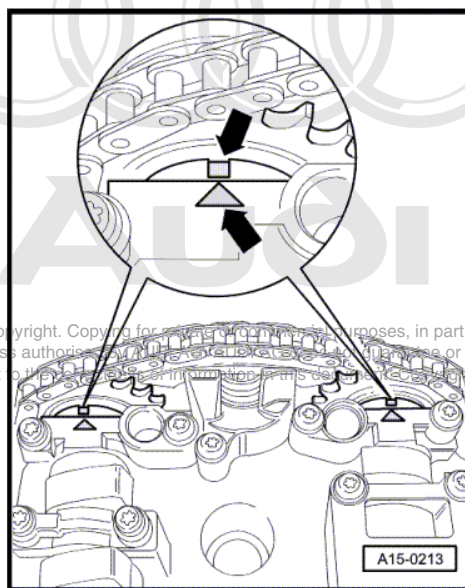
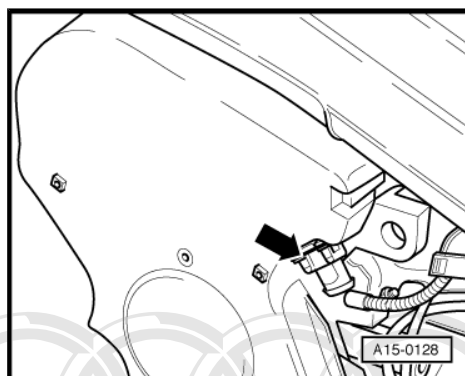
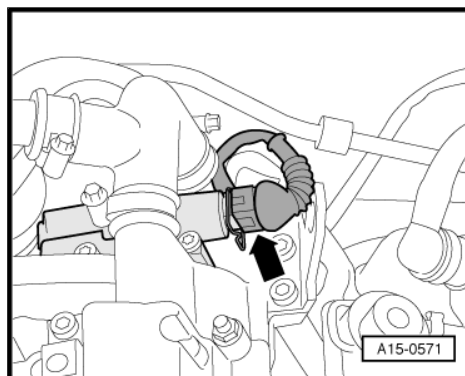


Vehicles with variable valve timing:

- Unplug electrical connector -arrow- at inlet camshaft control valve 1 -N205- .

All models:

- Remove cylinder head cover ⇒ [page 79](#) .
- Remove both oil deflectors.
- Unplug electrical connector -arrow- at Hall sender -G40- .
- Remove Hall sender ⇒ [Item 25 \(page 96\)](#) ,
⇒ [Item 26 \(page 96\)](#) and ⇒ [Item 28 \(page 96\)](#) .
- Check “TDC” position of camshafts again:
 - The two markings on the camshafts must be in line with the two arrows on the bearing caps -arrows-.



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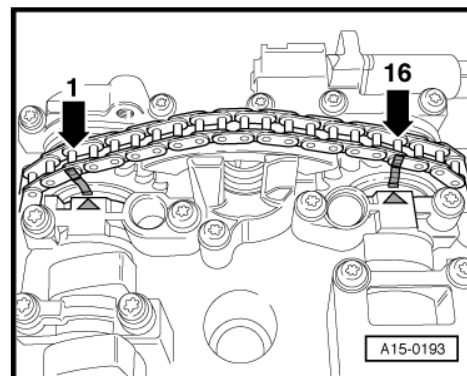
If old drive chain is to be reused:

- 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-.



Note

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



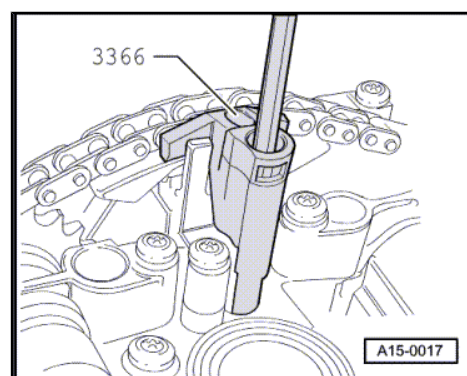
Continued for all drive chains:

- Secure hydraulic chain tensioner/camshaft adjuster with chain tensioner retainer -3366-.

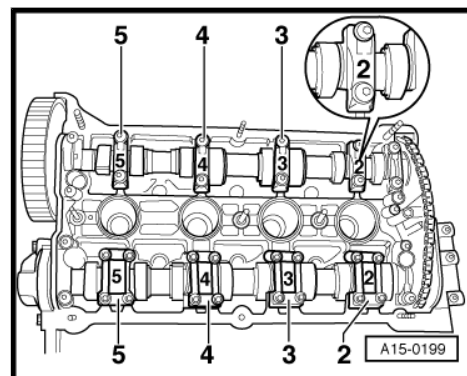


Note

Over-tightening -3366- can damage the chain tensioner/camshaft adjuster.

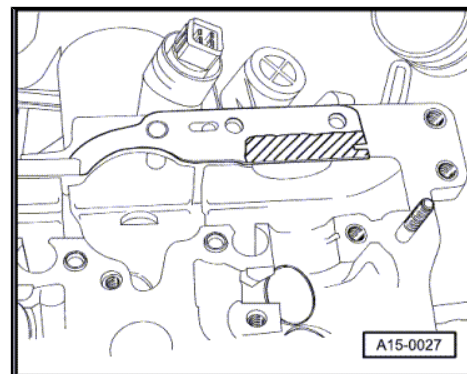


- First remove bearing caps -3- and -5- on inlet and exhaust camshafts.
- Remove double bearing cap.
- Remove the two bearing caps next to the chain sprockets on the inlet and exhaust camshafts.
- Unscrew securing bolts for hydraulic chain tensioner/camshaft adjuster.
- Slacken off bearing caps -2- and -4- of inlet and exhaust camshafts alternately and diagonally, and remove.
- Remove inlet and exhaust camshafts with hydraulic chain tensioner/camshaft adjuster.



Installing

- Pistons must not be at TDC.
- Renew rubber/metal gasket for hydraulic chain tensioner/camshaft adjuster and apply a thin coat of sealant to the -hatched area-; Sealant ⇒ Parts catalogue.

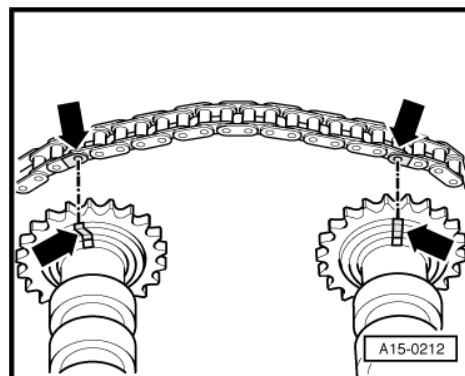


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- Position drive chain on camshaft chain sprockets as follows:

If old drive chain is to be reused:

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

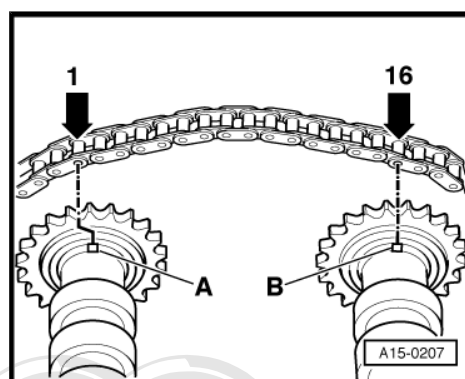


If new drive chain is being used:



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 107](#).*



- 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.
- Notch -A- is offset slightly towards the inside in relation to chain roller -1-.

Continued for all drive chains:

- Insert hydraulic chain tensioner/camshaft adjuster into the drive chain (2nd mechanic required).
- Fit camshafts with drive chain and hydraulic chain tensioner/camshaft adjuster in cylinder head.
- Lubricate running surfaces of camshafts.
- Dowel sleeves for bearing caps and hydraulic chain tensioner/camshaft adjuster must be positioned in cylinder head.

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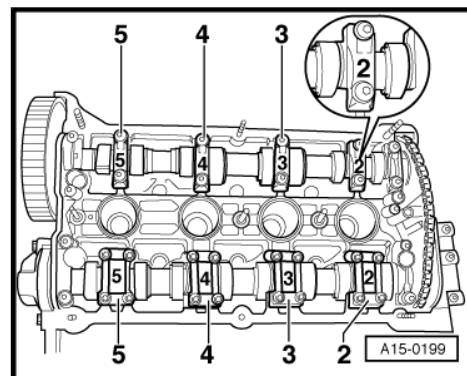


Note

When installing bearing caps ensure that the identification mark is readable from the inlet side of cylinder head.

- Secure hydraulic chain tensioner/camshaft adjuster (pay attention to dowel sleeves).

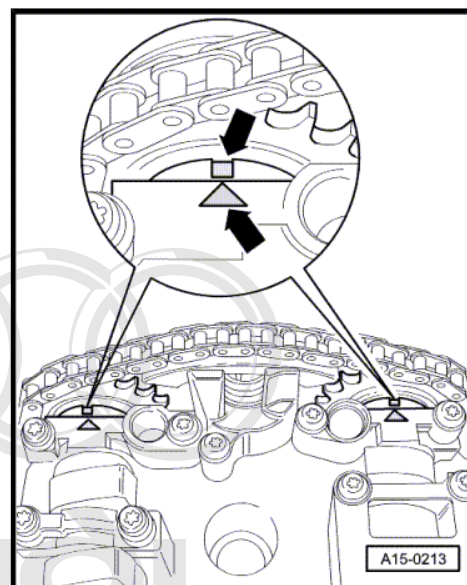
- Tighten bearing caps -2- and -4- of inlet and exhaust camshafts alternately and in diagonal sequence (pay attention to dowel sleeves).
- Install the two bearing caps next to the chain sprockets on the inlet and exhaust camshafts.
- Remove chain tensioner retainer -3366- .



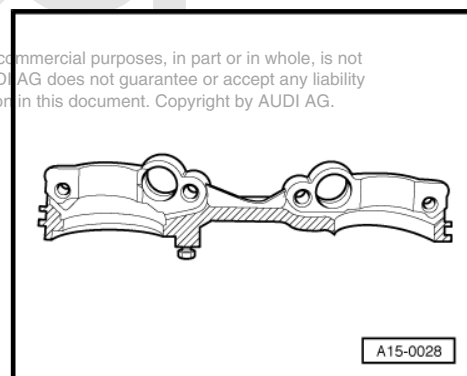
- Check correct setting of camshafts:
 - The two marks on the camshafts must be opposite the two arrows on the bearing caps -arrows-.

**Note**

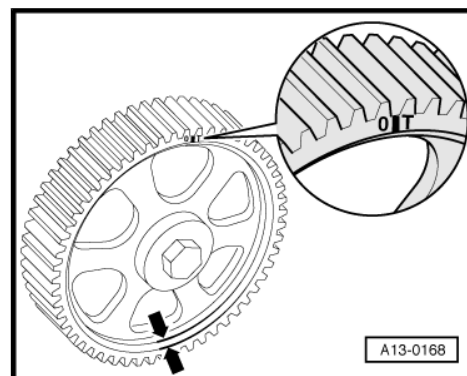
If necessary, turn camshaft slightly backwards or forwards so that the two marks coincide.



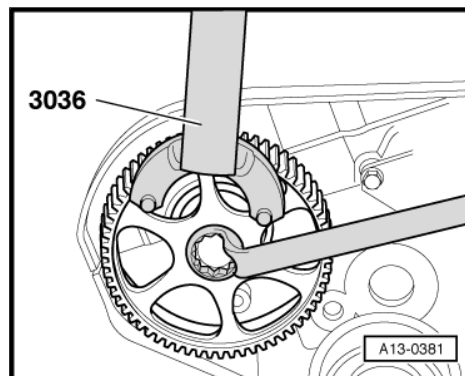
- Apply a small quantity of sealant to the -hatched area- of the double bearing cap: Refer to ⇒ **Parts catalogue for sealant**.
- Install remaining bearing caps (pay attention to dowel sleeves).
- Renew camshaft oil seals
 ⇒ ["2.3 Renewing exhaust camshaft oil seal", page 98](#) or
 ⇒ ["2.4 Renewing inlet camshaft oil seal", page 100](#) .
- Torque down remaining bearing caps.



- Install camshaft sprocket.
 - The thinner web of the camshaft sprocket faces outwards -arrows- and the marking for TDC is visible.



- Tighten securing bolt of camshaft sprocket (use counterhold tool -3036-).
- Install Hall sender ⇒ [Item 25 \(page 96\)](#) , ⇒ [Item 26 \(page 96\)](#) and ⇒ [Item 28 \(page 96\)](#) .
- Install cylinder head cover ⇒ [page 79](#) .
- Turn crankshaft approx. 45° clockwise to TDC position via securing bolt for toothed belt sprocket.
- Install toothed belt (adjust valve timing) ⇒ [page 52](#) .



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.*

Tightening torques

Component	Nm
Bearing cap to cylinder head	10
Hydraulic chain tensioner/camshaft adjuster to cylinder head	10
Hall sender rotor to camshaft	25
Hall sender housing to cylinder head	10
Camshaft sprocket to camshaft	65

2.6 Checking hydraulic bucket tappets

Special tools and workshop equipment required

- ◆ Feeler gauge
- ◆ Wooden/plastic wedge

Test sequence



Note

- ◆ *Hydraulic bucket tappets cannot be serviced.*
- ◆ *Irregular valve noises when starting engine are normal.*
- Start engine and let it run until the radiator fan has switched on once.
- Increase engine speed to approx. 2500 rpm for 2 minutes (perform road test if necessary).

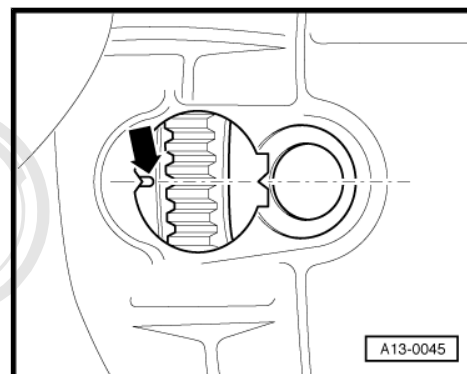


Note

If the irregular valve noises stop but recur repeatedly during short trips, renew the oil retention valve. The oil retention valve is located in the oil filter bracket ⇒ [Item 23 \(page 131\)](#) .

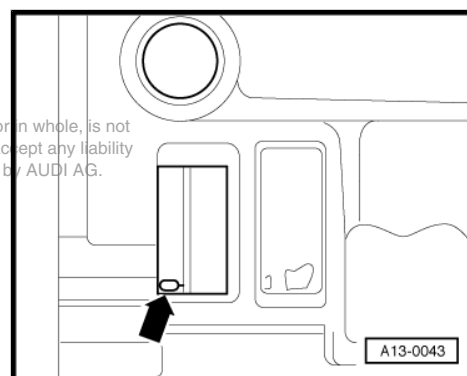
If the hydraulic tappets are still noisy, locate defective tappet as follows:

- Remove cylinder head cover ⇒ [page 79](#) .
- Turn crankshaft until cams of bucket tappets to be checked are pointing upwards.
- ◆ Vehicles with manual gearbox: push vehicle forwards with 4th gear engaged and ignition switched off.



- ◆ Vehicles with automatic gearbox: turn crankshaft at central bolt on crankshaft sprocket in direction of engine rotation to "TDC" mark -arrow-.

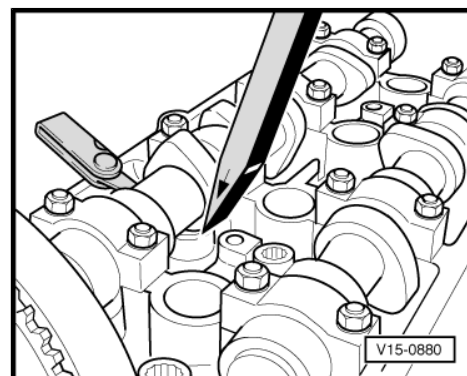
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- Push bucket tappet down with a wooden or plastic wedge to determine play between cam and bucket tappet.

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

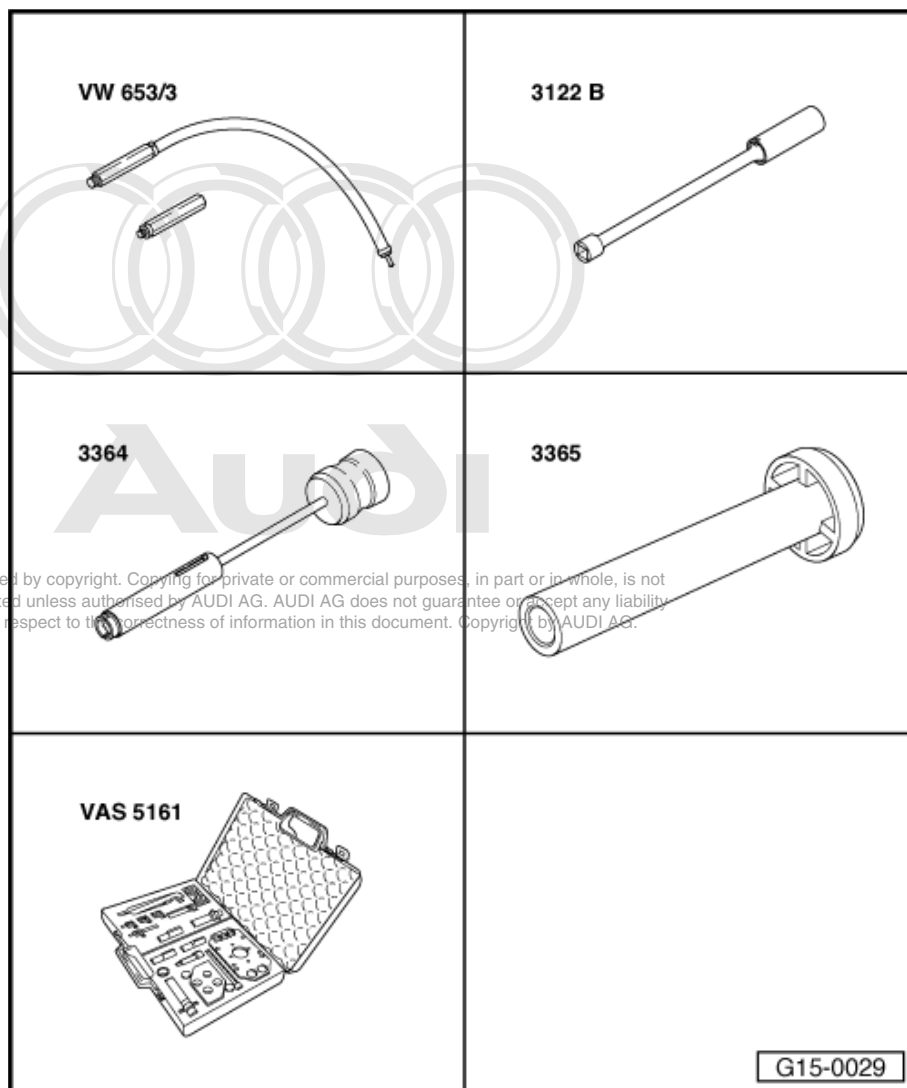
- Renew bucket tappet
⇒ ["2.5 Removing and installing camshafts and hydraulic chain tensioner/camshaft adjuster"](#), [page 102](#) .



2.7 Renewing valve stem oil seals

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 / installing device for valve cotters -VAS 5161-



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Procedure

- Cylinder head installed.
- Remove camshafts and hydraulic chain tensioner/camshaft adjuster ⇒ [page 102](#).

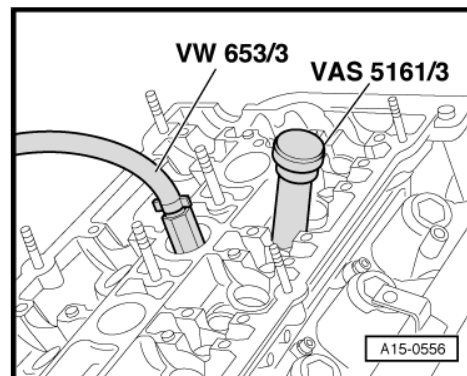


Note

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

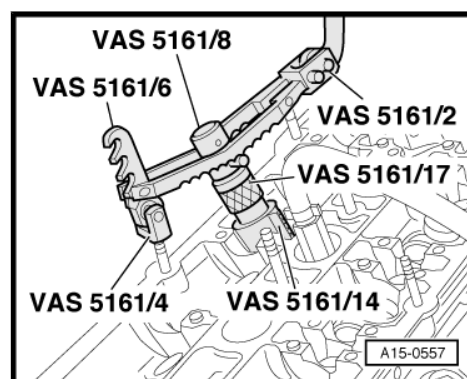
- Take bucket tappets out of guides and set them down with contact surface facing downwards.
- Remove spark plugs with spark plug socket -3122 B-.
- Set piston of the respective cylinder to “bottom dead centre”.

- Screw pressure hose -VW 653/3- into spark plug hole and connect to compressed air supply.
- Minimum pressure: 6 bar.
- Insert punch -VAS 5161/3- in bucket tappet guide.
- Knock sticking valve cotters loose on all 5 valves using a plastic hammer.



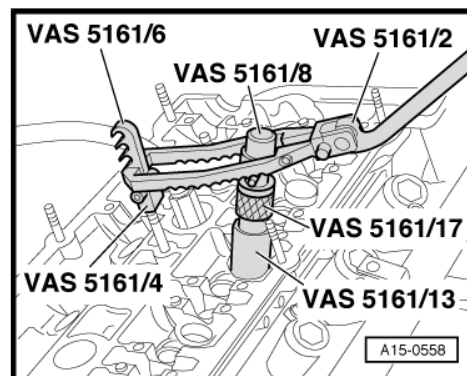
Exhaust side:

- Screw snap-in device -VAS 5161/6- with interlocking fork -VAS 5161/4- onto stud on cylinder head.
- Push guide bush -VAS 5161/14- as far as it will go into bucket tappet guide of the valve spring to be removed.
- 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 the pressure fork.
- Take off assembly cartridge with knurled spacer ring.
- Remove guide bush, valve spring plate and valve spring.



Inlet side

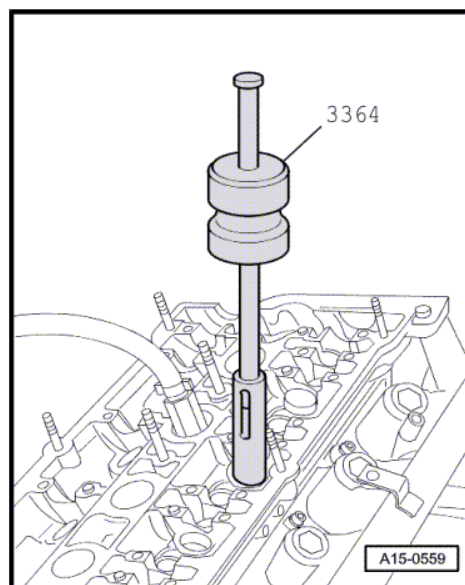
- Screw snap-in device -VAS 5161/6- with interlocking fork -VAS 5161/4- onto stud on cylinder head.
- Push guide bush -VAS 5161/13- as far as it will go into bucket tappet guide of the valve spring to be removed.
- Knurled surfaces face perpendicular to direction of travel.
- Slide knurled spacer ring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



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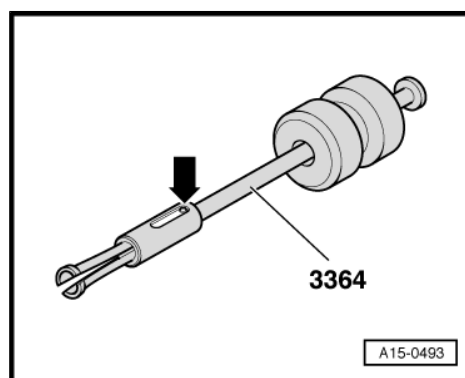
Continuation for both sides:

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

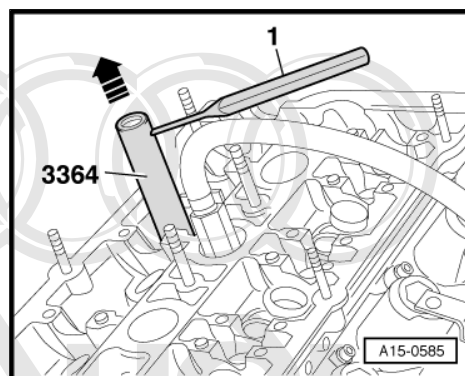


If the puller cannot be used on some of the valve stem oil seals due to the confined space, proceed as follows:

- Knock out pin -arrow- of puller using a drift and remove the extractor attachment.



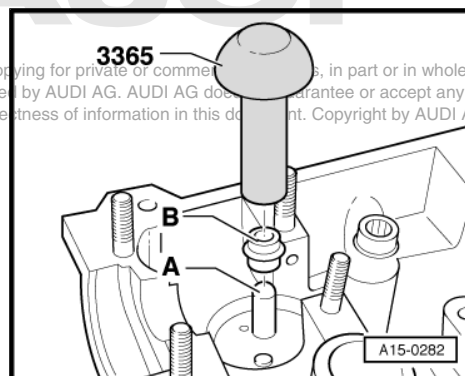
- Apply lower part of puller to valve stem oil seal.
- Secure puller with a punch -1- or other suitable tool as shown in the illustration.
- Apply assembly lever to puller and pull out valve stem oil seal -arrow-.



Note

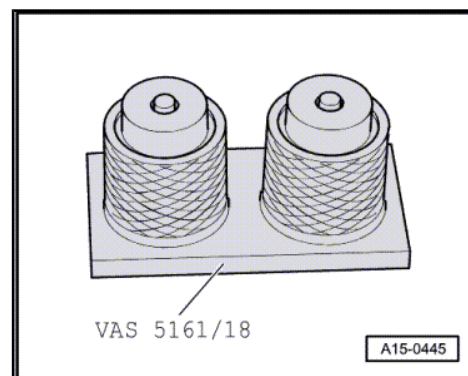
A plastic sleeve -A- is included with the new valve stem oil seals.

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



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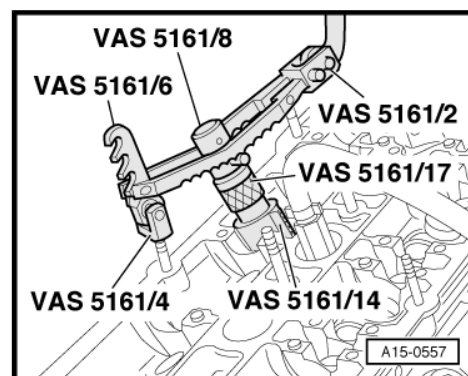
- If valve cotters have been removed from assembly cartridge, they need to be put into insertion device -VAS 5161/18- first.
- Larger diameter of valve cotters faces upwards.
- Press assembly cartridge onto valve insertion device from above and take up valve cotters.
- Insert guide bush -VAS 5161/13- or -VAS 5161/14- , valve spring and valve spring plate.



- Re-insert cartridge into guide bush.
- Push pressure fork down and pull knurled screw upwards while turning screw in both directions - this will insert the valve cotters.
- Release the pressure fork with knurled screw still in pulled position.
- Insert bucket tappets.

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

- Install spark plugs ⇒ Rep. Gr. 28 .
- Install camshafts and hydraulic chain tensioner/camshaft adjuster ⇒ [page 102](#) .



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.*



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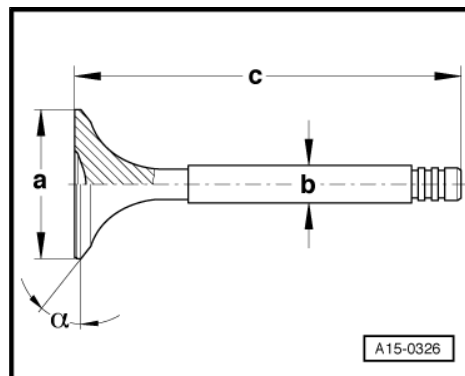
2.8 Valve dimensions



Note

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

Dimension		Inlet valve	Exhaust valve
Ø a	mm	26.80 ... 27.00	29.80 ... 30.00
Ø b	mm	5.95 ... 5.97	5.94 ... 5.95
c	mm	104.84 ... 105.34	103.64 ... 104.14
α	°	45	45



A15-0326



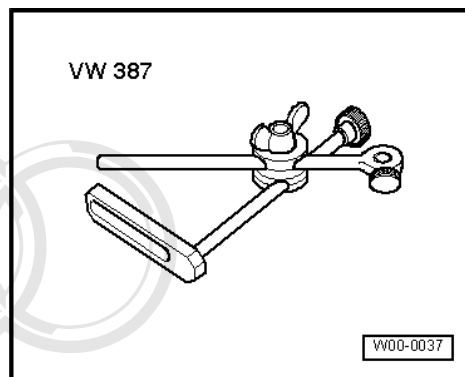
WARNING

- ♦ *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.*

2.9 Checking valve guides

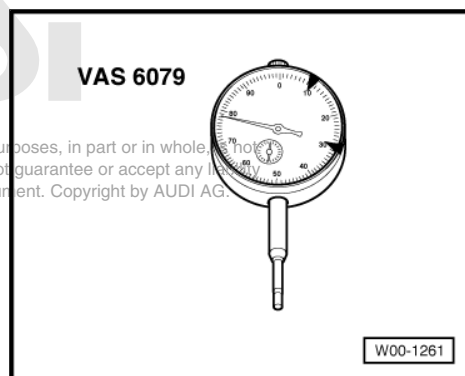
Special tools and workshop equipment required

- ♦ Universal dial gauge bracket -VW 387-



W00-0037

- ♦ Dial gauge -VAS 6079-



W00-1261

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Procedure

- Insert valve into valve guide.
- End of valve stem must be flush with valve guide.



Note

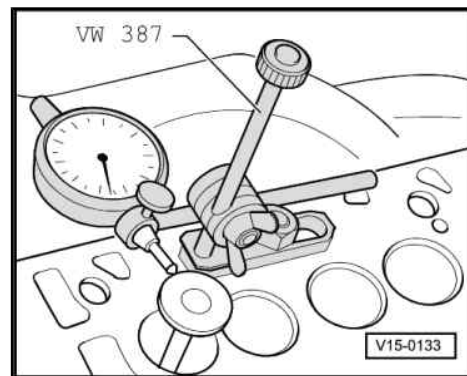
Only insert inlet valve into inlet guide and exhaust valve into exhaust guide, as the stem diameters are different.

- Determine amount of sideways play:
- Wear limit for inlet and exhaust valve guide: 0.8 mm.



Note

- ◆ *If the wear limit is exceeded, repeat the measurement with new valves. Renew cylinder head if wear limit is still exceeded.*
- ◆ *If the valve has to be renewed as part of a repair, use a new valve for the measurement.*



2.10 Machining valve seats

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Note

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 114](#).*
- ◆ *Valve seats should only be machined to the extent required to give a proper seating pattern.*
- ◆ *The maximum permissible machining dimension must be calculated before starting work.*
- ◆ *If the machining dimension is exceeded, the function of the hydraulic valve clearance compensation can no longer be ensured and the cylinder head must be renewed.*

Calculating maximum permissible machining dimension

- Insert valve and press firmly against valve seat.



Note

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

- Measure distance -a- between end of valve stem and upper cylinder head surface with a depth gauge.
- Calculate the maximum permissible machining dimension using the measured distance and the minimum dimension.

Minimum 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
Maximum 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.

Machining inlet valve seat

a - $\varnothing$ 26.2 mm

b - 1.5 ... 1.8 mm

Z - Bottom surface of cylinder head

α - 45° valve seat angle

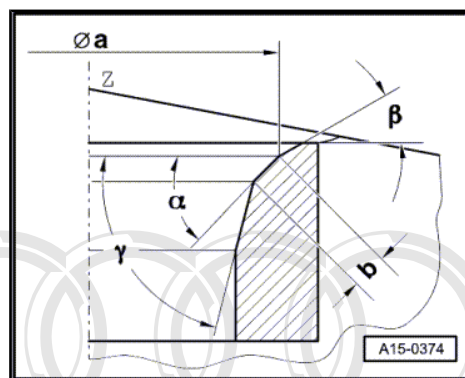
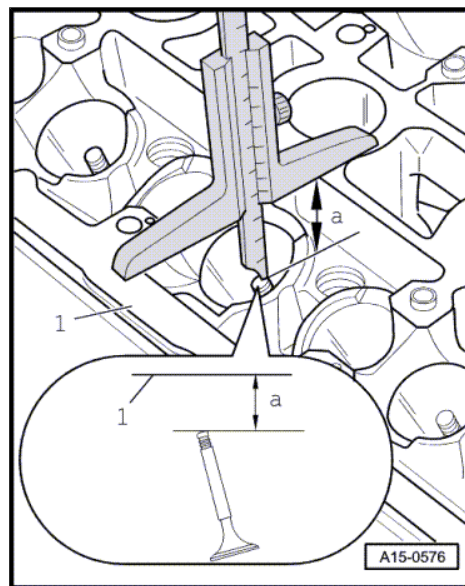
β - 30° upper correction angle

γ - 60° lower correction angle



Note

Calculating maximum permissible machining dimension
⇒ [page 116](#).



Audi

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Machining exhaust valve seat

a - $\varnothing$ 29.0 mm

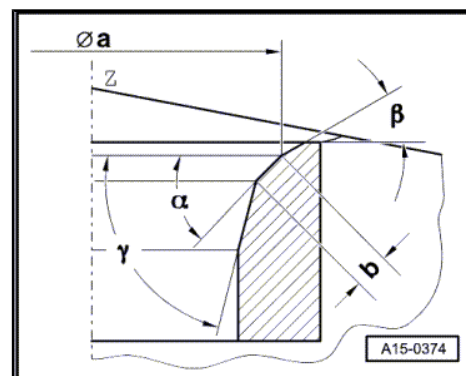
b - 1.8 mm

Z - Bottom surface of cylinder head

α - 45° valve seat angle

β - 30° upper correction angle

γ - 60° lower correction angle



Note

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Calculating maximum permissible machining dimension

⇒ page 116.

3 Checking variable valve timing - only on vehicles with engine code ARX, ARY, AUM, AUQ

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 inlet camshaft control valve 1 -N205- .

3.1 Checking function of variable valve timing



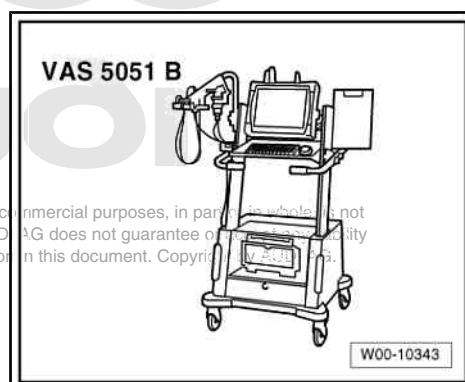
Note

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

Special tools and workshop equipment required

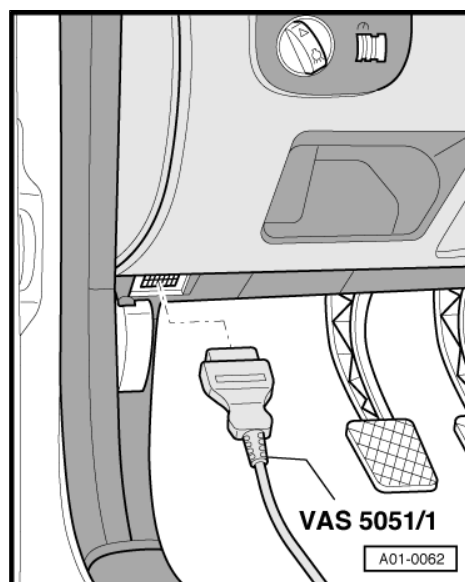
- ◆ Vehicle diagnostic, testing and information system -VAS 5051-

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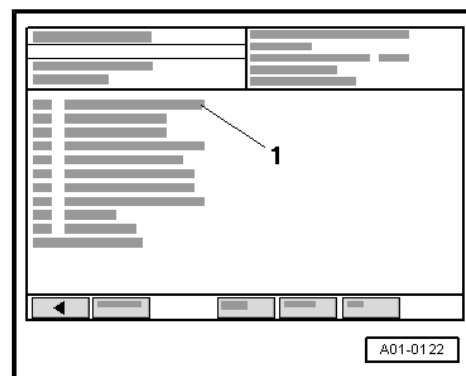
Procedure

- Coolant temperature at least 80 °C.
- Connect up vehicle diagnostic, testing and information system -VAS 5051- with diagnosis lead -VAS 5051/1- , press vehicle self-diagnosis key and select vehicle system "01 - Engine electronics". Engine must be idling.



Display on -VAS 5051 A- :

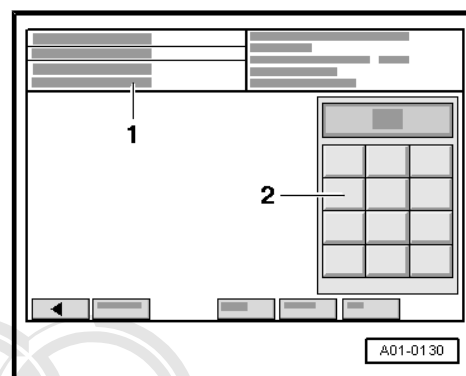
- From the selection menu -1- select diagnostic function "04 - Basic setting".



Display on -VAS 5051- :

1 - Enter display group

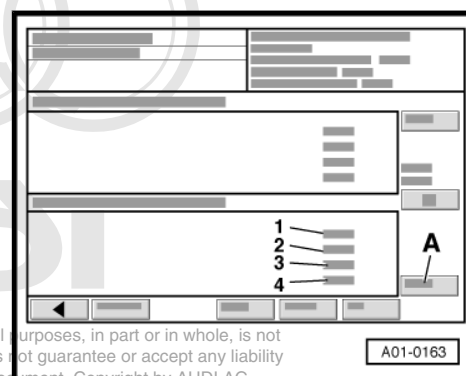
- Press keys **[9] [4]** on keypad -2- to select "Display group 094" and confirm entry by pressing key **[0]**.
- Increase engine speed to more than 1080 rpm.



Display on -VAS 5051- :

- Check display in zones -2- and -3-.

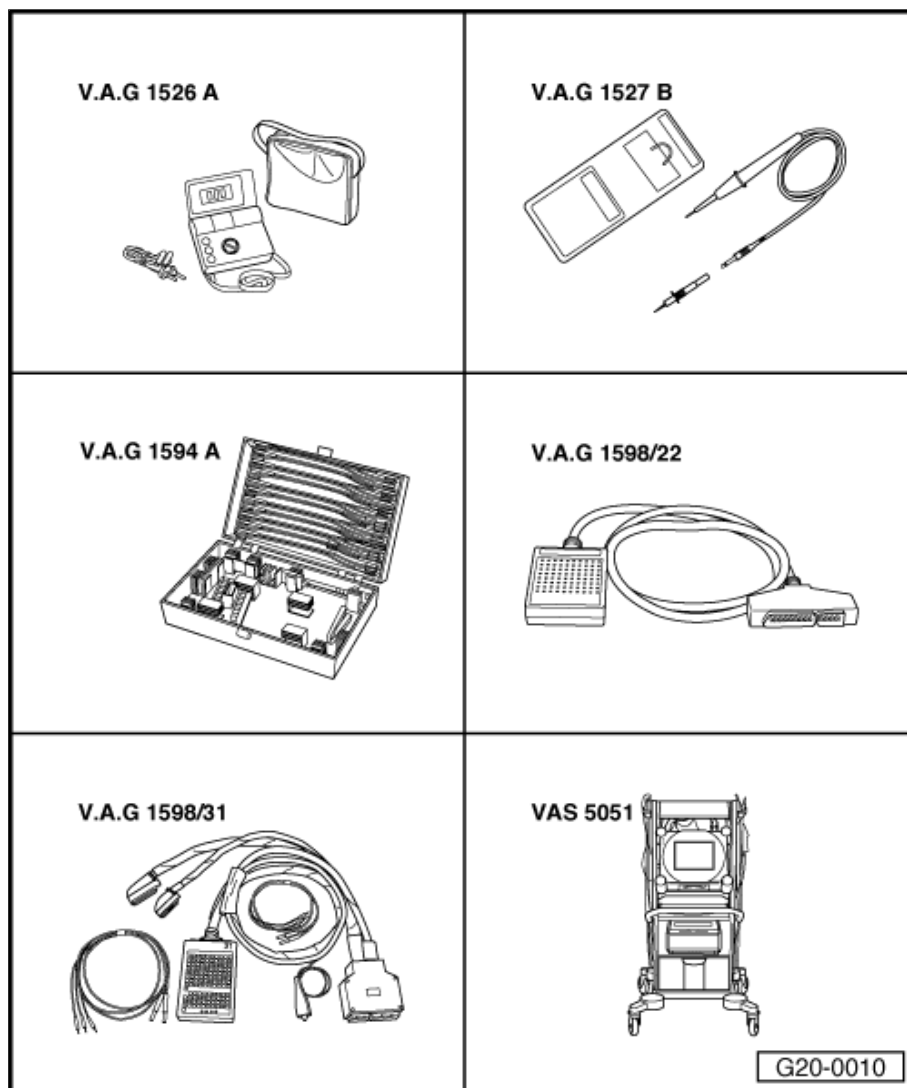
Display zones	Explanatory notes
2	... Variable valve timing • Specification: "CS-ctrl.OFF"
3	... Diagnosis of variable valve timing • Test OFF • Test ON • Specification: Syst. OK If readout shows "Syst.n.OK": check inlet camshaft control valve 1 -N205- => page 119 .



3.2 Checking inlet camshaft control valve 1 -N205-

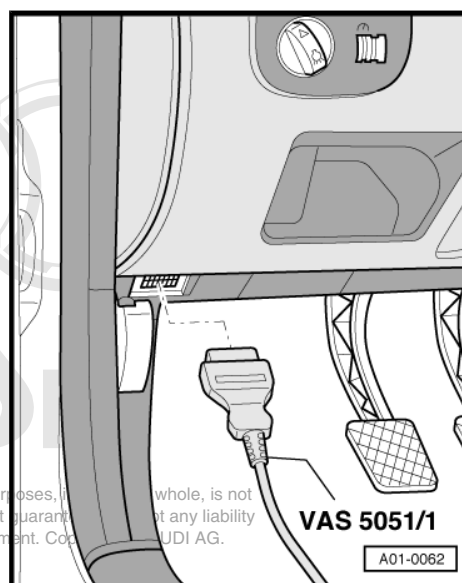
Special tools and workshop equipment required

- ◆ Hand-held multimeter - V.A.G 1526 C- 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-
- ◆ Adapter cable, 121-pin - V.A.G 1598/31- (test box)
- ◆ Vehicle diagnostic, testing and information system - VAS 5051-



Procedure

- Connect up vehicle diagnostic, testing and information system -VAS 5051- with diagnosis lead -VAS 5051/1-, press vehicle self-diagnosis key and select vehicle system "01 - Engine electronics". When doing this, the engine must be running at idling speed.



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Display on -VAS 5051- :

- From list -1-, select diagnosis function “02 - Interrogate fault memory”.

If the display shows a fault relating to inlet camshaft control valve 1 -N205- :

- Terminate function “02 - Interrogate fault memory” by touching  key.
- Press function “06 - end output” and switch off the ignition.

- Switch on ignition and select vehicle system “01 - Engine electronics”.

