Reparaturleitfaden
Industriemotor 2006 ➢

4-cylinder diesel engine (2.0 l engine, 2-valve, TDI)

Ausgabe 03.2007

Motorkenn-buchstaben	CBHA	CBJA	CBJB	CBKA					

Reparaturgruppenübersicht zum Reparaturleitfaden
Industriemotor 2006 ➢

4-cylinder diesel engine (2.0 l engine, 2-valve, TDI)
Ausgabe 03.2007

Tragen Sie bitte bei Ablage eines Technischen Merkblattes die Merkblatt-Nr. hinter der entsprechenden Reparaturgruppe ein. Sie können dann beim Benutzen des Reparaturleitfadens auf einen Blick sehen, ob zu der Reparaturgruppe, in der Sie sich informieren wollen, Technische Merkblätter erschienen sind.

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10 Removing and installing engine						
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17 Lubrication						
19 Cooling						
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23 Mixture preparation - injection						
26 Exhaust system						
27 Starter, voltage supply						
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Technische Informationen gehören unbedingt in die Hand der Meister und Mechaniker, denn ihre sorgfältige und ständige Beachtung ist Voraussetzung für die Erhaltung der Verkehrs- und Betriebssicherheit der Fahrzeuge. Unabhängig davon gelten selbstverständlich auch die bei der Instandsetzung von Kraftfahrzeugen allgemein üblichen Grundregeln der Sicherheit.

Printed in Germany
000.9204.58.0A

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00 – Technical data

1 Technical data

Engine number ⇒ Seite 1.

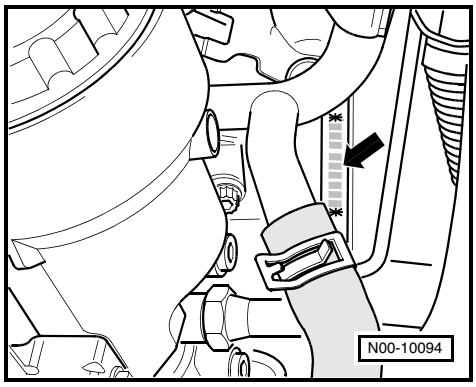
Engine features ⇒ Seite 1.

1.1 Engine number

The engine number („code letters“ and „serial number“) can be found at the separation point -arrow-.

Additionally there is a sticker on the toothed belt guard with „engine code“ and „serial number“.

The engine number consists of up to nine characters (alpha-numeric). The first part (maximum 3 characters) makes up the „engine code“, and the second part (6 characters), the „serial number“. If more than 999999 engines with the same engine code are produced, the first of the six characters is replaced with a letter.



1.2 Engine data

Engine codes		CBHA	CBJA	CBJB	CBKA
Manufactured		02.07 ➤	02.07 ➤	02.07 ➤	12.06 ➤
Capacity	l	2,0	2,0	2,0	2,0
Output	kW at rpm	47/3000	63/3000	55/2800	74/3000
Torque	Nm at rpm	200/1750	255/1750	240/1750	285/1750
Bore	∅ mm	81,0	81,0	81,0	81,0
Stroke	mm	95,5	95,5	95,5	95,5
Compression ratio		18,5	18,5	18,5	18,5
CN	min.	51	51	51	51
Valves per cylinder		2	2	2	2
Firing order		1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
Emissions fulfil		EU 97/68/EC level III A	EU 97/68/EC level III A	EU 97/68/EC level III A	EU 88/77/EEC Euro IV
Particulate filter		no	no	no	yes
Exhaust gas recirculation		yes	yes	yes	yes
Turbocharging/ supercharging		yes	yes	yes	yes
Charge air cooler		no	yes	yes	yes

01 – Self-diagnosis

1 Self-diagnosis

Hinweis

- *The engine has different performance figures depending on the engine control unit -J623- coding.*
- *When commissioning the engine for the first time, the engine control unit -J623- must be coded accordingly ⇒ Seite 231.*

Features of self-diagnosis ⇒ Seite 4.

Technical data of self-diagnosis ⇒ Seite 5.

Connect vehicle diagnosis, testing and information system and select engine control unit⇒ Seite 5.

Connect test box to check wiring ⇒ Seite 7.

1.1 Features of self-diagnosis

The engine control unit -J623- is equipped with a fault memory.

If faults occur in the sensors and components being monitored, they will be stored in the fault memory together with an indication of the type of fault.

After evaluating the information, the engine control unit decides between 73 different fault codes (see fault table from ⇒ Seite 10) and stores these until the contents of the fault memory are deleted.

Faults which occur temporarily (sporadically) are displayed with the addendum „sporadic fault“ „/SP“. The cause of sporadic faults can be e.g. a loose contact or a brief open circuit. If a sporadic fault does not occur again within 50 engine starts, it will be cleared from the fault memory.

If faults have been detected that influence the running performance of the engine, the glow period warning lamp - K29- and/or the exhaust gas warning lamp -K83- will light up.

The faults stored can be interrogated using vehicle diagnosis, testing and information system -VAS 5051- ⇒ Seite 9.

Once the fault or faults have been rectified, the fault memory must be erased ⇒ Seite 10.

Hinweis

General information about self-diagnosis can be found in the operating instructions for vehicle diagnosis, testing and information system -VAS 5051-.

1.2 Technical data of self-diagnosis

1.2.1 Interrogating engine control unit version

The control unit identification and coding are displayed when vehicle diagnosis, testing and information system -VAS 5051- is connected and vehicle system „01-Engine electronics“ is selected ⇒ Seite 5.

1.2.2 Selectable diagnosis functions when using vehicle diagnosis, testing and information system

Hinweis

The prerequisites for selecting the desired diagnosis functions can be determined from the following table.

Diagnosis functions	Prerequisite		
	Engine stationary, ignition switched on	Engine running at idling speed	Engine under load
01-Interrogate control unit version	yes	yes	yes
02-Interrogate fault memory	yes[1)]	yes	yes
03-Final control diagnosis	yes	yes	no
05-Erase fault memory	yes	yes	yes
07-Code control unit	yes	no	no
08-Read measured value block	yes	yes	yes
10-Adaption	yes	yes	yes

1) If the engine does not start, only carry out with the ignition switched on.

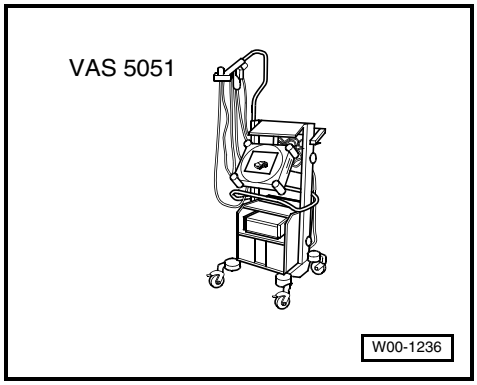
1.3 Connecting vehicle diagnosis, testing and information system and selecting engine control unit

Hinweis

- *Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.*
- *Detailed description of design, working principle and operation of vehicle diagnosis, testing and information system -VAS 5051- ⇒ operating instructions for vehicle diagnosis, testing and information system VAS 5051.*

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -



Prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK

Procedure

– Fit connector of diagnosis cable - VAS 5051/6A- onto diagnosis connection.

– Proceed as follows depending on desired function:

- switch on ignition or
- start engine ⇒ Seite 5, selectable diagnosis functions.

Hinweis

- *If the display remains blank, check voltage supply for diagnosis connector using current flow diagram ⇒ Seite 288.*
- *If the display does not indicate as described in the work sequence: ⇒ operating instructions for vehicle diagnosis, testing and information system VAS 5051.*

Select operating mode

– Press button on display for „vehicle self-diagnosis“.

Select vehicle system

– Press button „01 - Engine electronics“ on display.

The control unit identification and coding are indicated on the display of the engine control unit.

If the coding does not match the appropriate coding:

– Check control unit coding ⇒ Seite 231, code engine control unit.

Select diagnosis function

All the available diagnosis functions that can be carried out are shown on the display.

– Press button on display for the desired function.

Hinweis

The display zones in the function „08-Read measured value block“ will be displayed from top to bottom.

Selectable functions when using vehicle diagnosis, testing and information system ⇒ Seite 5.

1.4 Connecting test box to check wiring

Hinweis

- *Adapter cables -V.A.G 1598/39-1- and -V.A.G 1598/39-2- are used in conjunction with test box -V.A.G 1598/42- to check the wiring between the relevant components and the engine control unit.*
- *The contacts on the engine control unit and distributed over two different wiring harnesses.*
- *Depending on the component to be tested, a wiring check is carried out on the 60-pin or 94-pin wiring harness.*

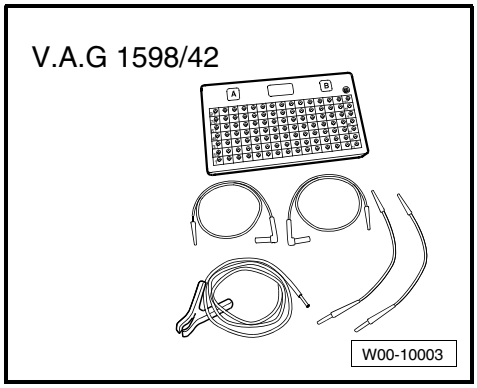
Connect test box -V.A.G 1598/42- with:

- adapter cable -V.A.G 1598/39-1- ⇒ Seite 7,
- adapter cable -V.A.G 1598/39-2- ⇒ Seite 8.

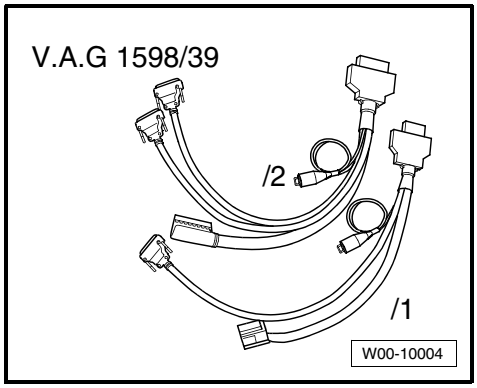
1.4.1 Connecting test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Test box -V.A.G 1598/42-



- Adapter cable -V.A.G 1598/39-1-



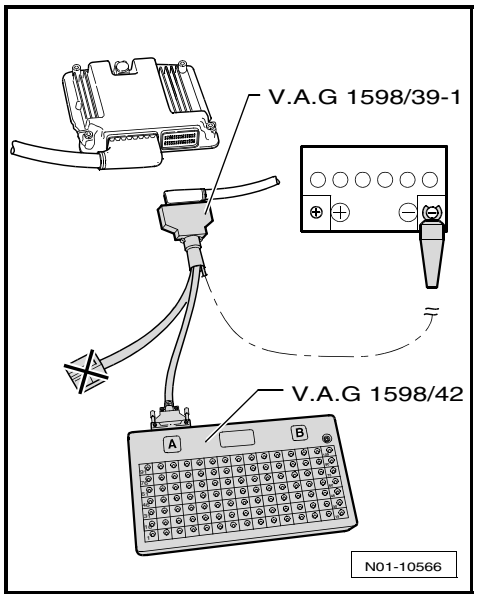
Prerequisites

- Ignition switched off.
- All electrical consumers must be switched off.

Procedure

– Pull off 60-pin connector from engine control unit -J623-.

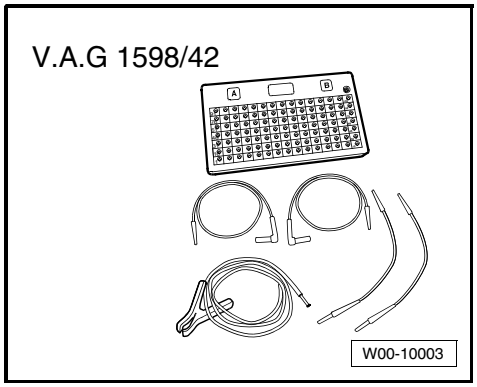
– Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1- to control unit wiring harness and -connection A- of test box. The engine control unit is not connected by this action.



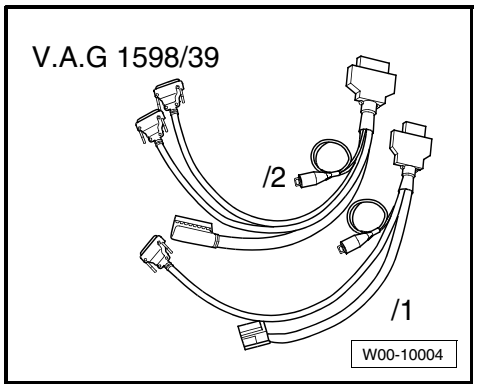
1.4.2 Connecting test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Test box -V.A.G 1598/42-



♦ Adapter cable -V.A.G 1598/39-2-



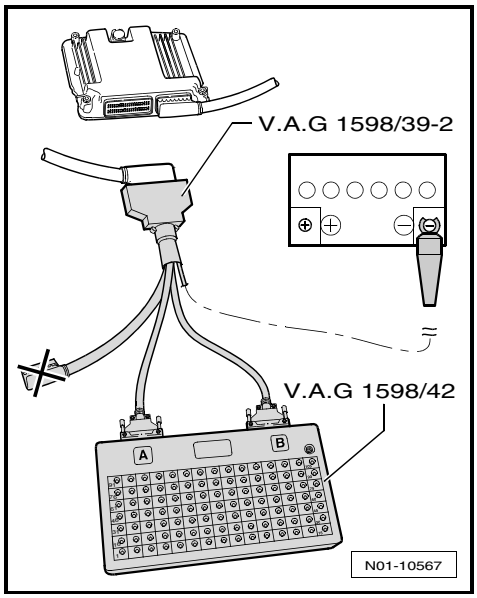
Prerequisites

- Ignition switched off.
- All electrical consumers must be switched off.

Procedure

– Pull off 94-pin connector from engine control unit -J623-.

– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-2- to control unit wiring harness and -connection A and B- of test box. The engine control unit is not connected by this action.



2 Fault memory

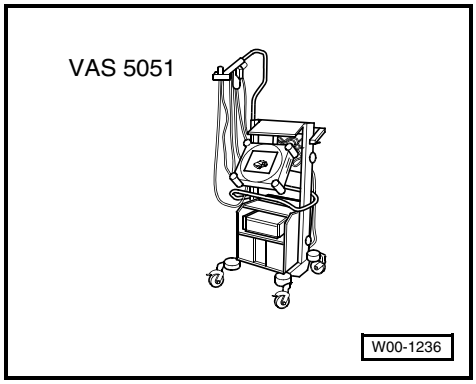
Interrogate fault memory ⇒ Seite 9.

Erase fault memory ⇒ Seite 10.

2.1 Interrogating fault memory

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -



Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Procedure

– Connect vehicle diagnosis, testing and information system -VAS 5051- and select diagnosis function „02-Interrogate fault memory“. Engine must be idling to do this. (Connect vehicle diagnosis, testing and information system and select engine control unit⇒ Seite 5.)

Only if engine does not start: - Switch on ignition.