Display on -VAS 5051- :

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

- Press the  key repeatedly until the following display appears:

Display on -VAS 5051- (example):

A - 5th control element in test

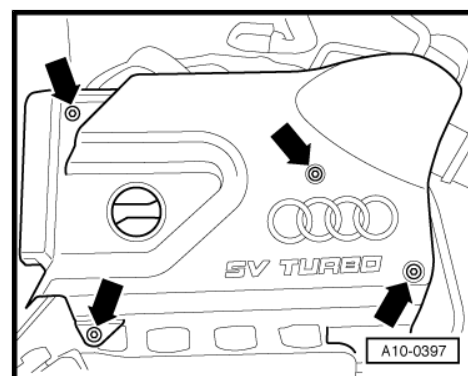
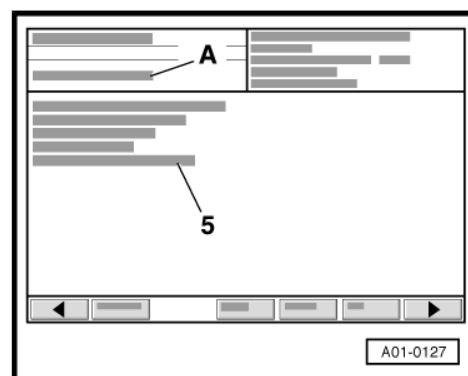
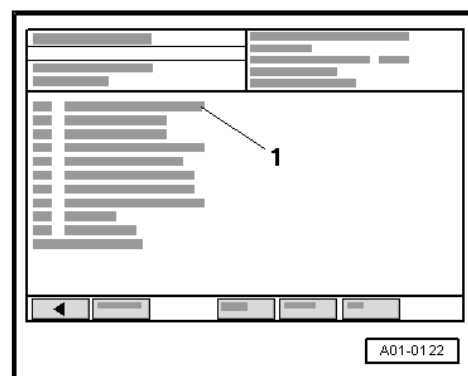
5 - Variable valve timing (camshaft adjustment)

- The valve is activated (clicks) intermittently for 1 minute unless the next control element is selected beforehand by touching the  key.
- Press the  key to exit from function “03 - Final control diagnosis”.
- Press function “06 - end output” and switch off the ignition.

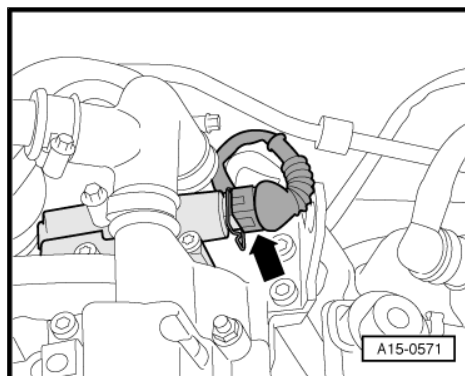
If the valve is not activated (does not click): part or in whole, is not permitted unless authorised by AUDI AG. AUDI AG does not guarantee or accept any liability with respect to the correctness of information in this document. Copyright by AUDI AG.

Checking internal resistance

- Take off engine cover panel -arrows-.



- Unplug electrical connector -arrow- at inlet camshaft control valve 1 -N205- .



- Connect hand-held multimeter -V.A.G 1526 C- to measure resistance between contacts on inlet camshaft control valve 1 -N205- .

- Specification: 10 ... 18 Ω .

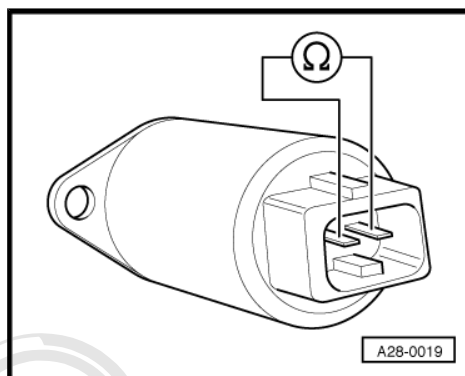
If specification is not obtained:

- Renew inlet camshaft control valve 1 -N205- .

If the specification is obtained:

Checking voltage supply

- Fuse for inlet camshaft control valve 1 -N205- OK $\Rightarrow$ Current flow diagrams, Electrical fault finding and Fitting locations.
- Fuel pump relay -J17- OK $\Rightarrow$ Current flow diagrams, Electrical fault finding and Fitting locations.



Note

The inlet camshaft control valve 1 -N205- is supplied with power via the fuel pump relay -J17- .

- Connect voltage tester -V.A.G 1527 B- between contact -1- of connector for inlet camshaft control valve 1 -N205- and engine earth “-”.
- Operate the starter briefly.
- The LED should light up.

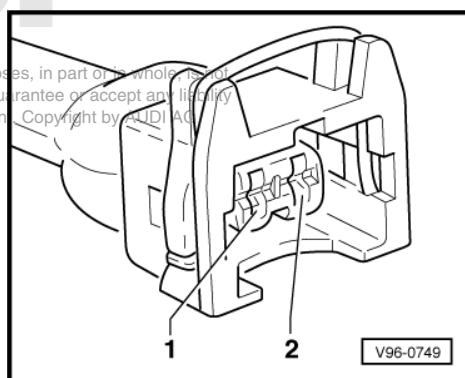
If LED does not light up:

- Check for open circuit in wiring from contact -1- of connector for inlet camshaft control valve 1 -N205- via fuse to fuel pump relay -J17- $\Rightarrow$ Current flow diagrams, Electrical fault finding and Fitting locations.
- Repair wiring connection if necessary.

If the LED lights up:

Checking activation

- Connect voltage tester -V.A.G 1527 B- between contact -1- and -2- of connector for inlet camshaft control valve 1 -N205- .
- Switch on ignition and select vehicle system “01 - Engine electronics”.
- Repeat function “03 - Final control diagnosis”.



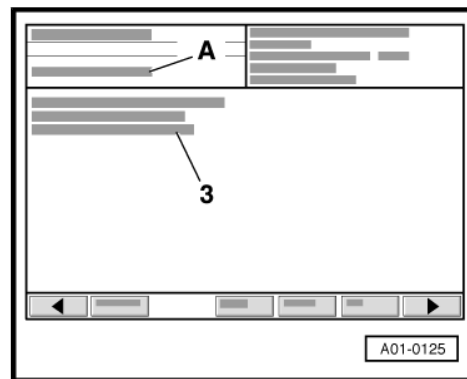
- Press the  key repeatedly until the following display appears:

Display on -VAS 5051- (example):

A - 3rd control element in test

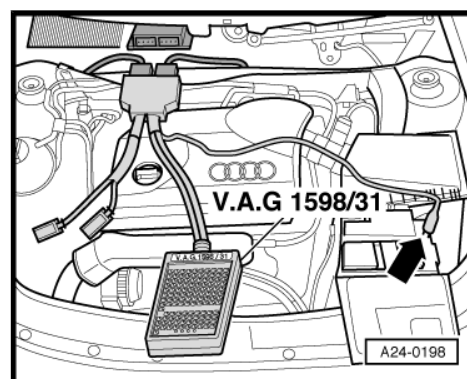
3 - Variable valve timing

- The LED should flash.
- Press the  key to exit from function “03 - Final control diagnosis”.
- Press function “06 - End output”.
- Switch off ignition and detach diagnostic connector.



If the LED does not flash or lights up continuously:

- Connect adapter cable -V.A.G 1598/31- (test box) to connectors of wiring harness; do not connect engine control unit. Connect earth clip of test box to earth -arrow- ⇒ Rep. Gr. 24 .



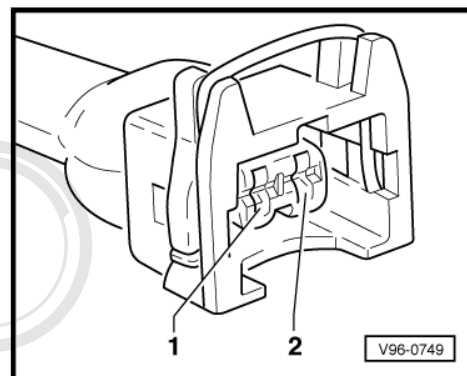
- Check for open circuit and short to positive or earth in the following wiring for inlet camshaft control valve -N205- .

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

- Repair wiring connection if necessary.

If no fault is found:

- Renew mechanical camshaft adjuster
⇒ [“2.5 Removing and installing camshafts and hydraulic chain tensioner/camshaft adjuster”, page 102](#) .



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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 and pressure relief valve ⇒ [page 125](#).

Viscosity grades and oil specifications ⇒ Maintenance ; Booklet 806 .

Oil capacities ⇒ Maintenance tables

1.1 Lubrication system - exploded view of components

1 - Oil pump

- ☐ With pressure relief valve (12 bar)
- ☐ Removing and installing ⇒ [page 129](#)
- ☐ Before installing, check that the two dowel sleeves ⇒ [Item 9 \(page 125\)](#) for centring oil pump/cylinder block are fitted.
- ☐ Renew if running surfaces and gears are scored
- ☐ Tightening torque for oil pump cover to oil pump housing: 10 Nm

2 - Chain sprocket for oil pump

- ☐ Sprocket can only be fitted on oil pump shaft in one position.

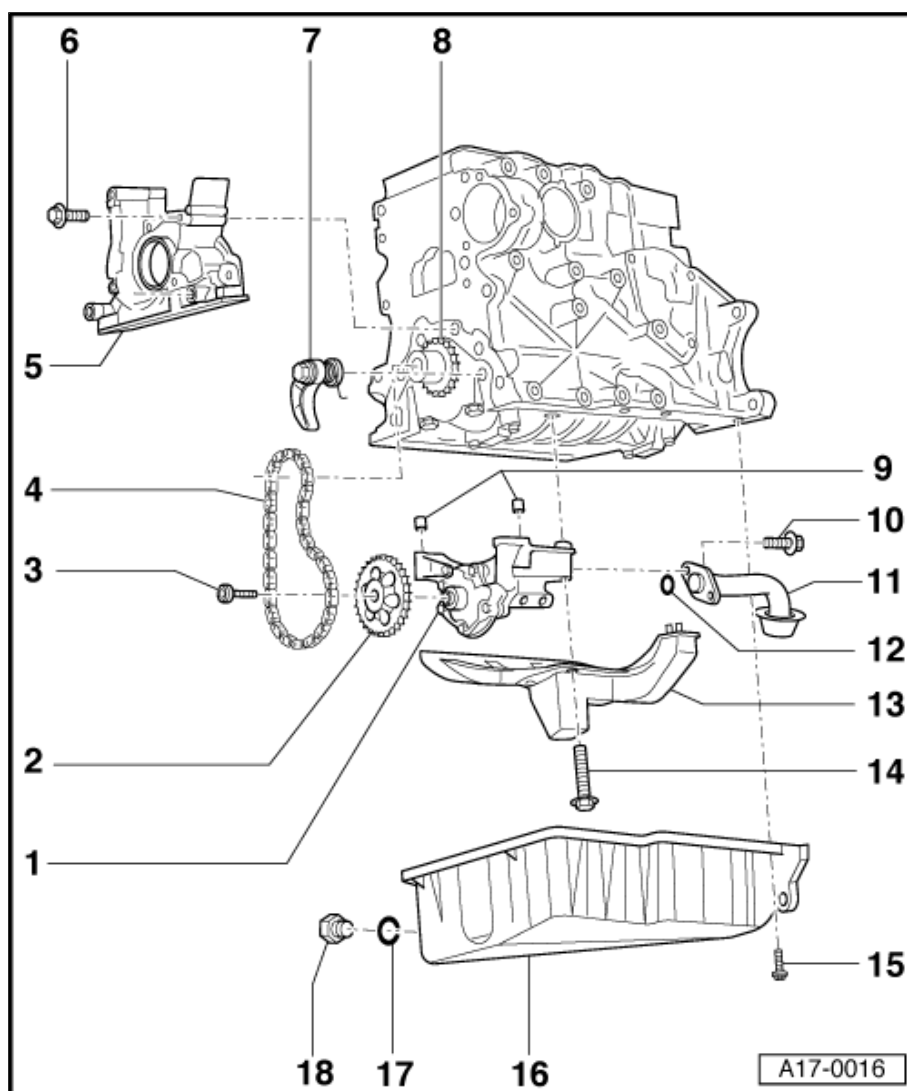
3 - 22 Nm

4 - Drive chain for oil pump

- ☐ Mark direction of rotation before removing
- ☐ Check for wear

5 - Sealing flange

- ☐ Apply sealant prior to installing ⇒ [page 60](#)
- ☐ Renewing crankshaft oil seal - pulley end ⇒ [page 58](#)



6 - 15 Nm**7 - Chain tensioner**

- ☐ Tighten to 16 Nm
- ☐ Do not dismantle
- ☐ Renew only as complete unit
- ☐ Note installation position
- ☐ When installing, pre-tension spring and engage

8 - Drive chain sprocket for oil pump

- ☐ Removing and installing ⇒ [page 68](#)

9 - Dowel sleeves

- ☐ 2 x

10 - 15 Nm**11 - Suction pipe**

- ☐ Clean strainer if dirty

12 - O-ring

- ☐ Renew

13 - Baffle plate**14 - 16 Nm****15 - 15 Nm****16 - Sump**

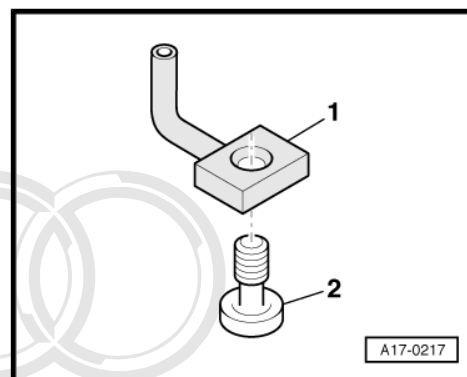
- ☐ Removing and installing ⇒ [page 125](#)
- ☐ Install using sealant; sealant ⇒ Parts catalogue

17 - Seal

- ☐ Renew

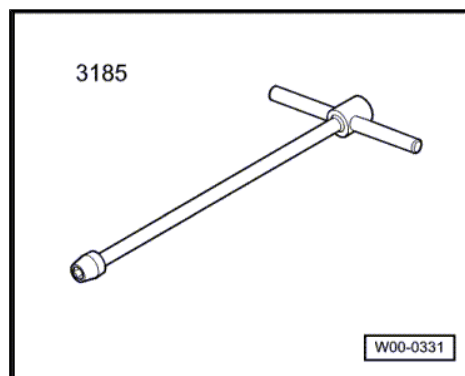
18 - Oil drain plug, 30 Nm**Oil spray jet and pressure relief valve**

- 1 - Oil spray jet (for cooling of pistons)
- 2 - Bolt with pressure relief valve, 27 Nm
- Opening pressure: 2.5 ... 3.2 bar.

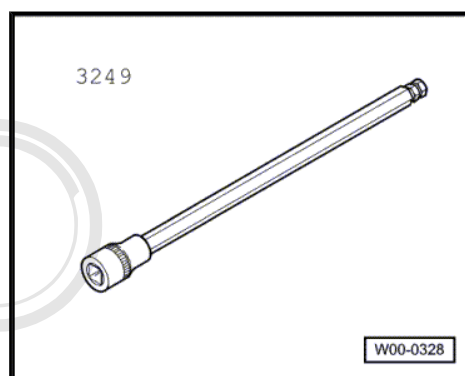
**1.2 Removing and installing sump****Special tools and workshop equipment required**

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- ◆ Jointed spanner -3185-



- ◆ Hexagon key extension, 5 mm -3249-



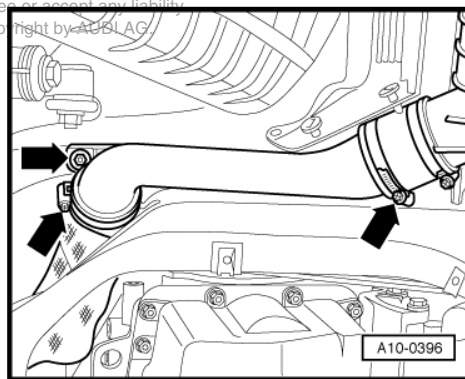
- ◆ Electric drill with plastic brush attachment

- ◆ Safety goggles

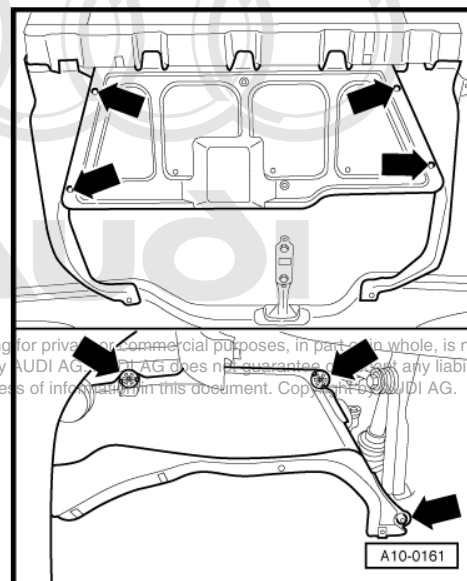
- ◆ Sealant ⇒ [Parts catalogue](#)

Removing

- Disconnect air pipe at bottom of right-hand longitudinal member -arrows- (air pipe leads to charge air cooler).

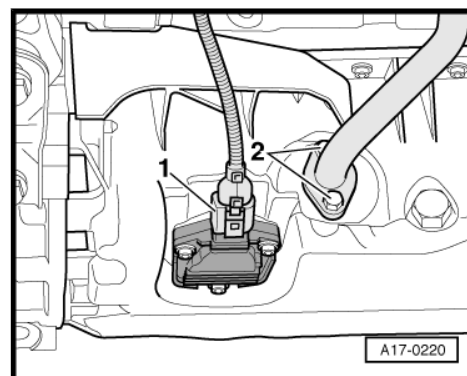


- Remove noise insulation panels (centre and right) -arrows-.
- Drain engine oil ⇒ Maintenance ; Booklet 806 .



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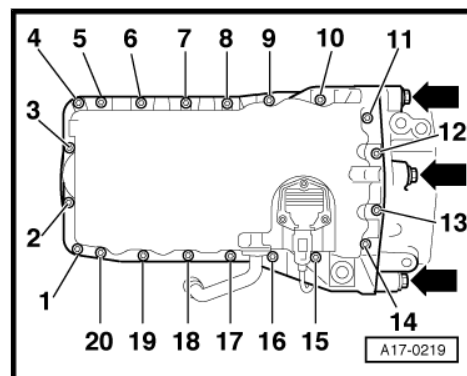
- If fitted, unplug electrical connector -1- at oil level and oil temperature sender -G266- .
- Unscrew bolts -2- on oil return pipe for turbocharger.



- Unscrew sump/gearbox bolts -arrows-.
- Slacken sump bolts -1 ... 20- in diagonal sequence using jointed spanner -3185- .
- Use hexagon key extension, 5 mm -3249- to remove sump bolts.
- Take off sump; if necessary loosen it by striking lightly with a rubber hammer.

Installing

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



Note

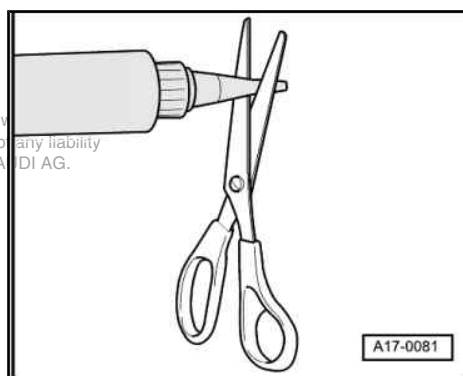
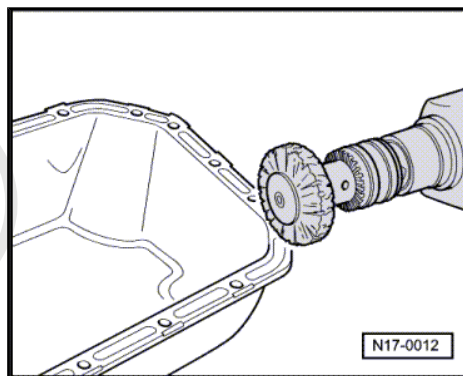
- ◆ *Renew seals and gaskets.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- Carefully remove sealant residue from cylinder block.



WARNING

Wear safety goggles.

- Remove sealant residue from sump, e.g. with rotating plastic brush or similar.
- Clean sealing surfaces; they must be free of oil and grease.
- Cut off tube nozzle at front marking (nozzle approx. 2 mm Ø).

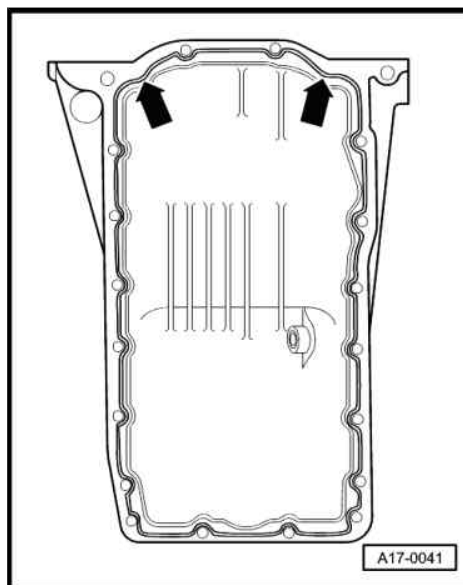


- Apply bead of sealant onto the clean sealing surface of the sump as shown in the illustration.
- Thickness of sealant bead: 2 ... 3 mm
- Take particular care when applying sealant bead in area of rear sealing flange -arrows-.



Note

- ◆ *The illustration shows the position of the sealant bead on the cylinder block.*
- ◆ *The sealant bead must not be thicker than specified, otherwise excess sealant could enter the sump and clog the strainer in the oil pump.*
- ◆ *The sump must be installed within 5 minutes after applying sealant.*



– Fit sump and tighten bolts as follows:

1. Pre-tighten bolts -1 ... 20- in diagonal sequence to 5 Nm.
2. Tighten bolts securing sump to gearbox -arrows-; tightening torque and differing tightening torque according to gearbox type ⇒ [page 129](#).
3. Tighten bolts -1 ... 20- in diagonal sequence to 15 Nm.



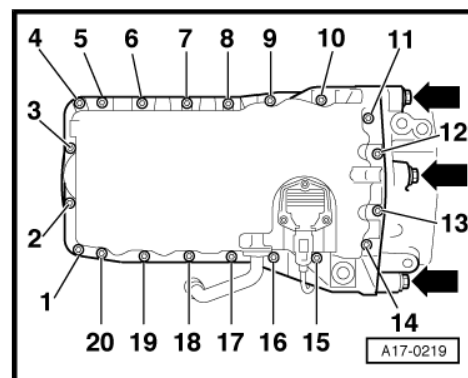
Note

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

– Fill up with engine oil and check oil level ⇒ [page 133](#).

Tightening torques

Component	Nm
Sump to: Cylinder block	15
Manual gearbox 02J	45
Manual gearbox 02M	40 ¹⁾
Automatic gearbox 01M, 09A	45
Oil return pipe to sump	10
Oil drain plug	30
• ¹⁾ Renew bolts.	



1.3 Removing and installing oil pump

Removing

- Remove sump ⇒ [page 125](#).
- Remove baffle plate.
- Remove bolt -2-.
- Pull chain sprocket off oil pump shaft.
- Unscrew bolts -1- and -3- and remove oil pump.

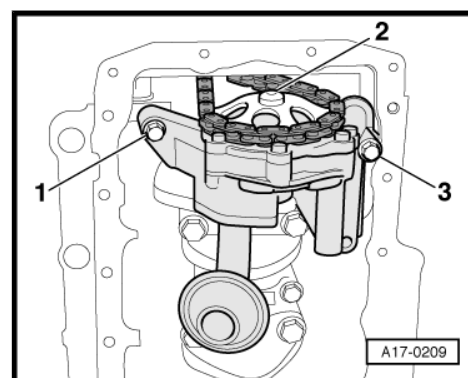
Installing

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

- Insert dowel sleeves ⇒ [Item 9 \(page 125\)](#) at top of oil pump.
- Chain sprocket can only be fitted on oil pump shaft in one position.
- Install sump ⇒ [page 127](#).

Tightening torques

Component	Nm
Chain sprocket to oil pump shaft	22
Oil pump to cylinder block	16



1.4 Oil filter and oil cooler - exploded view of components

1 - Screw plug, 40 Nm
2 - Seal

- ☐ Renew

3 - Spring

- ☐ For pressure relief valve, approx. 4 bar

4 - Piston

- ☐ For pressure relief valve, approx. 4 bar

5 - Gasket

- ☐ Renew

6 - Oil retention valve

- ☐ Tighten to 8 Nm
- ☐ Integrated into oil filter bracket

7 - O-ring

- ☐ Renew
- ☐ Slip on as far as collar of crankcase breather pipe
⇒ [Item 8 \(page 130\)](#)

8 - Crankcase breather pipe
9 - Retaining clip
10 - Screw plug, 15 Nm
11 - Seal

- ☐ If seal is leaking, cut open and renew

12 - 23 Nm
13 - Oil supply pipe

- ☐ To turbocharger

14 - Banjo bolt, 30 Nm
15 - Seals

- ☐ Renew

16 - Oil pressure switch -F1-

- ☐ Opening/closing pressure 1.4 bar
- ☐ Black insulation
- ☐ Checking ⇒ [page 131](#)
- ☐ Tighten to 25 Nm

17 - Seal

- ☐ If seal is leaking, cut open and renew

18 - 15 Nm + 90° (1/4 turn) further

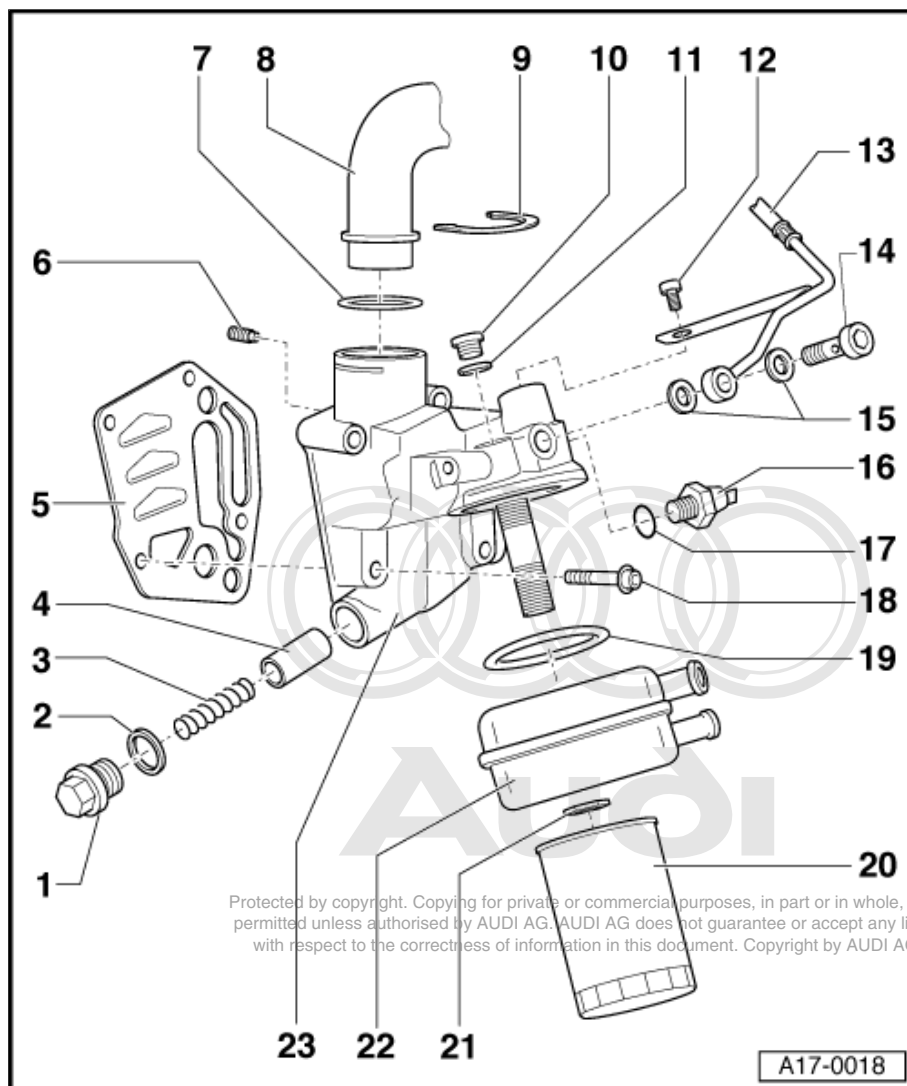
- ☐ Renew

19 - Seal

- ☐ Renew
- ☐ Engage in lugs on oil cooler

20 - Oil filter

- ☐ Observe change intervals ⇒ Maintenance ; Booklet 806
- ☐ Observe installation instructions on oil filter



- ☐ Tighten to 20 Nm

21 - 25 Nm

22 - Oil cooler

- ☐ See note ⇒ [page 124](#)
- ☐ Ensure clearance from surrounding components
- ☐ Diagram of coolant hose connections ⇒ [page 134](#)

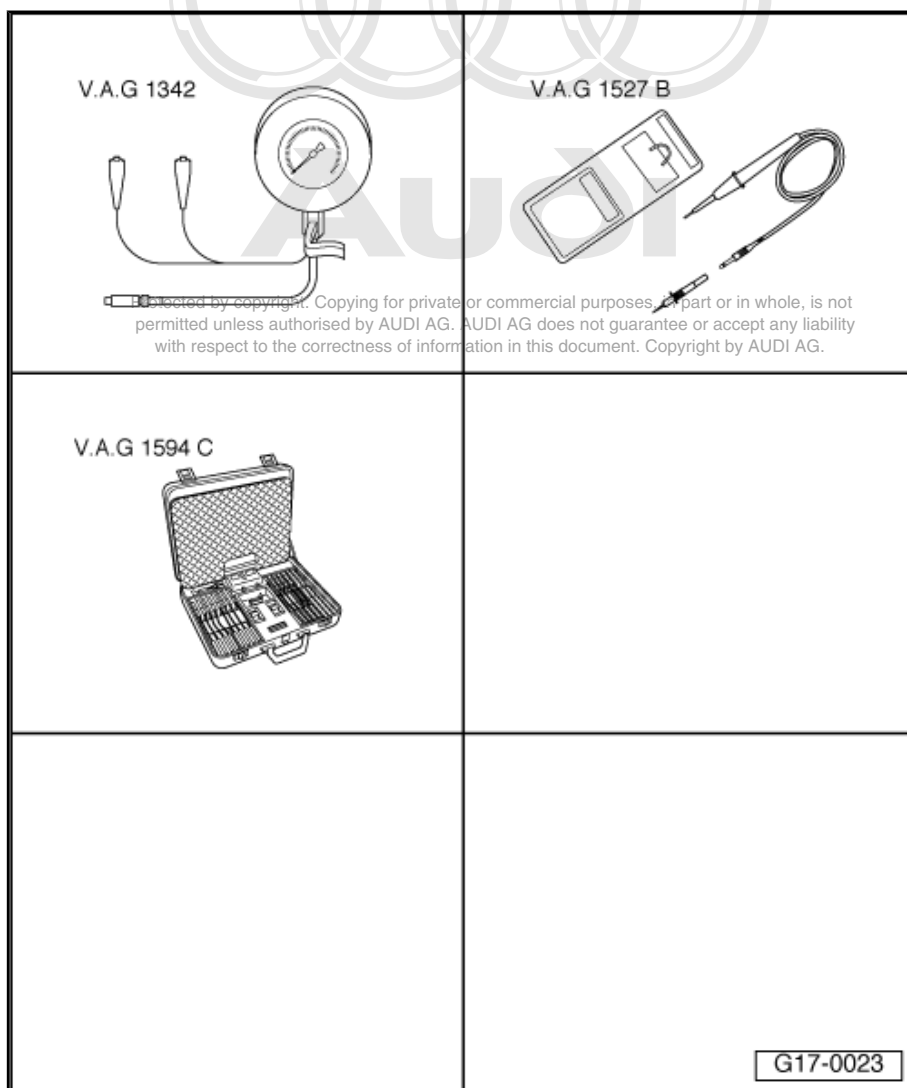
23 - Oil filter bracket

- ☐ With pressure relief valve, approx. 4 bar

1.5 Checking oil pressure and oil pressure switch -F1-

Special tools and workshop equipment required

- ◆ Oil pressure tester -V.A.G 1342- with adapter -V.A.G 1342/14-
- ◆ Voltage tester - V.A.G 1527 B-
- ◆ Auxiliary measuring set - V.A.G 1594 C-

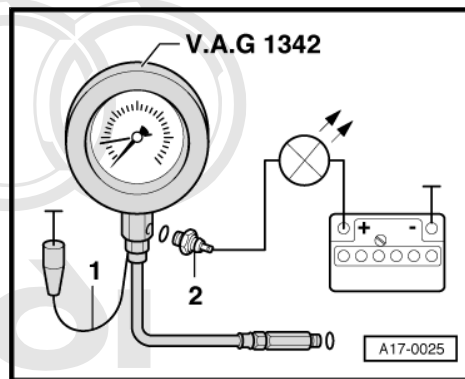


Procedure

- Oil level OK
- Engine oil temperature approx. 80 °C
- Oil pressure warning lamp -K3- should come on when ignition is switched on.
- On vehicles with driver information system (DIS), the display "OK" should light up.

Checking oil pressure switch

- Unplug electrical connector at oil pressure switch -F1- .
- Unscrew oil pressure switch -F1- .
- Connect oil pressure tester -V.A.G 1342- with adapter -V.A.G 1342/14- to bore for oil pressure switch.
- Screw oil pressure switch -2- into oil pressure tester -V.A.G 1342- .
- 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 ("+").



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- 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.

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

If LED does not light up:

- Renew oil pressure switch.

Checking oil pressure

- Start engine.
- Minimum oil pressure at idling speed: 1.3 bar
- Minimum oil pressure at 3500 rpm: 3.5 ... 4.5 bar.

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

- Renew oil pump ⇒ [page 129](#) .

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



Note

Renew seal for oil pressure switch.

Tightening torque

Component	Nm
Oil pressure switch to oil filter bracket	25

1.6 Engine oil

Viscosity grades and oil specifications ⇒ Maintenance ; Booklet 806 .

1.7 Checking oil level



Note

The oil level must not be above max. mark on dipstick - danger of damage to catalytic converter.

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.

Markings on oil dipstick:

a - Do not top up oil.

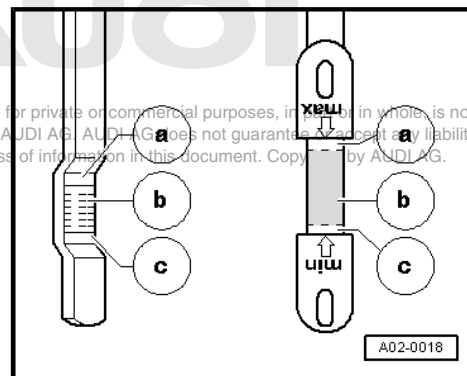
b - Oil may be topped up.

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



Note

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



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, seals and O-rings.*
- ◆ *When installing coolant hoses, route hoses so they are free of tension and do not come into contact with other components.*
- ◆ *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 hoses must align.*

1.1 Diagram of coolant hose connections



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1 - Radiator

- ☐ Removing and installing
⇒ [page 149](#)
- ☐ If renewed, refill system
with fresh coolant

2 - Oil cooler

- ☐ Removing and installing
⇒ [Item 22 \(page 131\)](#)

3 - Coolant pump/thermostat

- ☐ Removing and installing
coolant pump
⇒ [page 141](#)
- ☐ Removing and installing
thermostat ⇒ [page 142](#)
- ☐ Checking thermostat
⇒ [page 145](#)

4 - Cylinder head/cylinder block

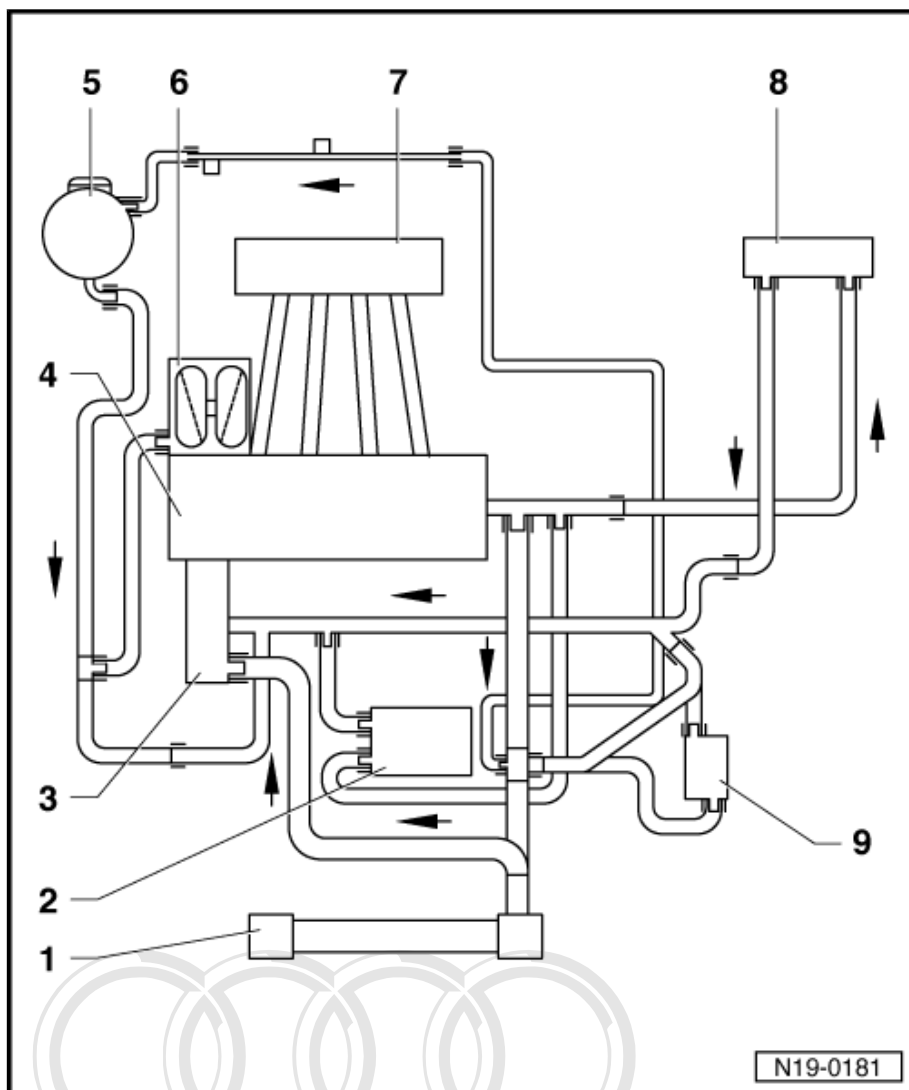
- ☐ If renewed, refill system
with fresh coolant

5 - Expansion tank

- ☐ With filler cap
- ☐ Checking pressure re-
lief valve in filler cap
⇒ [page 154](#)

6 - Turbocharger**7 - Intake manifold****8 - Heat exchanger**

- ☐ If renewed, refill system
with fresh coolant

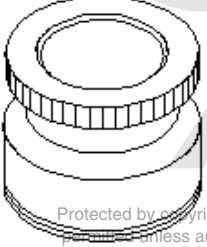
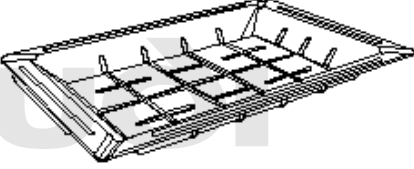
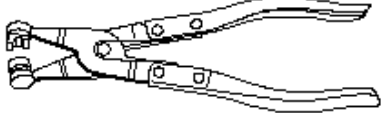
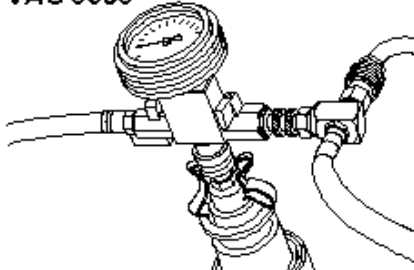
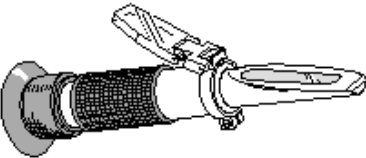
9 - Not fitted

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1.2 Draining and filling cooling system

Special tools and workshop equipment required

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

V.A.G 1274/8 	VAS 6208 
V.A.G 1921 	VAS 6096 
T10007 	G19-10005

Draining



Note

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

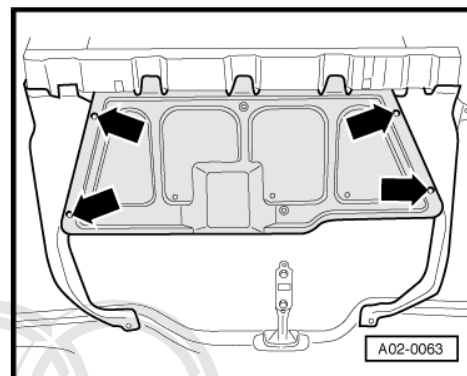


WARNING

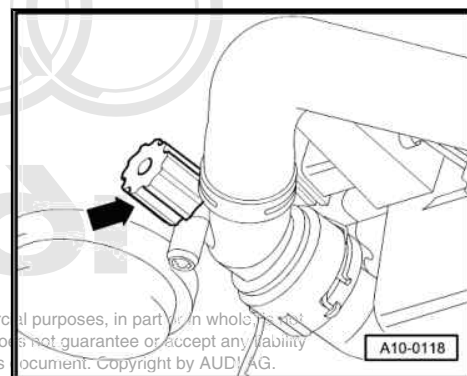
Hot steam or hot coolant can escape when expansion tank is opened; cover filler cap with cloth and open carefully.

- Open filler cap on coolant expansion tank.

- Unscrew bolts -arrows- and remove noise insulation.



- Place drip tray for workshop hoist -VAS 6208- under engine.
- Turn drain plug -arrow- on radiator anti-clockwise and drain coolant (attach hose to connection if necessary).



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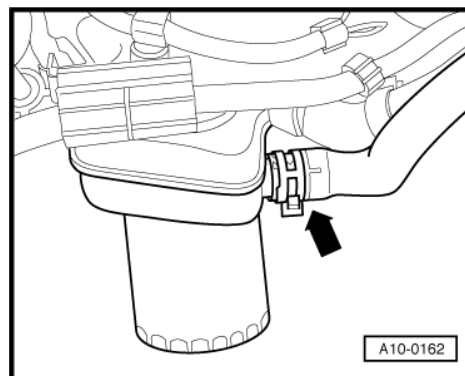
- Disconnect bottom coolant hose from oil cooler -arrow-, and drain off remaining coolant.

Filling

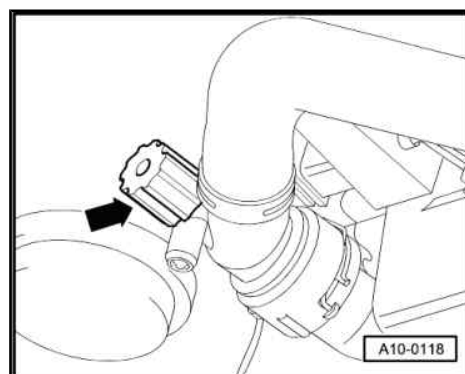


Note

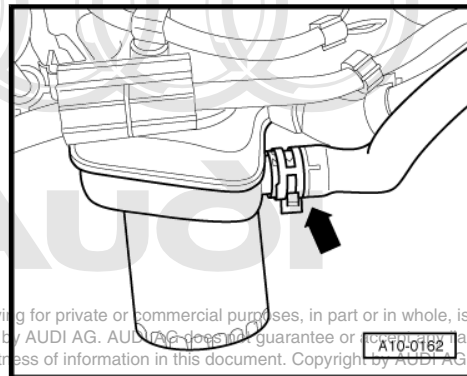
- ◆ The cooling system is filled all year round with a mixture of water and radiator antifreeze/anti-corrosion agent.
- ◆ It is important to use only coolant additive Plus -G 012 A8F A1- (also designated as "G12+") "meeting specification TL VW 774 F". Other coolant additives could seriously impair in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



- Close drain plug -arrow-.