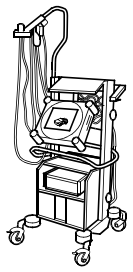
– If no fault is stored in the engine control unit, „0 fault(s) detected“ is displayed.
– If faults are stored in the engine control unit, these are shown one below the other on the display.
– End diagnosis function.
– Switch off ignition.
– Rectify any displayed faults using the fault table (⇒ Seite 10) and erase the fault memory on completion ⇒ Seite 10.

2.2 Erasing fault memory

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -

VAS 5051



W00-1236

Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Prerequisites

- Fault rectified

Procedure

Hinweis

After rectifying the faults, the fault memory must be interrogated again as follows and then erased.

– Connect vehicle diagnosis, testing and information system -VAS 5051- and select diagnosis function „02-Interrogate fault memory“. Engine must be idling to do this. (Connect vehicle diagnosis, testing and information system and select engine control unit⇒ Seite 5.)

– Select diagnosis function „05-Erase fault memory“.

Hinweis

If the fault memory cannot be erased, there is a fault still in the system and this must be rectified.

– End diagnosis function.

– Switch off ignition.

3 Fault table

Hinweis

- *The fault table is listed in ascending order, according to the 5 digit V.A.G fault code on the left.*
- *In addition, the so-called P-codes are also shown, e.g. P0118.*
- *Explanations about fault types (e.g. „open circuit/short circuit to earth“) ⇒ operating instructions for vehicle diagnosis, testing and information system VAS 5051.*
- *If components are indicated as faulty: First check the wiring and connectors to these components as well as the system earth wires using the current flow diagram. Only if no fault can be located here should the component be renewed. This is particularly relevant if faults are displayed as „sporadic“ (SP).*
- *Once the faults have been rectified, erase the fault memory ⇒ Seite 10.*

Indicated on display e.g.:

16502/P0118 035

Coolant temperature sender -G62-

Signal too high

Sporadic fault

Hinweis

- *16502 = Fault code*
- *P0118 = Additional fault code*
- *035 = Fault type as a number*
- *Coolant temperature sender -G62- = Faulty current path or fault location*
- *Signal too high = Fault type as text*
- *Sporadic faults = Faults that are not always present, e.g. loose contact*

Fault code:

- 16485/P0101...17084/P0700 ⇒ Seite 11,
- 17510/P1102...18364/P1959 ⇒ Seite 25,
- 18434/P2002...18885/P2453 ⇒ Seite 41,
- 19456/P3000...19794/P3338 ⇒ Seite 45.

3.1 Fault code: 16485/P0101...17084/P0700

Appears on display	Possible fault cause	Possible effects	Fault elimination
16485/P0101 Air mass meter -G70- Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ -G70- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– -G70- Check ⇒ Seite 220
16486/P0101 Air mass meter -G70- Signal too low	♦ Wiring open circuit or wiring short circuit to positive ♦ -G70- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– -G70- Check ⇒ Seite 220
16487/P0103 Air mass meter -G70-			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Signal too high	♦ Wiring open circuit or wiring short to earth ♦ -G70- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– -G70- Check ⇒ Seite 220
16496/P0112 Intake air temperature sender -G42- Signal too low	♦ Wiring open circuit or wiring short circuit to positive ♦ -G42- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– -G42- Check ⇒ Seite 213
16497/P0113 Intake air temperature sender -G42- Signal too high	♦ Wiring open circuit or wiring short to earth ♦ -G42- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– -G42- Check ⇒ Seite 213
16500/P0116 Coolant temperature sender -G62- Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ -G62- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Increased exhaust emissions	– -G62- Check ⇒ Seite 215 – Check thermostat ⇒ Seite 148, parts of cooling system on engine side
16501/P0117 Coolant temperature sender -G62- Signal too low	♦ Wiring open circuit or wiring short circuit to positive ♦ -G62- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Increased exhaust emissions	– -G62- Check ⇒ Seite 215 – Check thermostat ⇒ Seite 148, parts of cooling system on engine side
16502/P0118 Coolant temperature sender -G62- Signal too high	♦ Wiring open circuit or wiring short to earth ♦ -G62- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Increased exhaust emissions	– -G62- Check ⇒ Seite 215 – Check thermostat ⇒ Seite 148, parts of cooling system on engine side

Appears on display	Possible fault cause	Possible effects	Fault elimination
16514/P0130 Bank 1 - probe 1 Electrical fault in current circuit	♦ Wiring open circuit or wiring short circuit ♦ Lambda probe -G39- defective	♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251
16515/P0131 Bank 1 - probe 1 Voltage too low	♦ Voltage supply too low ♦ Lambda probe -G39- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251
16516/P0132 Bank 1 - probe 1 Voltage too high	♦ Voltage supply too high ♦ Lambda probe -G39- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251
16517/P0133 Bank 1 - probe 1 Signal too slow	♦ Wiring open circuit or wiring short circuit ♦ Lambda probe -G39- defective	♦ Glow period warning lamp -K29- lights up ♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251
16519/P0135 Bank 1 - probe 1, heater current circuit Electrical fault	♦ Wiring open circuit ♦ Lambda probe heater -Z19- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Increased exhaust emissions on cold engine	– -Z19- Check ⇒ Seite 253
16565/P0181 Fuel temperature sender -G81- Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ -G81- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Increased exhaust emissions	– -G81- Check ⇒ Seite 218
16566/P0182 Fuel temperature sender -G81- Short to earth	♦ Wiring short to earth ♦ -G81- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Increased exhaust emissions	– -G81- Check ⇒ Seite 218

Appears on display	Possible fault cause	Possible effects	Fault elimination
16567/P0183 Fuel temperature sender -G81- Open circuit/short to positive	♦ Wiring open circuit or wiring short circuit to positive ♦ -G81- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Increased exhaust emissions	– -G81- Check ⇒ Seite 218
16610/P0226 Accelerator pedal position sender 1/2 -G79 + G185- Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ -G79- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ No engine speed control	– -G79- Check ⇒ Seite 174
16611/P0227 Accelerator pedal position sender -G79- Signal too low	♦ Wiring open circuit or wiring short circuit to positive ♦ -G79- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ No engine speed control	– -G79- Check ⇒ Seite 174
16612/P0228 Accelerator pedal position sender -G79- Signal too high	♦ Wiring open circuit or wiring short to earth ♦ -G79- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ No engine speed control	– -G79- Check ⇒ Seite 174
16618/P0234 Charge pressure control Control limit exceeded	♦ Charge pressure control solenoid -N75- defective ♦ Hose connections interchanged, not connected	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Charge pressure too high	– Check -N75- ⇒ Seite 49, final control diagnosis – Checking charge pressure regulation ⇒ Seite 187.
16619/P0235 Charge pressure control			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Control limit not reached	♦ Charge pressure control solenoid -N75- defective ♦ Turbocharger defective ♦ Leaks between exhaust turbocharger and engine (charge air path)	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Charge pressure too low	– Check -N75- ⇒ Seite 49, final control diagnosis – Checking charge air system for leaks ⇒ Seite 185 – Checking charge pressure regulation ⇒ Seite 187.
16620/P0236 Charge pressure sender -G31- Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ -G31- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance	– -G31- Check ⇒ Seite 192 – Checking charge pressure regulation ⇒ Seite 187.
16621/P0237 Charge pressure sender -G31- Signal too low	♦ Wiring open circuit or wiring short circuit to positive ♦ -G31- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance	– -G31- Check ⇒ Seite 192 – Checking charge pressure regulation ⇒ Seite 187.
16622/P0238 Charge pressure sender -G31- Signal too high	♦ Wiring open circuit or wiring short to earth ♦ -G31- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance	– -G31- Check ⇒ Seite 192 – Checking charge pressure regulation ⇒ Seite 187.
16627/P0243 Charge pressure control solenoid -N75- Open circuit/short to earth	♦ Wiring open circuit or wiring short to earth ♦ -N75- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance	– Check -N75- ⇒ Seite 49, final control diagnosis
16629/P0245 Charge pressure control solenoid -N75- Short to earth	♦ Wiring short to earth ♦ -N75- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance	– Check -N75- ⇒ Seite 49, final control diagnosis
16630/P0246 Charge pressure control solenoid -N75-			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Short to positive	♦ Wire has short to positive ♦ -N75- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance	– Check -N75- ⇒ Seite 49, final control diagnosis
16683/P0299 Charge pressure control Control limit not reached	♦ Charge pressure control solenoid -N75- defective ♦ Turbocharger defective ♦ Leaks between exhaust turbocharger and engine (charge air path)	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Charge pressure too low	– Check -N75- ⇒ Seite 49, final control diagnosis – Checking charge air system for leaks ⇒ Seite 185 – Checking charge pressure regulation ⇒ Seite 187.
16684/P0300 Engine misfire detected	♦ Poor compression figures ♦ Unit injector valves (cylinder 1...4) -N240...N243- defective	♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– Checking compression ⇒ Seite 126 – Check unit injector valve (cylinder 1...4) -N240...N243- ⇒ Seite 205
16685/P0301 Cyl. 1 misfire detected	♦ Poor compression figures for cylinder 1 ♦ Unit injector valve (cylinder 1...4) -N240- defective	♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– Checking compression ⇒ Seite 126 – -N240- Check ⇒ Seite 205
16686/P0302 Cyl. 2 misfire detected	♦ Poor compression figures for cylinder 2 ♦ Unit injector valve (cylinder 2...4) -N241- defective	♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– Checking compression ⇒ Seite 126 – -N241- Check ⇒ Seite 205
16687/P0303 Cyl. 3 misfire detected	♦ Poor compression figures for cylinder 3 ♦ Unit injector valve (cylinder 3...4) -N242- defective	♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– Checking compression ⇒ Seite 126 – -N242- Check ⇒ Seite 205

Appears on display	Possible fault cause	Possible effects	Fault elimination
16688/P0304 Cyl. 4 misfire detected	♦ Poor compression figures for cylinder 4 ♦ Unit injector valve (cylinder 4...4) -N243- defective	♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– Checking compression ⇒ Seite 126 – -N243- Check ⇒ Seite 205
16705/P0321 Engine speed sender -G28- Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ -G28- defective or loose ♦ Metal filings on sender wheel or -G28- ♦ Gap between -G28-/ sender wheel too great	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Increased exhaust emissions ♦ Engine liable to stall ♦ Engine not running smoothly ♦ Rev. counter no display	– -G28- Check ⇒ Seite 210
16706/P0322 Engine speed sender -G28- No signal	♦ Wiring open circuit or wiring short circuit ♦ -G28- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Engine does not start ♦ Engine stalls ♦ Rev. counter no display	– -G28- Check ⇒ Seite 210
16725/P0341 Camshaft pos. sensor => sender -G40- Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ Hall sender -G40- defective or loose ♦ Metal filings on hub or Hall sender -G40- ♦ Gap between Hall sender -G40-/hub too great ♦ Hub with sender wheel on camshaft is twisted or loose	♦ Increased exhaust emissions ♦ Reduced performance at full throttle ♦ Higher fuel consumption ♦ Engine starts poorly or not at all in cold state	– -G40- Check ⇒ Seite 212 – Check position of camshaft and sender wheel ⇒ Seite 116, Removing, installing, tensioning toothed belt
16784/P0400 Exhaust gas recirculation system			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Malfunction	♦ Exhaust gas recirculation system defective	♦ No exhaust gas recirculation ♦ Reduced performance ♦ Increased exhaust emissions	– Check exhaust gas recirculation ⇒ Seite 244
16785/P0401 Exhaust gas recirculation system Flow rate too low	♦ Exhaust gas recirculation system blokked	♦ Exhaust gas warning lamp -K83- lights up ♦ Insufficient exhaust gas recirculation ♦ Reduced performance ♦ Increased exhaust emissions	– Check exhaust gas recirculation ⇒ Seite 244
16786/P0402 Exhaust gas recirculation system Flow rate too high	♦ Leaks in exhaust gas recirculation system	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Insufficient exhaust gas recirculation ♦ Reduced performance ♦ Increased exhaust emissions	– Check exhaust gas recirculation ⇒ Seite 244
16787/P0403 Exhaust gas recirculation valve -N18- Malfunction	♦ -N18- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ No exhaust gas recirculation ♦ Reduced performance ♦ Increased exhaust emissions	– Check -N18- ⇒ Seite 49, final control diagnosis – Check exhaust gas recirculation ⇒ Seite 244
16791/P0407 Exhaust gas recirculation potentiometer -G212-			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Signal too low	♦ Wiring open circuit or wiring short circuit to positive ♦ -G212- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ No exhaust gas recirculation ♦ Reduced performance ♦ Increased exhaust emissions	– Check -G212- ⇒ Seite 245, check exhaust gas recirculation valve -N18- – Check exhaust gas recirculation ⇒ Seite 244
16792/P0408 Exhaust gas recirculation potentiometer -G212- Signal too high	♦ Wiring open circuit or wiring short to earth ♦ -G212- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ No exhaust gas recirculation ♦ Reduced performance ♦ Increased exhaust emissions	– Check -G212- ⇒ Seite 245, check exhaust gas recirculation valve -N18- – Check exhaust gas recirculation ⇒ Seite 244
16855/P0471 Exhaust gas pressure sensor 1 -G450- Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ -G450- defective ♦ Control lines between -G450- and particulate filter blocked	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– -G450- Check ⇒ Seite 261 – Check control lines ⇒ Seite 237, Assembly overview - particulate filter (engine code CBKA) – Check particulate filter ⇒ Seite 265
16856/P0472 Exhaust gas pressure sensor 1 -G450- Short to earth	♦ Wiring short to earth ♦ -G450- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– -G450- Check ⇒ Seite 261
16857/P0473 Exhaust gas pressure sensor 1 -G450- Short to positive	♦ Wire has short to positive ♦ -G450- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– -G450- Check ⇒ Seite 261