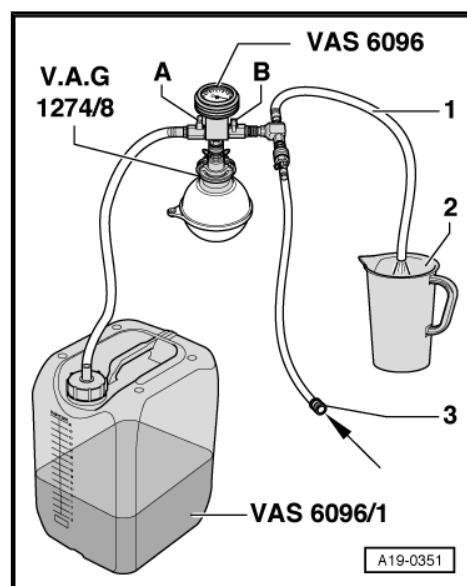


- Connect coolant hose at bottom of oil cooler -arrow-.



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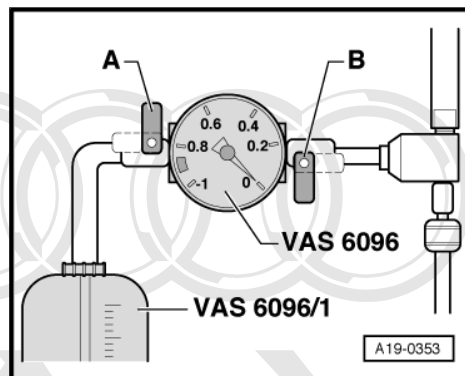
- Fill reservoir -VAS 6096/1- with at least 7 litres of premixed coolant (based on recommended ratio):
 - “G12+” (40 %) and water (60 %) for frost protection to –25 °C.
 - “G12+” (50 %) and water (50 %) for frost protection to –35 °C.
 - “G12+” (60 %) and water (40 %) for frost protection to –40 °C.
- Screw adapter for cooling system tester -V.A.G 1274/8- onto coolant expansion tank.
- Attach cooling system charge unit -VAS 6096- onto adapter -V.A.G 1274/8- .
- Run vent hose -1- into a small container -2-. (The vented air draws along a small amount of coolant, which should be collected.)
- Close the two valves -A- and -B- by setting lever at right angle to direction of flow.
- Connect hose -3- to compressed air.
- Pressure: 6 ... 10 bar.



- 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-.

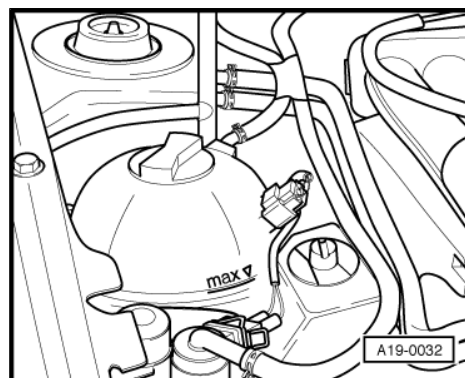
The partial vacuum in the cooling system causes the coolant to be drawn up out of the reservoir -VAS 6096/1- ; the cooling system is then filled.

- Check the coolant level and top up coolant as far as the “max” mark.
- Start engine, run for 2 minutes (maximum) at approx. 1500 rpm and top up coolant to overflow hole on expansion tank with engine running.
- Close coolant expansion tank.
- Run engine until radiator fan cuts in.
- Switch off ignition and allow to cool down.



WARNING

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

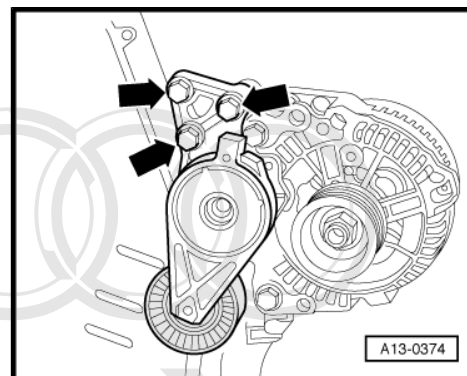


- Check coolant level.
- The coolant level must be at the “max” marking when the engine is cold.
- The coolant level can be above the “max” marking when the engine is warm.

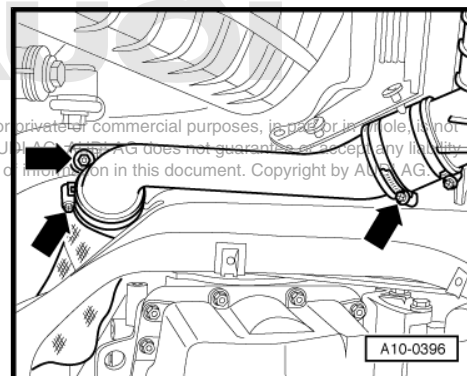
1.3 Removing and installing coolant pump

Removing

- Remove poly V-belt ⇒ [page 39](#) .
- Remove poly V-belt tensioner -arrows-.
- Remove toothed belt from camshaft sprocket ⇒ [page 53](#) .



- Disconnect air pipe at bottom of right-hand longitudinal member -arrows- (air pipe leads to charge air cooler).

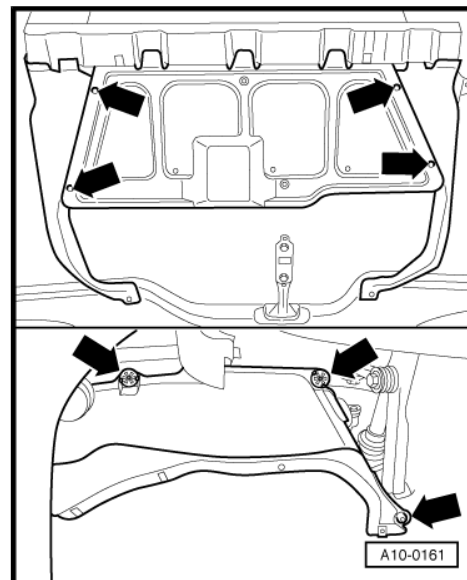


- Remove noise insulation panels (centre and right) -arrows-.
- Drain off coolant ⇒ [page 136](#) .
- Remove centre section of toothed belt cover
⇒ [Item 19 \(page 47\)](#) .



Note

- ◆ *Vibration damper and bottom section of toothed belt cover can remain installed.*
- ◆ *The toothed belt should be left in position on the crankshaft sprocket.*
- ◆ *Before removing coolant pump, cover toothed belt with a cloth to protect against coolant.*



- Remove bolts -1- and detach coolant pump -2-.

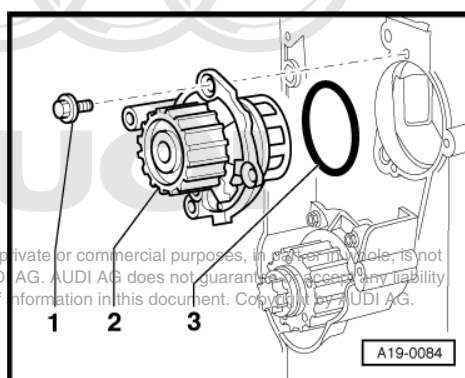
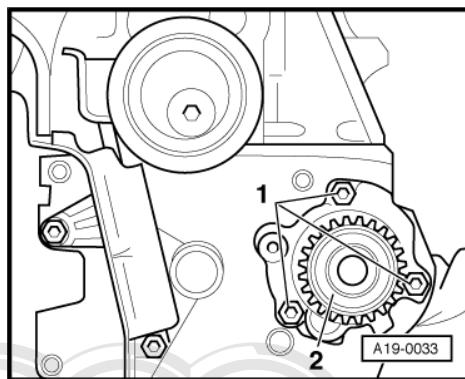
Installing

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



Note

- ◆ *Renew seals and gaskets.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- Clean and smoothen sealing surface for O-ring as required.
- Lubricate new O-ring -3- with coolant additive “G12+”.
- Fit coolant pump -2-.
- Sealing plug in housing faces downwards.
- Tighten bolts -1- for coolant pump.
- Install toothed belt (adjust valve timing) ⇒ [page 55](#) .
- Install poly V-belt ⇒ [page 39](#) .
- Fill cooling system ⇒ [page 138](#) .



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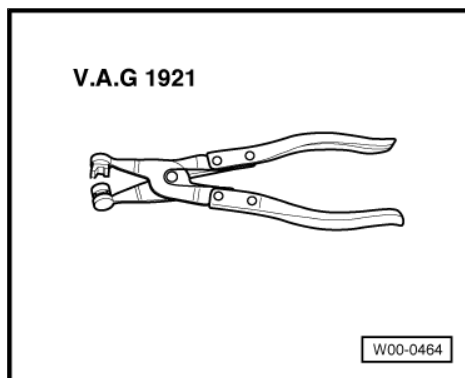
Tightening torques

Component	Nm
Coolant pump to cylinder block	15
Toothed belt cover (centre) to cylinder block	10 ¹⁾
Tensioner for poly V-belt to bracket for ancillaries	23
Hose clips for air hoses	3.5
• ¹⁾ Install using locking fluid; locking fluid ⇒ Parts catalogue .	

1.4 Removing and installing thermostat

Special tools and workshop equipment required

- ◆ Hose clip pliers -V.A.G 1921-



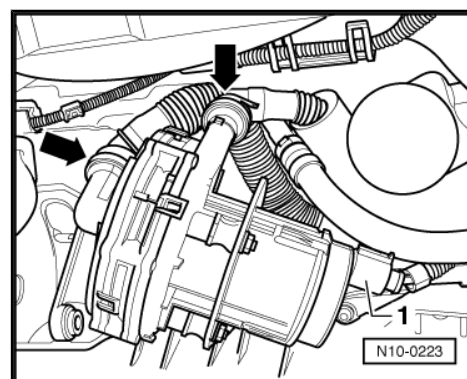
Removing



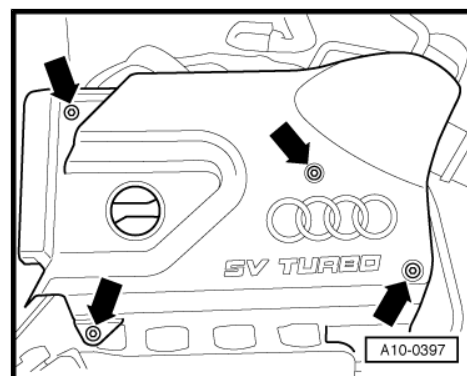
Note

The following description corresponds to the removal and installation on vehicles with electronic throttle and secondary air system. Some operations may not be required for earlier vehicles.

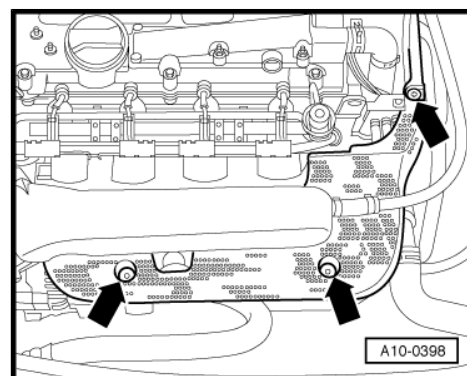
- Note (if necessary obtain) code on vehicles with coded radio / radio and navigation system (RNS).
- Disconnect earth wire at battery with ignition switched off.
- Drain off coolant ⇒ [page 136](#) .
- Disconnect hoses -arrows- at secondary air pump.



- Take off engine cover panel -arrows-.

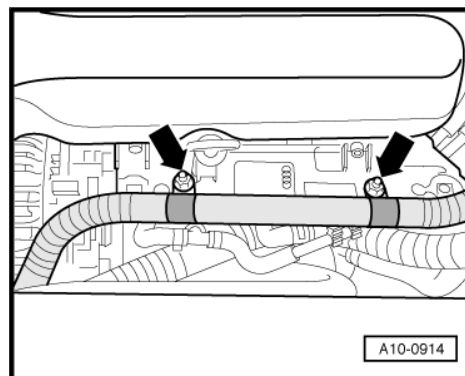


- Remove cover in front of intake manifold -arrows-.

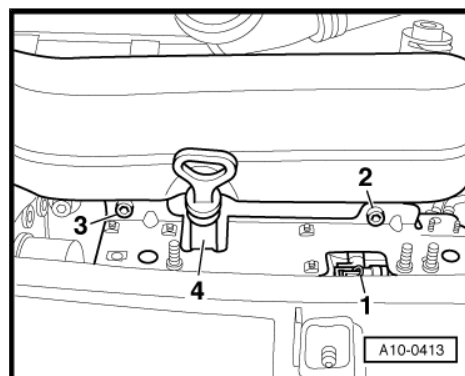


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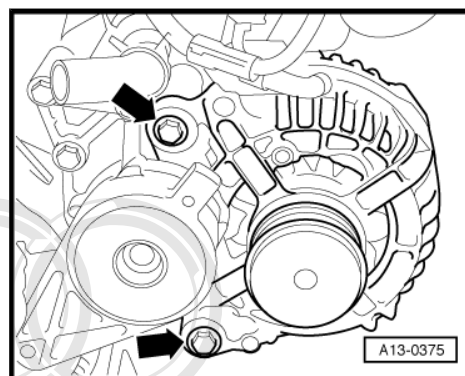
- Detach pipe for secondary air system from brackets on engine -arrows-.



- Remove bolts -2- and -3- and detach bracket for dipstick guide tube -4-.
- Unplug connectors -1- for turbocharger air recirculation valve -N249- and secondary air inlet valve -N112- on underside of retainer for electrical change-over valves.
- Detach vacuum hose going to electrical change-over valves at intake manifold.
-
- Move bracket clear to the side.



- Slacken poly V-belt ⇒ [page 39](#) and detach belt from alternator pulley.
- Unbolt alternator -arrows- and move clear to the front. The electrical wires remain connected.



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- Detach coolant hose from hose connection -3-.
- Unscrew bolts -4- and remove hose connection with O-ring -2- and thermostat -1-.

Installing

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



Note

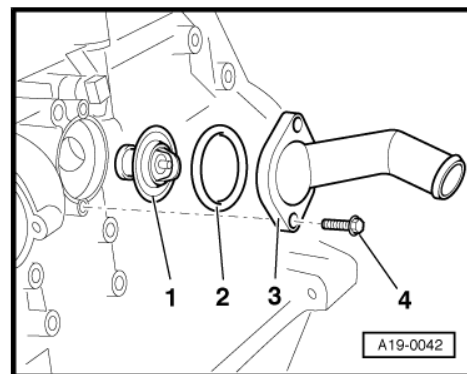
Renew seals and gaskets.

- Clean and smoothen sealing surface for O-ring as required.
- Insert thermostat.
- Cross-piece on thermostat should be vertical.
- Moisten new O-ring with coolant additive "G12+".
- Install alternator ⇒ Rep. Gr. 27 .
- Install poly V-belt ⇒ [page 39](#) .
- Fill cooling system ⇒ [page 138](#) .



Note

- ◆ *When the battery is reconnected, please ensure that the vehicle equipment (e.g. radio, radio/navigation system, clock, electric window lifters) is activated as described in the operating instructions.*
- ◆ *For further operations after reconnecting power supply, refer to ⇒ Rep. Gr. 24 .*



Tightening torque

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Component	Nm
Hose connection to cylinder block	15

1.5 Checking thermostat

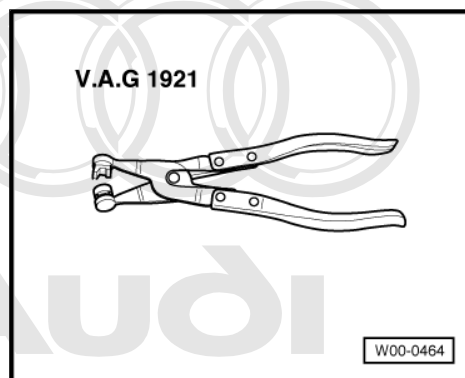
- Thermostat removed.
- Heat up the thermostat in a tub of water.

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

1.6 Removing and installing coolant pipe

Special tools and workshop equipment required

- ◆ Hose clip pliers -V.A.G 1921-



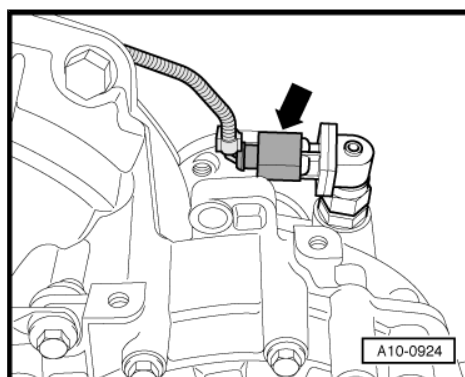
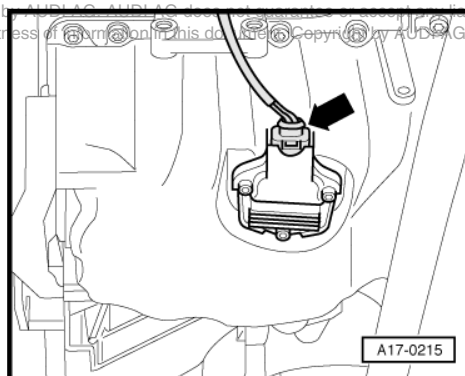
Removing



Note

The following description corresponds to the removal and installation on vehicles with electronic throttle and secondary air system. Some operations may not be required for earlier vehicles.

- Drain off coolant ⇒ [page 136](#) .
- If fitted, unplug electrical connector -arrow- at oil level and oil temperature sender -G266- .
- Unplug electrical connector -arrow- at speedometer sender -G22- on gearbox and move wiring clear.
- Remove intake manifold ⇒ [page 87](#) .



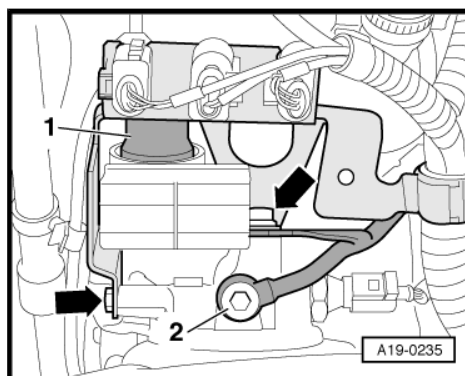
- Unbolt retaining plate for electrical connectors from oil filter bracket -arrows-.



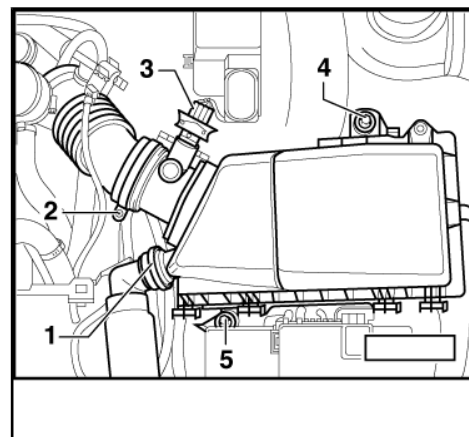
Note

The electrical connectors remain attached.

- Disconnect oil pipe -2- from oil filter bracket.
- Disengage clip and detach crankcase breather pipe -1- from oil filter bracket.
- Seal opening.
- Detach knock sensor on left of cylinder block.



- Detach air intake hose -1- leading to secondary air pump at air cleaner housing.
- Release hose clip -2- and detach air duct from air mass meter -G70-.
- Unplug electrical connector at air mass meter -G70- -item 3-.
- Unscrew bolts -4- and -5- and remove air cleaner housing.

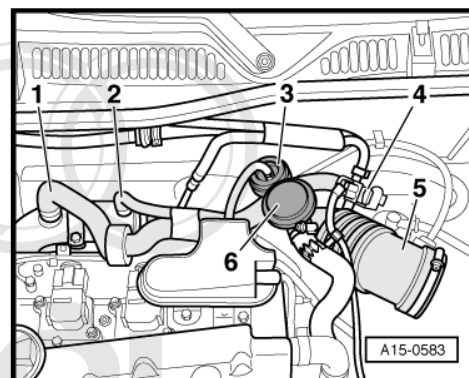


- Detach mechanical air recirculation valve -3-, pressure control valve for crankcase breather -6- and charge pressure control solenoid valve -N75- -item 4- from air duct.
- Pull locking clip out at turbocharger connection and detach air duct -5-.

**Note**

Seal off opening in turbocharger intake system with a clean cloth.

- Disconnect coolant hose from coolant pipe (hose leads to heat exchanger for heater).

**Vehicles with automatic gearbox 01M:**

- Unplug electrical connectors:
 - 1 - To solenoid valves
 - 2 - To vehicle speed sender -G68-

**Note**

Disregard items marked -3- and -4-.

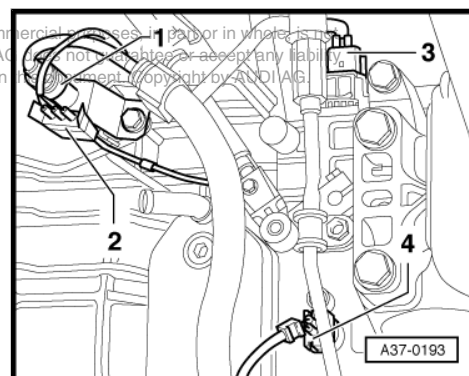
All models:

- Detach coolant flange on left of cylinder head.

**Note**

Leave hoses and electrical connector in position.

- Detach all hoses from coolant pipe.
- Move wiring clear at coolant pipe.
- Unbolt coolant pipe from cylinder block.



- Pull coolant pipe -2- out of connection on cylinder block.

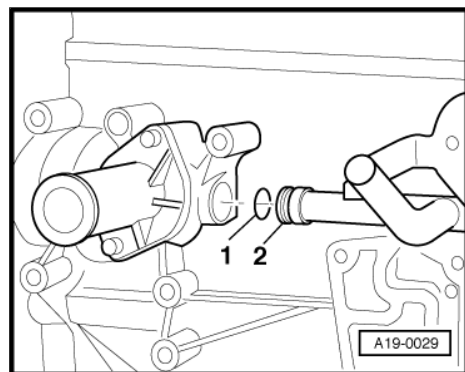
Installing

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



Note

- ◆ *Always renew seals and gaskets.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- Clean and smoothen sealing surface for O-ring as required.
- Lubricate new O-ring -1- with coolant additive “G12+” and push onto coolant pipe -2-.
- Push coolant pipe into connection on cylinder block.
- Install intake manifold ⇒ [page 87](#) .
- Fill cooling system ⇒ [page 138](#) .



Tightening torques

Component		Nm
Coolant pipe to cylinder block	M7	15
	M8	25
Knock sensor to cylinder block		20
Retaining plate for electrical connectors to oil filter bracket	M6	10
	M8	20
Oil supply pipe to oil filter bracket	M8	23
Banjo bolt		30
Coolant flange to cylinder head		10

1.7 Radiator and radiator fan - exploded view of components

1 - Radiator

- ☐ Removing and installing
⇒ [page 149](#)
- ☐ If renewed, change
coolant in entire system

2 - O-ring

- ☐ Renew

3 - Coolant hose (top)**4 - Radiator cowl****5 - 10 Nm****6 - Auxiliary radiator fan**

- ☐ Depending on equip-
ment

7 - Fan ring**8 - Retaining clip****9 - Electrical connector****10 - Radiator fan -V7-****11 - Retainer**

- ☐ For electrical connector

12 - Coolant hose (bottom)

- ☐ To connection for ther-
mostat

13 - O-ring

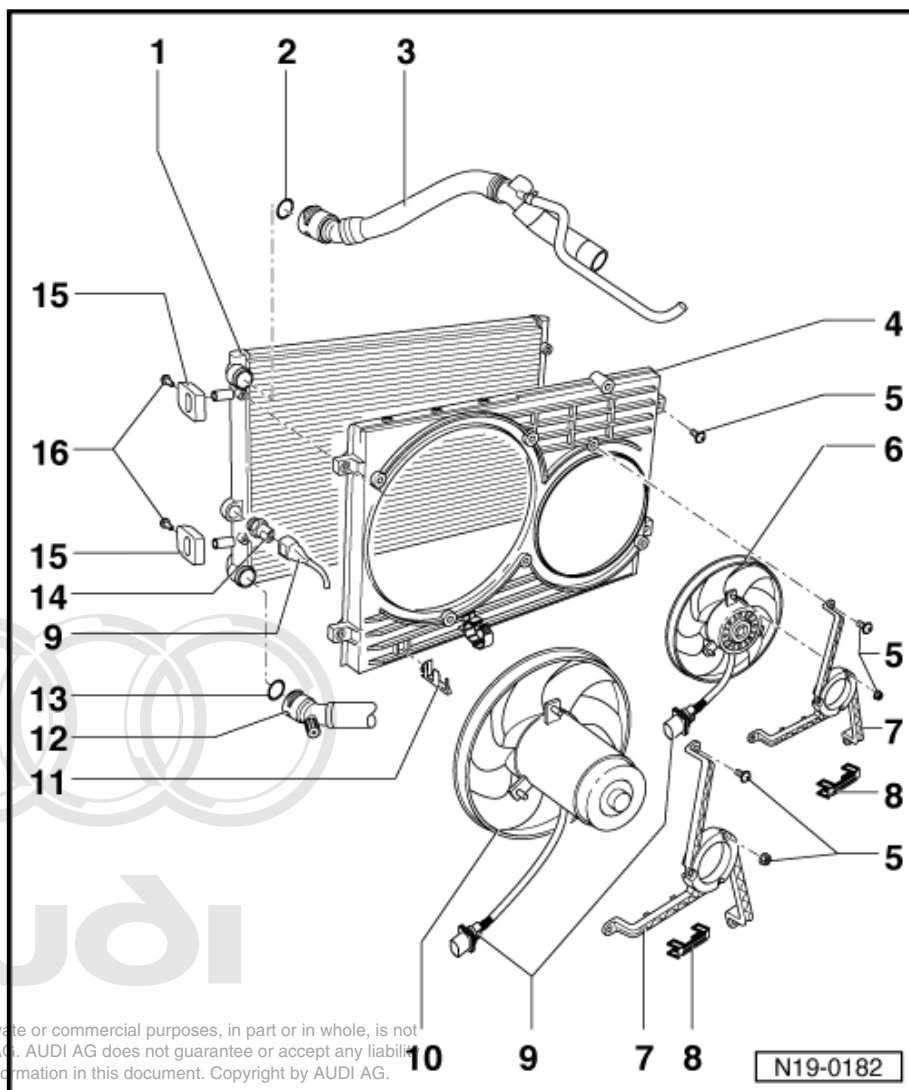
- ☐ Renew

**14 - Radiator fan thermal
switch -F18-**

- ☐ Switching tempera-
tures: 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

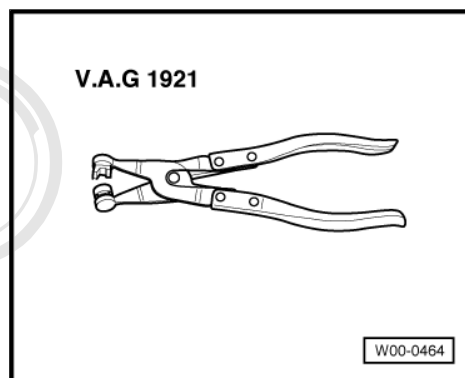
15 - Mounting for radiator

- ☐ Note installation position

16 - 15 Nm**1.8 Removing and installing radiator**

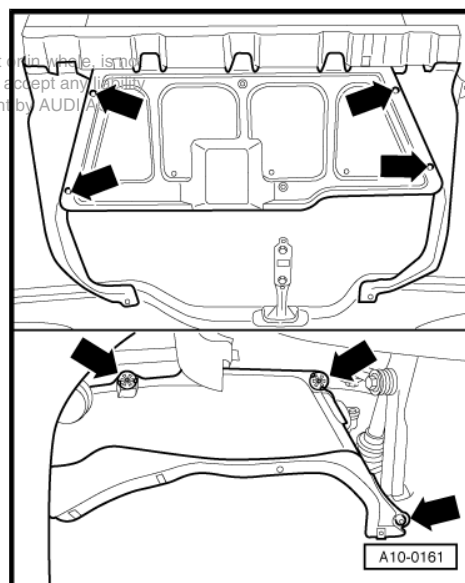
Special tools and workshop equipment required

- ◆ Hose clip pliers -V.A.G 1921-

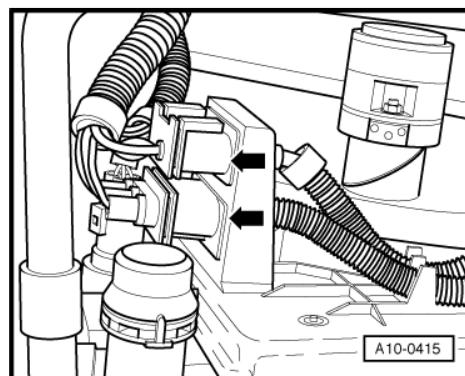


Removing

- Remove noise insulation panels (centre, left and right) -arrows-.
- Drain off coolant ⇒ [page 136](#) .



- Detach electrical connectors -arrows- for radiator fan on bottom left of radiator cowl.



- Unplug electrical connector -2- at radiator fan thermal switch -F18-.

Vehicles with air conditioning:



WARNING

The air conditioner refrigerant circuit must not be opened.



Note

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

- Detach refrigerant line -1- from radiator.

All models:

- Remove top coolant hose -1- at radiator.
- Remove bumper cover (front) ⇒ Rep. Gr. 63.

Vehicles with air conditioning:



WARNING

The air conditioner refrigerant circuit must not be opened.



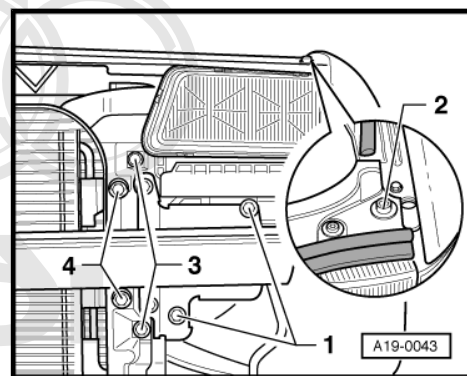
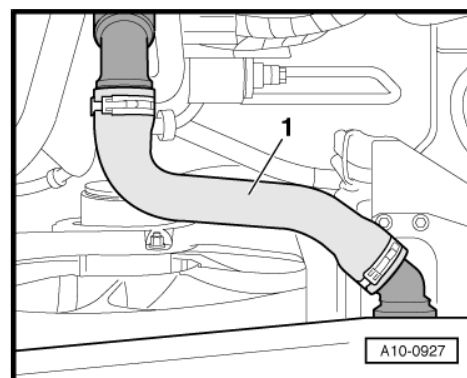
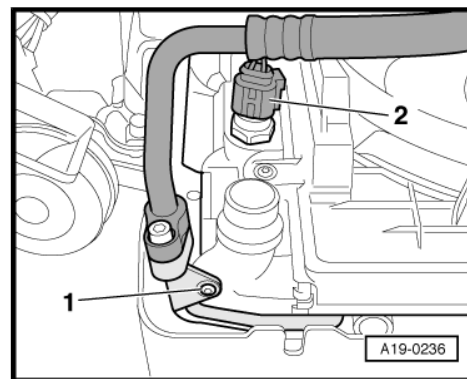
Note

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

- Remove bolts -4- for condenser.
- Tie up condenser to lock carrier with wire.

All models:

- Remove bolts -3- at radiator.
- Unscrew bolts -1- for lock carrier.
- Slacken bolts -2- two turns.
- Carefully move lock carrier to front as far as possible (2nd mechanic required) and remove radiator with radiator fan downwards.



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Installing

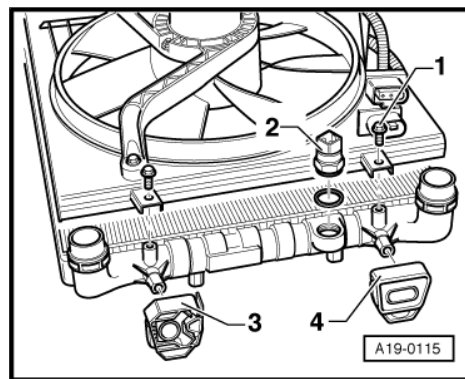
Installation is carried out in the reverse order; note the following:



Note

Renew O-rings in coolant hose connections.

- Fit mountings -3- and -4- on radiator as illustrated.
- Fit securing bolts for radiator (the help of a 2nd mechanic is required).
- Install lock carrier with attachments ⇒ Rep. Gr. 50 .
- Install bumper cover (front) ⇒ Rep. Gr. 63 .
- Fill cooling system ⇒ [page 138](#) .



Tightening torques

Component	Nm
Radiator cowl to radiator	10
Radiator fan thermal switch -F18- to radiator	35
Refrigerant line to radiator	10
Condenser to radiator	10
Radiator to lock carrier	15
Hose clips for coolant hoses	2

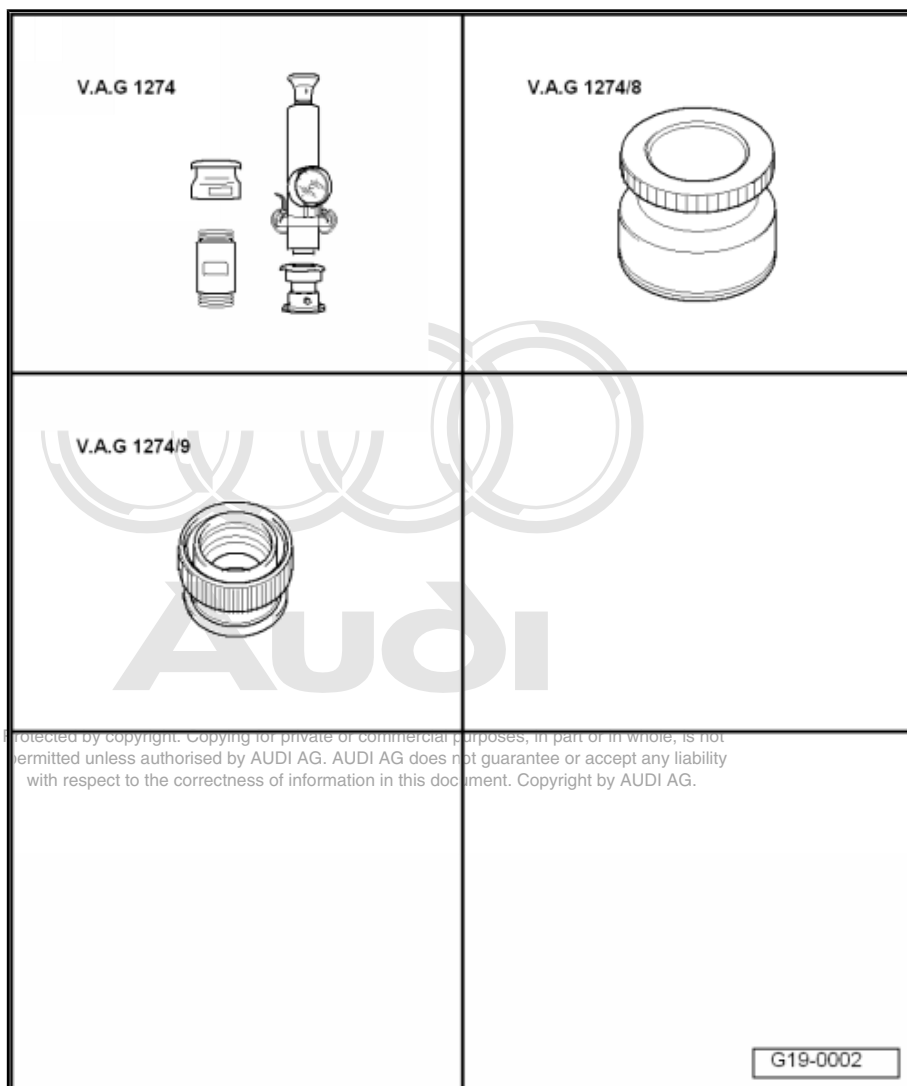
1.9 Checking cooling system for leaks



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Special tools and workshop equipment required

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

**Procedure**

- Engine must be warm.

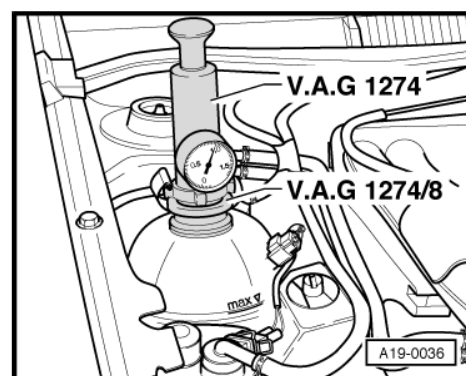
**WARNING**

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

- Open filler cap 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:

- Locate leak and eliminate fault.



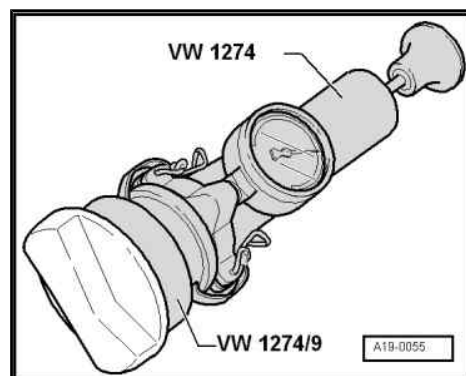


Checking pressure relief valve in filler cap

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

If the relief valve does not open as described:

- Renew filler cap.



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21 – Turbocharging/supercharging

1 Charge air system with turbocharger

Note

- ◆ *Observe rules for cleanliness ⇒ [page 184](#) .*
- ◆ *Before carrying out tests or repair work, make sure that all pipes and hoses are securely connected and that there are no leaks.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly. Do NOT use lubricant.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ *Parts catalogue*.*
- ◆ *Charge air system must be free of leaks.*

1.1 Safety precautions

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



WARNING

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

1.2 Test requirements for checking turbocharging

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- Coolant temperature at least 80 °C.
- Fault memory of engine control unit interrogated.
- No leaks in the intake and exhaust systems. Effects of leaks ⇒ [page 159](#) .
- No leaks in vacuum hoses.
- Vacuum pipe to charge pressure regulating valve not obstructed, loose or leaking.
- No faults on engine or injection system (e.g. compression pressure or injectors).