Appears on display	Possible fault cause	Possible effects	Fault elimination
16885/P0501 Vehicle speed signal Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ Switch or button for working speed regulator defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Working speed regulation not OK	– Check components for working speed regulation ⇒ Seite 288, current flow diagrams
16887/P0503 Vehicle speed signal Signal too high	♦ Wiring open circuit or wiring short to earth ♦ Switch or button for working speed regulator defective	♦ Working speed regulation not OK	– Check components for working speed regulation ⇒ Seite 288, current flow diagrams
16891/P0507 Idling speed control Speed above specification	♦ Unmetered air ♦ Leaks between exhaust turbocharger and engine (charge air path)	♦ Increased idling speed	– Check air intake system for leaks – Checking charge air system for leaks ⇒ Seite 185
16929/P0545 Exhaust gas temperature sender 1 -G235- Short to earth	♦ Wiring short to earth ♦ -G235- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– -G235- Check ⇒ Seite 254
16930/P0546 Exhaust gas temperature sender 1 -G235- Short to positive	♦ Wire has short to positive ♦ -G235- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– -G235- Check ⇒ Seite 254
16946/P0562 Voltage supply			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Voltage too low	♦ Voltage supply too low ♦ Defective terminal 30 voltage supply relay -J317 -	♦ Engine does not start ♦ Various running problems to engine stalling	– Check power supply for engine control unit -J623- ⇒ Seite 229
16955/P0571 Brake light switch -F- Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ Brake light switch -F- defective ♦ Brake pedal switch -F47- defective	♦ Glow period warning lamp -K29- lights up ♦ Various running problems ♦ Brake light defective	– Check -F- and -F47- ⇒ Seite 288, current flow diagrams
16986/P0602 Control unit programming Malfunction	♦ Invalid control unit coding for engine control unit -J623-	♦ Glow period warning lamp -K29- lights up ♦ Various running problems ♦ Engine stalls	– -J623- requires coding ⇒ Seite 231
16988/P0604 Control unit defective	♦ Engine control unit -J623- internal fault	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Various running problems ♦ Engine stalls	– -J623- Renew ⇒ Seite 230
16990/P0606 Control unit defective	♦ Engine control unit -J623- internal fault	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Various running problems ♦ Engine stalls	– -J623- Renew ⇒ Seite 230
16994/P0610 Engine control unit Incorrect coding	♦ Invalid control unit coding for engine control unit -J623-	♦ Glow period warning lamp -K29- lights up ♦ Various running problems ♦ Engine stalls	– -J623- requires coding ⇒ Seite 231
17018/P0634 Temperature shutoff control unit	♦ Engine control unit -J623- internal fault	♦ Various running problems	– -J623- Renew ⇒ Seite 230
17026/P0642 Sender reference voltage „A“			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Too low	♦ Wiring open circuit or wiring short circuit ♦ Hall sender -G40- defective ♦ Accelerator position sender -G79- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Increased exhaust emissions ♦ Reduced performance at full throttle ♦ Higher fuel consumption ♦ Engine starts poorly or not at all in cold state ♦ No engine speed control	– -G40- Check ⇒ Seite 212 – -G79- Check ⇒ Seite 174
17027/P0643 Sender reference voltage „A“ Too high	♦ Wiring open circuit or wiring short circuit ♦ Hall sender -G40- defective ♦ Accelerator position sender -G79- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Increased exhaust emissions ♦ Reduced performance at full throttle ♦ Higher fuel consumption ♦ Engine starts poorly or not at all in cold state ♦ No engine speed control	– -G40- Check ⇒ Seite 212 – -G79- Check ⇒ Seite 174
17036/P0652 Sender reference voltage „B“			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Too low	♦ Wiring open circuit or wiring short circuit ♦ -G28- defective ♦ Charge pressure sender -G31- defective ♦ Air mass meter -G70- defective ♦ Accelerator position sender -G79- defective ♦ Exhaust gas recirculation potentiometer -G212- defective ♦ Exhaust gas recirculation valve -N18- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Engine liable to stall ♦ Engine not running smoothly ♦ Rev. counter no display ♦ Increased exhaust emissions ♦ Reduced performance ♦ Higher fuel consumption ♦ No exhaust gas recirculation ♦ No engine speed control ♦ Engine starts poorly or not at all in cold state	– -G28- Check ⇒ Seite 210 – -G31- Check ⇒ Seite 192 – -G70- Check ⇒ Seite 220 – -G79- Check ⇒ Seite 174 – Check -G212- ⇒ Seite 245, check exhaust gas recirculation valve -N18- – Check -N18- ⇒ Seite 49, final control diagnosis
17037/P0653 Sender reference voltage „B“ Too high	♦ Wiring open circuit or wiring short circuit ♦ Engine speed sender -G28- defective ♦ Charge pressure sender -G31- defective ♦ Air mass meter -G70- defective ♦ Accelerator position sender -G79- defective ♦ Exhaust gas recirculation potentiometer - G212- defective ♦ Exhaust gas recirculation valve -N18- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Engine liable to stall ♦ Engine not running smoothly ♦ Rev. counter no display ♦ Increased exhaust emissions ♦ Reduced performance ♦ Higher fuel consumption ♦ No exhaust gas recirculation ♦ No engine speed control ♦ Engine starts poorly or not at all in cold state	– -G28- Check ⇒ Seite 210 – -G31- Check ⇒ Seite 192 – -G70- Check ⇒ Seite 220 – -G79- Check ⇒ Seite 174 – Check -G212- ⇒ Seite 245, check exhaust gas recirculation valve -N18- – Check -N18- ⇒ Seite 49, final control diagnosis
17054/P0670 Glow period control unit 1, glow current circuit			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Electrical fault in current circuit	♦ Wiring open circuit or wiring short circuit ♦ Automatic glow period control unit - J179- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Engine starts with difficulty or not at all in cold state.	– Check -J179- ⇒ Seite 49, final control diagnosis
17055/P0671 Glow plug 1 -Q10- Electrical fault in current circuit	♦ Wiring open circuit or wiring short circuit ♦ Glow plug 1 -Q10- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Engine starts with difficulty or not at all in cold state.	– Check -Q10- ⇒ Seite 321, Removing, installing, checking ceramic glow plugs
17056/P0672 Glow plug 2 -Q11- Electrical fault in current circuit	♦ Wiring open circuit or wiring short circuit ♦ Glow plug 2 -Q11- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Engine starts with difficulty or not at all in cold state.	– Check -Q11- ⇒ Seite 321, Removing, installing, checking ceramic glow plugs
17057/P0673 Glow plug 3 -Q12- Electrical fault in current circuit	♦ Wiring open circuit or wiring short circuit ♦ Glow plug 3 -Q12- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Engine starts with difficulty or not at all in cold state.	– Check -Q12- ⇒ Seite 321, Removing, installing, checking ceramic glow plugs
17058/P0674 Glow plug 4 -Q13- Electrical fault in current circuit	♦ Wiring open circuit or wiring short circuit ♦ Glow plug 4 -Q13- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Engine starts with difficulty or not at all in cold state.	– Check -Q13- ⇒ Seite 321, Removing, installing, checking ceramic glow plugs
17068/P0684 Glow period control unit 1 -J179- Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ Automatic glow period control unit - J179- defective	♦ Glow period warning lamp -K29- lights up ♦ Engine starts with difficulty or not at all in cold state.	– Check -J179- ⇒ Seite 49, final control diagnosis
17082/P0698 Sender reference voltage „C“			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Too low	♦ Wiring open circuit or wiring short circuit ♦ Air mass meter -G70- defective ♦ Exhaust gas pressure sensor 1 -G450- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– -G70- Check ⇒ Seite 220 – -G450- Check ⇒ Seite 261
17083/P0699 Sender reference voltage „C“ Too high	♦ Wiring open circuit or wiring short circuit ♦ Air mass meter -G70- defective ♦ Exhaust gas pressure sensor 1 -G450- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– -G70- Check ⇒ Seite 220 – -G450- Check ⇒ Seite 261
17084/P0700 Control unit defective	♦ Engine control unit -J623- internal fault	♦ Glow period warning lamp -K29- lights up ♦ Various running problems ♦ Engine stalls	– -J623- Renew ⇒ Seite 230

3.2 Fault code: 17510/P1102...18364/P1959

Appears on display	Possible fault cause	Possible effects	Fault elimination
17510/P1102 Bank 1 - probe 1, heater current circuit Short to positive	♦ Wire has short to positive ♦ Lambda probe heater -Z19- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Increased exhaust emissions on cold engine	– -Z19- Check ⇒ Seite 253
17523/P1115 Bank 1 - probe 1, heater current circuit Short to earth	♦ Wiring short to earth ♦ Lambda probe heater -Z19- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Increased exhaust emissions on cold engine	– -Z19- Check ⇒ Seite 253
17524/P1116 Bank 1 - probe 1, heater current circuit			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Open circuit	♦ Wiring open circuit ♦ Lambda probe heater -Z19- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Increased exhaust emissions on cold engine	– -Z19- Check ⇒ Seite 253
17552 P1144 Air mass meter -G70- Open circuit/short to earth	♦ Wiring open circuit or wiring short to earth ♦ -G70- defective	♦ Reduced performance ♦ Increased exhaust emissions	– -G70- Check ⇒ Seite 220
17553 P1145 Air mass meter -G70- Short to positive	♦ Wire has short to positive ♦ -G70- defective	♦ Reduced performance ♦ Increased exhaust emissions	– -G70- Check ⇒ Seite 220
17554 P1146 Air mass meter -G70- Supply voltage	♦ Operating voltage too high or too low ♦ Wiring open circuit ♦ -G70- defective	♦ Reduced performance ♦ Increased exhaust emissions	– -G70- Check ⇒ Seite 220
17570/P1162 Fuel temperature sender -G81- Short to earth	♦ Wiring short to earth ♦ -G81- defective	♦ Increased exhaust emissions	– -G81- Check ⇒ Seite 218
17571/P1163 Fuel temperature sender -G81- Open circuit/short to positive	♦ Wiring open circuit or wiring short circuit to positive ♦ -G81- defective	♦ Increased exhaust emissions	– -G81- Check ⇒ Seite 218
17586/P1178 Linear lambda probe / pump current Open circuit	♦ Wiring open circuit ♦ Lambda probe -G39- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251
17589/P1181 Linear lambda probe / reference voltage			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Open circuit 17592/P1184 Linear lambda probe / common earth wire	♦ Wiring open circuit ♦ Lambda probe -G39- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251
Open circuit 17663/P1255 Coolant temperature sender -G62-	♦ Wiring open circuit ♦ Lambda probe -G39- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251
Short to earth 17664/P1256 Coolant temperature sender -G62-	♦ Wiring short to earth ♦ -G62- defective	♦ Increased exhaust emissions	– -G62- Check ⇒ Seite 215
Open circuit/short to positive 17668/P1260 Unit injector valve (cylinder 1) -N240-	♦ Wiring open circuit or wiring short circuit to positive ♦ -G62- defective	♦ Increased exhaust emissions	– -G62- Check ⇒ Seite 215
Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ -N240- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– -N240- Check ⇒ Seite 205
17669/P1261 Unit injector valve (cylinder 1) -N240- Control limit exceeded	♦ -N240- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– -N240- Check ⇒ Seite 205

Appears on display	Possible fault cause	Possible effects	Fault elimination
17670/P1262 Unit injector valve (cylinder 1) -N240-			
Control limit not reached	♦ -N240- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– -N240- Check ⇒ Seite 205
17671/P1263 Unit injector valve (cylinder 2) -N241-			
Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ -N241- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– -N241- Check ⇒ Seite 205
17672/P1264 Unit injector valve (cylinder 2) -N241-			
Control limit exceeded	♦ -N241- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– -N241- Check ⇒ Seite 205
17673/P1265 Unit injector valve (cylinder 2) -N241-			
Control limit not reached	♦ -N241- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– -N241- Check ⇒ Seite 205

Appears on display	Possible fault cause	Possible effects	Fault elimination
17674/P1266 Unit injector valve (cylinder 3) -N242-			
Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ -N242- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– -N242- Check ⇒ Seite 205
17675/P1267 Unit injector valve (cylinder 3) -N242-			
Control limit exceeded	♦ -N242- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– -N242- Check ⇒ Seite 205
17676/P1268 Unit injector valve (cylinder 3) -N242-			
Control limit not reached	♦ -N242- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– -N242- Check ⇒ Seite 205
17677/P1269 Unit injector valve (cylinder 4) -N243-			
Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ -N243- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– -N243- Check ⇒ Seite 205

Appears on display	Possible fault cause	Possible effects	Fault elimination
17678/P1270 Unit injector valve (cylinder 4) -N243-			
Control limit exceeded	♦ -N243- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– -N243- Check ⇒ Seite 205
17679/P1271 Unit injector valve (cylinder 4) -N243-			
Control limit not reached	♦ -N243- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– -N243- Check ⇒ Seite 205
17793/P1385 Control unit defective	♦ Engine control unit -J623- internal fault	♦ Exhaust gas warning lamp -K83- lights up ♦ Various running problems ♦ Engine stalls	– -J623- Renew ⇒ Seite 230
17795/P1387 Control unit defective	♦ Engine control unit -J623- internal fault	♦ Exhaust gas warning lamp -K83- lights up ♦ Various running problems ♦ Engine stalls	– -J623- Renew ⇒ Seite 230
17808/P1400 Exhaust gas recirculation valve -N18-			
Electrical fault in current circuit	♦ Wiring open circuit or wiring short circuit ♦ -N18- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ No exhaust gas recirculation ♦ Reduced performance ♦ Increased exhaust emissions	– Check -N18- ⇒ Seite 49, final control diagnosis
17810/P1402 Exhaust gas recirculation valve -N18-			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Short to positive 17847/P1439 Exhaust gas recirculation potentiometer -G212-	♦ Wire has short to positive ♦ -N18- defective	♦ No exhaust gas recirculation ♦ Reduced performance ♦ Increased exhaust emissions	– Check -N18- ⇒ Seite 49, final control diagnosis
Fault in basic setting 17849/P1441 Exhaust gas recirculation valve -N18-	♦ Fault in basic setting of exhaust gas recirculation valve -N18-	♦ Exhaust gas warning lamp -K83- lights up ♦ No exhaust gas recirculation ♦ Reduced performance ♦ Increased exhaust emissions	– Perform basic setting of -N18- ⇒ Seite 250
Open circuit/short to earth	♦ Wiring open circuit or wiring short to earth ♦ -N18- defective	♦ No exhaust gas recirculation ♦ Reduced performance ♦ Increased exhaust emissions	– Check -N18- ⇒ Seite 49, final control diagnosis
P145A Exhaust gas temperature sender 3 -G527-			
Electrical fault in current circuit P145B Exhaust gas temperature sender 3 -G527-	♦ Wiring open circuit or wiring short circuit ♦ Temperature sender after particulate filter -G527- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– -527- Check ⇒ Seite 259
Implausible signal P145C Exhaust gas temperature sender 3 -G527-	♦ Wiring open circuit or wiring short to earth ♦ Temperature sender after particulate filter -G527- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– -527- Check ⇒ Seite 259

Appears on display	Possible fault cause	Possible effects	Fault elimination
Short to earth P145D Exhaust gas temperature sender 3 -G527-	♦ Wiring short to earth ♦ Temperature sender after particulate filter -G527- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– -527- Check ⇒ Seite 259
Short to positive 17903/P1495 Changeover valve for exhaust gas recirculation cooler -N345-	♦ Wire has short to positive ♦ Temperature sender after particulate filter -G527- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– -527- Check ⇒ Seite 259
Open circuit/short to earth 17904/P1496 Changeover valve for exhaust gas recirculation cooler -N345-	♦ Wiring open circuit or wiring short to earth ♦ -N345- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– Check -N345- ⇒ Seite 49, final control diagnosis
Short to positive 17909/P1501 Fuel pump relay -J17-	♦ Wire has short to positive ♦ -N345- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– Check -N345- ⇒ Seite 49, final control diagnosis
Short to earth 17910/P1502 Fuel pump relay -J17-	♦ Wiring short to earth ♦ -J17- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Engine does not start ♦ Various running problems to engine stalling	– Check -J17- and ⇒ Seite 288, current flow diagrams
Short to positive	♦ Wire has short to positive ♦ -J17- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Engine does not start ♦ Various running problems to engine stalling	– Check -J17- and ⇒ Seite 288, current flow diagrams