1.3 Diagram of connections for charge pressure control system

Vehicles with throttle cable

1 - Breather pipe

- ☐ From fuel tank

2 - Activated charcoal filter

- ☐ With activated charcoal filter system solenoid valve 1 -N80-

3 - Turbocharger

- ☐ Checking charge pressure ⇒ [page 160](#)

4 - Non-return valve

- ☐ Between activated charcoal filter and intake pipe upstream of turbocharger
- ☐ Installation position: arrow points direction of flow

5 - Vacuum unit for charge pressure control

6 - Mechanical air recirculation valve

- ☐ Checking ⇒ [page 169](#)

7 - Solenoid valve for charge pressure control -N75-

8 - Brake servo

9 - Non-return valve

- ☐ Between brake servo and intake manifold
- ☐ Installation position: arrow points direction of flow

10 - Air cleaner with air mass meter -G70-

11 - Pressure control valve for crankcase breather system

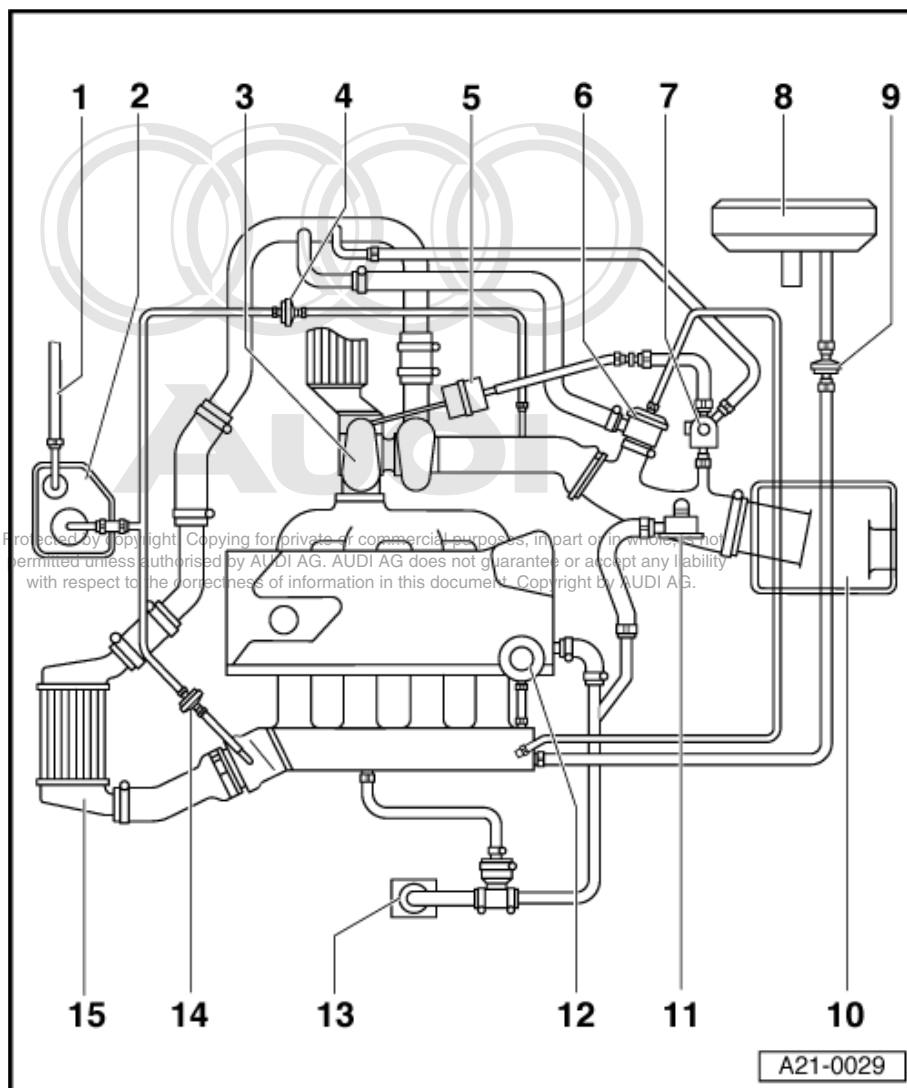
12 - Fuel pressure regulator

13 - Crankcase breather

14 - Non-return valve

- ☐ Between activated charcoal filter and intake manifold
- ☐ Installation position: arrow points direction of flow

15 - Charge air cooler



Vehicles with electronic throttle, not fitted with secondary air system

1 - Activated charcoal filter

- ☐ With activated charcoal filter system solenoid valve 1 -N80-

2 - Non-return valve

- ☐ Between activated charcoal filter and intake pipe upstream of turbo-charger
- ☐ Installation position: arrow points direction of flow

3 - Turbocharger

- ☐ Checking charge pressure ⇒ [page 160](#)

4 - Vacuum unit for charge pressure control**5 - Mechanical air recirculation valve**

- ☐ Checking ⇒ [page 169](#)

6 - Brake servo**7 - Non-return valve**

- ☐ Between brake servo and intake manifold
- ☐ Installation position: arrow points direction of flow

8 - Solenoid valve for charge pressure control -N75-

- ☐ Checking ⇒ [page 175](#)

9 - Air mass meter -G70-**10 - Air cleaner****11 - Pressure control valve for crankcase breather system****12 - Vacuum reservoir**

- ☐ Bolted to cylinder head cover

13 - Fuel pressure regulator**14 - Intake manifold**

- ☐ With intake air temperature sender -G42-

15 - Crankcase breather**16 - Non-return valve**

- ☐ Installation position: arrow points direction of flow

17 - Turbocharger air recirculation valve -N249-

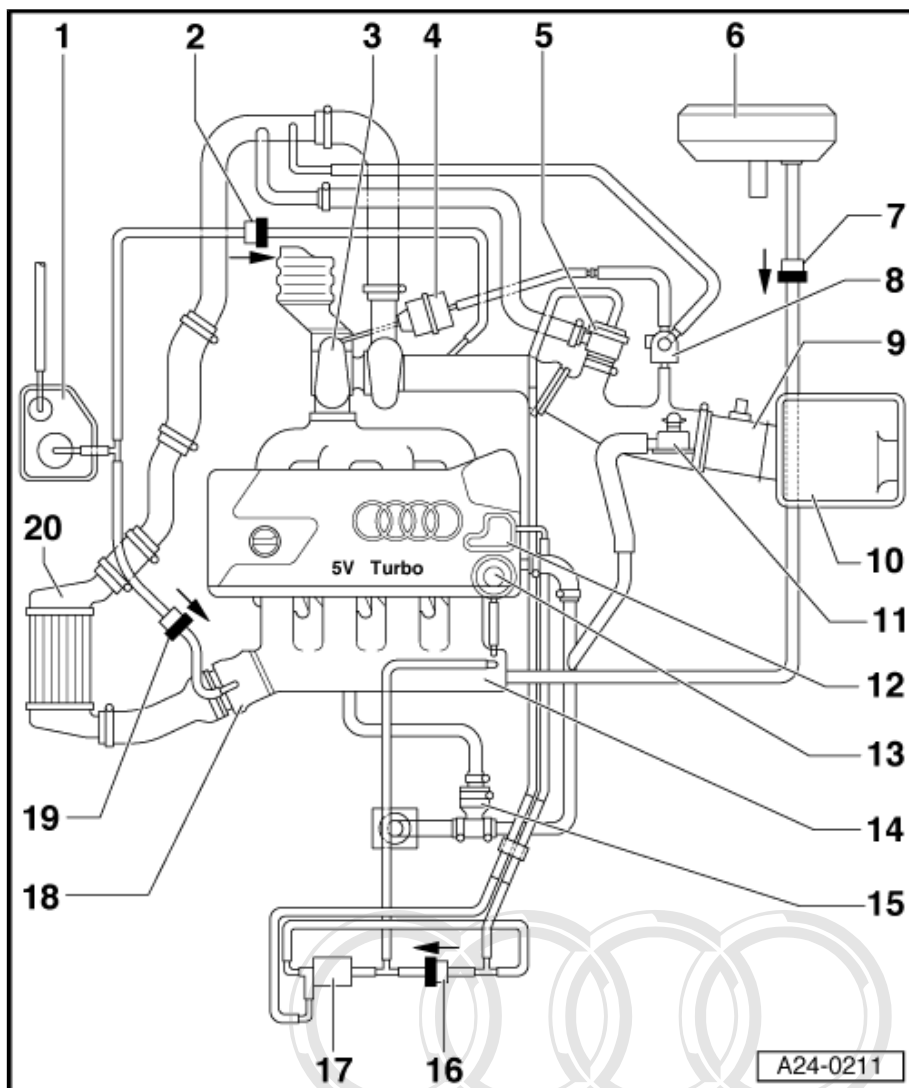
- ☐ Checking ⇒ [page 170](#)

18 - Throttle valve module -J338-**19 - Non-return valve**

- ☐ Between activated charcoal filter and intake manifold
- ☐ Installation position: arrow points direction of flow

20 - Charge air cooler

- ☐ With charge pressure sender -G31-



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- ☐ Checking charge pressure sender -G31- ⇒ [page 180](#)

Vehicles with electronic throttle and secondary air system

1 - From fuel tank

2 - Activated charcoal filter

- ☐ With activated charcoal filter system solenoid valve 1 -N80-

3 - Non-return valve

- ☐ Between activated charcoal filter and intake pipe upstream of turbo-charger
- ☐ Installation position: arrow points direction of flow

4 - Turbocharger

- ☐ Checking charge pressure ⇒ [page 160](#)

5 - Vacuum unit for charge pressure control

6 - Mechanical air recirculation valve

- ☐ Checking ⇒ [page 169](#)

7 - Brake servo

8 - Non-return valve

- ☐ Between brake servo and intake manifold
- ☐ Installation position: arrow points direction of flow

9 - Solenoid valve for charge pressure control -N75-

- ☐ Checking ⇒ [page 175](#)

10 - Air mass meter -G70-

11 - Air cleaner

12 - Pressure control valve for crankcase breather system

13 - Combination valve for secondary air system

14 - Vacuum reservoir

- ☐ Bolted to cylinder head cover

15 - Fuel pressure regulator

16 - Intake manifold

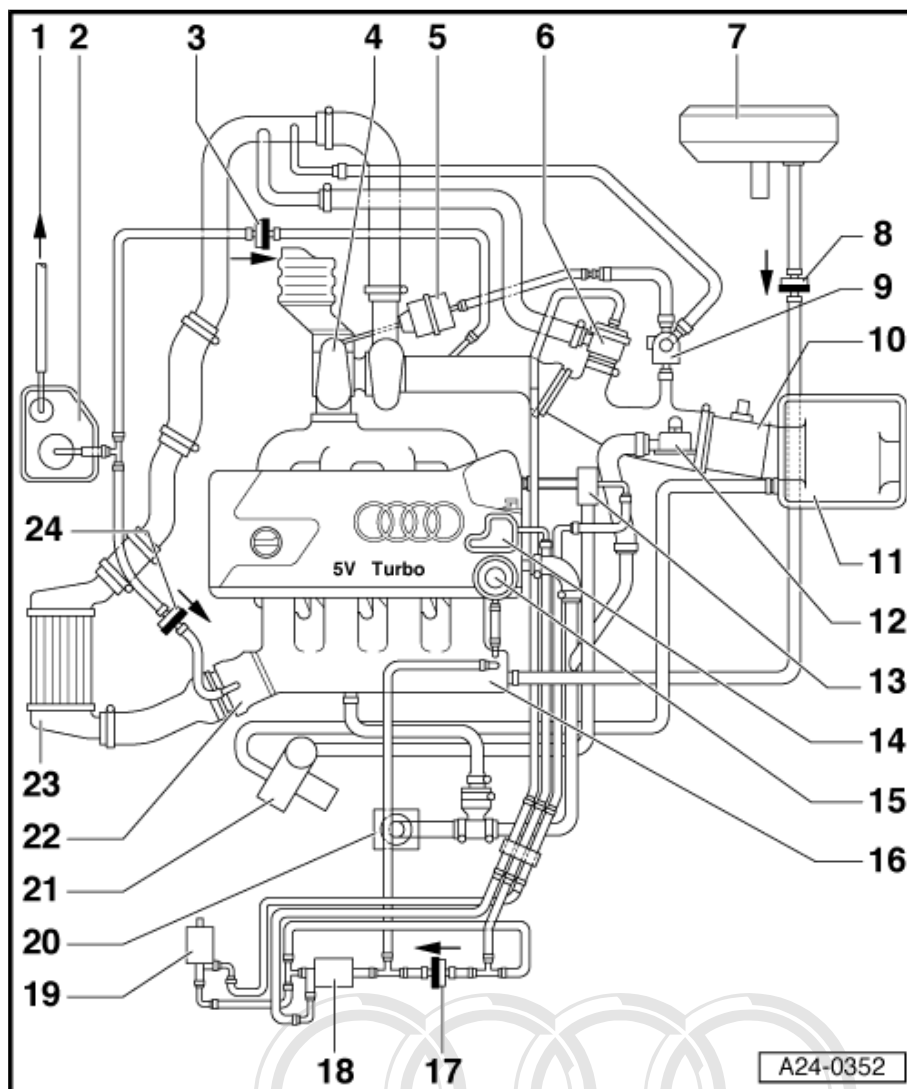
- ☐ With intake air temperature sender -G42-

17 - Non-return valve

- ☐ Installation position: arrow points direction of flow

18 - Turbocharger air recirculation valve -N249-

- ☐ Checking ⇒ [page 170](#)



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19 - Secondary air inlet valve -N112-

- ☐ Checking ⇒ [page 219](#)

20 - Crankcase breather**21 - Secondary air pump motor -V101-****22 - Throttle valve module -J338-****23 - Charge air cooler**

- ☐ With charge pressure sender -G31-
- ☐ Checking charge pressure sender -G31- ⇒ [page 180](#)

24 - Non-return valve

- ☐ Between activated charcoal filter and intake manifold
- ☐ Installation position: arrow points direction of flow

1.4 Effects of leaks in charge air system**A - Leaks downstream of air mass meter**

◆ Possible causes of trouble:

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

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3 - Connecting hose to activated charcoal filter

◆ Effect:

- Loss of power

B - Leaks downstream of turbocharger (intake side)

◆ Possible causes of trouble:

- 1 - Connecting hoses and pipes between turbocharger and charge air cooler
- 2 - Hose between charge air cooler and intake manifold
- 3 - Charge air cooler
- 4 - Seal of charge pressure sender -G31- (in charge air cooler)
- only on vehicles with electronic throttle
- 5 - Gasket between throttle valve module -J338- and intake manifold
- 6 - Gasket between intake manifold and cylinder head
- 7 - Connecting hose to solenoid valve for charge pressure control -N75-

◆ Effect:

- Inadequate charge pressure

C - Leaks downstream of turbocharger (exhaust side)

◆ Possible causes of trouble:

- 1 - Connection between turbocharger and exhaust manifold
- 2 - Connection between exhaust manifold and cylinder head

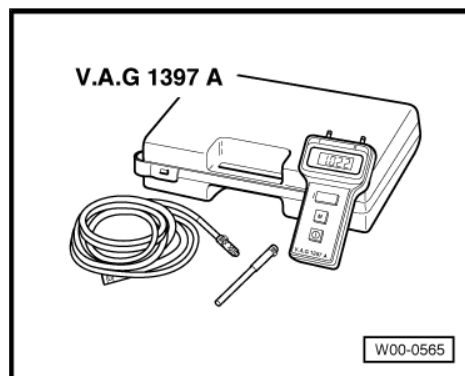
◆ Effect:

- Inadequate charge pressure; possible smell of exhaust gas, traces of soot in engine compartment

1.5 Checking turbocharger and charge pressure regulating valve - vehicles with throttle cable

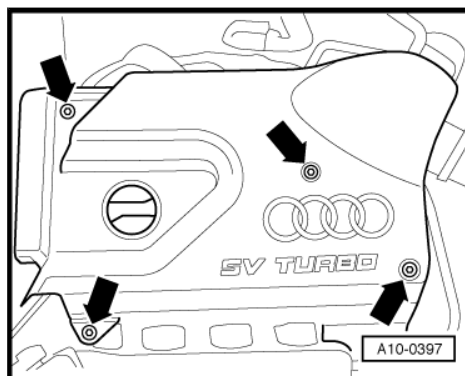
Special tools and workshop equipment required

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



Procedure

- All hoses and pipes securely fitted and and free of leaks.
- Fault memory interrogated and final control diagnosis performed ⇒ Rep. Gr. 01 .
- Take off engine cover panel -arrows-.



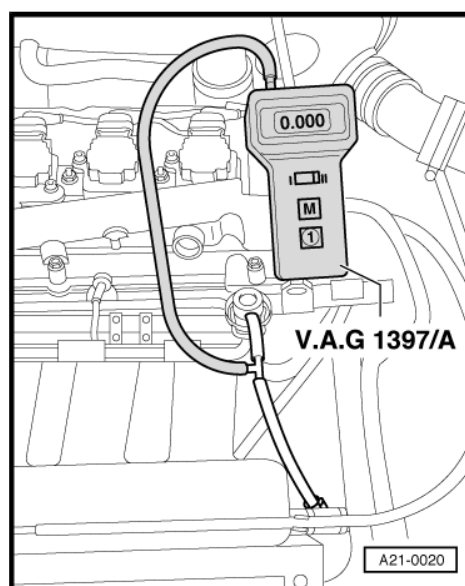
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WARNING

To avoid accident risks when road testing the vehicle with test equipment, always observe the relevant safety precautions ⇒ [page 155](#) .

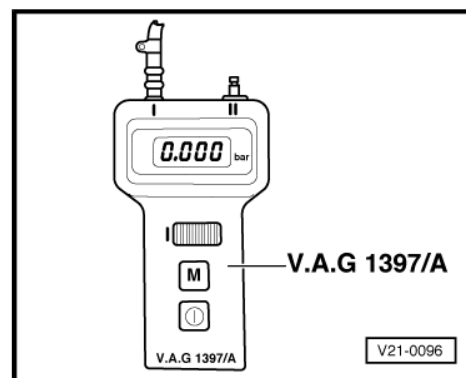
- Route test hose under rear edge of bonnet and through right window into passenger compartment.



- Switch on turbocharger tester and set measuring range selector switch to position -I- (absolute pressure).
- Attach test hose to connection -I-.

**Note**

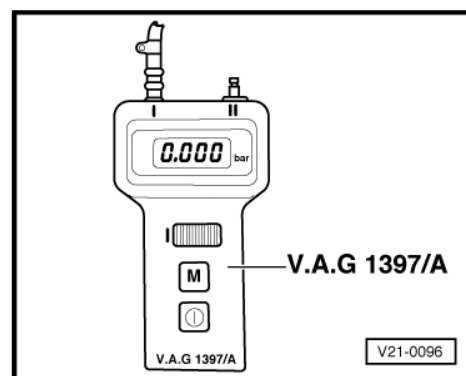
- ◆ *Ensure absolute leakproof connection of hoses to avoid measurement errors.*
- ◆ *Take care not to trap test hose at bonnet and side window.*
- ◆ *Pressing memory button -M- on turbocharger tester causes last measured value to be stored until memory button -M- is pressed again or tester is switched off.*
- ◆ *The decimal point in the display flashes to indicate that the value is being stored.*
- ◆ *If the battery voltage of the turbocharger tester drops below the minimum level, an arrow will appear at the top left of the display.*
- ◆ *Before performing the test, drive vehicle moderately fast for at least 3 km (without stopping at traffic lights etc.).*

**Vehicles with manual gearbox:**

- Accelerate vehicle in 3rd gear from 2000 rpm at full throttle while a second mechanic observes the rev counter.
- Second mechanic should press memory button -M- on - V.A.G 1397 A- at approx. 3000 rpm.
- Specification: 1.300 ... 1.400 bar.

Vehicles with automatic gearbox:

- Move selector lever in position "2" and start to drive.
- Accelerate to 3000 rpm and wait until the gearbox engages 2nd gear.
- Depress accelerator pedal with kick-down (gearbox will not select a lower gear at this engine speed).
- Second mechanic should press memory button -M- on - V.A.G 1397 A- at approx. 4500 rpm.
- Specification: 1.300 ... 1.400 bar.

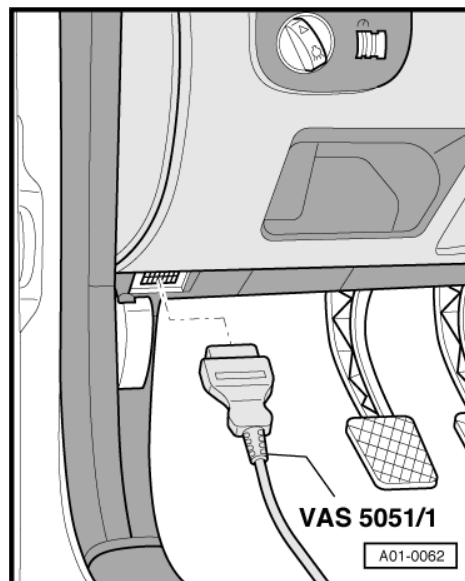




Note

On vehicles with automatic gearbox the charge pressure test is not always a reliable indication of the proper function of the charge pressure control system. Therefore, if the pressure value is close to the lower tolerance limit, check the load signal in order to test the charge pressure control function.

- Connect up vehicle diagnostic, testing and information system -VAS 5051- with diagnosis lead -VAS 5051/1- , press vehicle self-diagnosis key and select vehicle system “01 - Engine electronics”. Engine must be idling.



Display on -VAS 5051- :

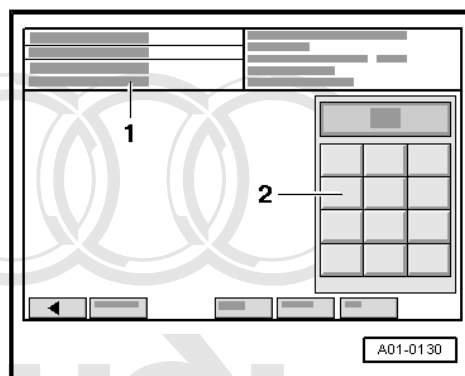
- From the list -1- select diagnostic function “08 - Read measured value block”.



Display on -VAS 5051- :

- Press keys 2 5 on keypad -2- to select “Display group 25” and confirm entry by pressing key Q.

1 - Enter display group



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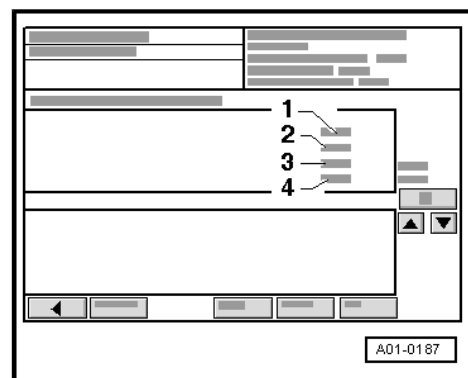
Display on -VAS 5051- :

- Accelerate vehicle at a constant rate and have a second mechanic check the displays in zones -2- and -3-.
- Specification: maximum difference between values 0.3 ms.



Note

If the self-diagnosis function of the control unit detects a fault in the charge pressure control system, the duty cycle in display zone -4- is set to 5 % (constant).



All models:

If specification is not obtained:

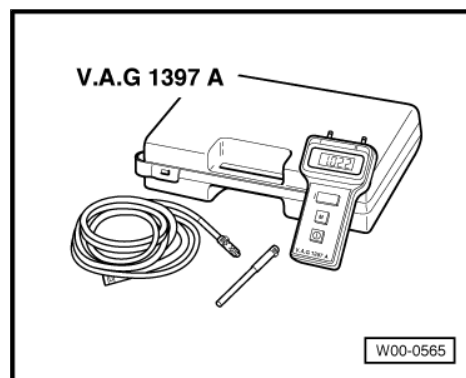
- Find fault causes using fault table below.

Fault	Possible causes
Charge pressure below specification	◆ Hose connections to charge pressure control solenoid valve -N75- defective. Connection diagram ⇒ page 155 ◆ Charge pressure control solenoid valve -N75- defective. Checking ⇒ page 175 ◆ Charge pressure regulating valve in turbocharger stuck in open position. Renew turbocharger ⇒ page 187 ◆ Leak between turbocharger and intake manifold (air intake hoses and vacuum hoses) ◆ Mechanical air recirculation valve defective. Checking ⇒ page 169 ◆ Turbocharger air recirculation valve -N249- defective. Checking ⇒ page 170 ◆ Turbocharger defective. Renewing ⇒ page 187
Charge pressure above specification ¹⁾	◆ Air leaks in hoses or connections to vacuum unit for charge pressure control (via -N75-). Connection diagram ⇒ page 155 ◆ Vacuum unit for charge pressure control defective. Renew turbocharger ⇒ page 187 ◆ Charge pressure regulating valve in turbocharger sticking in closed position. Renew turbocharger ⇒ page 187
• ¹⁾ If the charge pressure is too high the fuel supply will be shut off in order to protect the engine. Misfiring will then occur at higher engine speeds.	

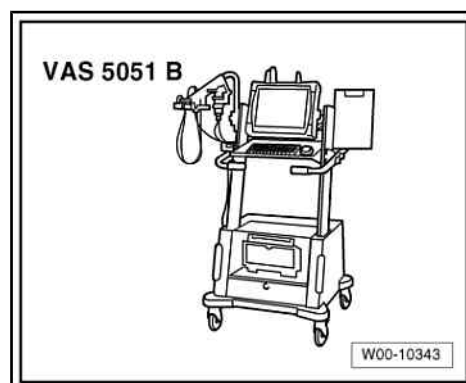
1.6 Checking turbocharger and charge pressure regulating valve - vehicles with electronic throttle

Special tools and workshop equipment required

◆ Turbocharger tester -V.A.G 1397 A-



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



Procedure

- All hoses and pipes securely fitted and and free of leaks.
- Fault memory interrogated and final control diagnosis performed ⇒ Rep. Gr. 01 .

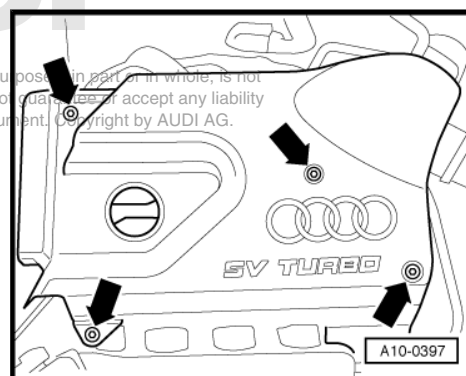


WARNING

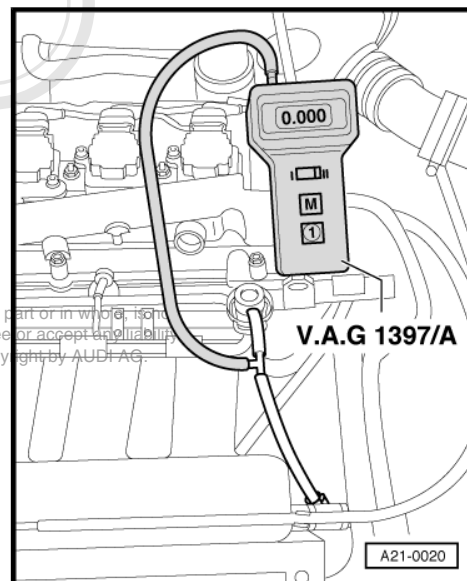
To avoid accident risks when road testing the vehicle with test equipment, always observe the relevant safety precautions ⇒ [page 155](#) .

- Take off engine cover panel -arrows-.

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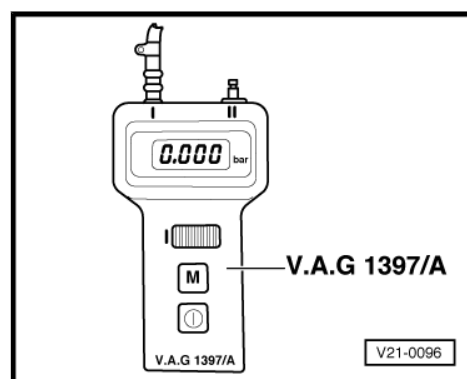
- Connect T-piece with test hose of turbocharger tester - V.A.G 1397 A- to intake manifold (front).
- Route test hose under rear edge of bonnet and through right window into passenger compartment.



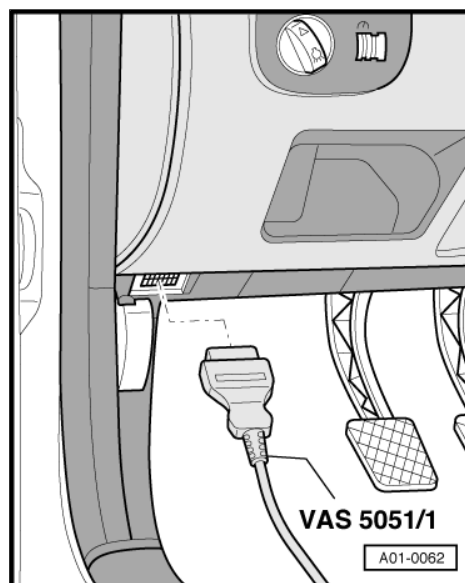
- Switch on turbocharger tester and set measuring range selector switch to position -I- (absolute pressure).
- Attach test hose to connection -I-.

**Note**

- ◆ *Ensure absolute leakproof connection of hoses to avoid measurement errors.*
- ◆ *Take care not to trap test hose at bonnet and side window.*
- ◆ *Pressing memory button -M- on turbocharger tester causes last measured value to be stored until memory button -M- is pressed again or tester is switched off.*
- ◆ *The decimal point in the display flashes to indicate that the value is being stored.*
- ◆ *If the battery voltage of the turbocharger tester drops below the minimum level, an arrow will appear at the top left of the display.*
- ◆ *Before performing the test, drive vehicle moderately fast for at least 3 km (without stopping at traffic lights etc.).*

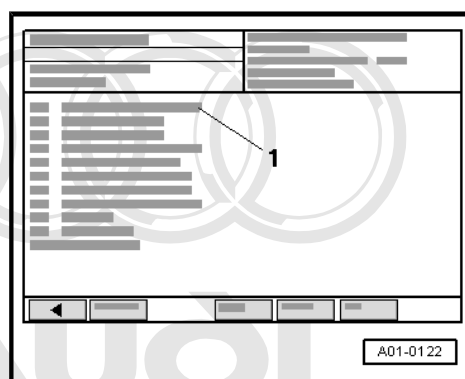


- Connect up vehicle diagnostic, testing and information system -VAS 5051- with diagnosis lead -VAS 5051/1-, press vehicle self-diagnosis key and select vehicle system “01 - Engine electronics”. Engine must be idling.



Display on -VAS 5051- :

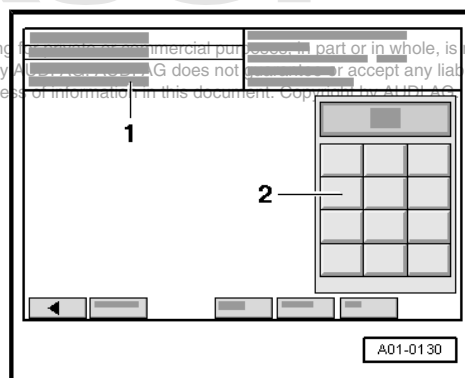
- From the list -1- select diagnostic function “08 - Read measured value block”.



Display on -VAS 5051- :

- Press keys 1 1 5 on keypad -2- to select “Display group 115” and confirm entry by pressing key Q.

1 - Enter display group



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Vehicles with engine code AQA, ARX, ARZ, AUM:

- Accelerate vehicle in 3rd gear from 2000 rpm at full throttle while a second mechanic observes the rev counter.
- Have the second mechanic press **PRINT** key on -VAS 5051- and memory key -M- on -V.A.G 1397 A- simultaneously at approx. 2500 rpm.

**Note**

The charge pressure should be measured using turbocharger tester -V.A.G 1397 A-. Vehicle diagnostic, testing and information system -VAS 5051- is used to check whether the charge pressure is being registered by the control unit.

- Specification on -V.A.G 1397 A- : 1.500 ... 1.650 bar.
- Specification on -VAS 5051- in display zone - 4-: 1500 ... 1650 mbar.

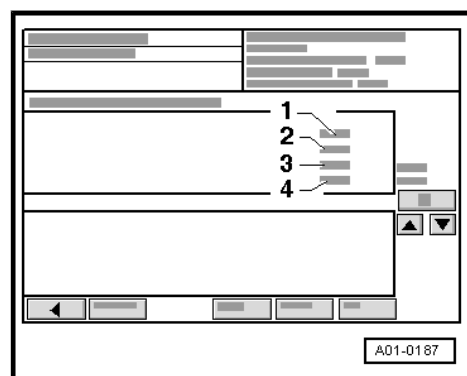
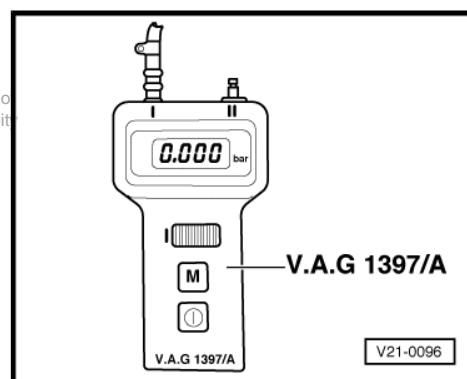
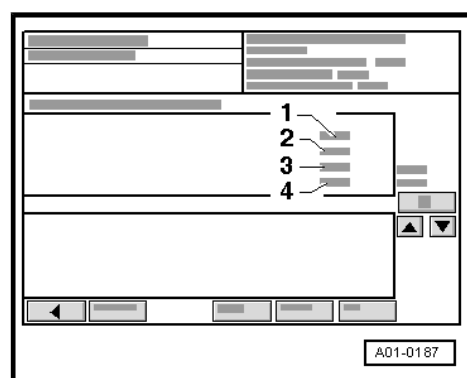
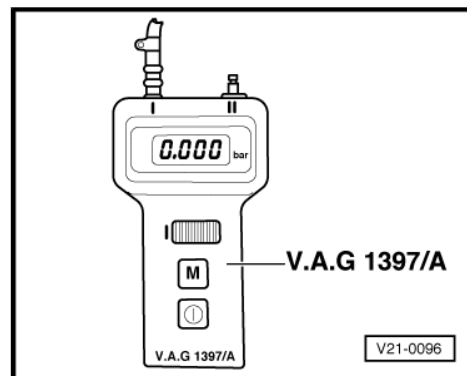
**Vehicles with engine code AJQ, APP:**

- Accelerate vehicle in 3rd gear from 2000 rpm at full throttle while a second mechanic observes the rev counter.
- Have the second mechanic press **PRINT** key on -VAS 5051- and memory key -M- on -V.A.G 1397 A- simultaneously at approx. 2800 rpm.

**Note**

The charge pressure should be measured using turbocharger tester -V.A.G 1397 A-. Vehicle diagnostic, testing and information system -VAS 5051- is used to check whether the charge pressure is being registered by the control unit.

- Specification on -V.A.G 1397 A- : 1.800 ... 1.900 bar.
- Specification on -VAS 5051- in display zone - 4-: 1800 ... 1900 mbar.



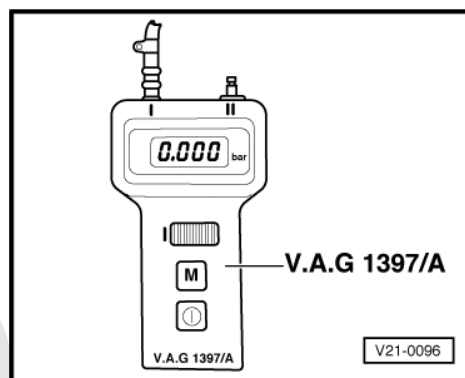
Vehicles with engine code : ARY, AUQ:

- Accelerate vehicle in 3rd gear from 2000 rpm at full throttle while a second mechanic observes the rev counter.
- Have the second mechanic press **PRINT** key on -VAS 5051- and memory key -M- on -V.A.G 1397 A- simultaneously at approx. 2800 rpm.



Note

The charge pressure should be measured using turbocharger tester -V.A.G 1397 A-. Vehicle diagnostic, testing and information system -VAS 5051- is used to check whether the charge pressure is being registered by the control unit.



- Specification on -V.A.G 1397 A- : 1.600 ... 1.700 bar.
- Specification on -VAS 5051- in display zone - 4-: 1600 ... 1700 mbar.

All models:

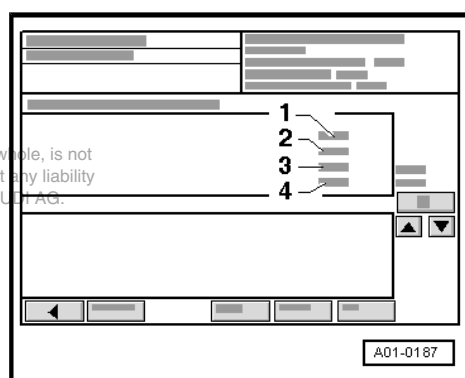
- Press the **key** to exit from the function “08 - Read measured value block”.

If the specification is obtained:

- Press function “06 - End output”.
- Switch off ignition and detach diagnostic connector.

If specification is not obtained:

- Find fault causes using fault table below.



Fault	Possible causes
Charge pressure below specification	◆ Hose connections to charge pressure control solenoid valve -N75- defective. Connection diagram ➔ page 155 ◆ Charge pressure control solenoid valve -N75- defective. Checking ➔ page 175 ◆ Charge pressure regulating valve in turbocharger stuck in open position. Renew turbocharger ➔ page 187 ◆ Leak between turbocharger and intake manifold (air intake hoses and vacuum hoses) ◆ Mechanical air recirculation valve defective. Checking ➔ page 169 ◆ Turbocharger air recirculation valve -N249- defective. Checking ➔ page 170 ◆ Turbocharger defective. Renewing ➔ page 187
Charge pressure above specification	◆ Air leaks in hoses or connections to vacuum unit for charge pressure control (via -N75-). Connection diagram ➔ page 155 ◆ Vacuum unit for charge pressure regulating valve defective. Renew turbocharger ➔ page 187 ◆ Charge pressure regulating valve in turbocharger sticking in closed position. Renew turbocharger ➔ page 187

1.7 Checking mechanical air recirculation valve



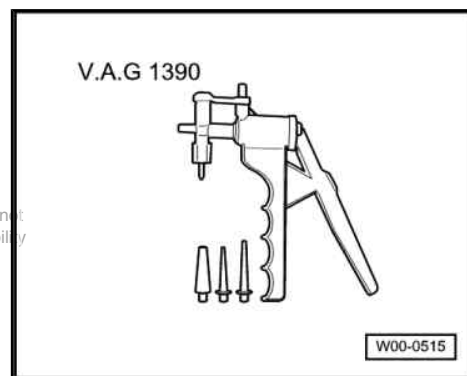
Note

- ◆ *The mechanical air recirculation valve is located upstream of the turbocharger. It is opened by vacuum during overrun, at idle and at part throttle. This dissipates the charge pressure upstream of the throttle valve and maintains a higher turbocharger speed.*
- ◆ *The mechanical air recirculation valve is controlled via the turbocharger air recirculation valve -N249-.*
- ◆ *Check mechanical air recirculation valve in the event of loss of power or jolting during load change.*

Special tools and workshop equipment required

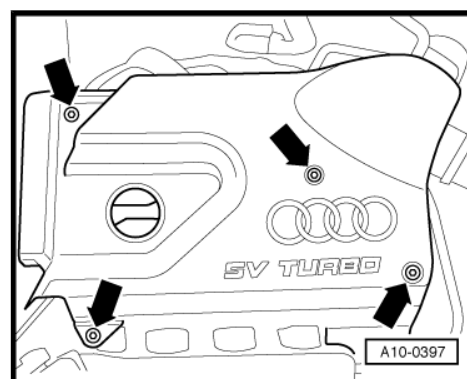
- ◆ Hand-operated vacuum pump with accessories -V.A.G 1390-

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Procedure

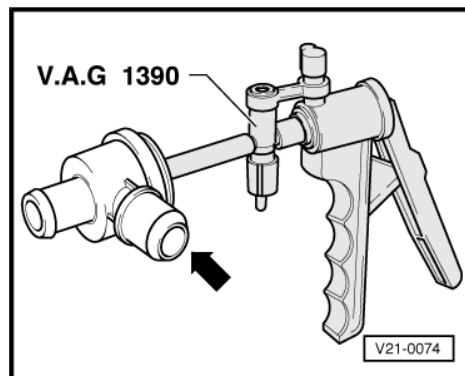
- Take off engine cover panel -arrows-.



- Detach vacuum hose at air recirculation valve.
- Connect hand-operated vacuum pump -V.A.G 1390- to air recirculation valve.
- Use hand-operated vacuum pump to generate vacuum.
 - Air recirculation valve should open -arrow-
- Operate vent valve on hand-operated vacuum pump after approx. 30 seconds.
 - Air recirculation valve should close -arrow-.

If air recirculation valve does not open/close or if valve plate does not provide a tight closure when air recirculation valve is closed:

- Renew air recirculation valve.



Note

Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.

1.8 Checking air recirculation valve for turbocharger -N249- - vehicles with electronic throttle

Special tools and workshop equipment required

- ◆ Hand-held multimeter - V.A.G 1526 C- 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-
- ◆ Adapter cable -V.A.G 1598/31- (test box)
- ◆ Vehicle diagnostic, testing and information system - VAS 5051- with diagnosis

V.A.G 1526 A	V.A.G 1527 B
V.A.G 1594 A	V.A.G 1598/31
VAS 5051	G24-0023

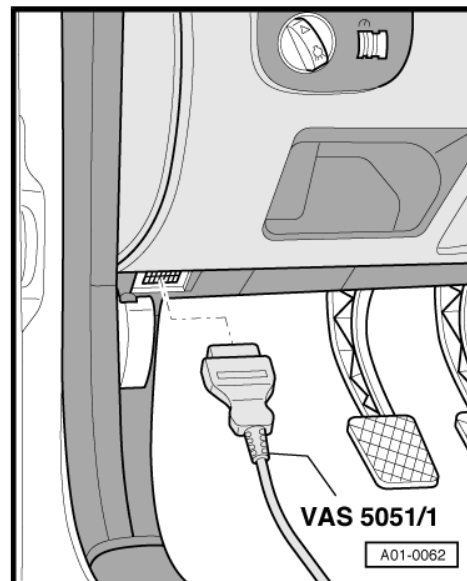
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lead -VAS 5051/1-

Procedure**Note**

Air recirculation valve for turbocharger -N249- and its wiring are monitored by the engine control unit.

- Connect up vehicle diagnostic, testing and information system -VAS 5051- with diagnosis lead -VAS 5051/1-, press vehicle self-diagnosis key and select vehicle system “01 - Engine electronics”. When doing this, the engine must be running at idling speed.

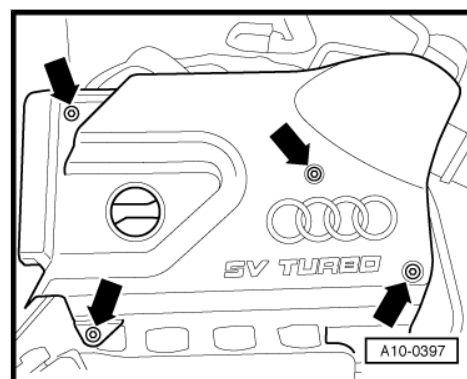


Display on -VAS 5051- :

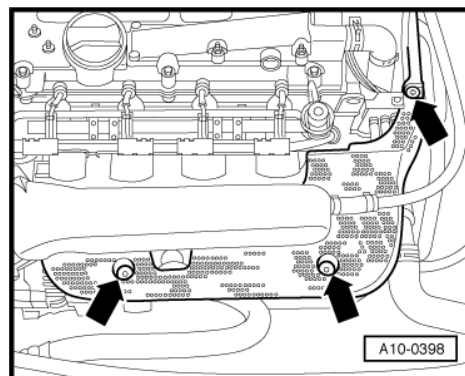
- From list 1, select diagnosis function “02 - Interrogate fault memory”.

If the display shows a fault relating to air recirculation valve for turbocharger -N249- :

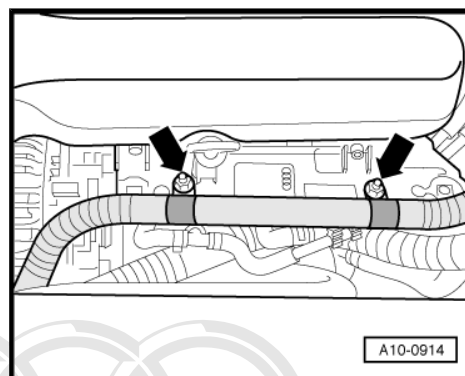
- Terminate function “02 - Interrogate fault memory” by touching  key.
- Press function “06 - end output” and switch off the ignition.
- Take off engine cover panel -arrows-.



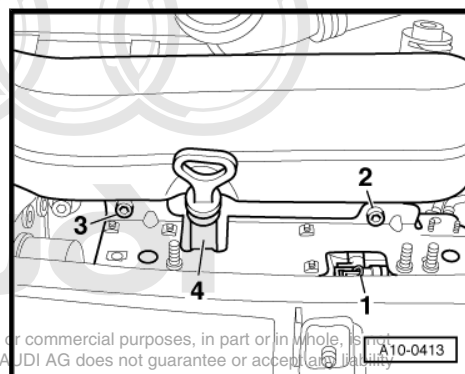
- Remove cover in front of intake manifold -arrows-.



- Detach pipe for secondary air system from brackets on engine -arrows-.



- Remove bolts -2- and -3- and detach bracket for dipstick guide tube -4-.
- Unplug connectors -1- for turbocharger air recirculation valve -N249- and secondary air inlet valve -N112- on underside of retainer for electrical change-over valves.
- Detach vacuum hose going to electrical change-over valves at intake manifold.
- Disconnect both hoses from secondary air pump.



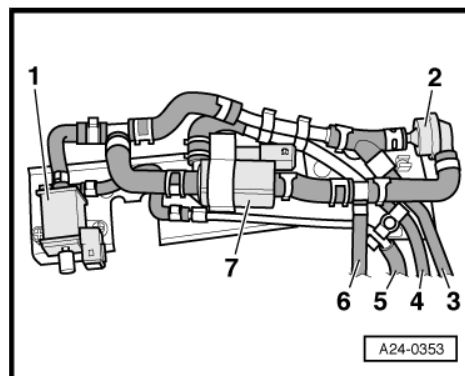
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- Disconnect hoses from turbocharger air recirculation valve - N249- -item 7-; re-attach electrical connector.

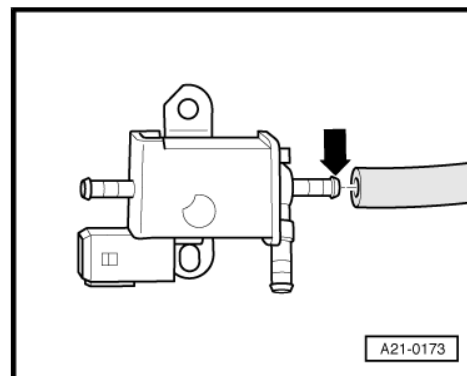


Note

- ◆ The illustration shows the retainer for electrical change-over valves from below and removed from the engine.
- ◆ Illustration shows version for vehicles with secondary air system.
- ◆ On vehicles without secondary air system, only the turbocharger air recirculation valve -N249- is fitted to the retainer for electrical change-over valves.
- ◆ Disregard -items 1 ... 6-.



- Connect test hose to the hose connection on the turbocharger air recirculation valve -N249- marked with an -arrow-.



- Switch on ignition and select vehicle system "01 - Engine electronics".

Display on -VAS 5051- :

- From the menu -1- select the diagnostic function "03 - Final control diagnosis".



- Press the  key repeatedly until the following display appears:

Display on -VAS 5051- (example):

A - 6th control element in test

6 - Turbocharger air recirculation valve -N249-

- The valve should click and open and close (check by blowing into the test hose).

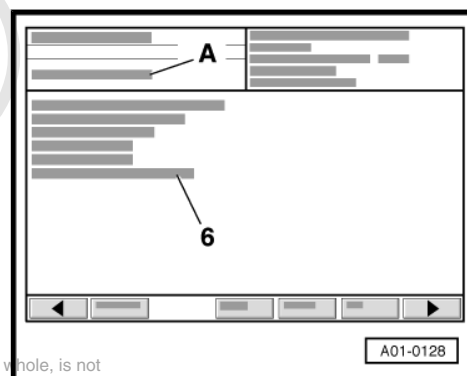
- Press the  key to exit from function "03 - Final control diagnosis".