Appears on display	Possible fault cause	Possible effects	Fault elimination
17911/P1503 Load signal from alternator terminal DF			
Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ Alternator -C- defective ♦ Voltage regulator -C1- defective	♦ Various running problems	– Check alternator -C- and voltage regulator -C1- ⇒ Seite 277
17948/P1540 Vehicle speed signal			
Signal too high	♦ Wiring open circuit or wiring short to earth ♦ Switch or button for working speed regulator defective	♦ Working speed regulation not OK	– Check components for working speed regulation ⇒ Seite 288, current flow diagrams
17949/P1541 Fuel pump relay -J17-			
Open circuit	♦ Wiring open circuit ♦ -J17- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Engine does not start ♦ Various running problems to engine stalling	– Check -J17- and ⇒ Seite 288, current flow diagrams
17954/P1546 Charge pressure control solenoid -N75-			
Short to positive	♦ Wire has short to positive ♦ -N75- defective	♦ Reduced performance ♦ Charge pressure too low	– Check -N75- ⇒ Seite 49, final control diagnosis
17957/P1549 Charge pressure control solenoid -N75-			
Open circuit/short to earth	♦ Wiring open circuit or wiring short to earth ♦ -N75- defective	♦ Reduced performance ♦ Charge pressure too low ♦ Charge pressure too high	– Check -N75- ⇒ Seite 49, final control diagnosis
P154F Charge pressure control			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Malfunction 17958/P1550 Charge pressure	♦ Charge pressure control defective ♦ Turbocharger defective ♦ Leaks between exhaust turbocharger and engine (charge air path)	♦ Reduced performance ♦ Charge pressure too low ♦ Charge pressure too high	– Checking charge air system for leaks ⇒ Seite 185 – Checking charge pressure regulation ⇒ Seite 187.
Control difference 17964/P1556 Charge pressure control	♦ Charge pressure control defective ♦ Turbocharger defective ♦ Leaks between exhaust turbocharger and engine (charge air path)	♦ Reduced performance ♦ Charge pressure too low ♦ Charge pressure too high	– Checking charge air system for leaks ⇒ Seite 185 – Checking charge pressure regulation ⇒ Seite 187.
Control limit not reached 17965/P1557 Charge pressure control	♦ Charge pressure control defective ♦ Turbocharger defective ♦ Leaks between exhaust turbocharger and engine (charge air path)	♦ Reduced performance ♦ Charge pressure too low	– Checking charge air system for leaks ⇒ Seite 185. – Checking charge pressure regulation ⇒ Seite 187.
Control limit exceeded 18000/P1592 Altitude sender signal/ charge pressure sensor	♦ Charge pressure control defective ♦ Hose connections interchanged, not connected	♦ Reduced performance ♦ Charge pressure too high	– Checking charge pressure regulation ⇒ Seite 187.
Implausible ratio 18008/P1600 Voltage supply term. 15	♦ Charge pressure sender -G31- defective ♦ Altitude sender -F96- in engine control unit -J623- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ No charge pressure control ♦ No exhaust gas recirculation ♦ Reduced performance ♦ Increased exhaust emissions	– -G31- Check ⇒ Seite 192 – Renew -J623- if necessary ⇒ Seite 230

Appears on display	Possible fault cause	Possible effects	Fault elimination
Voltage too low 18009/P1601 Voltage supply relay - terminal 30- -J317-	♦ No voltage with ignition on (terminal 15)	♦ Engine does not start ♦ Various running problems to engine stalling	– Check power supply for engine control unit -J623- ⇒ Seite 229
Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ -J317- defective ♦ Relay sticking (sporadic)	♦ Engine does not start ♦ Various running problems to engine stalling	– Check power supply for engine control unit -J623- ⇒ Seite 229
18011/P1603 Control unit defective	♦ Engine control unit -J623- internal fault	♦ Glow period warning lamp -K29- lights up ♦ Various running problems ♦ Engine stalls	– -J623- Renew ⇒ Seite 230
18012/P1604 Control unit defective	♦ Engine control unit -J623- internal fault	♦ Exhaust gas warning lamp -K83- lights up ♦ Various running problems ♦ Engine stalls	– -J623- Renew ⇒ Seite 230
18018/P160A Control unit defective 18020/P0612 Engine control unit	♦ Engine control unit -J623- internal fault	♦ Various running problems ♦ Engine stalls	– -J623- Renew ⇒ Seite 230
Coded incorrectly 18024/P1616 Glow period warning lamp -K29-	♦ Invalid control unit coding for engine control unit -J623-	♦ Glow period warning lamp -K29- lights up ♦ Various running problems ♦ Engine stalls	– -J623- requires coding ⇒ Seite 231
Short to positive 18025/P1617 Glow period warning lamp -K29-	♦ Wire has short to positive ♦ -K29- defective	---	– Check -K29- ⇒ Seite 49, final control diagnosis
Open circuit/short to earth	♦ Wiring open circuit or wiring short to earth ♦ -K29- defective	---	– Check -K29- ⇒ Seite 49, final control diagnosis
18026/P1618 Glow plug relay -J52-			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Short to positive P161A Glow plug 1 -Q10-	♦ Wire has short to positive ♦ Automatic glow period control unit - J179- defective	♦ Engine starts with difficulty or not at all in cold state.	– Check -J179- ⇒ Seite 49, final control diagnosis
Open circuit P161B Glow plug 2 - Q11-	♦ Wiring open circuit ♦ -Q10- defective	♦ Engine starts with difficulty or not at all in cold state.	– Check -Q10- ⇒ Seite 321, Removing, installing, checking ceramic glow plugs
Open circuit P161C Glow plug 3 - Q12-	♦ Wiring open circuit ♦ -Q11- defective	♦ Engine starts with difficulty or not at all in cold state.	– Check -Q11- ⇒ Seite 321, Removing, installing, checking ceramic glow plugs
Open circuit P161D Glow plug 4 - Q13-	♦ Wiring open circuit ♦ -Q12- defective	♦ Engine starts with difficulty or not at all in cold state.	– Check -Q12- ⇒ Seite 321, Removing, installing, checking ceramic glow plugs
Open circuit 18039/P1631 Accelerator pedal position sender -G79-	♦ Wiring open circuit ♦ -Q13- defective	♦ Engine starts with difficulty or not at all in cold state.	– Check -Q13- ⇒ Seite 321, Removing, installing, checking ceramic glow plugs
Signal too high 18040/P1632 Accelerator pedal position sender -G79-	♦ Wiring open circuit or wiring short to earth ♦ -G79- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ No engine speed control	– -G79- Check ⇒ Seite 174
Supply voltage	♦ Operating voltage too high or too low ♦ Wiring open circuit ♦ -G79- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ No engine speed control	– -G79- Check ⇒ Seite 174

Appears on display	Possible fault cause	Possible effects	Fault elimination
18041/P1633 Accelerator pedal position sender 2 -G185-			
Signal too low	♦ Wiring open circuit or wiring short circuit to positive ♦ Accelerator position sender -G79- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ No engine speed control	– -G79- Check ⇒ Seite 174
18042/P1634 Accelerator pedal position sender -G79-			
Signal too high	♦ Wiring open circuit or wiring short to earth ♦ -G79- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ No engine speed control	– -G79- Check ⇒ Seite 174
18043/P1635 Drive train data bus			
No message from air conditioning CU	♦ Fault in data lines to air conditioning control unit -J301- ♦ Missing communication	♦ Air conditioning has no function or function is impaired	– Check data bus ⇒ Seite 232
18047/P1639 Accelerator pedal position sender 1/2 -G79 + G185-			
Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ Accelerator position sender -G79- defective	♦ Glow period warning lamp -K29- lights up ♦ No engine speed control	– -G79- Check ⇒ Seite 174
18048/P1640 Control unit defective	♦ Engine control unit -J623- internal fault	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Various running problems ♦ Engine stalls	– -J623- Renew ⇒ Seite 230
18049/P1641 Please interrogate fault memory of air conditioning CU	♦ Refrigerant pressure not OK	♦ Air conditioning has no function or function is impaired	– Check air conditioning
18056/P1648 Drive train data bus defective	♦ Fault in data lines ♦ Missing communication	♦ Exhaust gas warning lamp -K83- lights up	– Check data bus ⇒ Seite 232
18058/P1650 Drive train data bus			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Missing message from combi-instrument 18059/P1651 Drive train data bus	♦ Fault in data lines to combi-instrument	♦ Combi-instrument has no function or function is impaired	– Check data bus ⇒ Seite 232
Missing messages 18071/P1663 Unit injector valve actuation	♦ Fault in data lines	♦ Exhaust gas warning lamp -K83- lights up	– Check data bus ⇒ Seite 232
Short to positive 18072/P1664 Unit injector valve actuation	♦ Wire has short to positive ♦ Unit injector valves (cylinder 1...4) -N240...N243- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– -N240...N243- Check ⇒ Seite 205
Electrical fault in current circuit 18074/P1666 Unit injector valve (cylinder 1) -N240-	♦ Wiring open circuit or wiring short circuit ♦ Unit injector valves (cylinder 1...4) -N240...N243- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– -N240...N243- Check ⇒ Seite 205
Electrical fault in current circuit	♦ Wiring open circuit or wiring short circuit ♦ -N240- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– -N240- Check ⇒ Seite 205