- Press function "06 - end output" and switch off the ignition.

If valve clicks but does not open or close correctly:

- Renew air recirculation valve for turbocharger -N249- .

If valve does not click:



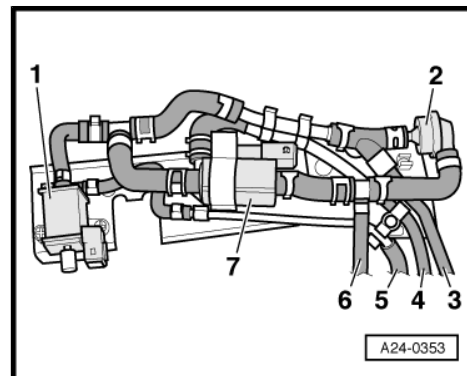
Checking internal resistance

- Unplug electrical connector at turbocharger air recirculation valve -N249- -item 7-.



Note

- ◆ The illustration shows the retainer for electrical change-over valves from below and removed from the engine.
- ◆ Illustration shows version for vehicles with secondary air system.
- ◆ On vehicles without secondary air system, only the turbocharger air recirculation valve -N249- is fitted to the retainer for electrical change-over valves.
- ◆ Disregard -items 1 ... 6-.



- Connect hand-held multimeter -V.A.G 1526 C- to measure resistance between contacts on turbocharger air recirculation valve -N249- .

- Specification: 21 ... 24 Ω .

If the specification is not attained:

- Renew air recirculation valve for turbocharger -N249- .

If the specification is obtained:

Checking voltage supply

- Fuse for turbocharger air recirculation valve -N249- OK $\Rightarrow$ Current flow diagrams, Electrical fault finding and Fitting locations.
- Fuel pump relay -J17- OK $\Rightarrow$ Current flow diagrams, Electrical fault finding and Fitting locations.



Note

Turbocharger air recirculation valve -N249- is supplied with power via fuel pump relay -J17- .

- Connect voltage tester -V.A.G 1527 B- between contact -1- of connector for turbocharger air recirculation valve -N249- and earth “-”.
- Operate the starter briefly.
- The LED should light up.

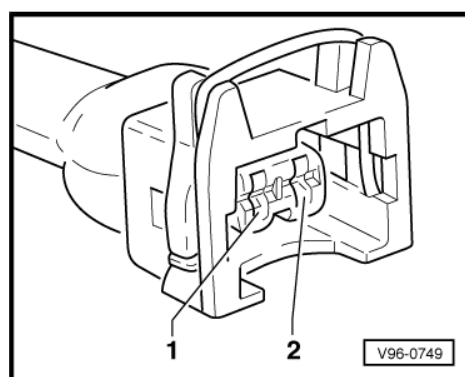
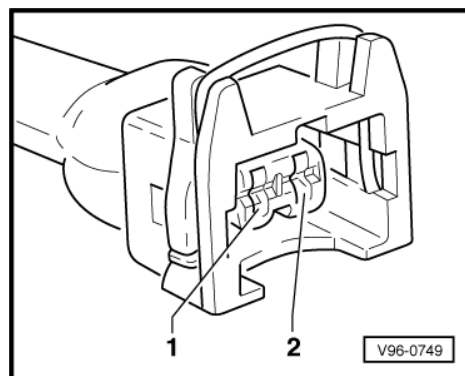
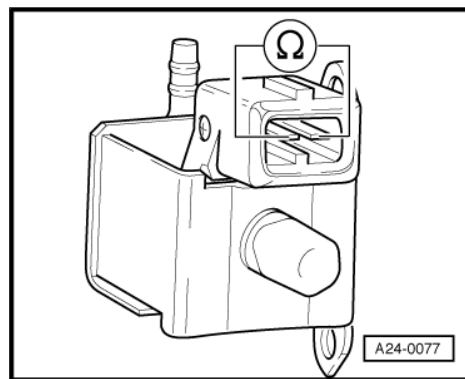
If LED does not light up:

- Check for open circuit in wiring from contact -1- of connector for turbocharger air recirculation valve -N249- via fuse to fuel pump relay -J17- $\Rightarrow$ Current flow diagrams, Electrical fault finding and Fitting locations.
- Repair wiring connection if necessary.

If the LED lights up:

Checking activation

- Connect voltage tester -V.A.G 1527 B- between contact -1- and -2- of connector for turbocharger air recirculation valve -N249- .
- Switch on ignition and select vehicle system “01 - Engine electronics”.
- Repeat function “03 - Final control diagnosis”.



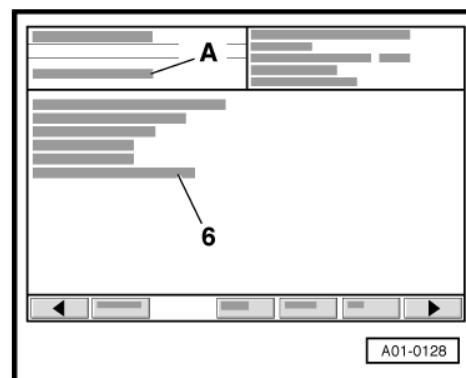
- Press the  key repeatedly until the following display appears:

Display on -VAS 5051- (example):

A - 6th control element in test

6 - Turbocharger air recirculation valve -N249-

- The LED should flash.
- Press the  key to exit from function “03 - Final control diagnosis”.
- Press function “06 - End output”.
- Switch off ignition and detach diagnostic connector.



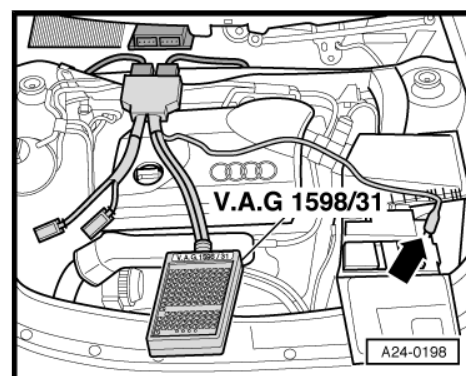
If the LED does not flash or lights up continuously:

- Connect adapter cable -V.A.G 1598/31- (test box) to connectors of wiring harness; do not connect engine control unit. Connect earth clip of test box to earth -arrow- ⇒ Rep. Gr. 24 .



Caution

To prevent damage to electronic components, select appropriate measuring range before connecting measuring leads and observe test requirements.



- Check for open circuit and short to positive or earth in the following wiring:

Connector Contact	-V.A.G 1598/31- Socket
-2-	105

- Repair wiring connection if necessary.

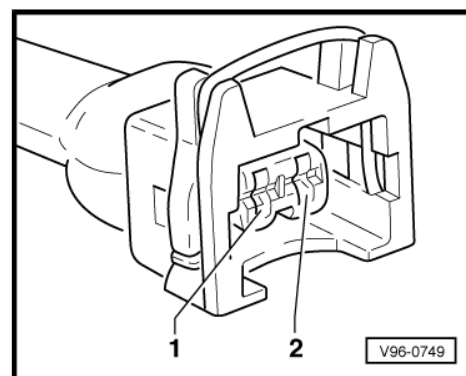
Assembling

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



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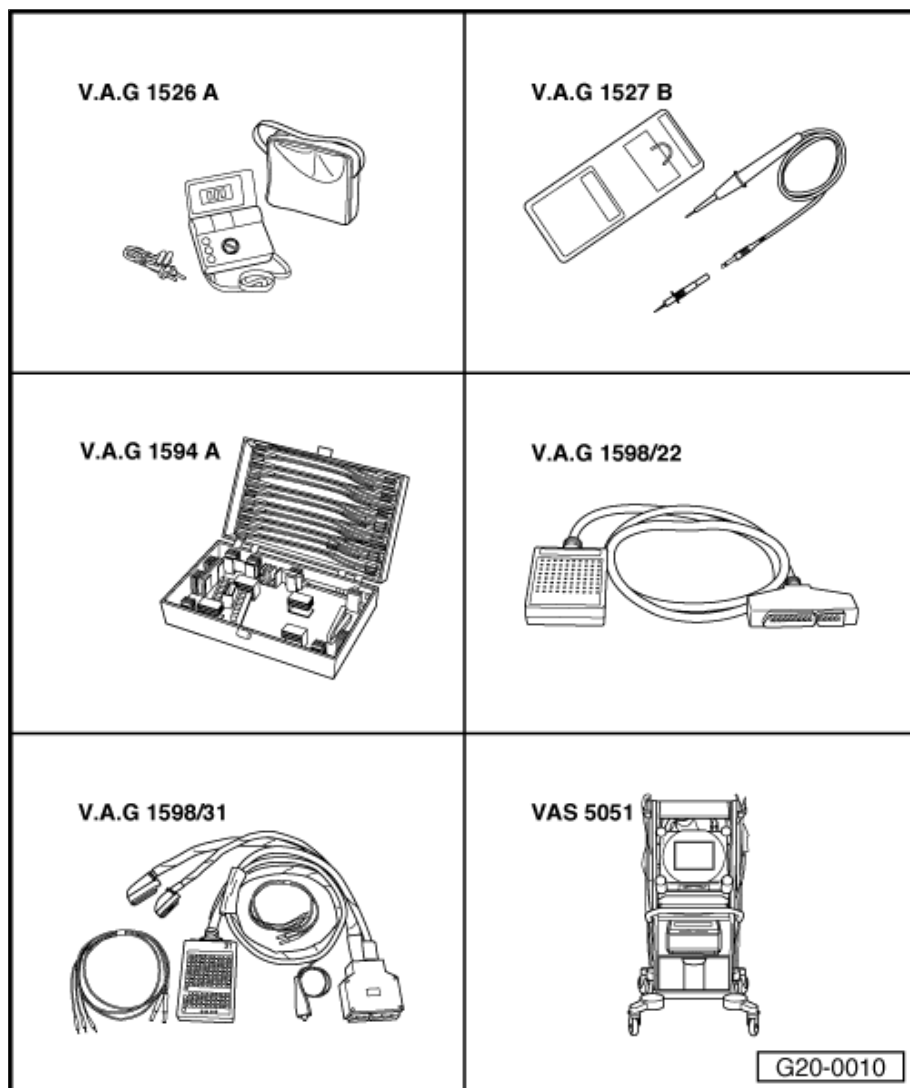
Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.



1.9 Checking solenoid valve for charge pressure control -N75-

Special tools and workshop equipment required

- ◆ Hand-held multimeter - V.A.G 1526 C- 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-
- ◆ Adapter -V.A.G 1598/22- (test box) for vehicles with throttle cable
- ◆ Adapter cable -V.A.G 1598/31- (test box) for vehicles with electronic throttle
- ◆ Vehicle diagnostic, testing and information system - VAS 5051- with diagnosis lead -VAS 5051/1-



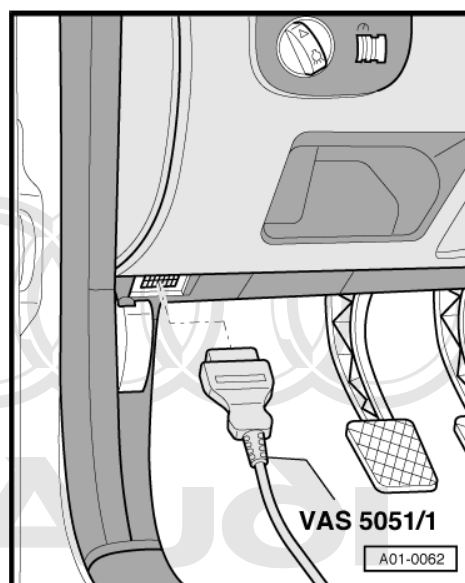
Procedure



Note

Charge pressure control valve -N75- and its wiring are monitored by the engine control unit.

- Connect up vehicle diagnostic, testing and information system -VAS 5051- with diagnosis lead -VAS 5051/1- , press vehicle self-diagnosis key and select vehicle system "01 - Engine electronics". When doing this, the engine must be running at idling speed.



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Display on -VAS 5051- :

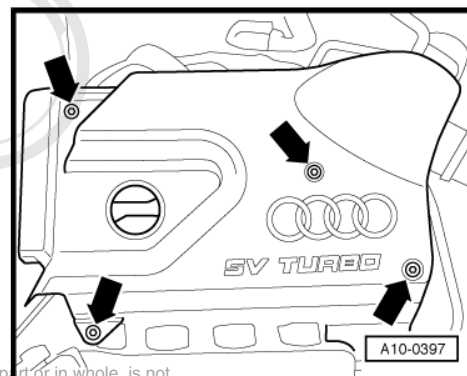
- From list -1-, select diagnosis function "02 - Interrogate fault memory".

If the display shows a fault relating to charge pressure control valve -N75- :

- Terminate function "02 - Interrogate fault memory" by touching  key.
- Press function "06 - end output" and switch off the ignition.



- Take off engine cover panel -arrows-.

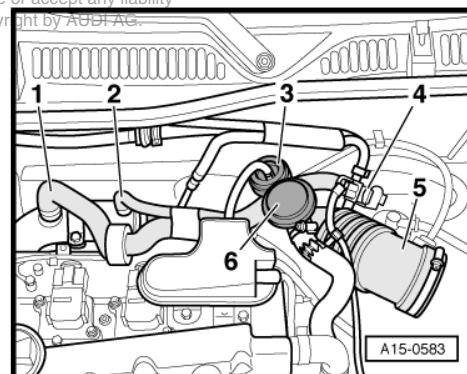


- Disconnect hoses from solenoid valve for charge pressure control -N75- -item 4-; leave electrical connector attached.

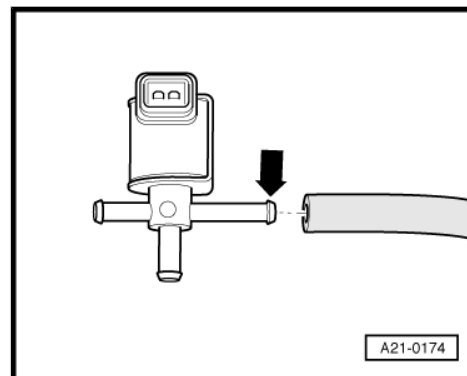


Note

Ignore other -items-.



- Connect test hose to the long hose connection -arrow- on charge pressure control solenoid valve -N75- .



- Switch on ignition and select vehicle system “01 - Engine electronics”.

Display on -VAS 5051- :

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



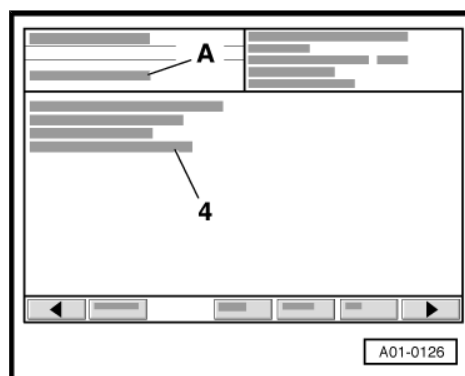
- Press the key repeatedly until the following display appears:

Display on -VAS 5051- (example):

A - 4th control element in test

4 - Solenoid valve for charge pressure control -N75-

- The valve should click and open and close (check by blowing into the test hose).
- Press the key to exit from function “03 - Final control diagnosis”.
- Press function “06 - end output” and switch off the ignition.



If valve clicks but does not open or close correctly:

- Renew charge pressure control solenoid valve -N75- .

If valve does not click:

Checking internal resistance

- Disconnect electrical connector at charge pressure control solenoid valve -N75- .
- Connect hand-held multimeter -V.A.G 1526 C- to measure resistance between contacts of charge pressure control solenoid valve -N75- .
- Specification: 25 ... 35 Ω.

If the specification is not attained:

- Renew charge pressure control solenoid valve -N75-.

If the specification is obtained:

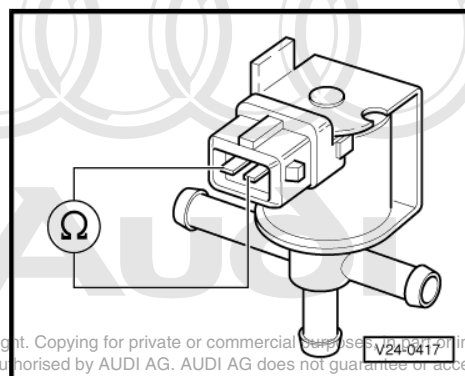
Checking voltage supply

- Fuse for charge pressure control solenoid valve -N75- OK
⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Fuel pump relay -J17- OK ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.



Note

Charge pressure control solenoid valve -N75- is supplied with power via fuel pump relay -J17- .



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- Connect voltage tester -V.A.G 1527 B- between contact -1- of connector for charge pressure control solenoid valve -N75- and earth “-”.
- Operate the starter briefly.
- The LED should light up.

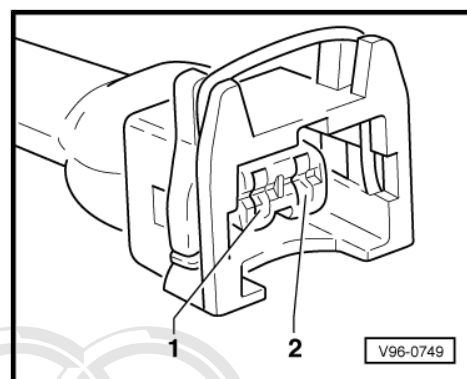
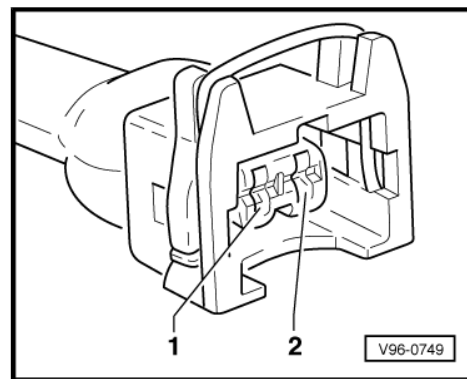
If LED does not light up:

- Check for open circuit in wiring from contact -1- of connector for charge pressure solenoid valve -N75- via fuse to fuel pump relay -J17- ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Repair wiring connection if necessary.

If the LED lights up:

Checking activation

- Connect voltage tester -V.A.G 1527 B- between contact -1- and -2- of connector for charge pressure control solenoid valve -N75- .
- Switch on ignition and select vehicle system “01 - Engine electronics”.
- Repeat function “03 - Final control diagnosis”.



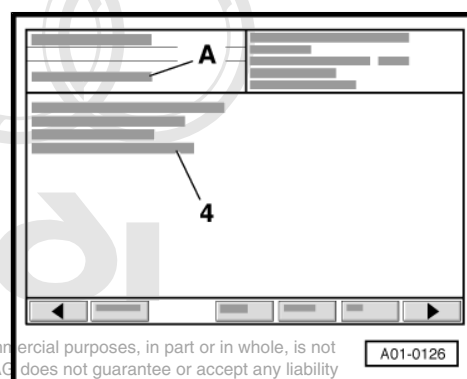
- Press the  key repeatedly until the following display appears:

Display on -VAS 5051- (example):

A - 4th control element in test

4 - Solenoid valve for charge pressure control -N75-

- The LED should flash.
- Press the  key to exit from function “03 - Final control diagnosis”.
- Press function “06 - End output”.
- Switch off ignition and detach diagnostic connector



If the LED does not flash or lights up continuously:

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Vehicles with throttle cable:

- Connect adapter -V.A.G 1598/22- (test box) to connectors on wiring harness; do not connect engine control unit ⇒ Rep. Gr. 24 .



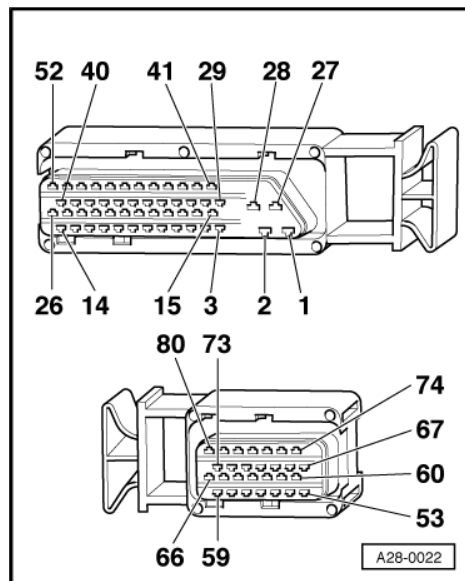
Caution

To prevent damage to electronic components, select appropriate measuring range before connecting measuring leads and observe test requirements.

- Check for open circuit and short to positive or earth in the following wiring:

Connector Contact	-V.A.G 1598/22- Socket
-2-	64

- Repair wiring connection if necessary.



Vehicles with electronic throttle:

- Connect adapter cable -V.A.G 1598/31- (test box) to connectors of wiring harness; do not connect engine control unit. Connect earth clip of test box to earth -arrow- ⇒ Rep. Gr. 24 .



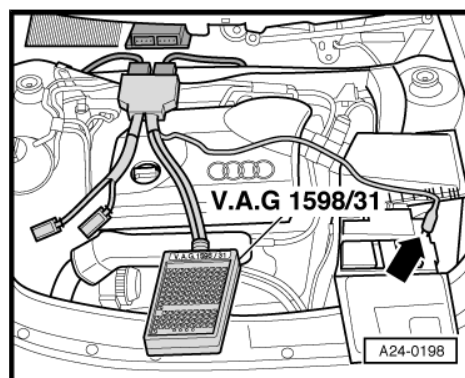
Caution

To prevent damage to electronic components, select appropriate measuring range before connecting measuring leads and observe test requirements.

- Check for open circuit and short to positive or earth in the following wiring:

Connector Contact	-V.A.G 1598/31- Socket
-2-	104

- Repair wiring connection if necessary.



Assembling

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



Note

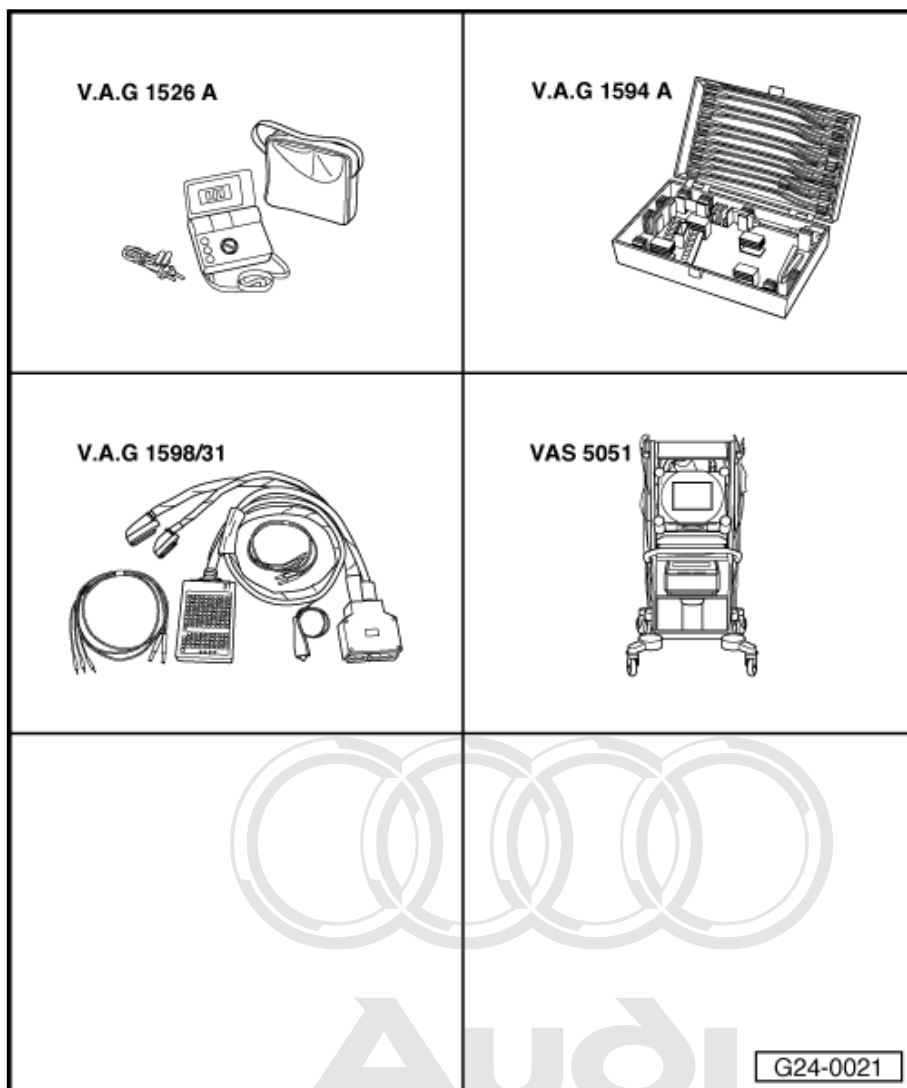
Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.

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1.10 Checking charge pressure sender -G31- - vehicles with electronic throttle

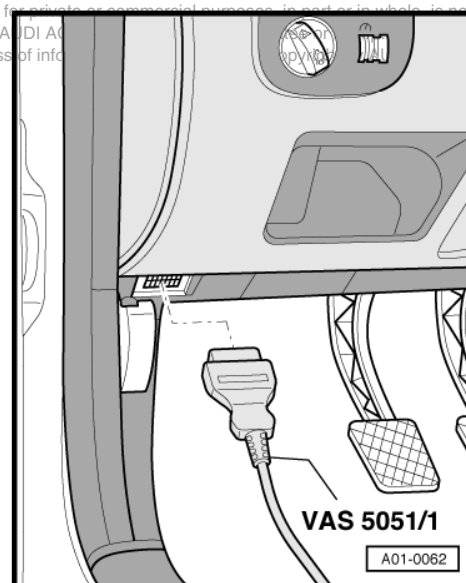
Special tools and workshop equipment required

- ◆ Hand-held multimeter - V.A.G 1526 C- or - V.A.G 1526 A-
- ◆ Auxiliary measuring set - V.A.G 1594 C- or - V.A.G 1594 A-
- ◆ Adapter cable -V.A.G 1598/31- (test box)
- ◆ Vehicle diagnostic, testing and information system - VAS 5051- with diagnosis lead -VAS 5051/1-

**Procedure****Note**

The charge pressure sender -G31- and the wiring connections are monitored by the engine control unit.

- Connect up vehicle diagnostic, testing and information system -VAS 5051- with diagnosis lead -VAS 5051/1- , press vehicle self-diagnosis key and select vehicle system "01 - Engine electronics". When doing this, the engine must be running at idling speed.

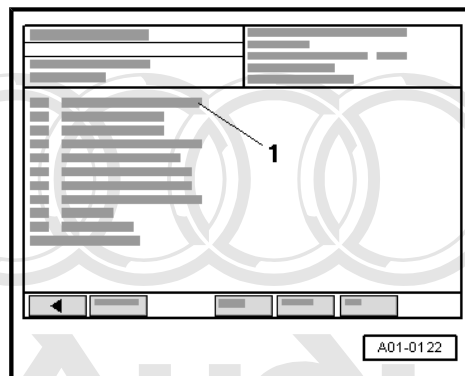


Display on -VAS 5051- :

- From list -1-, select diagnosis function "02 - Interrogate fault memory".

If a fault relating to charge pressure sender -G31- is displayed:

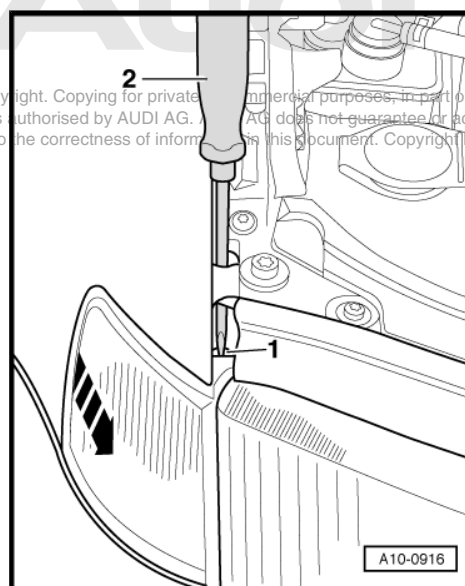
- Terminate function "02 - Interrogate fault memory" by touching  key.
- Press function "06 - End output".
- Switch off ignition and detach diagnostic connector.



Vehicles up to model year 2000:

- Release catch -1- at turn signal housing with cross-head screwdriver -2- by turning $\frac{1}{4}$ turn to left.

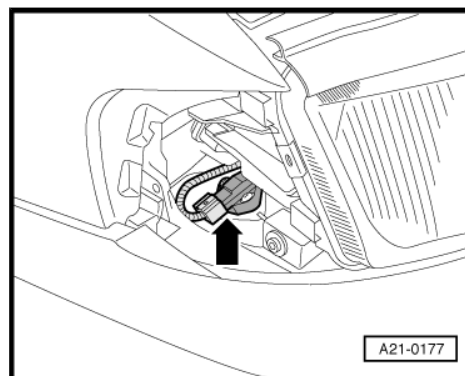
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- Reach through opening for turn signal and unplug connector at charge pressure sender -G31- .

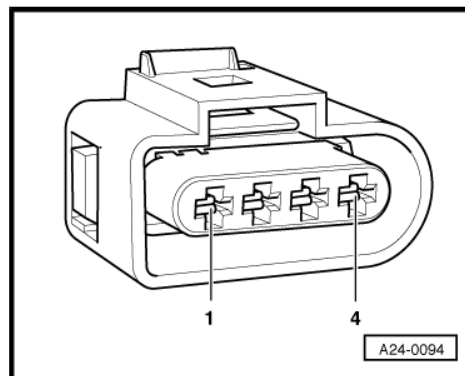
Vehicles from model year 2001 onwards:

- Remove washer fluid reservoir ⇒ Rep. Gr. 94 .
- Unplug electrical connector at charge pressure sender -G31- .



Checking voltage supply

- Connect hand-held multimeter -V.A.G 1526 C- to measure voltage between contacts -1- and -3- of connector for charge pressure sender -G31- .
- Switch on ignition.
- Specification: approx. 5 V



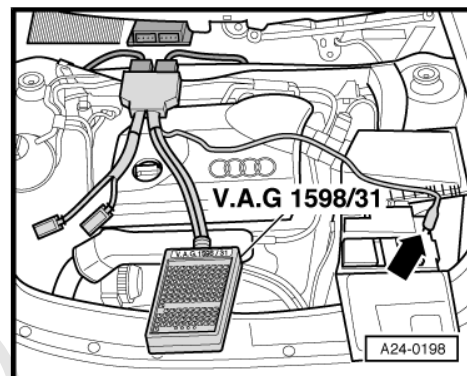
If specification is not obtained:

- Connect adapter cable -V.A.G 1598/31- (test box) to connectors of wiring harness; do not connect engine control unit.
Connect earth clip of test box to earth -arrow- ⇒ Rep. Gr. 24 .



Caution

To prevent damage to electronic components, select appropriate measuring range before connecting measuring leads and observe test requirements.



- Check for open circuit and short to positive or earth in the following wiring:

Connector Contact	-V.A.G 1598/31- Socket
-1-	108
-3-	98

- Repair wiring connection if necessary.

If the specification is obtained:

Checking signal wire

- Plug in connector at charge pressure sender -G31- .
- Connect hand-held multimeter -V.A.G 1526 C- (voltage measurement range) between sockets "101" and "108" on -V.A.G 1598/31- .
- Start engine and run at idling speed.
 - Specification: approx. 1.90 V
- Increase engine speed by depressing accelerator pedal briefly.
 - Specification: 2.00 ... 3.00 V

If the specifications are not obtained:

- Check for open circuit and short to positive or earth in the following wiring:

Connector Contact	-V.A.G 1598/31- Socket
-4-	101

- Repair wiring connection if necessary.

If wiring is OK:

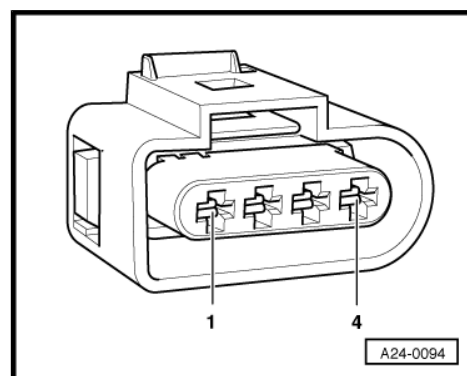
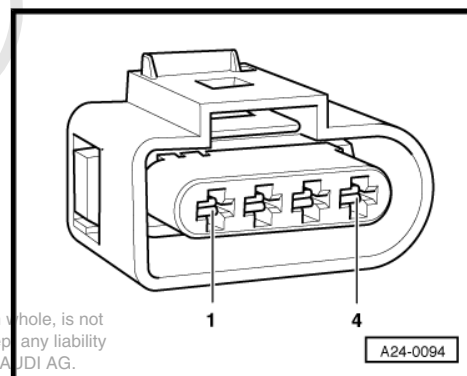
- Renew charge pressure sender -G31- .

Assembling

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

Vehicles from model year 2001 onwards:

- Install washer fluid reservoir ⇒ Rep. Gr. 94 .



2 Servicing charge air system with turbocharger

2.1 Rules for cleanliness

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

- ◆ Thoroughly clean all unions and surrounding areas before disconnecting.
- ◆ Place parts that have been removed on a clean surface and cover them over. Use only lint-free cloths.
- ◆ **Carefully cover or seal open components if repairs cannot be carried out immediately.**
- ◆ Only install clean components; replacement parts should only be unpacked immediately prior to installation. Do not use parts that have been previously unpacked and stored away loose (e.g. in toolboxes, etc.).
- ◆ When the system is open: Do not work with compressed air if this can be avoided. Do not move the vehicle unless absolutely necessary.

2.2 Turbocharger - exploded view of components

Part 1

1 - Front exhaust pipe**2 - 40 Nm**

- ☐ Renew

3 - Shim**4 - Gasket**

- ☐ Renew

5 - Turbocharger

- ☐ Checking ⇒ [page 160](#)
- ☐ Removing and installing
⇒ [page 187](#)

6 - O-ring

- ☐ Renew

7 - 10 Nm**8 - Connection****9 - Gasket**

- ☐ Renew
- ☐ Note installation position

10 - 23 Nm**11 - Heat shield****12 - 10 Nm****13 - Banjo bolt, 30 Nm****14 - Oil supply pipe**

From oil filter bracket
⇒ [Item 23 \(page 131\)](#)

15 - 35 Nm

- ☐ Renew

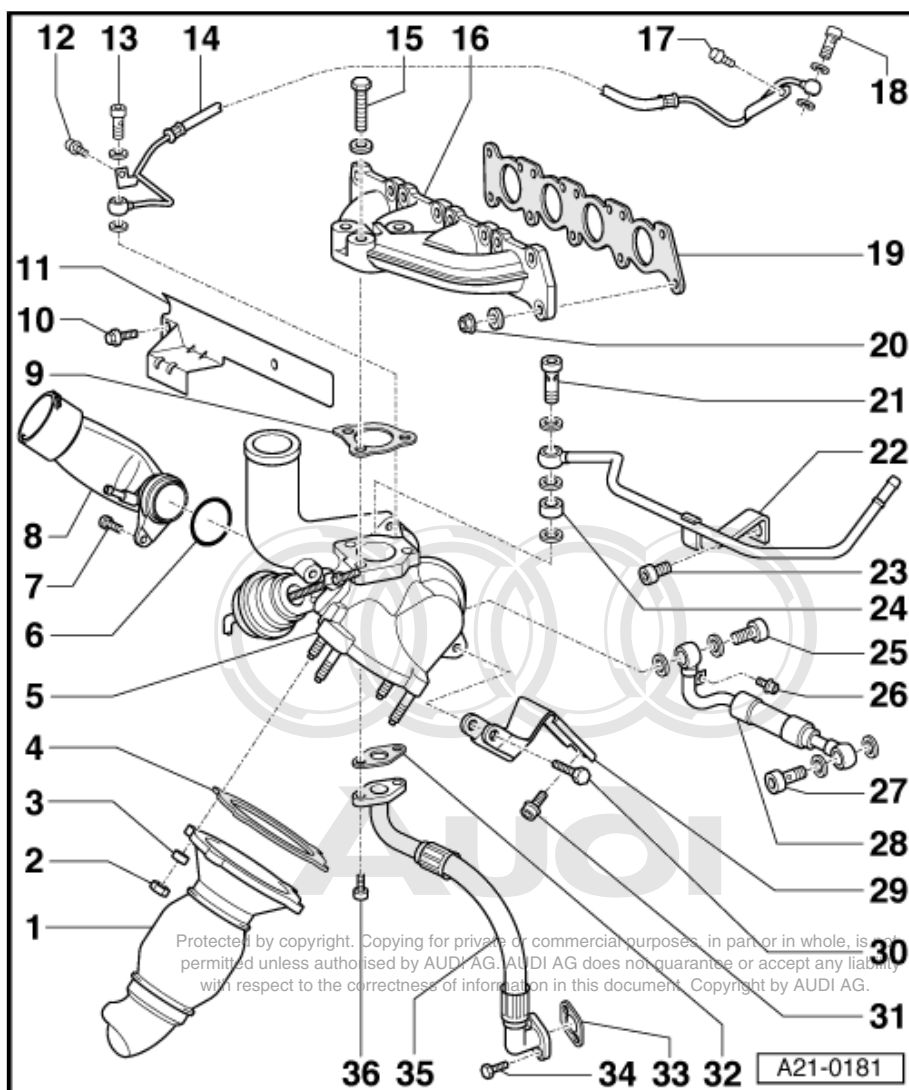
- ☐ Coat thread and contact surface of bolt head with high-temperature paste; ⇒ Parts catalogue

16 - Exhaust manifold**17 - 23 Nm****18 - Banjo bolt, 30 Nm****19 - Gasket**

- ☐ Renew
- ☐ Note installation position

20 - 30 Nm

- ☐ Renew





21 - Banjo bolt, 35 Nm

22 - Coolant return hose/pipe

23 - 23 Nm

24 - Spacer sleeve

25 - Banjo bolt, 35 Nm

26 - 10 Nm

27 - Banjo bolt, 35 Nm

28 - Coolant supply pipe

29 - Bracket

30 - 45 Nm

☐ Use only genuine bolt ⇒ Parts catalogue

31 - 25 Nm

32 - Gasket

☐ Renew

33 - Gasket

☐ Renew

34 - 10 Nm

35 - Oil return pipe

☐ To sump

36 - 10 Nm

Part 2



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1 - To solenoid valve for charge pressure control -N75-

2 - Retaining clip

3 - O-ring

☐ Renew

4 - Air intake hose

☐ To connection on turbo-charger

5 - Solenoid valve for charge pressure control -N75-

6 - Mechanical air recirculation valve

7 - Hose

☐ To turbocharger air re-circulation valve -N249-

8 - Pressure control valve for crankcase breather system

9 - Hose

☐ From mechanical air re-circulation valve to top air pipe

10 - To crankcase breather

11 - Top air pipe

12 - 25 Nm

13 - 25 Nm

14 - To throttle valve housing

15 - Non-return valve

☐ Installation position: as illustrated

16 - To activated charcoal filter system solenoid valve 1 -N80-

17 - Hose

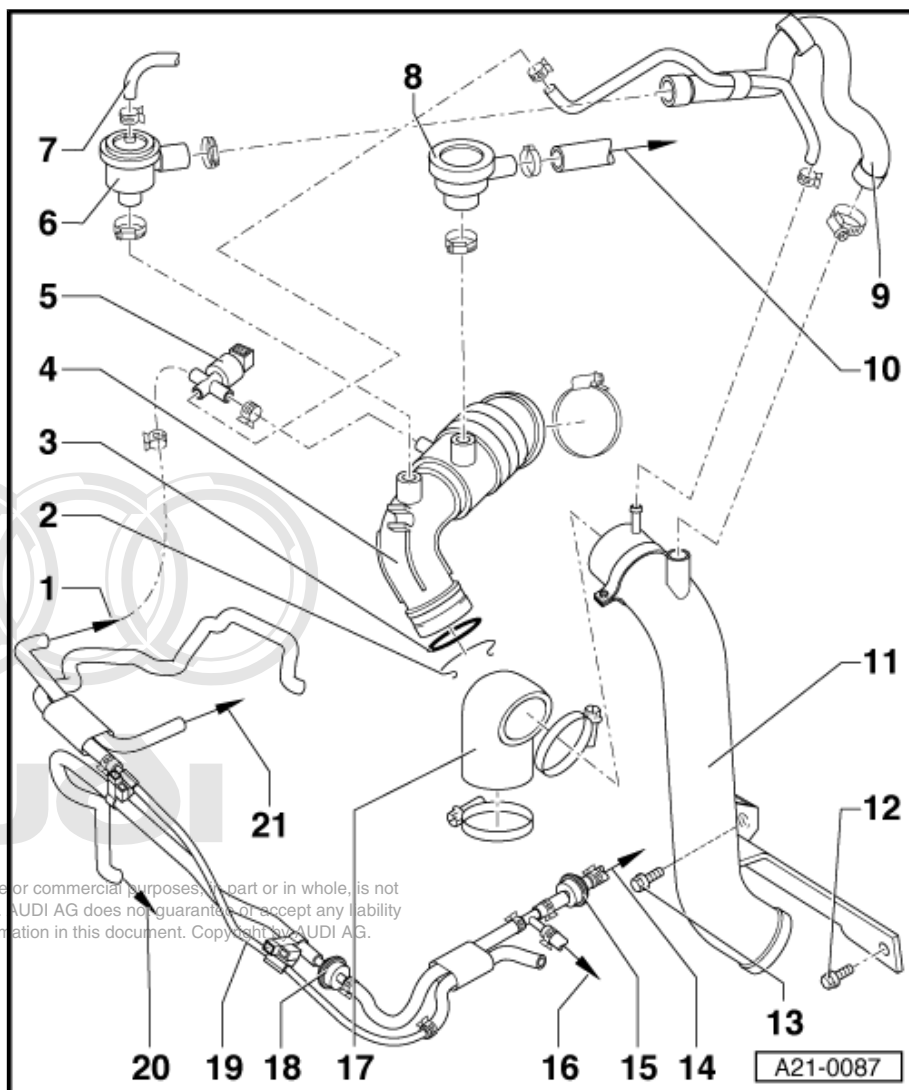
18 - Non-return valve

☐ Installation position: as illustrated

19 - Coolant pipe

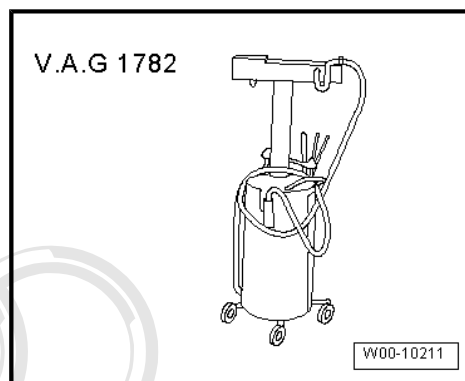
20 - To connection on turbocharger

21 - To vacuum unit for charge pressure control



2.3 Removing and installing turbocharger

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



Removing



Note

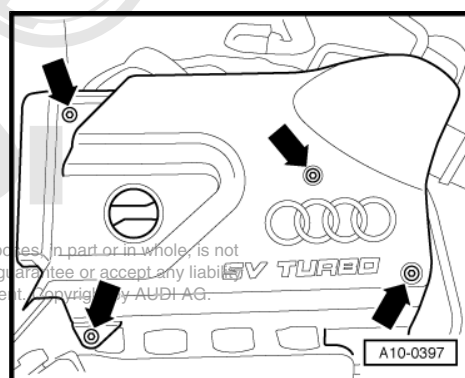
All cable ties which are released or cut open when removing must be fitted in the same position when installing.

- Take off engine cover panel -arrows-

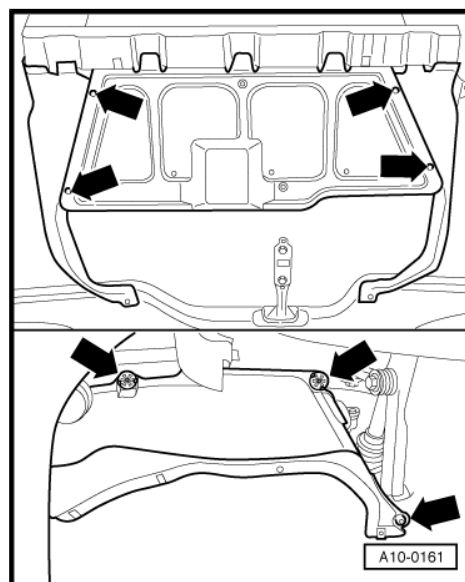


WARNING

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 panels (centre and right) -arrows-.
- Drain off coolant ➔ [page 136](#) .

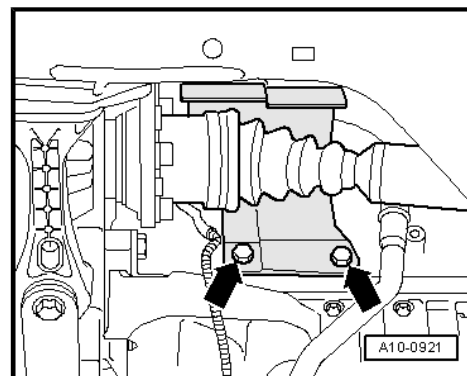


Vehicles with front-wheel drive:

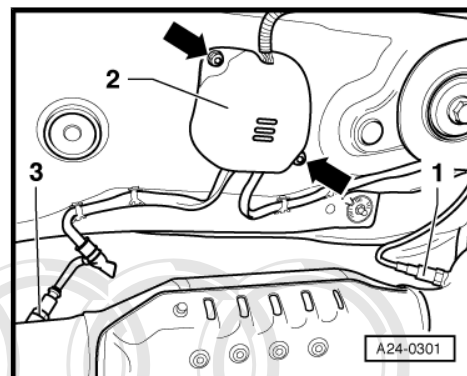
- Unbolt heat shield for drive shaft (right-side).
- Remove drive shaft (right-side) ⇒ Rep. Gr. 40 .

Vehicles with four-wheel drive:

- Remove bevel box ⇒ Rep. Gr. 34 .

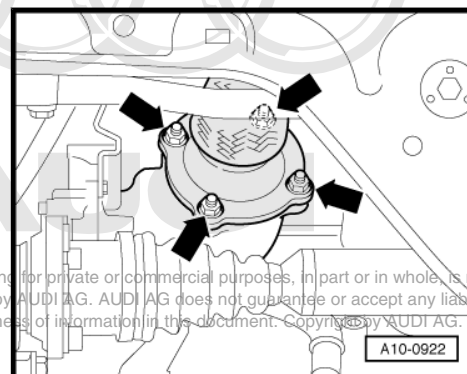
**All models:**

- Unbolt protective cover -2- -arrows-.
- Unplug electrical connectors and move aside wiring for Lambda probes -1- and -3-.

**Note**

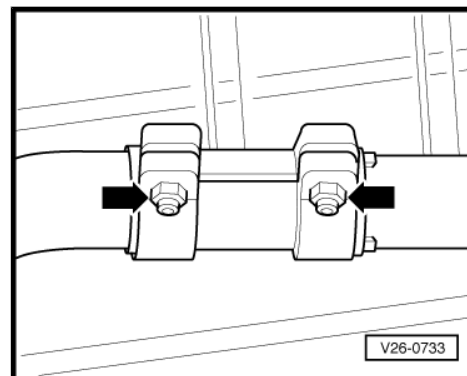
To avoid any damage, the flexible joint in the front exhaust pipe must not be bent more than 10°.

- Unscrew nuts -arrows- securing front exhaust pipe to turbo-charger.

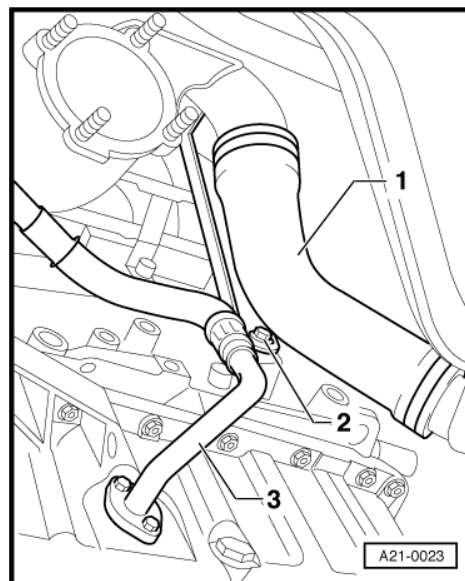


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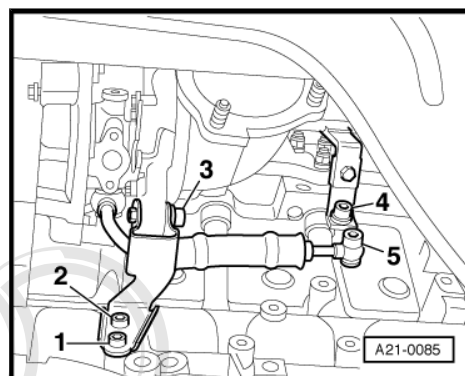
- Disconnect exhaust system at clamp -arrows- and push clamp towards rear of vehicle.
- Detach front exhaust pipe with catalytic converter.
- Place used oil collection and extraction unit -V.A.G 1782- under engine and drain engine oil.



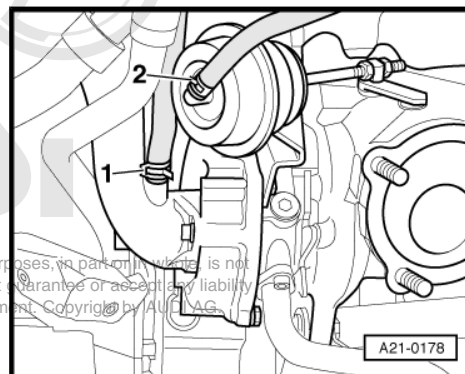
- Remove air intake hose -1- between top air pipe and bottom air pipe.
- Unbolt bracket -2- or retaining clip (depending on version) for top air pipe.
- Remove oil return pipe -3-.



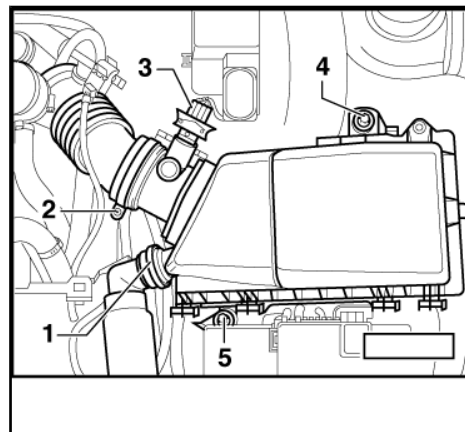
- Slacken bolted connection -3- for turbocharger bracket a few turns.
- Remove bolts -1- and -2- and detach bracket for turbocharger.
- Unbolt bracket for coolant return pipe -4-.
- Unbolt coolant supply pipe -5- at cylinder block.



- Detach hoses -1- and -2- from turbocharger.



- Detach air intake hose -1- leading to secondary air pump at air cleaner housing.
- Release hose clip -2- and detach air duct from air mass meter -G70-.
- Unplug electrical connector at air mass meter -G70-item 3-.
- Unscrew bolts -4- and -5- and remove air cleaner housing.



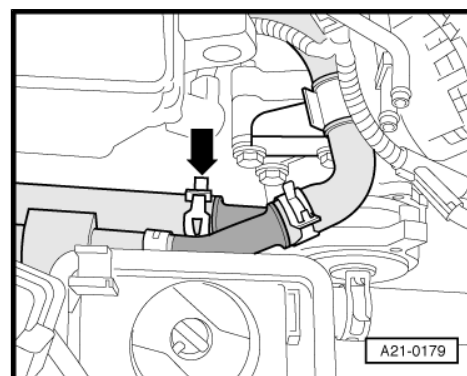
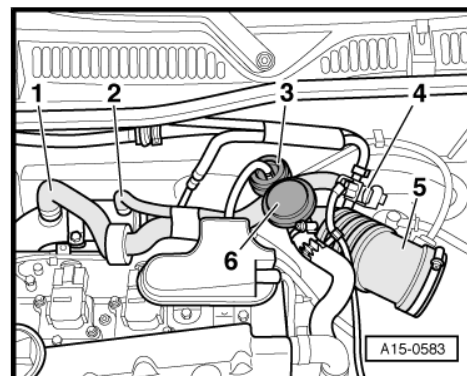
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- Detach mechanical air recirculation valve -3-, pressure control valve for crankcase breather -6- and charge pressure control solenoid valve -N75- -item 4- from air duct.
- Pull locking clip out at turbocharger connection and detach air duct -5-.

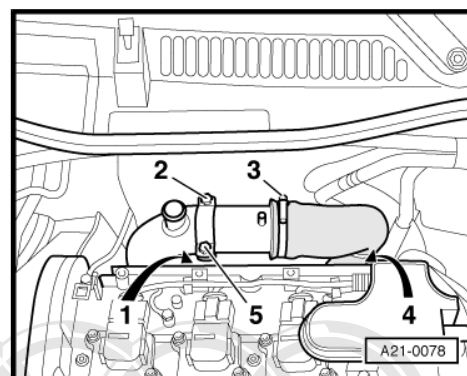
**Note**

Seal off opening in turbocharger intake system with a clean cloth.

- Detach hoses -1- and -2- from top air pipe.
- Detach coolant return hose -arrow- to turbocharger at Y-piece on right side next to cylinder head.



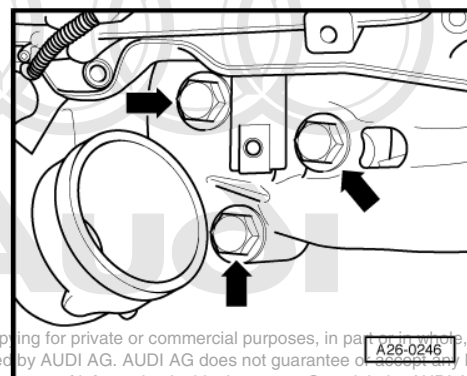
- Disconnect air intake hose -3- leading to turbocharger from top air pipe.
- Unscrew bolts -2- and -5- on retaining clip for top air pipe.
- Unscrew bolts -1- and -4- for heat shield at back of cylinder head.
- Remove top air pipe and heat shield.



- Unbolt turbocharger from exhaust manifold -arrows-.
- Remove gasket. The turbocharger will drop slightly.

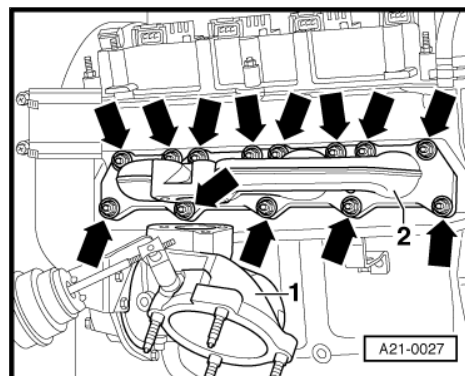
**Note**

Seal off opening in turbocharger intake system with a clean cloth.

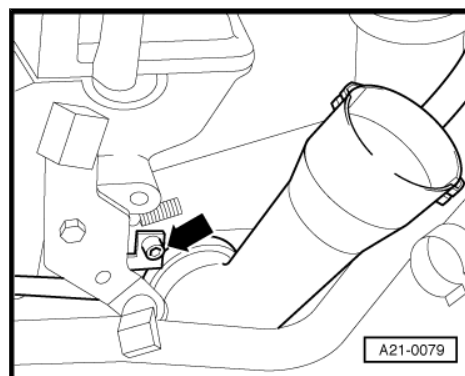


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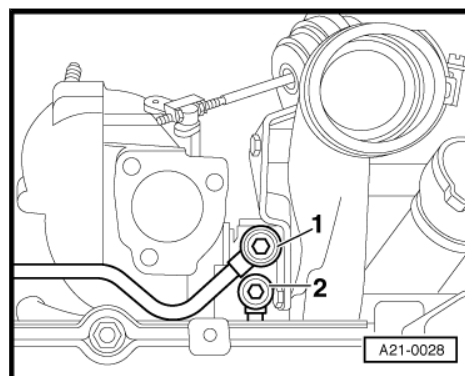
- Unscrew nuts -arrows- at exhaust manifold (accessible from above).
- Remove washers and exhaust manifold.



- Unscrew retainer for oil supply pipe at turbocharger -arrow-.
- Re-connect bracket for turbocharger to cylinder block.



- Disconnect oil supply pipe -2- and coolant return pipe -1- at turbocharger.
- Detach spacer sleeve below connection for coolant return pipe.
- Detach coolant return pipe.
- Unscrew bracket for turbocharger from cylinder block and detach turbocharger.



Installing

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



Note

- ◆ *Renew gaskets, seals and self-locking nuts.*
- ◆ *Fill turbocharger with engine oil at connection for oil supply pipe.*
- ◆ *Fit all heat insulation sleeves in the original position when installing.*
- ◆ *Hose connections and hoses for charge air system must be free of oil and grease before assembly.*
- ◆ *Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.*
- ◆ *Charge air system must be free of leaks.*
- ◆ *Fit all cable ties in the original positions when installing.*
- Loosely attach turbocharger bracket to turbocharger.
- Fit turbocharger onto engine from underneath and attach bracket to cylinder block (hand-tight).

- Screw on oil supply pipe -2- and retainer.
- Connect coolant return pipe -1- with spacer sleeve to turbocharger.
- Unscrew bracket for turbocharger from cylinder block again.
- Fit exhaust manifold.
- Bolt turbocharger to exhaust manifold.

Vehicles with front-wheel drive:

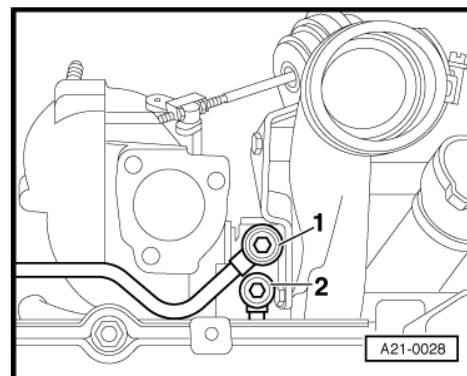
- Install drive shaft (right-side) ⇒ Rep. Gr. 40 .

Vehicles with four-wheel drive:

- Install bevel box ⇒ Rep. Gr. 34 .

All models:

- Check oil level ⇒ [page 133](#) .
- Fill cooling system ⇒ [page 138](#) .

**Note**

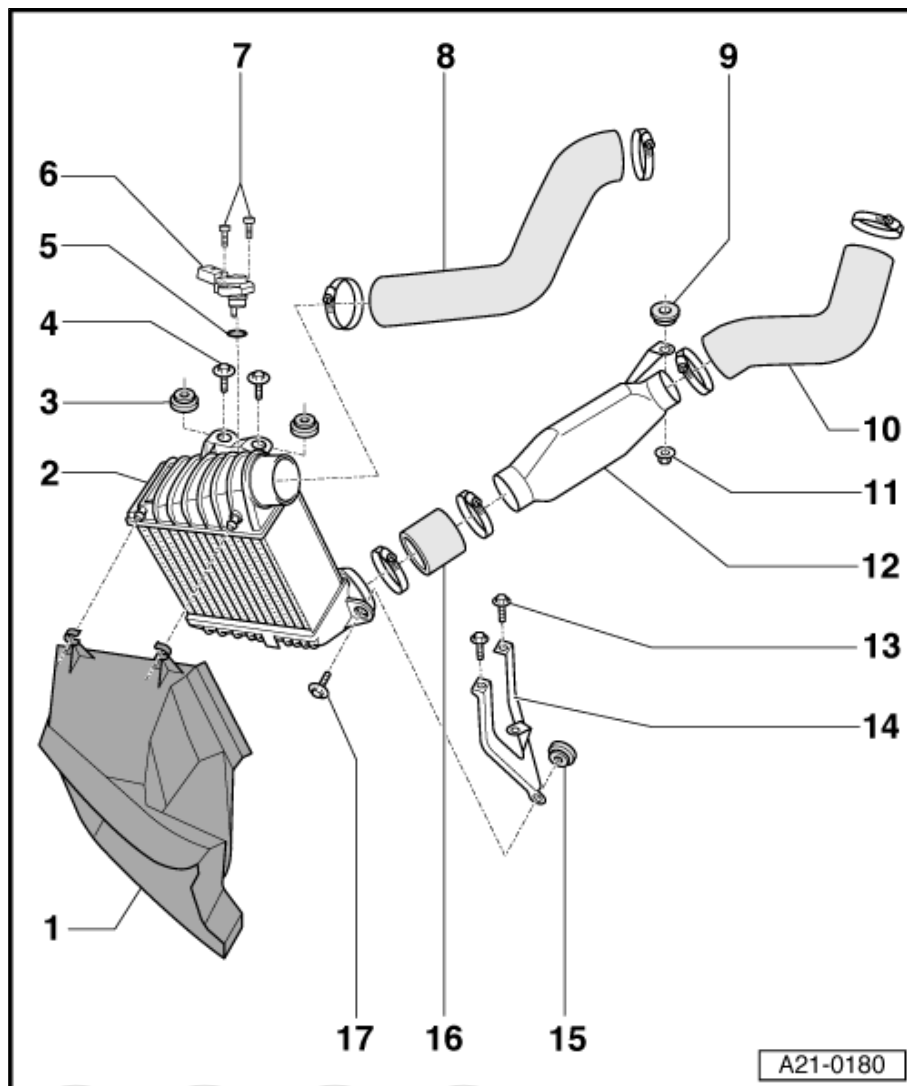
After installing turbocharger, allow engine to idle for approx. 1 minute and do not rev up immediately to ensure turbocharger is supplied with oil.

Tightening torques

Component	Nm
Exhaust manifold to cylinder head	30 ¹⁾
Coolant supply pipe to: Turbocharger	35
Cylinder block	35
Coolant return pipe to turbocharger	35
Bracket for coolant return pipe to cylinder block	23
Oil supply pipe to turbocharger	30
Bracket for coolant supply pipe to turbocharger	10
Turbocharger to exhaust manifold	35 ²⁾³⁾
Bracket for turbocharger to: Cylinder block	25
Turbocharger	45
Retainer for oil supply pipe to cylinder head	10
Heat shield to cylinder head	23
Oil return pipe to: Sump	10
Turbocharger	10
Front exhaust pipe with catalytic converter to turbocharger	40
Drive shaft heat shield to cylinder block	35
Hose clips for air hoses	3.5
• ¹⁾ Renew nuts. • ²⁾ Renew bolts. • ³⁾ Coat threads and contact surface of bolt heads with high-temperature paste; for high-temperature paste refer to ⇒ Parts catalogue .	

2.4 Charge air cooler - exploded view of components

- 1 - Air duct
- 2 - Charge air cooler
 - ☐ Removing and installing
⇒ [page 194](#)
- 3 - Rubber grommet
 - ☐ With sleeve
- 4 - 10 Nm
- 5 - O-ring
 - ☐ Renew if damaged
- 6 - Charge pressure sender - G31-
- 7 - 3 Nm
- 8 - Air intake hose
 - ☐ Between intake manifold and charge air cooler
- 9 - Rubber grommet
 - ☐ With sleeve
- 10 - Air intake hose
 - ☐ Between top and bottom air pipes
- 11 - 10 Nm
- 12 - Bottom air pipe
- 13 - 10 Nm
- 14 - Bracket
- 15 - Rubber grommet
 - ☐ With sleeve
- 16 - Air intake hose
- 17 - 10 Nm

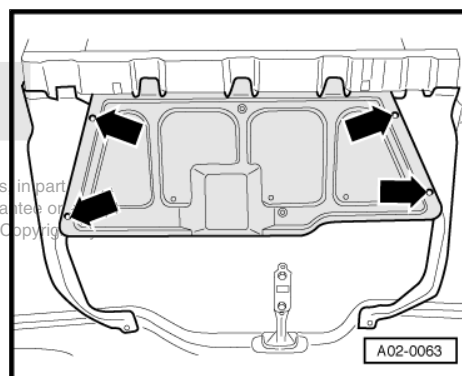


2.5 Removing and installing charge air cooler

Removing

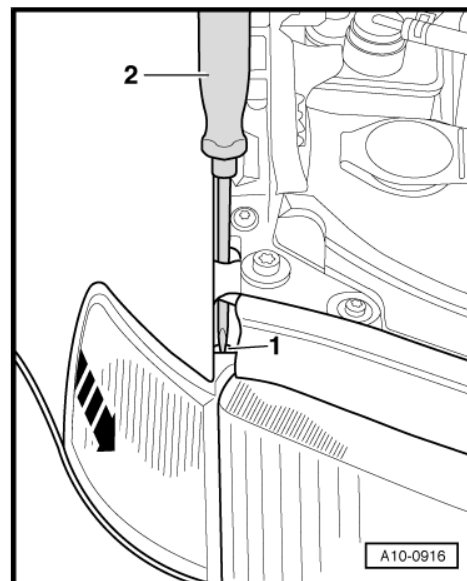
- Remove bumper cover (front) ⇒ Rep. Gr. 63 .
- Remove centre noise insulation -arrows-.

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Vehicles with electronic throttle up to model year 2000:

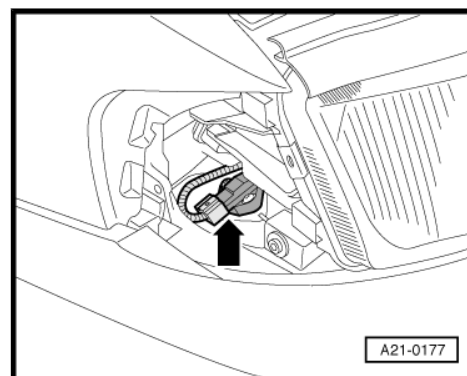
- Release catch -1- at turn signal housing with cross-head screwdriver -2- by turning 1/4 turn to left.
- Press down catch and slide turn signal housing to front -arrow- out of guide.



- Reach through opening for turn signal and unplug connector at charge pressure sender -G31- .

Vehicles from model year 2001 onwards:

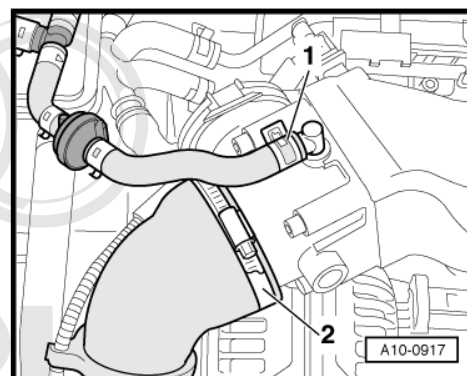
- Remove washer fluid reservoir ⇒ Rep. Gr. 94 .
- Unplug electrical connector at charge pressure sender -G31- .

**All models:**

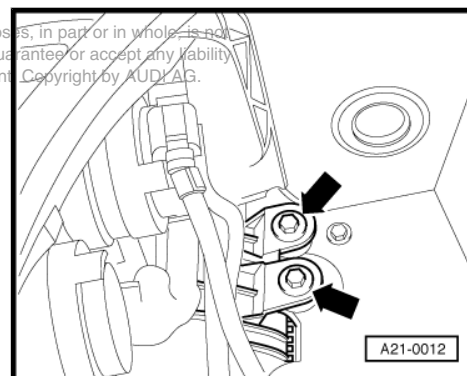
- Detach air intake hose -2- from throttle valve module -J338- .

**Note**

Disregard -item 1-.



- Remove top bolts -arrows- securing charge air cooler



- Remove bottom bolt -1- securing charge air cooler.
- Disconnect bottom hose -2- from charge air cooler.
- Disconnect top hose from charge air cooler.
- Take out charge air cooler downwards.

Installing

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



Note

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

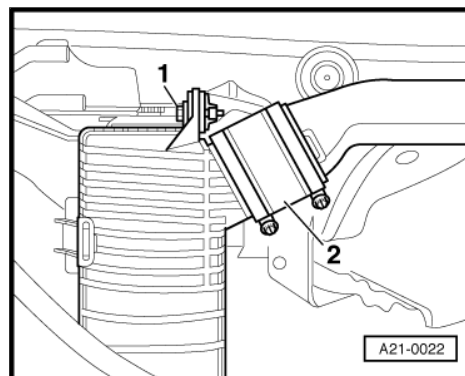
- Install bumper cover (front) ⇒ Rep. Gr. 63 .

Vehicles from model year 2001 onwards:

- Install washer fluid reservoir ⇒ Rep. Gr. 94 .

Tightening torques

Component	Nm
Charge air cooler to bracket	10
Hose clips for air hoses	3.5



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26 – Exhaust system

1 Removing and installing parts of exhaust system - vehicles with front-wheel drive



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 clamp(s) 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 distributed evenly.
- ◆ Use screwdriver to unfasten and tighten lock washers for heat shields. Tightening torque: 2 Nm.

1.1 Exhaust system - exploded view of components

1 - Tunnel cross-piece

- ☐ With bore for aligning exhaust system
⇒ [page 204](#)

2 - Centre silencer

- ☐ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point
⇒ [page 200](#)
- ☐ Align exhaust system so it is free of stress
⇒ [page 204](#)

3 - Mounting

- ☐ Renew if damaged
- ☐ Installation position
⇒ [page 199](#)

4 - 23 Nm

5 - 40 Nm

- ☐ Renew

6 - Spacer

7 - Gasket

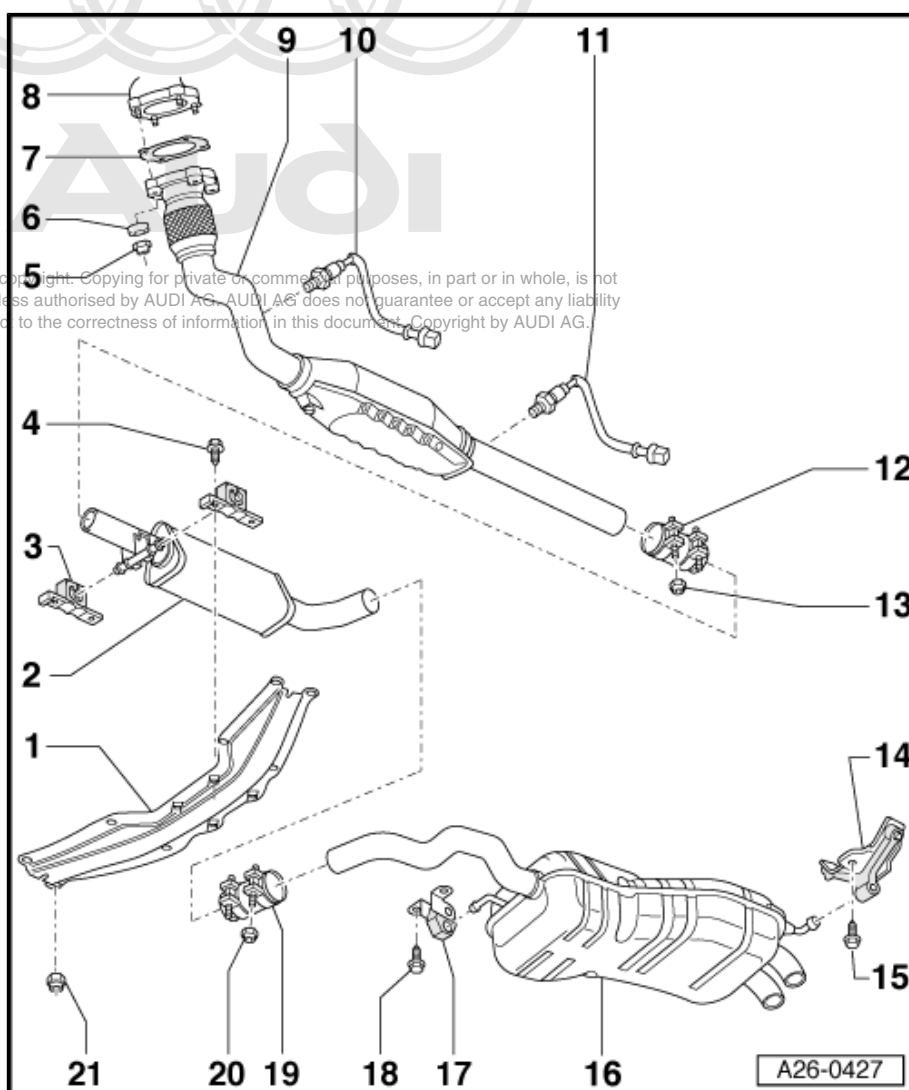
- ☐ Renew

8 - Turbocharger

- ☐ Removing and installing
⇒ [page 187](#)

9 - Front exhaust pipe with catalytic converter

- ☐ Protect against knocks





and impact

- ☐ With flexible joint
- ☐ Do not bend flexible joint more than 10° - otherwise it can be damaged
- ☐ Removing and installing ⇒ [page 200](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 204](#)

10 - Lambda probe -G39- (before catalytic converter)

- ☐ The threads on the new Lambda probes are coated with a special assembly paste.
- ☐ If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ⇒ Parts catalogue for high-temperature paste.
- ☐ The assembly paste/high-temperature paste must not get into the slots on the probe body.
- ☐ Tighten to 55 Nm

11 - Lambda probe after catalytic converter -G130-

- ☐ **Not fitted on engine code AJQ**
- ☐ The threads on the new Lambda probes are coated with a special assembly paste.
- ☐ If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ⇒ Parts catalogue for high-temperature paste.
- ☐ The assembly paste/high-temperature paste must not get into the slots on the probe body.
- ☐ Tighten to 55 Nm

12 - Clamp (front)

- ☐ Before tightening, align exhaust system so it is free of stress ⇒ [page 204](#)
- ☐ Installation position ⇒ [page 199](#)
- ☐ Tighten bolt connections evenly

13 - 40 Nm

14 - Mounting

- ☐ Renew if damaged

15 - 23 Nm

16 - Rear silencer

- ☐ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point ⇒ [page 200](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 204](#)

17 - Mounting

- ☐ Renew if damaged

18 - 23 Nm

19 - Clamp (rear)

- ☐ For separate replacement of centre and rear silencers
- ☐ Before tightening, align exhaust system so it is free of stress ⇒ [page 204](#)
- ☐ Installation position ⇒ [page 199](#)
- ☐ Tighten bolt connections evenly

20 - 40 Nm

21 - 23 Nm

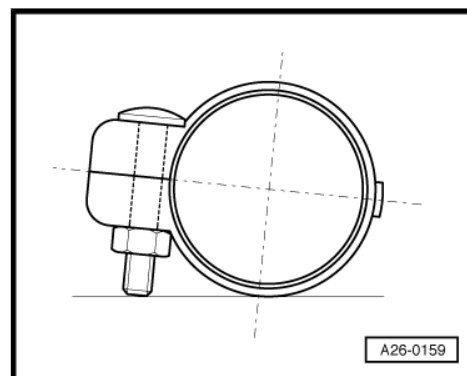
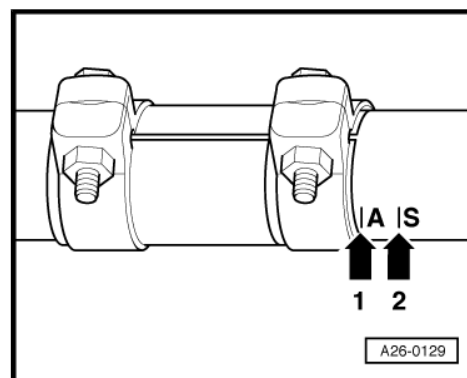
Installation position of front clamp

- Position clamp about 5 mm away from marking “A” -arrow 1- and tighten evenly to 40 Nm.

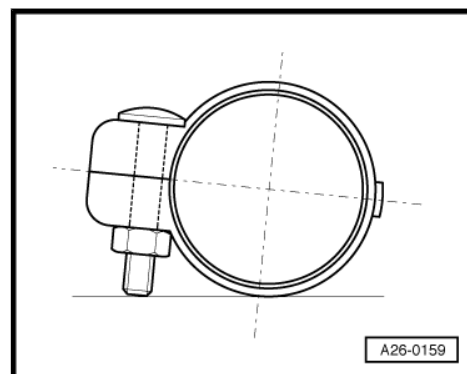
**Note**

Ignore marking “S” -arrow 2-.

- Fit clamp so that ends of bolts do not protrude beyond bottom of clamp.
- Bolt connection faces to left.

**Installation position of rear clamp**

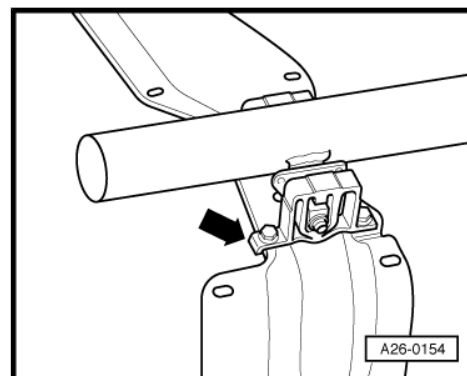
- Fit clamp so that ends of bolts do not protrude beyond bottom of clamp.
- Bolt connection faces front.



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Installation position of mounting

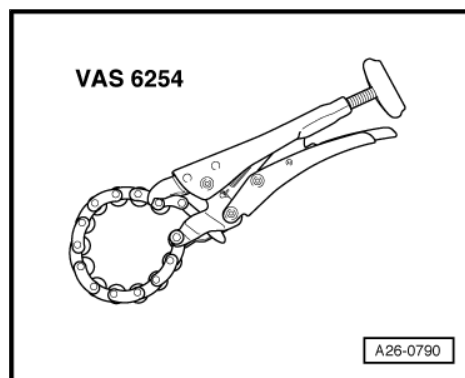
- Flanged end on base of mounting -arrow- faces in direction of travel.

**1.2 Separating centre and rear silencers**

- ◆ The connecting pipe can be cut through at the cutting point provided in order to renew the centre and rear silencers separately.
- ◆ Cutting location is marked by an indentation on circumference of exhaust pipe.

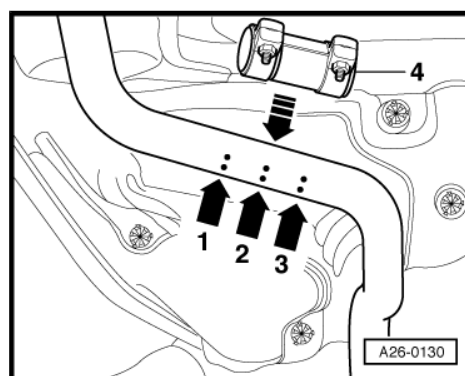
Special tools and workshop equipment required

♦ Chain-type pipe cutter -VAS 6254-

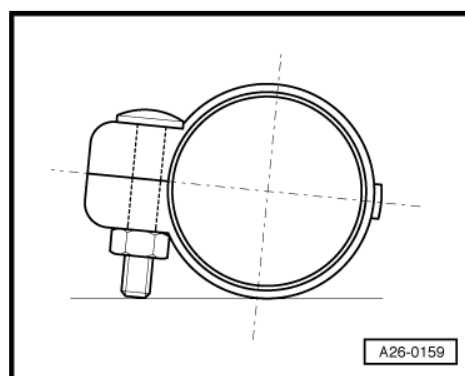


Procedure

- Cut through exhaust pipe at a right angle at cutting point -arrow 2- using chain-type pipe cutter -VAS 6254- .
- When installing, position clamp -4- at the marks -arrow 1- and -arrows 3-.



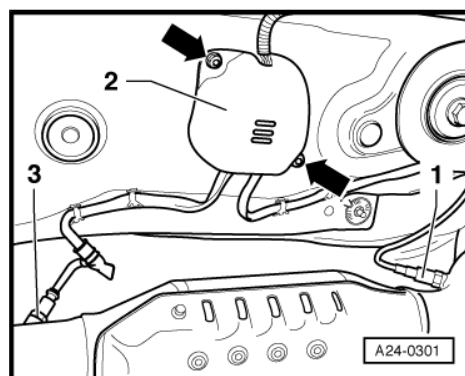
- Fit clamp.
- Bolt connection faces front.
- Align exhaust system so it is free of stress ➔ [page 204](#) .



1.3 Removing and installing front exhaust pipe with catalytic converter

Removing

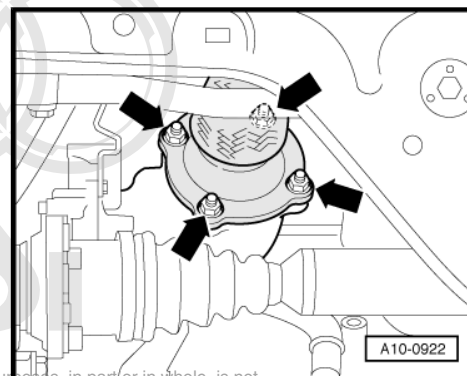
- Unbolt protective cover -2- -arrows-.
- Unplug electrical connectors and move aside wiring for Lambda probes -1- and -3-.



i Note

To avoid any damage, the flexible joint in the front exhaust pipe must not be bent more than 10°.

- Unbolt front exhaust pipe from turbocharger -arrows-.



- Disconnect exhaust system at clamp -arrows- and detach front exhaust pipe with catalytic converter.

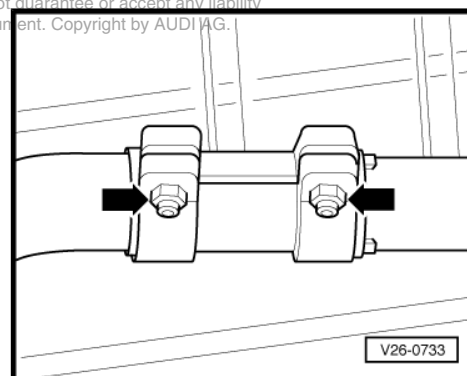
Installing

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

i Note

Renew gaskets and self-locking nuts.

- Align exhaust system so it is free of stress ⇒ [page 204](#) .

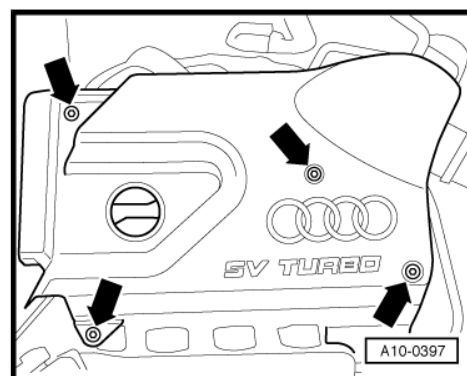
**Tightening torques**

Component	Nm
Lambda probe to front exhaust pipe	55 ¹⁾
Front exhaust pipe to turbocharger	40
• ¹⁾ The threads on the new Lambda probes are coated with a special assembly paste. If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ⇒ Parts catalogue for high-temperature paste. The assembly paste/ high-temperature paste must not get into the slots on the probe body.	

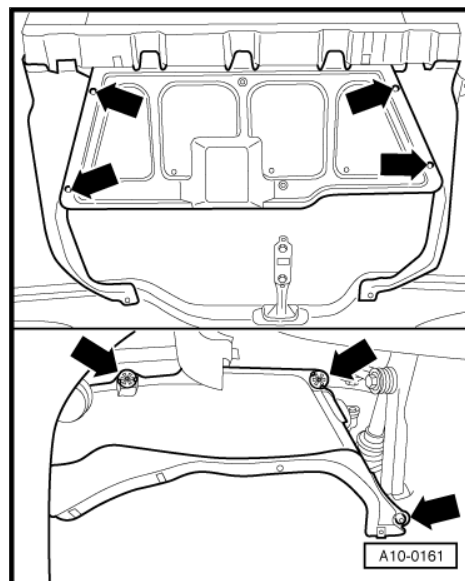
1.4 Removing and installing exhaust manifold

Removing

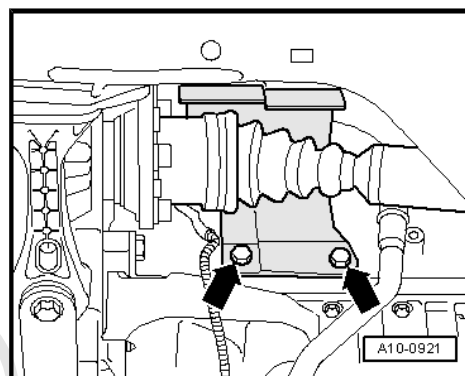
- Take off engine cover panel -arrows-.



- Remove noise insulation panels (centre and right) -arrows-.
- Remove front exhaust pipe together with catalytic converter
⇒ [page 200](#) .



- Unbolt heat shield for drive shaft (right-side) from cylinder block -arrows-.



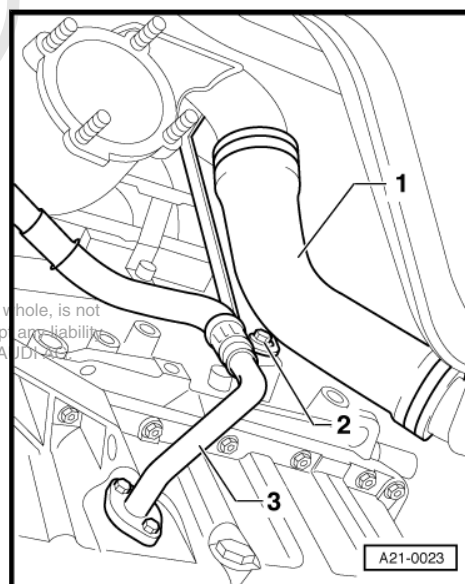
- Remove air intake hose -2- between top air pipe and bottom air pipe.
- Unbolt bracket -2- or retaining clip (depending on version) for top air pipe.



Note

Disregard -item 3-.

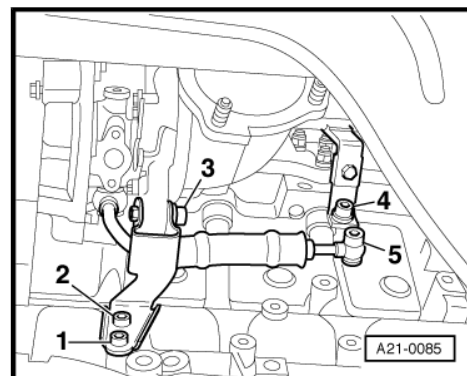
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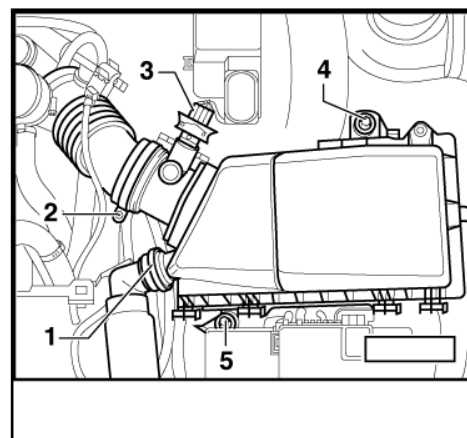
- Slacken bolted connection -3- for turbocharger bracket a few turns.
- Remove bolts -1- and -2- and detach bracket for turbocharger.
- Unbolt bracket for coolant return pipe -4-.

**Note**

Disregard -item 5-.



- Detach air hose -1- leading to secondary air pump at air cleaner housing.
- Release hose clip -2- and detach air duct from air mass meter -G70-.
- Unplug electrical connector at air mass meter -G70- -item 3-.
- Unscrew bolts -4- and -5- and remove air cleaner housing.

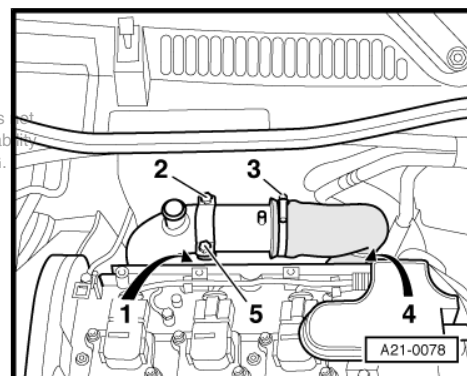
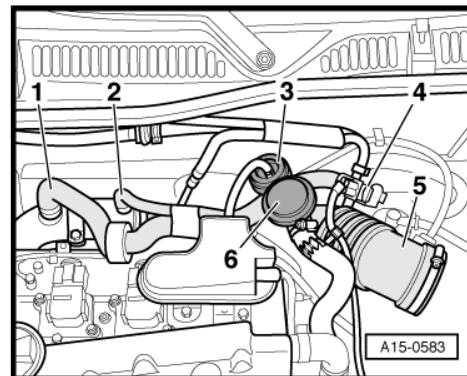


- Detach mechanical air recirculation valve -3-, pressure control valve for crankcase breather -6- and charge pressure control solenoid valve -N75- -item 4- from air duct.
- Pull locking clip out at turbocharger connection and detach air duct -5-.

**Note**

Seal off opening in turbocharger intake system with a clean cloth.

- Detach hoses -1- and -2- from top air pipe.
- Disconnect air intake hose -3- leading to turbocharger from top air pipe.
- Unscrew bolts -2- and -5- on retaining clip for top air pipe.
- Unscrew bolts 1 and 4 for heat shield at back of cylinder head.
- Remove top air pipe and heat shield.

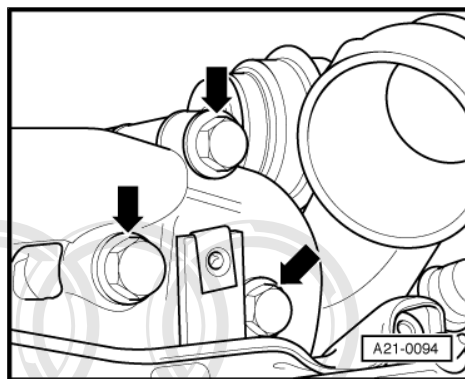


- Unbolt turbocharger from exhaust manifold -arrows-.
- Remove gasket. The turbocharger will drop slightly.



Note

Seal off opening in turbocharger intake system with a clean cloth.



- Unscrew nuts -arrows- at exhaust manifold -2- (accessible from above).
- Remove washers and exhaust manifold.

Installing

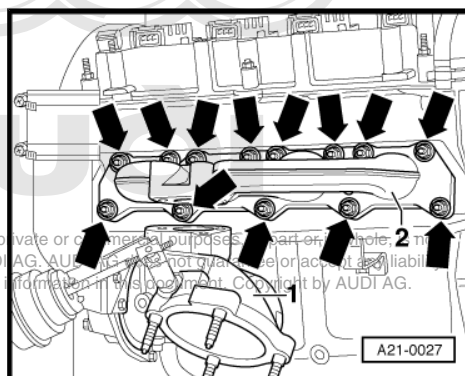
Installation is carried out in the reverse order; note the following:



Note

Renew gaskets and self-locking nuts.

- Install cross piece for suspension strut ⇒ Rep. Gr. 40 .
- Align exhaust system so it is free of stress ⇒ [page 204](#) .



Tightening torques

Component	Nm
Exhaust manifold to cylinder head	30
Turbocharger to exhaust manifold	35 ¹⁾²⁾
Bracket for turbocharger to cylinder block	25
Bracket for coolant return pipe to cylinder block	23
Bracket for turbocharger to turbocharger	45
Front exhaust pipe to turbocharger	40
Drive shaft heat shield to cylinder block	35
Heat shield to cylinder head	23
Air pipe to bracket	10
Hose clips for air hoses	3.5
• ¹⁾ Renew bolts. • ²⁾ Coat with high-temperature paste; refer to ⇒ Parts catalogue .	

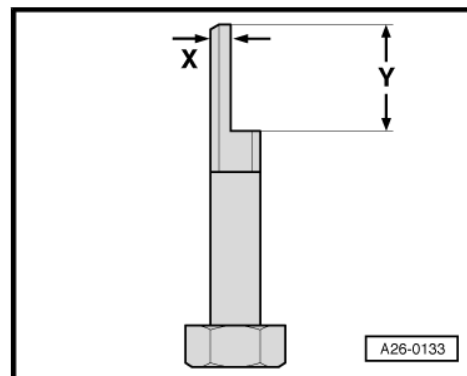
1.5 Stress-free alignment of exhaust system

- The exhaust system must be aligned when it is cool.

Special tools and workshop equipment required

- ◆ Improvised tool made from an M10 bolt

- Modify an M10 bolt according to the dimensions given to use as a tool.
- Dimension -X- = 4 mm.
- Dimension -Y- = 25 mm.



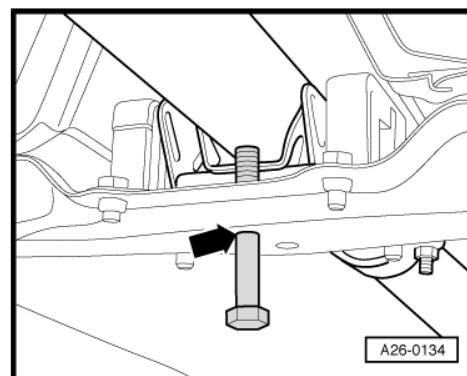
Procedure

- Loosen bolt connections of front clamp
⇒ [Item 12 \(page 198\)](#).
- Insert improvised tool through rear bore -arrow- in tunnel cross-piece.
- The flat part faces the mounting pin on the exhaust system.

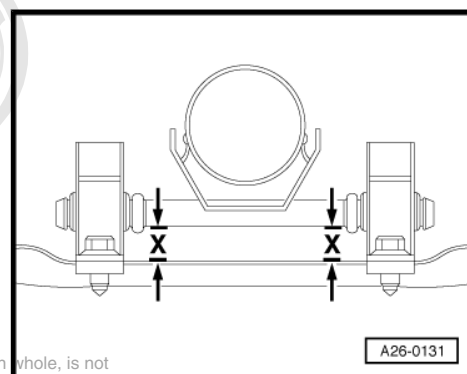


Note

Exhaust system is pre-tensioned in direction of travel with improvised tool inserted.



- Align centre and rear silencers horizontally:
- The mounting pin on the exhaust pipe must be positioned parallel with the tunnel cross-piece.
- Dimension -x- (left-side) = dimension -x- (right-side)



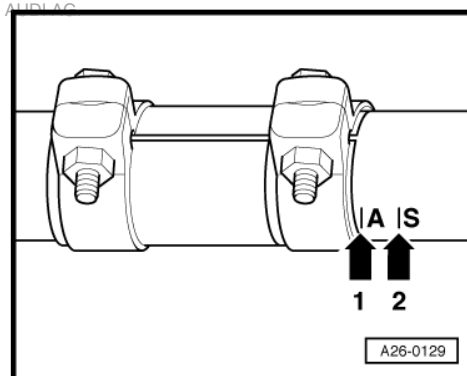
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- Position clamp at a distance of approx. 5 mm from marking "A" -arrow 1-.



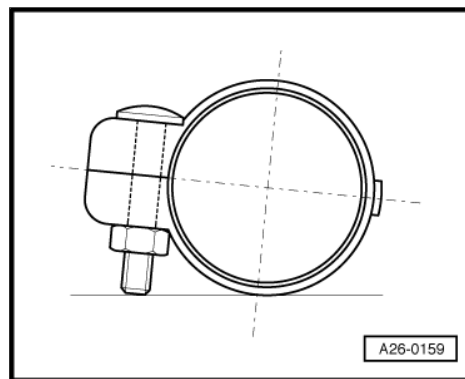
Note

Ignore marking "S" -arrow 2-.





- Position clamp as follows:
- Bolt connection faces to left.
- Install clamp so that ends of bolts do not protrude beyond bottom of clamp.
- Align rear silencer horizontally.
- Tighten bolts on clamp evenly to 40 Nm.



1.6 Checking exhaust system for leaks

- Start engine and run at idling speed.
- Seal off tailpipes for duration of leak test with cloths or plugs, etc.
- Listen at joints between cylinder head/exhaust manifold, exhaust manifold/turbocharger, turbocharger/front exhaust pipe etc. to check for leaks.
- Repair any leaks that are found.



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2 Removing and installing parts of exhaust system - vehicles with four-wheel drive



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 clamp(s) 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 distributed evenly.
- ◆ Use screwdriver to unfasten and tighten lock washers for heat shields. Tightening torque: 2 Nm.

2.1 Exhaust system - exploded view of components

1 - Centre silencer

- ☐ Combined in one unit with rear silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point
⇒ [page 209](#)
- ☐ Align exhaust system so it is free of stress
⇒ [page 215](#)

2 - 40 Nm

3 - Clamp (front)

- ☐ Before tightening, align exhaust system so it is free of stress
⇒ [page 215](#)
- ☐ Installation position
⇒ [page 209](#)
- ☐ Tighten bolt connections evenly

4 - Rubber mounting

- ☐ Renew if damaged

5 - 23 Nm

6 - Mounting bracket

- ☐ For exhaust system mounting in propshaft tunnel

7 - 23 Nm

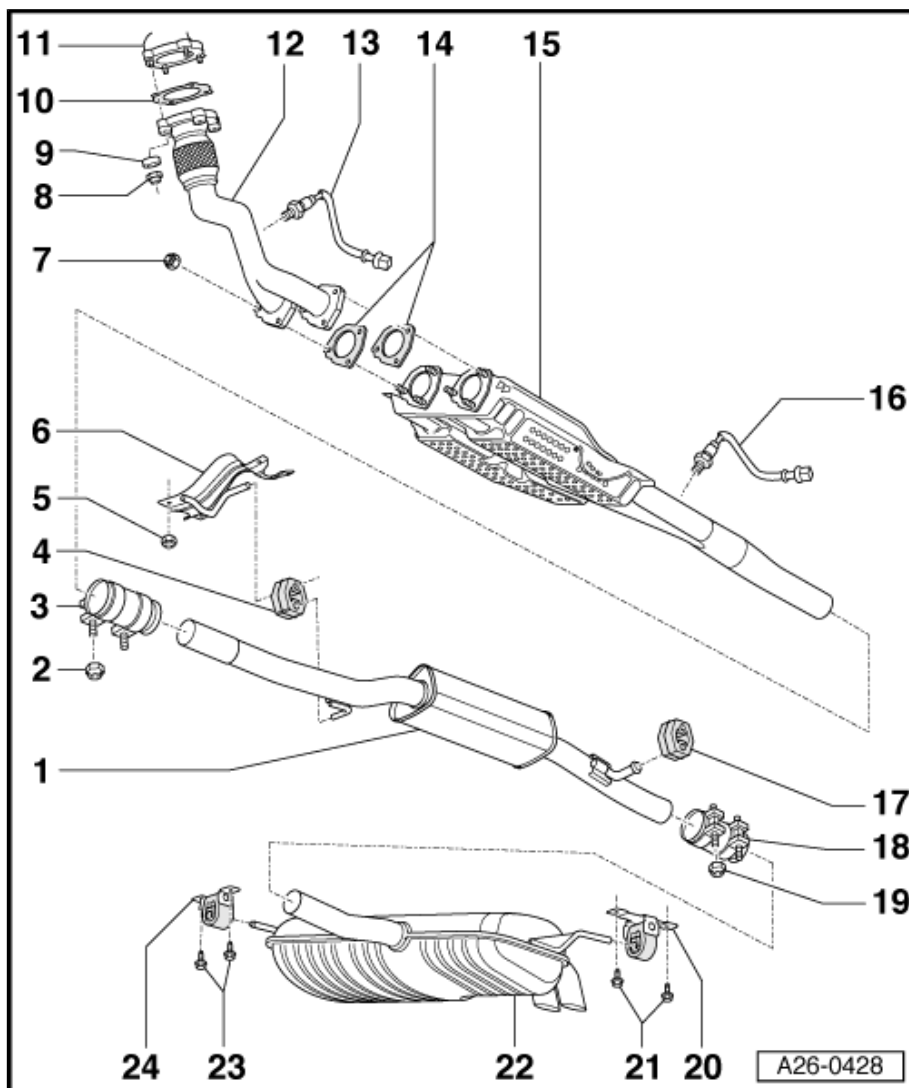
8 - 40 Nm

- ☐ Renew

9 - Spacer

10 - Gasket

- ☐ Renew



11 - Turbocharger

- ☐ Removing and installing ⇒ [page 187](#)

12 - Front exhaust pipe

- ☐ With flexible joint
- ☐ Do not bend flexible joint more than 10° - otherwise it can be damaged
- ☐ Removing and installing ⇒ [page 210](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 215](#)

13 - Lambda probe -G39- (before catalytic converter)

- ☐ The threads on the new Lambda probes are coated with a special assembly paste.
- ☐ If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ⇒ Parts catalogue for high-temperature paste.
- ☐ The assembly paste/high-temperature paste must not get into the slots on the probe body.
- ☐ Tighten to 55 Nm

14 - Gaskets

- ☐ Renew

15 - Catalytic converter

- ☐ Protect against knocks and impact
- ☐ Removing and installing together with front exhaust pipe ⇒ [page 210](#)

16 - Lambda probe after catalytic converter -G130-

- ☐ Not fitted on engine code AJQ
- ☐ The threads on the new Lambda probes are coated with a special assembly paste.
- ☐ If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ⇒ Parts catalogue for high-temperature paste.
- ☐ The assembly paste/high-temperature paste must not get into the slots on the probe body.
- ☐ Tighten to 55 Nm

17 - Rubber mounting

- ☐ Renew if damaged

18 - Clamp (rear)

- ☐ For separate replacement of centre and rear silencers
- ☐ Before tightening, align exhaust system so it is free of stress ⇒ [page 215](#)
- ☐ Installation position ⇒ [page 209](#)
- ☐ Tighten bolt connections evenly

19 - 40 Nm**20 - Mounting**

- ☐ Renew if damaged

21 - 23 Nm**22 - Rear silencer**

- ☐ Combined in one unit with centre silencer as original equipment. Can be renewed individually for repair purposes
- ☐ Cutting point ⇒ [page 209](#)
- ☐ Align exhaust system so it is free of stress ⇒ [page 215](#)

23 - 23 Nm

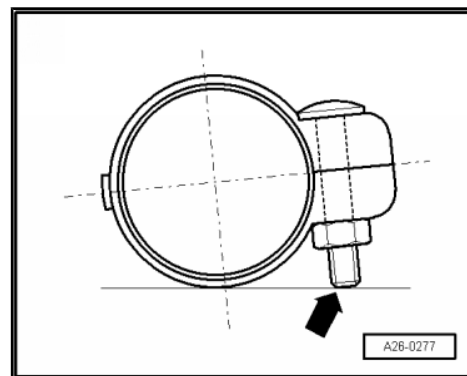
- ☐ Renew

24 - Mounting

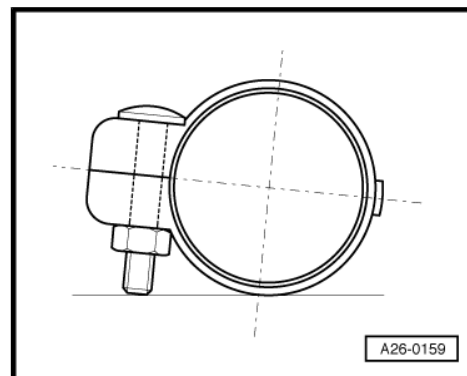
- ☐ Renew if damaged

Installation position of front clamp

- When fitting clamp, make sure the ends of the bolts do not project below the bottom of the clamp -arrow-.
- Bolt connection faces to right.

**Installation position of rear clamp**

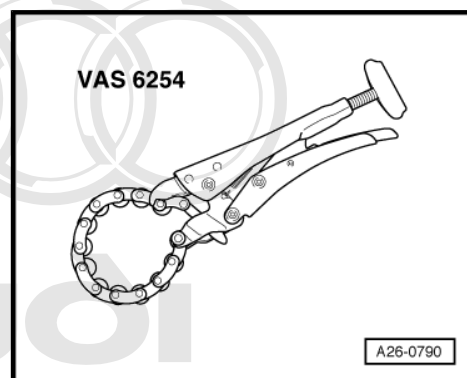
- Fit clamp so that ends of bolts do not protrude beyond bottom of clamp.
- Bolt connection faces to left.

**2.2 Separating centre and rear silencers**

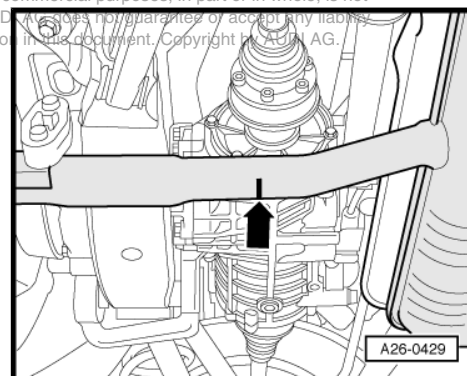
- ◆ The connecting pipe can be cut through at the cutting point provided in order to renew the centre and rear silencers separately.
- ◆ The cutting point is marked by an indentation on the outside of the exhaust pipe.

Special tools and workshop equipment required

- ◆ Chain-type pipe cutter -VAS 6254-

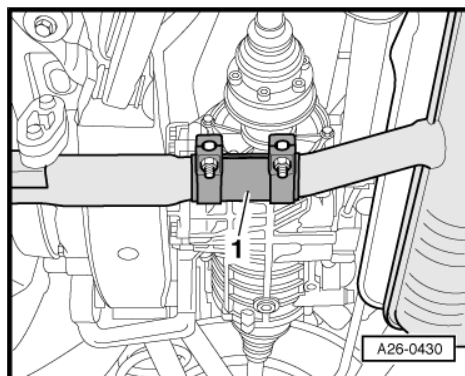
**Procedure**

- Cut through exhaust pipe at a right angle at cutting point -arrow- using chain-type pipe cutter -VAS 6254-.

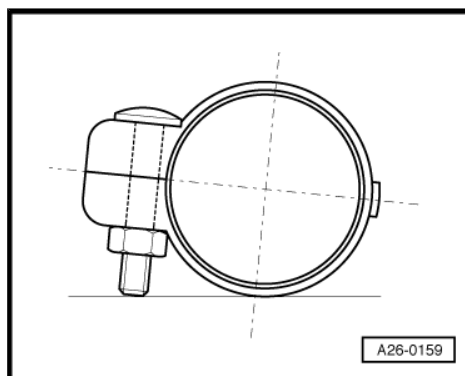


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- When reassembling, position the clamp -1- centrally over the cutting point.



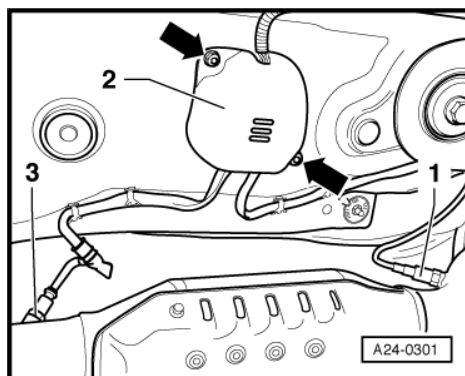
- Bolt connection faces front.
- Align exhaust system so it is free of stress ⇒ [page 215](#) .



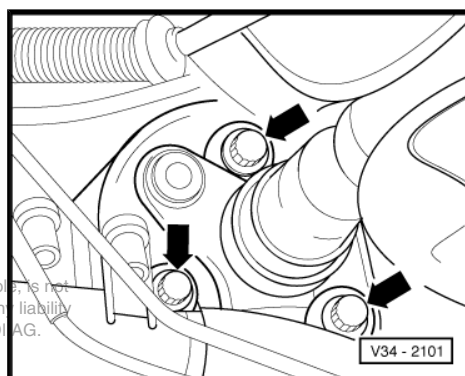
2.3 Removing and installing front exhaust pipe with catalytic converter

Removing

- Unbolt protective cover -2- -arrows-.
- Unplug the electrical connectors and move wiring to lambda probes -1- and -3- clear.



- Mark position of propshaft at flexible coupling on bevel box.
- Unscrew propshaft with flexible coupling from bevel box -arrows- (counter-hold using a suitable lever at the triangular flange).

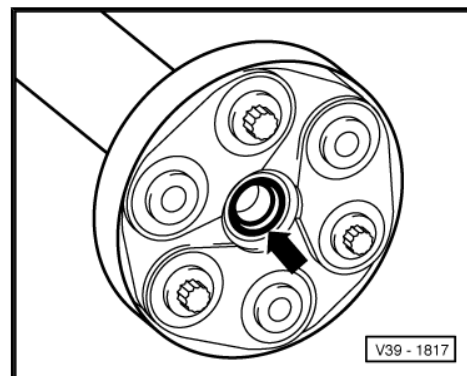


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**Caution**

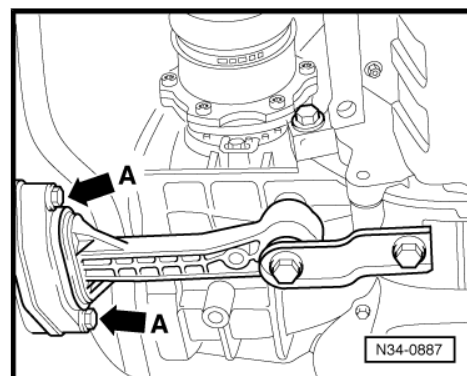
Avoid damaging the seal -arrow- in the propshaft flange when removing. If a seal is damaged the propshaft must be renewed.

- Push propshaft horizontally as far back as possible.

**Caution**

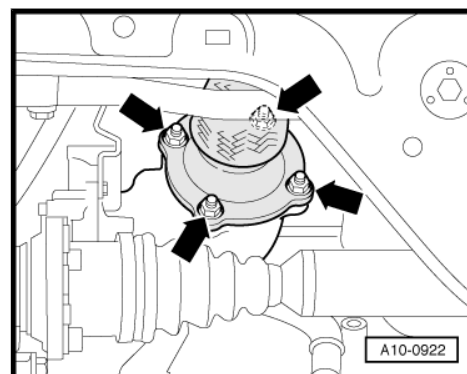
After unscrewing the bolts -A-, the engine/gearbox assembly swings slightly forward.

- Unbolt pendulum support at subframe -arrows A-.
- Carefully move engine/gearbox assembly to front.

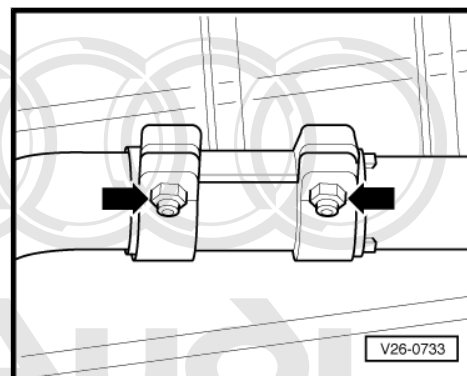
**Note**

To avoid any damage, the flexible joint in the front exhaust pipe must not be bent more than 10°.

- Unbolt front exhaust pipe from turbocharger -arrows-.



- Separate exhaust system at clamp -arrows-.
- Push clamp back and remove front exhaust pipe with catalytic converter.



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- If necessary, unbolt catalytic converters from front exhaust pipe -arrows-.

Installing

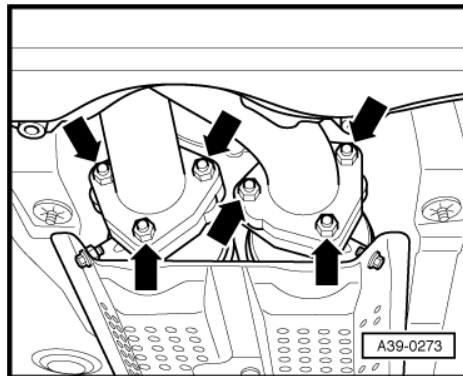
Installation is carried out in the reverse order; note the following:



Note

Renew gaskets and self-locking nuts.

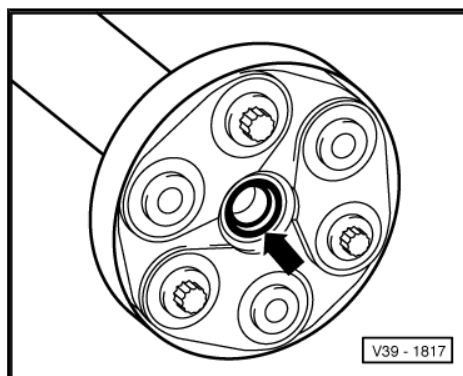
- Secure front exhaust pipe to turbocharger.



Caution

Avoid damaging the seal -arrow- in the propshaft flange when installing. If a seal is damaged the propshaft must be renewed.

- Push engine/gearbox assembly towards bulkhead; the journal of the bevel box must be simultaneously inserted horizontally and carefully into the flange of the propshaft.



- Secure pendulum support to subframe -arrows A-.
- Use new bolts for securing.
- Secure propshaft with flexible coupling to bevel box ⇒ Rep. Gr. 39 .

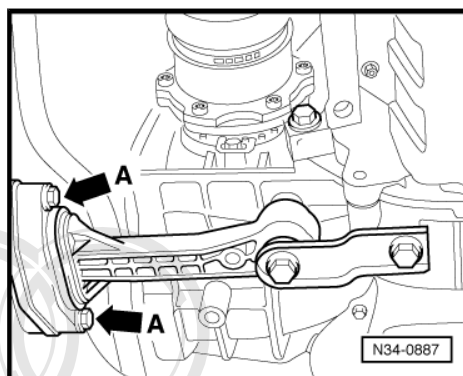
Perform further installation in reverse order, paying attention to the following:

- Align exhaust system so it is free of stress ⇒ [page 215](#) .

Tightening torques

Component	Nm
Lambda probe to front exhaust pipe	55 ¹⁾
Front exhaust pipe to turbocharger	40
Catalytic converter to front exhaust pipe	25
Pendulum support to subframe	20 + 90° ²⁾³⁾

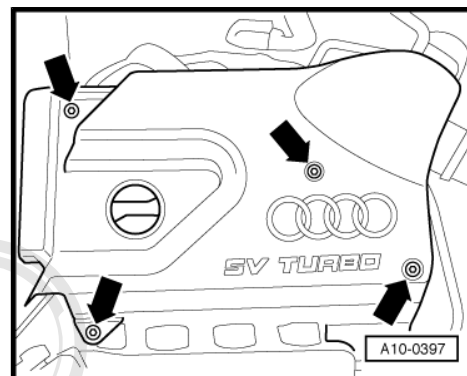
- ¹⁾ The threads on the new Lambda probes are coated with a special assembly paste. If re-installing old Lambda probe, coat thread with high-temperature paste: Refer to ⇒ Parts catalogue for high-temperature paste. The assembly paste/high-temperature paste must not get into the slots on the probe body.
- ²⁾ Renew bolts.
- ³⁾ 90° = one quarter turn.



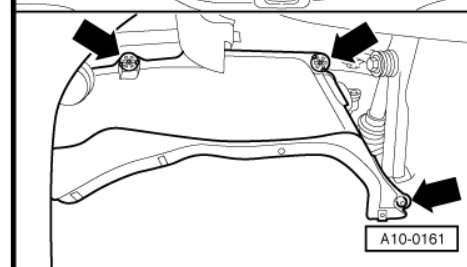
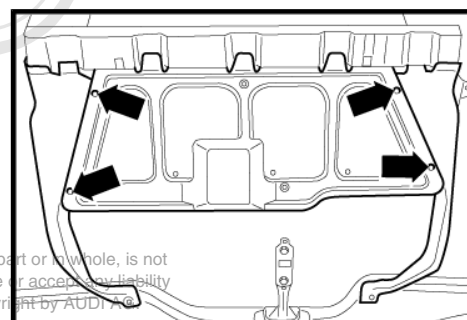
2.4 Removing and installing exhaust manifold

Removing

- Take off engine cover panel -arrows-.



- Remove noise insulation panels (centre and right) -arrows-.
- Remove front exhaust pipe together with catalytic converter ⇒ [page 210](#).
- Remove bevel box ⇒ Rep. Gr. 34.

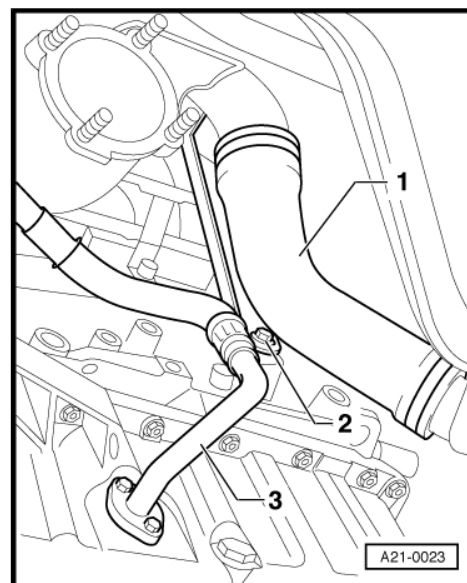


- Remove air intake hose -1- between top air pipe and bottom air pipe.
- Unbolt bracket -2- or retaining clip (depending on version) for top air pipe.



Note

Disregard -item 3-.

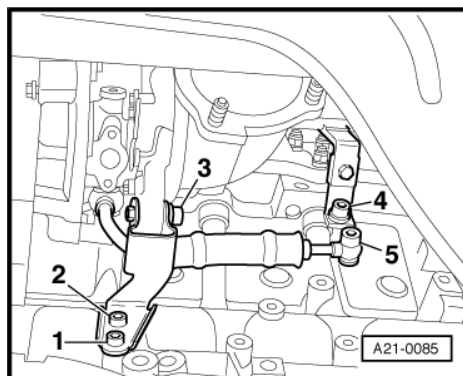


- Slacken bolted connection -3- for turbocharger bracket a few turns.
- Remove bolts -1- and -2- and detach bracket for turbocharger.
- Unbolt bracket for coolant return pipe -4-.

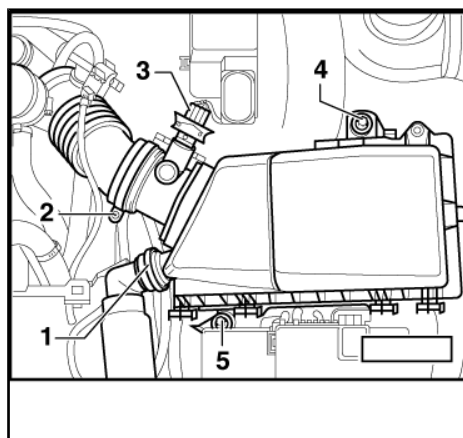


Note

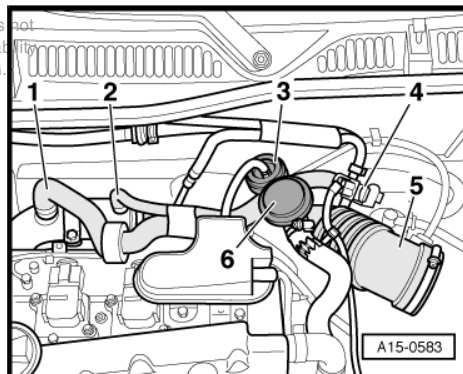
Disregard -item 5-.



- Detach air hose -1- leading to secondary air pump at air cleaner housing.
- Release hose clip -2- and detach air duct from air mass meter -G70-.
- Unplug electrical connector at air mass meter -G70- -item 3-.
- Unscrew bolts -4- and -5- and remove air cleaner housing.



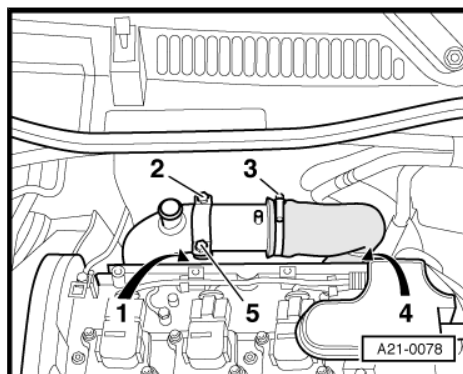
- Detach mechanical air recirculation valve -3- pressure control valve for crankcase breather -6- and charge pressure control solenoid valve -N75- -item 4- from air duct.
- Pull locking clip out at turbocharger connection and detach air duct -5-.



Note

Seal off opening in turbocharger intake system with a clean cloth.

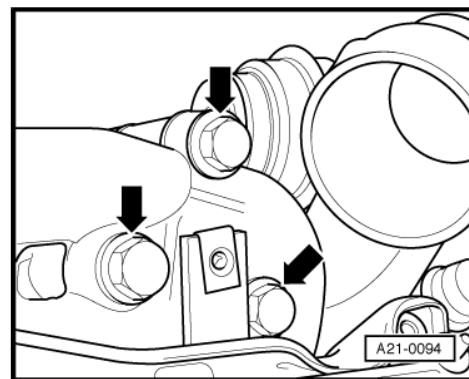
- Disconnect air intake hose -3- leading to turbocharger from top air pipe.
- Unscrew bolts -2- and -5- on retaining clip for top air pipe.
- Unscrew bolts -1- and -4- for heat shield at back of cylinder head.
- Remove top air pipe and heat shield.



- Unbolt turbocharger from exhaust manifold -arrows-.
- Remove gasket. The turbocharger will drop slightly.

**Note**

Seal off opening in turbocharger intake system with a clean cloth.



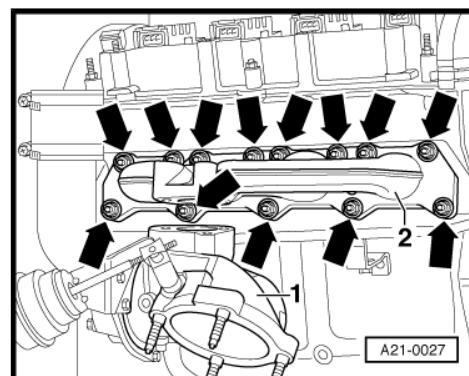
- Unscrew nuts -arrows- at exhaust manifold (accessible from above).
- Remove washers and exhaust manifold.

Installing

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

**Note**

Renew gaskets and self-locking nuts.



- Install bevel box ⇒ Rep. Gr. 34 .
- Align exhaust system so it is free of stress ⇒ [page 215](#) .

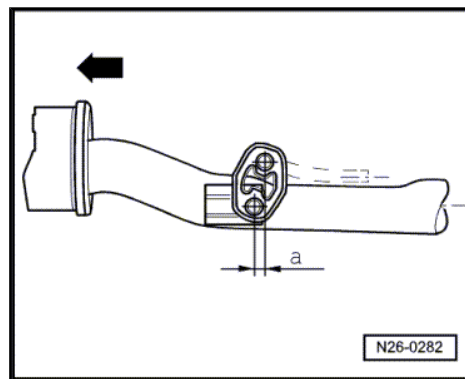
Tightening torques

Component	Nm
Exhaust manifold to cylinder head	30
Turbocharger to exhaust manifold	35 ¹⁾²⁾
Bracket for turbocharger to:	Cylinder block
	Turbocharger
Bracket for coolant return pipe to cylinder block	25
Front exhaust pipe to turbocharger	40
Heat shield to cylinder head	23
Air pipe to bracket	10
Hose clips for air hoses	3.5
• ¹⁾ Renew bolts. • ²⁾ Coat with high-temperature paste; refer to ⇒ Parts catalogue .	

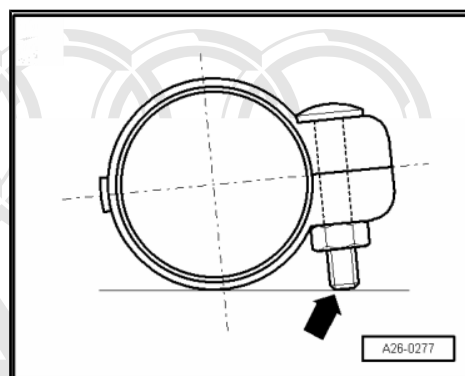
2.5 Stress-free alignment of exhaust system

- The exhaust system must be aligned when it is cool.

- Loosen bolt connections of front clamp ⇒ [Item 3 \(page 207\)](#) .
- Push exhaust system towards front of vehicle -arrow-, so that rear rubber mounting for centre silencer is preloaded by dimension -a- = 8 ... 12 mm.



- When positioning clamp, make sure the ends of the bolts do not project below the bottom of the clamp -arrow-.
- Bolt connection faces to right.
- Tighten bolts on clamp evenly to 40 Nm.



2.6 Checking exhaust system for leaks

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

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3 Secondary air system - not on engine code AGU, AJQ, AQA

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.

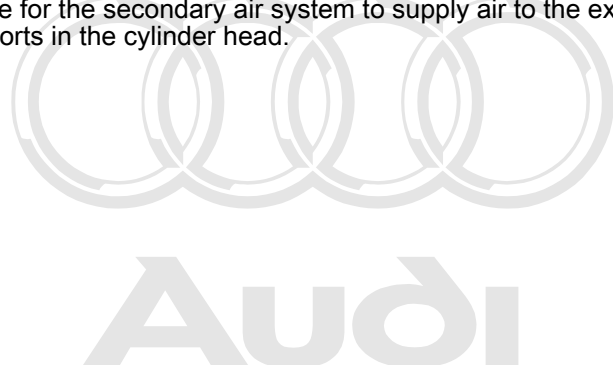
3.1 Principle and function

Principle

Because of the over-enrichment of the mixture in the cold start phase, the concentration 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 oxidation accelerates the "light off" of the catalytic converter and significantly improves exhaust gas quality during warm-up.

Function

- ◆ In the cold running phase, the Motronic control unit -J220- activates the secondary air pump -V101- via the secondary air pump relay -J299-. Air is routed to the secondary air combination valve.
- ◆ In parallel to this, the secondary air inlet valve -N112- is activated and allows vacuum to pass to the secondary air combination valve. In this way, the combination valve opens a passage for the secondary air system to supply air to the exhaust ports in the cylinder head.



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1 - Motronic control unit -J220-
2 - Secondary air pump relay - J299-

- ☐ Fitting location
⇒ [page 219](#)
- ☐ Checking ⇒ [page 225](#)

3 - Secondary air pump motor -V101-

- ☐ Fitting location
⇒ [page 219](#)
- ☐ Checking ⇒ [page 225](#)
- ☐ Removing and installing
⇒ [page 233](#)

4 - Intake manifold
5 - Air cleaner
6 - Combination valve for secondary air system

- ☐ Fitting location
⇒ [page 219](#)
- ☐ Checking ⇒ [page 230](#)
- ☐ Removing and installing
⇒ [page 232](#)

7 - Vacuum reservoir

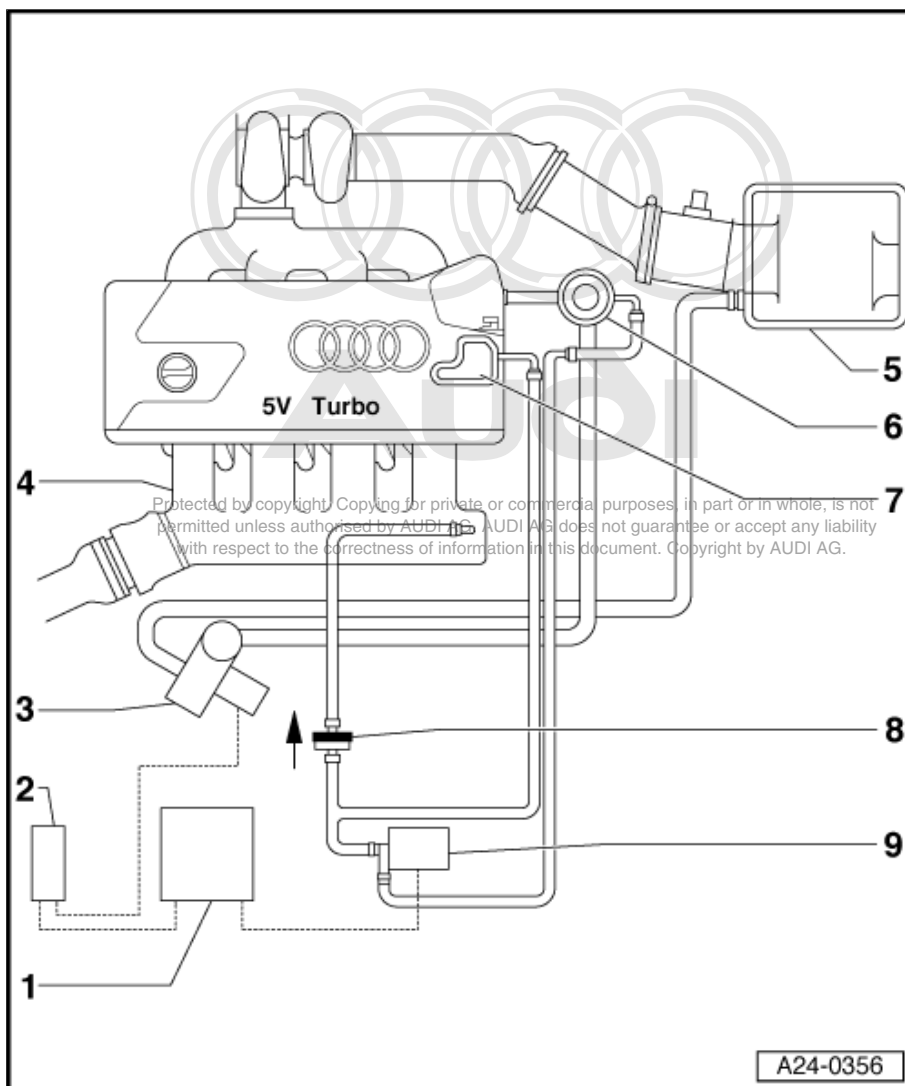
- ☐ Bolted to cylinder head cover

8 - Non-return valve

- ☐ Installation position: arrow points direction of flow

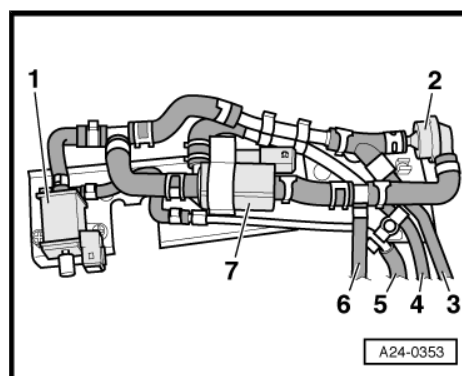
9 - Secondary air inlet valve - N112-

- ☐ Fitting location ⇒ [page 218](#)
- ☐ Checking ⇒ [page 219](#)


Fitting location of secondary air inlet valve -N112-

- ◆ Fitting location: below retainer for electrical change-over valves at front of intake manifold.

- 1 - Secondary air inlet valve -N112-
- 2 - Non-return valve
- 3 - To vacuum reservoir
- 4 - To mechanical air recirculation valve
- 5 - To combination valve for secondary air
- 6 - To connection on intake manifold
- 7 - Turbocharger air recirculation valve -N249-


Note

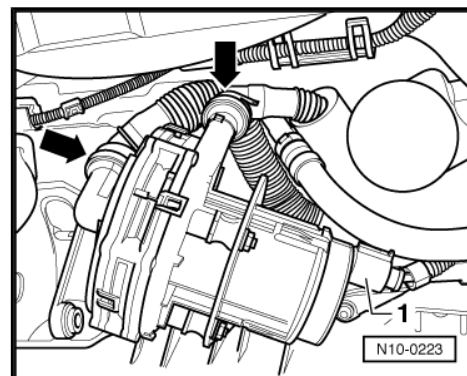
The illustration shows the retainer for electrical change-over valves from below and removed from the engine.

Fitting location of secondary air pump motor -V101-

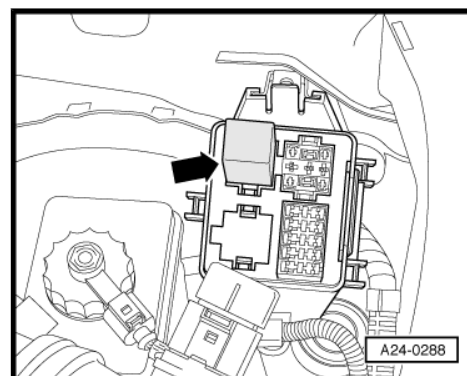
- ◆ Fitting location: At front right of engine compartment, below alternator/air conditioner compressor.

**Note**

Ignore -arrows-.

**Fitting location of secondary air pump relay -J299-**

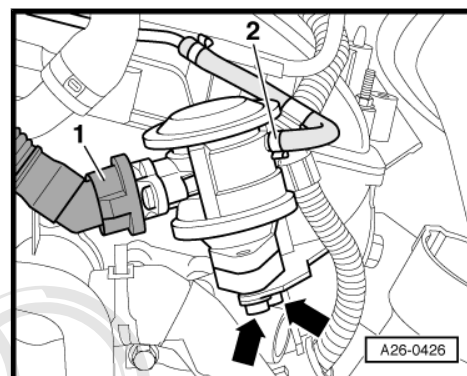
- ◆ Fitting location: Under cover on bulkhead (left-side) -arrow-.

**Fitting location of combination valve for secondary air**

- ◆ Fitting location: On right side of cylinder head.

**Note**

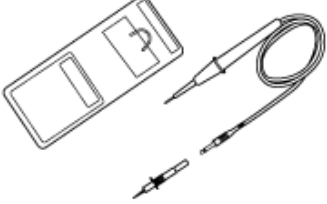
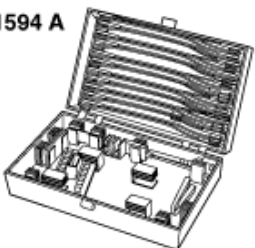
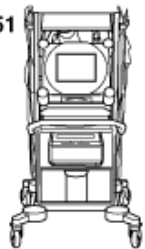
Disregard items marked -1-, -2- and -arrows-.

**3.2 Checking secondary air inlet valve -N112-**

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Special tools and workshop equipment required

- ◆ Hand-held multimeter - V.A.G 1526 C- 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-
- ◆ Adapter cable -V.A.G 1598/31- (test box)
- ◆ Vehicle diagnostic, testing and information system - VAS 5051- with diagnosis lead -VAS 5051/1-

V.A.G 1526 A 	V.A.G 1527 B 
V.A.G 1594 A 	V.A.G 1598/31 
VAS 5051 	G24-0023

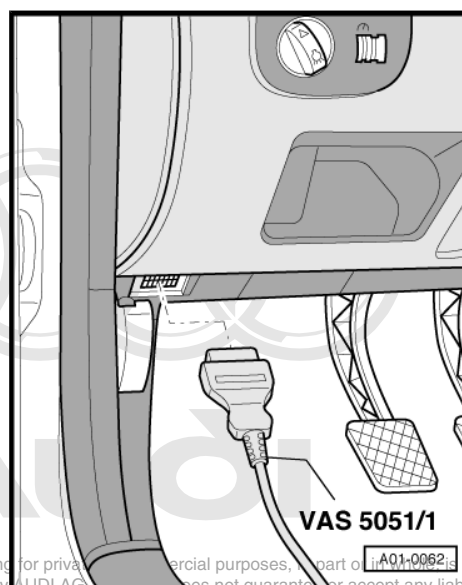
Procedure



Note

The secondary air inlet valve -N112- and the wiring connections are monitored by the engine control unit.

- Connect up vehicle diagnostic, testing and information system -VAS 5051- with diagnosis lead -VAS 5051/1- , press vehicle self-diagnosis key and select vehicle system "01 - Engine electronics". When doing this, the engine must be running at idling speed.



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Display on -VAS 5051- :

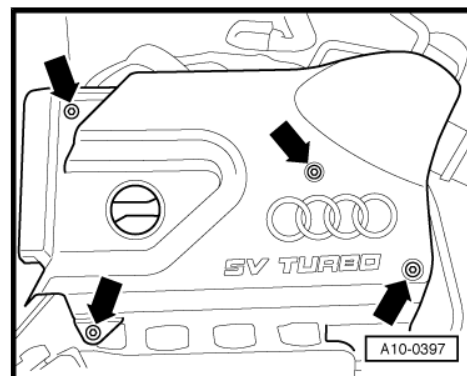
- From list -1-, select diagnosis function "02 - Interrogate fault memory".

If a fault relating to secondary air inlet valve -N112- is displayed:

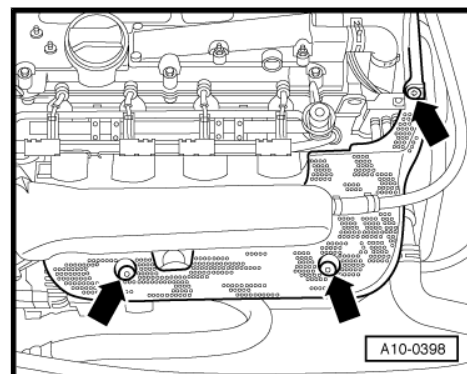
- Terminate function "02 - Interrogate fault memory" by touching  key.
- Press function "06 - end output" and switch off the ignition.



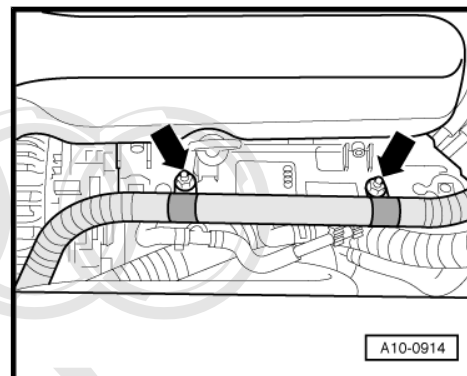
- Take off engine cover panel -arrows-.



- Remove cover in front of intake manifold -arrows-.

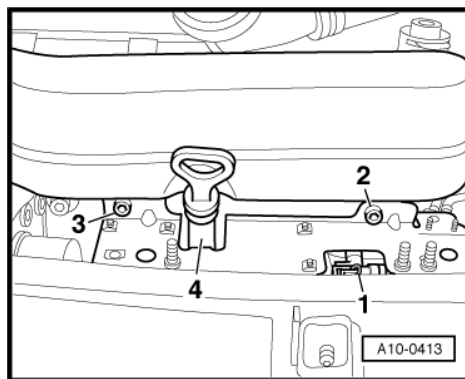


- Detach pipe for secondary air system from brackets on engine -arrows-.



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- Remove bolts -2- and -3- and detach bracket for dipstick guide tube -4-.
- Unplug connectors -1- for turbocharger air recirculation valve -N249- and secondary air inlet valve -N112- on underside of retainer for electrical change-over valves.
- Detach vacuum hose going to electrical change-over valves at intake manifold.
- Unscrew retainer for electrical change-over valves from intake manifold.

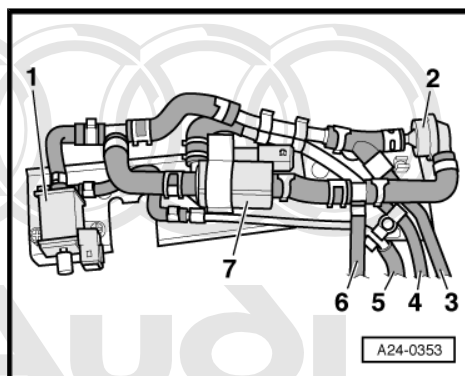


- Disconnect hoses from secondary air inlet valve -N112- -item 1-; attach electrical connector again.



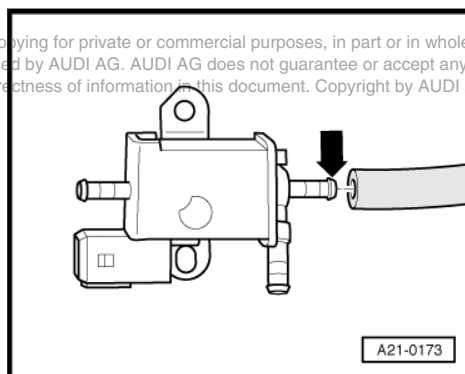
Note

- ◆ The illustration shows the retainer for electrical change-over valves from below and removed from the engine.
- ◆ Disregard -items 2 ... 7-.



- Connect test hose to connection on secondary air inlet valve -N112- marked with an -arrow-.

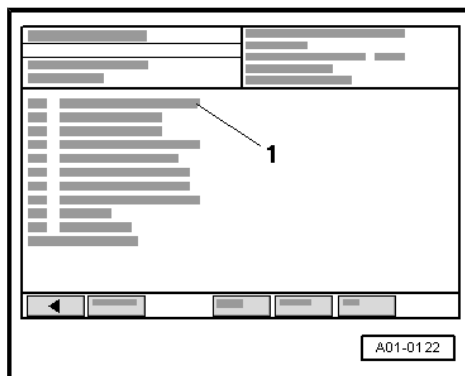
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- Switch on ignition and select vehicle system "01 - Engine electronics".

Display on -VAS 5051- :

- From the menu -1- select the diagnostic function "03 - Final control diagnosis".



- Press the  key repeatedly until the following display appears:

Display on -VAS 5051- (example):

A - 2nd control element in test

2 - Secondary air inlet valve -N112-

- The valve should click and open and close (check by blowing into the test hose).

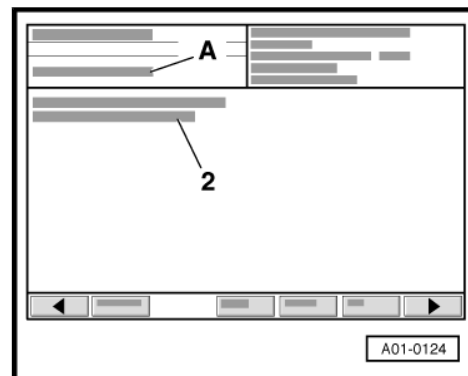
- Press the  key to exit from function “03 - Final control diagnosis”.

- Press function “06 - end output” and switch off the ignition.

If valve clicks but does not open or close correctly:

- Renew secondary air inlet valve -N112- .

If valve does not click:



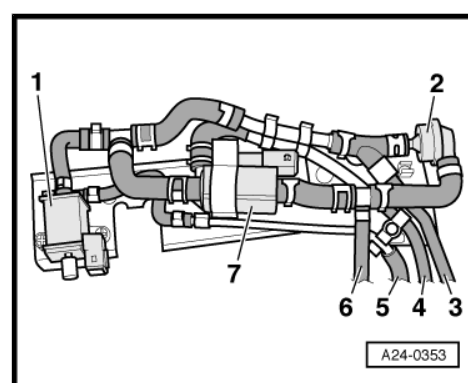
Checking internal resistance

- Unplug electrical connector at secondary air inlet valve -N112- -item 1-.



Note

- ◆ *The illustration shows the retainer for electrical change-over valves from below and removed from the engine.*
- ◆ *Disregard -items 2 ... 7-.*



- Connect hand-held multimeter -V.A.G 1526 C- to measure resistance between contacts on secondary air inlet valve -N112- .

- Specification: 25 ... 35 Ω .

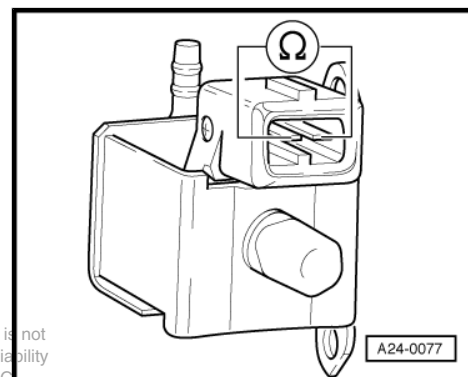
If the specification is not attained:

- Renew secondary air inlet valve -N112- .

If the specification is obtained:

Checking voltage supply

- Fuse for secondary air inlet valve -N112- OK $\Rightarrow$ Current flow diagrams, Electrical fault finding and Fitting locations.
- Fuel pump relay -J17- OK $\Rightarrow$ Current flow diagrams, Electrical fault finding and Fitting locations.



Note

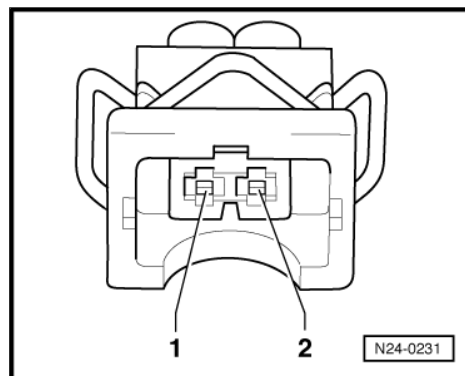
The secondary air inlet valve -N112- is supplied with power via the fuel pump relay -J17- .

- Connect voltage tester -V.A.G 1527 B- between contact -1- of connector for secondary air inlet valve -N112- and earth “-”.
- Operate the starter briefly.
- The LED should light up.

If LED does not light up:

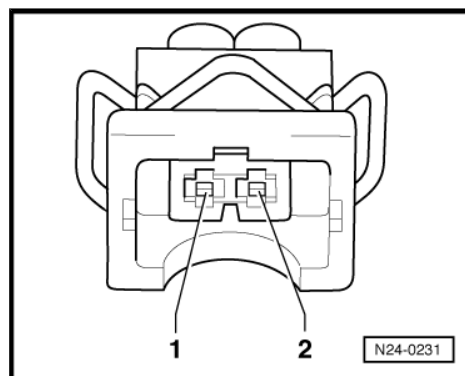
- Repair wiring from contact -1- of connector for secondary air inlet valve -N112- , via fuse, to fuel pump relay -J17- → Current flow diagrams, Electrical fault finding and Fitting locations.

If the LED lights up:



Checking activation

- Connect voltage tester -V.A.G 1527 B- between contact -1- and -2- of connector for secondary air inlet valve -N112- .
- Switch on ignition and select vehicle system “01 - Engine electronics”.
- Repeat function “03 - Final control diagnosis”.



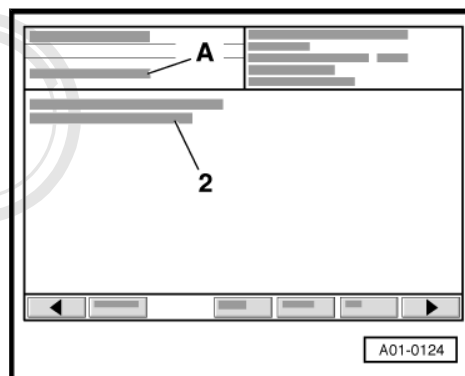
- Press the key repeatedly until the following display appears:

Display on -VAS 5051- (example):

A - 2nd control element in test

2 - Secondary air inlet valve -N112-

- The LED should flash.
- Press the key to exit from function “03 - Final control diagnosis”.
- Press function “06 - End output”.
- Switch off ignition and detach diagnostic connector.



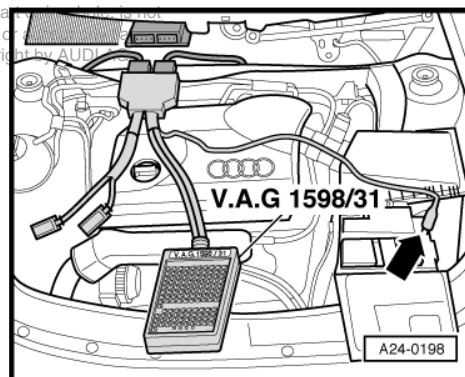
If the LED does not flash:

- Connect adapter cable -V.A.G 1598/31- (test box) to connectors of wiring harness; do not connect engine control unit. Connect earth clip of test box to earth -arrow- → Rep. Gr. 24 .



Caution

To prevent damage to electronic components, select appropriate measuring range before connecting measuring leads and observe test requirements.



- Check for open circuit and short to positive or earth in the following wiring:

Connector Contact	-V.A.G 1598/31- Socket
-2-	9

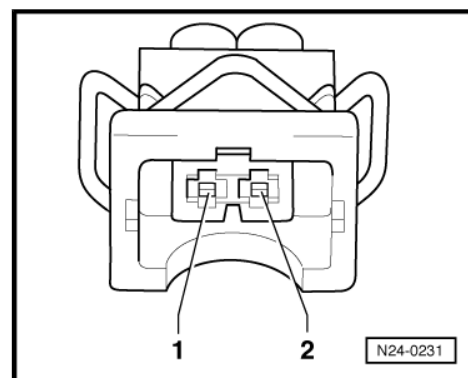
Assembling

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



Note

Secure all hose connections with the correct type of hose clips (same as original equipment) ⇒ Parts catalogue.



3.3 Checking secondary air pump relay -J299- and secondary air pump motor -V101-

Special tools and workshop equipment required

- ◆ Hand-held multimeter - V.A.G 1526 C- 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-
- ◆ Adapter cable -V.A.G 1598/31- (test box)
- ◆ Vehicle diagnosis, testing and information system - VAS 5051-

V.A.G 1526 A



V.A.G 1527 B



V.A.G 1594 A



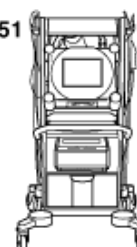
V.A.G 1598/22



V.A.G 1598/31



VAS 5051



G20-0010

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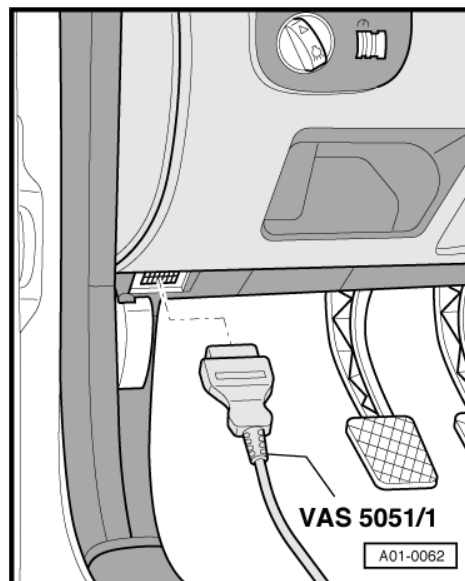
Procedure



Note

The secondary air pump relay -J299-, the secondary air pump motor -V101- and the wiring connections are monitored by the engine control unit.

- Connect up vehicle diagnostic, testing and information system -VAS 5051- with diagnosis lead -VAS 5051/1-, press vehicle self-diagnosis key and select vehicle system “01 - Engine electronics”. When doing this, the engine must be running at idling speed.

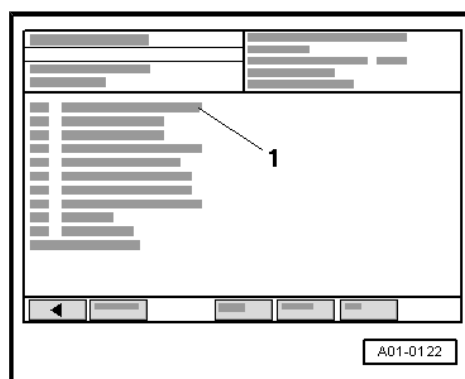


Display on -VAS 5051- :

- From list -1-, select diagnosis function “02 - Interrogate fault memory”.

If the display shows a fault relating to secondary air inlet valve - N112- or secondary air pump motor -V101- :

- Terminate function “02 - Interrogate fault memory” by touching  key.
- Press function “06 - End output”.
- Switch ignition off and then on again and select vehicle system “01 - Engine electronics” again if necessary.
- From the menu -1- select the diagnostic function “03 - Final control diagnosis”.

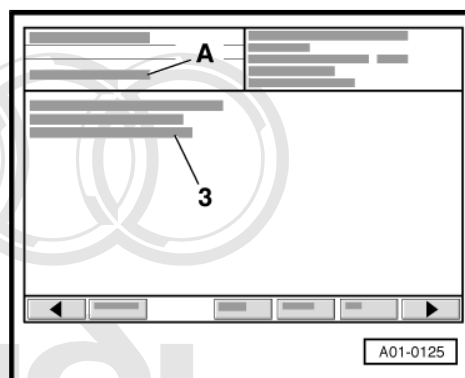


- Press the  key repeatedly until the following display appears:

Display on -VAS 5051- (example):

A - 3rd control element in test

3 - Secondary air pump relay -J299-



- The secondary air pump relay -J299- -item 1- (below cover on left side of bulkhead) should pick up intermittently (with an audible click) and the secondary air pump motor -V101- should start up intermittently.
- Press the  key to exit from function “03 - Final control diagnosis”.
- Press the diagnostic function “06 - end output” and switch off the ignition.

A - If the relay does not pick up:

- Check voltage supply of secondary air pump relay -J299- [⇒ page 227](#) .
- Check activation of secondary air pump relay -J299- [⇒ page 228](#) .

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 229](#) .

Checking voltage supply for secondary air pump relay -J299-

- Fuse for secondary air pump relay -J299- OK ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.
- Fuel pump relay -J17- OK ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.



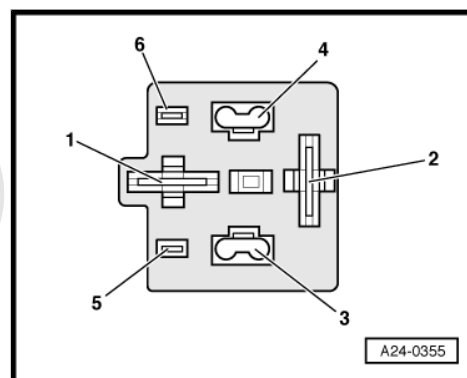
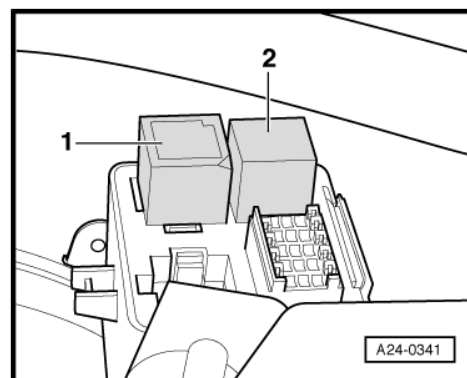
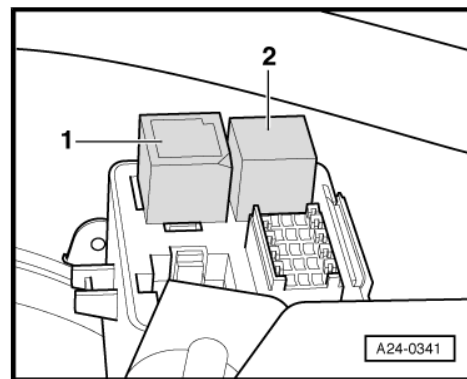
Note

Secondary air pump relay -J299- is supplied with power via fuel pump relay -J17- .

- Detach secondary air pump relay -J299- -item 1- beneath cover on left at bulkhead.
- Connect hand-held multimeter -V.A.G 1526 C- (voltage measuring range) between relay socket, contact -1- and earth “-”.
- Specification: approx. battery voltage

If specification is not obtained:

- Repair wiring from relay socket contact -1-, via fuse, to battery “+” (terminal 30) ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

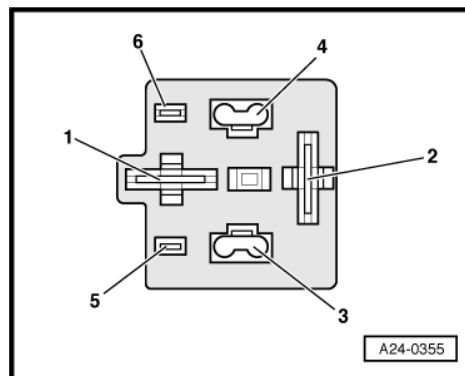


If the specification is obtained:

- Connect hand-held multimeter -V.A.G 1526 C- (voltage measuring range) between relay socket, contact -3- and earth “-”.
- Operate the starter briefly.
- Specification: approx. battery voltage
- Switch off ignition.

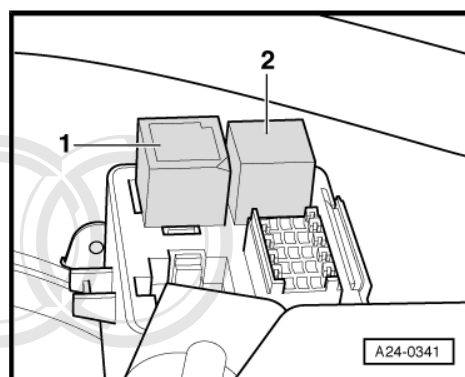
If specification is not obtained:

- Repair wiring from relay socket contact -3-, via fuse, to fuel pump relay -J17- → Current flow diagrams, Electrical fault finding and Fitting locations.

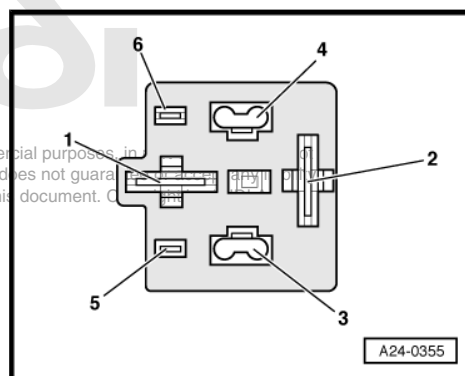


Checking activation of secondary air pump relay

- Detach secondary air pump relay -J299- -item 1- beneath cover on left at bulkhead.



- Connect up voltage tester -V.A.G 1527 B- between relay socket contact -4- and battery “+”.
- Switch on ignition and select vehicle system “01 - Engine electronics”.
- Repeat function “03 - Final control diagnosis”.



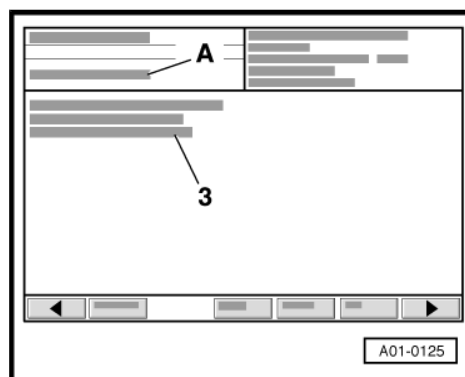
- Press the key repeatedly until the following display appears:

Display on -VAS 5051- (example):

A - 3rd control element in test

3 - Secondary air pump relay -J299-

- The LED should flash.
- Press the key to exit from function “03 - Final control diagnosis”.
- Press function “06 - end output” and switch off the ignition.



If the LED does not flash:

- Connect adapter cable -V.A.G 1598/31- (test box) to connectors of wiring harness; do not connect engine control unit. Connect earth clip of test box to earth -arrow- → Rep. Gr. 24 .



Caution

To prevent damage to electronic components, select appropriate measuring range before connecting measuring leads and observe test requirements.

- Check for open circuit and short to positive or earth in the following wiring:

Relay socket contact	-V.A.G 1598/31- Socket
-4-	66

- Repair wiring connection if necessary.

If no fault in wire is detected:

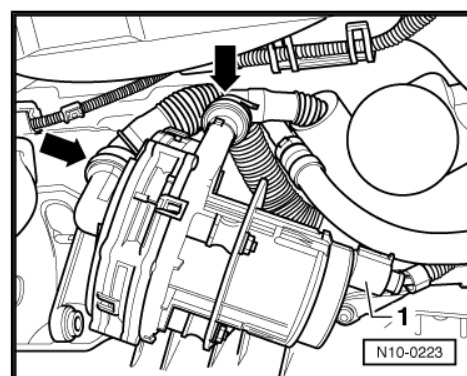
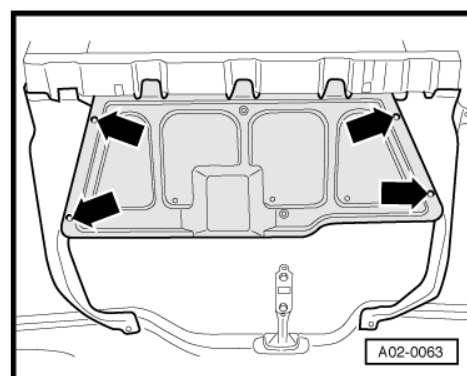
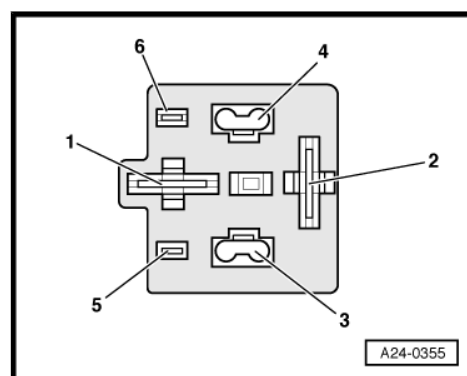
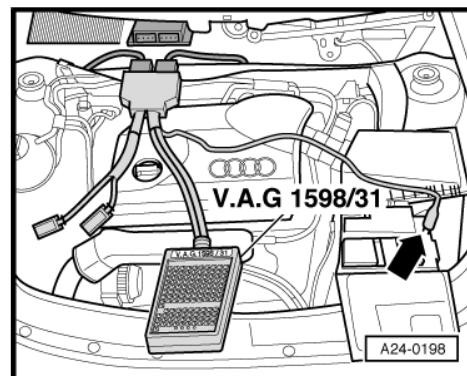
- Renew secondary air pump relay -J299- .

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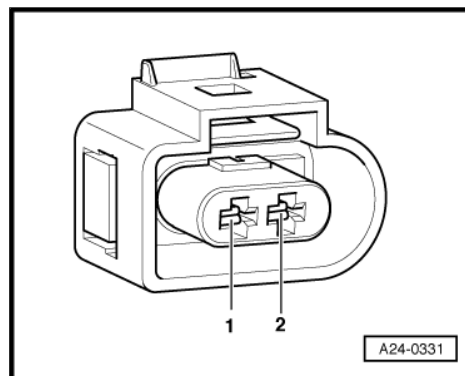
Checking voltage supply for secondary air pump motor -V101-

- Remove centre noise insulation -arrows-.

- Unplug electrical connector -1- at secondary air pump motor -V101- .



- Connect voltage tester -V.A.G 1527 B- between contact -1- and -2- of connector for secondary air pump motor -V101- .
- Switch on ignition and select vehicle system “01 - Engine electronics”.
- Repeat function “03 - Final control diagnosis”.



- Press the key repeatedly until the following display appears:

Display on -VAS 5051- (example):

A - 3rd control element in test

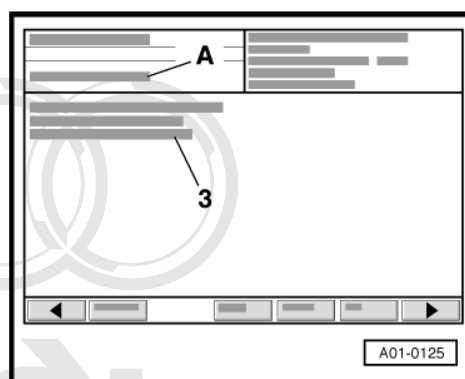
3 - Secondary air pump relay -J299-

- The LED should flash.

- Press the key to exit from function “03 - Final control diagnosis”.

- Press function “06 - End output”.

- Switch off ignition and detach diagnostic connector.

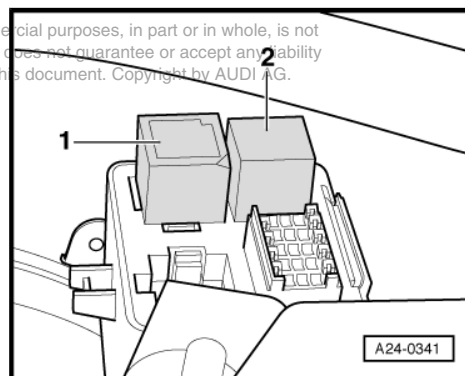


If the LED does not flash:

- Check wiring between connector at secondary air pump motor -V101- and secondary air pump relay -J299- item 1- (beneath cover on left at bulkhead).
- Check for open circuit in wiring between connector at secondary air pump motor -V101- and earth ⇒ Current flow diagrams, Electrical fault finding and Fitting locations.

If no fault is found:

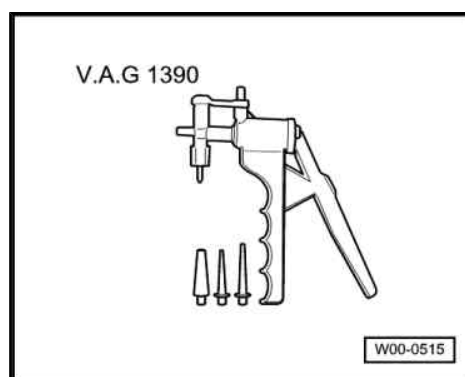
- Renew secondary air pump.



3.4 Checking combination valve for secondary air system for proper operation and leakage

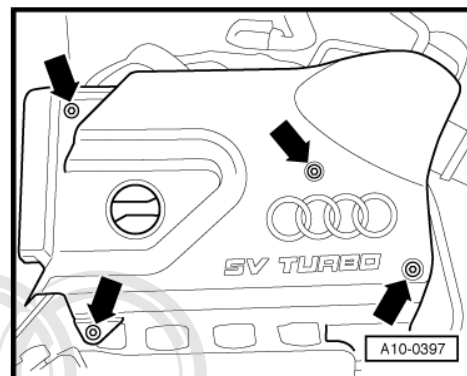
Special tools and workshop equipment required

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

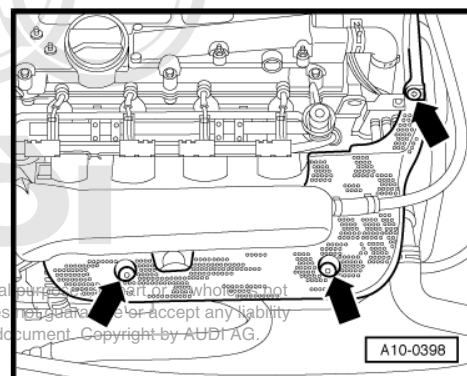


Procedure

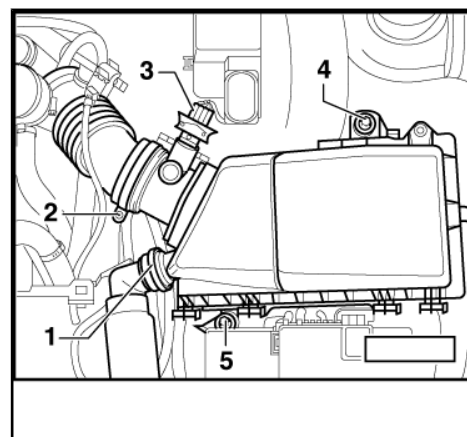
- Vacuum hoses and hose connections do not leak.
- Vacuum hoses are not clogged.
- Take off engine cover panel -arrows-.



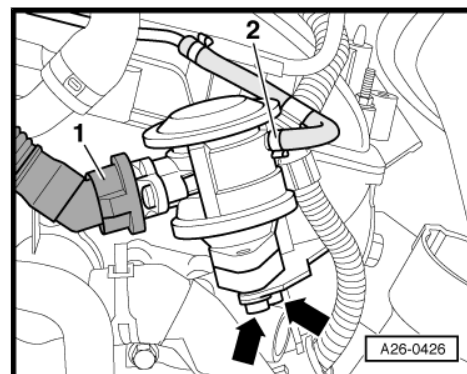
- Remove cover in front of intake manifold -arrows-.



- Detach air hose -1- leading to secondary air pump at air cleaner housing.
- Release hose clip -2- and detach air duct from air mass meter -G70-.
- Unplug electrical connector at air mass meter -G70- -item 3-.
- Unscrew bolts -4- and -5- and remove air cleaner housing.



- Detach vacuum hose -2- from combination valve for secondary air system.
- Connect the hand-operated vacuum pump -V.A.G 1390- to vacuum connection of combination valve for secondary air.



- Disconnect air hose -arrow- at secondary air pump.
- Connect suitable test hose to air hose connection on secondary air pump.
- Blow gently into hose (do not use compressed air).
- The combination valve for secondary air should be closed; it should not be possible to blow through the hose.
- Use hand-operated vacuum pump to generate vacuum.
- The combination valve for secondary air should open; it should now be possible to blow through the hose.

If combination valve for secondary air does not react as described:

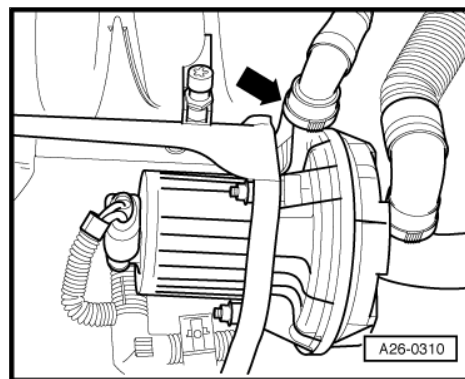
- Renew secondary air combination valve ➔ [page 232](#) .

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



Note

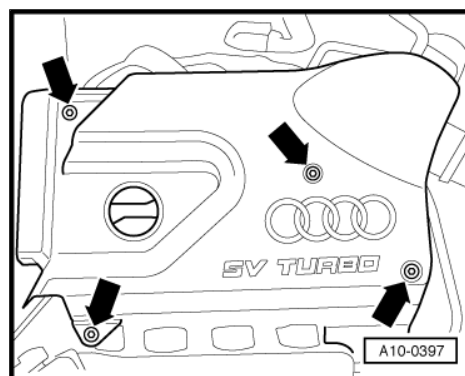
Secure all hose connections with the correct type of hose clips (same as original equipment) ➔ *Parts catalogue*.



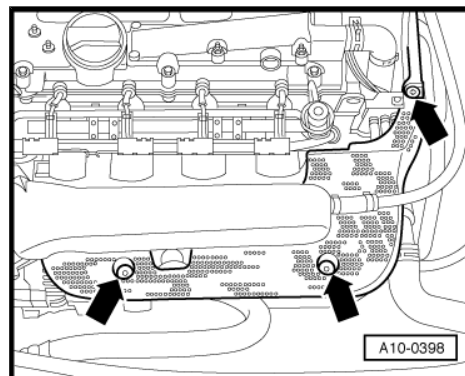
3.5 Removing and installing combination valve for secondary air system

Removing

- Take off engine cover panel -arrows-.



- Remove cover in front of intake manifold -arrows-.



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- Detach vacuum hose -2- and connecting pipe -1- at combination valve for secondary air system.
- Unscrew combination valve for secondary air from bracket -arrows-.

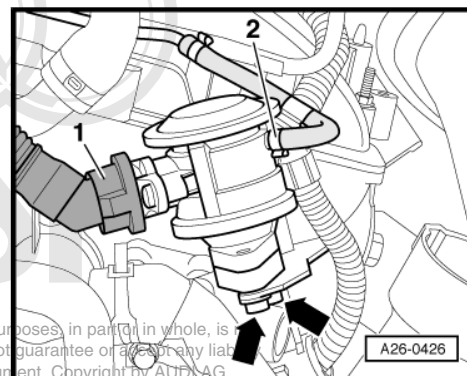
Installing

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



Note

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



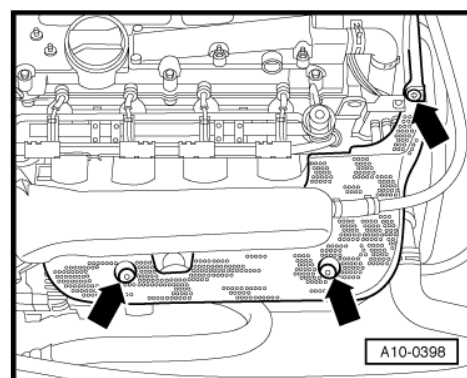
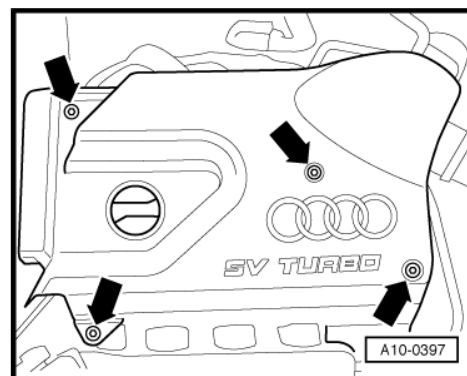
Tightening torque

Component	Nm
Combination valve for secondary air to flange	10

3.6 Removing and installing secondary air pump

Removing

- Take off engine cover panel -arrows-.
- Remove cover in front of intake manifold -arrows-.

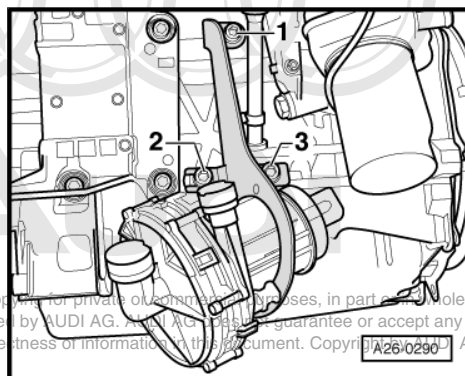


- Loosen bolt -1- approx. 2 turns from top of engine compartment.



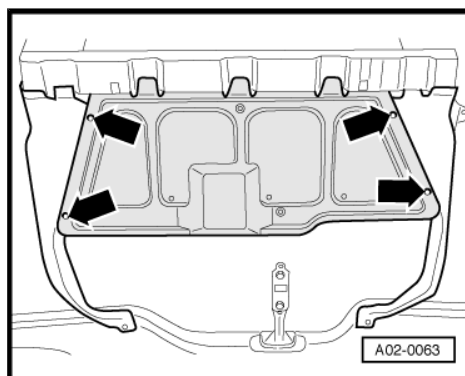
Note

Shown in illustration with engine removed.

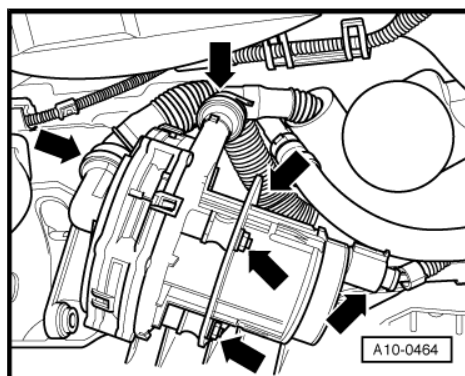


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- Remove centre noise insulation -arrows-.



- Unplug electrical connector at secondary air pump motor -V101-, detach hoses and remove nuts -arrows-.
- Detach secondary air pump.



- Unscrew bolts -2- and -3- on bracket for secondary air pump.
- Swivel bracket aside and pull out secondary air pump downwards.

Installing

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

Tightening torques

Component	Nm
Secondary air pump to bracket	10
Bracket for secondary air pump to cylinder block	40