Appears on display	Possible fault cause	Possible effects	Fault elimination
18075/P1667 Unit injector valve (cylinder 2) -N241-			
Electrical fault in current circuit	♦ Wiring open circuit or wiring short circuit ♦ -N241- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– -N241- Check ⇒ Seite 205
18076/P1668 Unit injector valve (cylinder 3) -N242-			
Electrical fault in current circuit	♦ Wiring open circuit or wiring short circuit ♦ -N242- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– -N242- Check ⇒ Seite 205
18077/P1669 Unit injector valve (cylinder 4) -N243-			
Electrical fault in current circuit	♦ Wiring open circuit or wiring short circuit ♦ -N243- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Engine misfire ♦ Increased exhaust emissions ♦ Engine not running smoothly	– -N243- Check ⇒ Seite 205
18082/P1674 Drive train data bus			
Implausible message from combi-instrument	♦ Fault in data lines to combi-instrument ♦ Missing communication	♦ Combi-instrument has no function or function is impaired	– Check data bus ⇒ Seite 232
18095/P1687 Drive train data bus			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Implausible message from air conditioning CU	♦ Fault in data lines to air conditioning control unit -J301- ♦ Missing communication	♦ Air conditioning has no function or function is impaired	– Check data bus ⇒ Seite 232
18156/P1748 Control unit defective	♦ Engine control unit -J623- internal fault	♦ Glow period warning lamp -K29- lights up ♦ Various running problems ♦ Engine stalls	– -J623- Renew ⇒ Seite 230
18263/P1855 Drive train data bus			
Software status monitoring	♦ Fault in data lines ♦ Missing communication	♦ Air conditioning has no function or function is impaired	– Check data bus ⇒ Seite 232
18288/P1880 Drive train data bus			
Missing message from diagnosis interface CU	♦ Fault in data lines ♦ Missing communication	---	– Check data bus ⇒ Seite 232
18365/P1957 Exhaust gas temperature sender 2 -G448-			
Short to earth	♦ Wiring short to earth ♦ -G448- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions ♦ Particulate filter regeneration blocked	– -G448- Check ⇒ Seite 257
18366/P1958 Exhaust gas temperature sender 2 -G448-			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Short to positive 18367/P1959 Exhaust gas temperature sender 2 -G448-	♦ Wire has short to positive ♦ -G448- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions ♦ Particulate filter regeneration blocked	– -G448- Check ⇒ Seite 257
Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ -G448- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions ♦ Particulate filter regeneration blocked	– -G448- Check ⇒ Seite 257

3.3 Fault code: 18434/P2002...18885/P2453

Appears on display	Possible fault cause	Possible effects	Fault elimination
18434/P2002 Particulate filter bank 1 Malfunction	♦ Exhaust gas pressure sensor 1 -G450- defective ♦ Control lines between exhaust gas pressure sensor 1 -G450- and particulate filter blocked	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ No exhaust gas recirculation ♦ Reduced performance ♦ Increased exhaust emissions	– -G450- Check ⇒ Seite 261 – Check control lines ⇒ Seite 237, Assembly overview - particulate filter (engine code CBKA) – Check particulate filter ⇒ Seite 265
18447/P2015 Intake manifold flap position sender Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ Intake manifold flap motor -V157- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Cold starting problems ♦ Cold idling problems ♦ Idling speed problems ♦ Hard load changes ♦ Hard engine stop jolt	– Check -V157- ⇒ Seite 49, final control diagnosis

Appears on display	Possible fault cause	Possible effects	Fault elimination
18448/P2016 Intake manifold flap position sender			
Short to earth	♦ Wiring short to earth ♦ Intake manifold flap motor -V157- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Cold starting problems ♦ Cold idling problems ♦ Idling speed problems ♦ Hard load changes ♦ Hard engine stop jolt	– Check -V157- ⇒ Seite 49, final control diagnosis
18449/P2017 Intake manifold flap position sender			
Short to positive	♦ Wire has short to positive ♦ Intake manifold flap motor -V157- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Cold starting problems ♦ Cold idling problems ♦ Idling speed problems ♦ Hard load changes ♦ Hard engine stop jolt	– Check -V157- ⇒ Seite 49, final control diagnosis
18512/P2080 Exhaust gas temperature sender 1 -G235-			
Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ -G235- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– -G235- Check ⇒ Seite 254
18627/P2195 Lambda probe 1 - bank 1			
Signal too lean	♦ Wiring open circuit ♦ Lambda probe -G39- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251
18628/P2196 Lambda probe 1 - bank 1			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Signal too rich 18669/P2237 Lambda probe 1 - bank 1, pump current	♦ Wiring open circuit ♦ Lambda probe -G39- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251
Open circuit 18670/P2238 Lambda probe 1 - bank 1, pump current	♦ Wiring open circuit ♦ Lambda probe -G39- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251
Short to earth 18671/P2239 Lambda probe 1 - bank 1, pump current	♦ Wiring short to earth ♦ Lambda probe -G39- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251
Short to positive 18675/P2243 Lambda probe 1 - bank 1, reference voltage	♦ Wire has short to positive ♦ Lambda probe -G39- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251
Open circuit 18676/P2244 Lambda probe 1 - bank 1, reference voltage	♦ Wiring open circuit ♦ Lambda probe -G39- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251
Implausible signal 18677/P2245 Lambda probe 1 - bank 1, reference voltage	♦ Wiring open circuit or wiring short to earth ♦ Lambda probe -G39- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251

Appears on display	Possible fault cause	Possible effects	Fault elimination
Short to earth 18678/P2246 Lambda probe 1 - bank 1, reference voltage	♦ Wiring short to earth ♦ Lambda probe -G39- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251
Short to positive 18683/P2251 Lambda probe 1 - bank 1, earth wire	♦ Wire has short to positive ♦ Lambda probe -G39- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251
Open circuit 18684/P2252 Lambda probe 1 - bank 1, earth wire	♦ Wiring open circuit ♦ Lambda probe -G39- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251
Short to earth 18685/P2253 Lambda probe 1 - bank 1, earth wire	♦ Wiring short to earth ♦ Lambda probe -G39- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251
Short to positive	♦ Wire has short to positive ♦ Lambda probe -G39- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251
18711/P2279 Air leakage in intake system	♦ Leaks between exhaust turbocharger and engine (charge air path)	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Charge pressure too low ♦ Particulate filter regeneration blocked	– Checking charge air system for leaks ⇒ Seite 185 – Checking charge pressure regulation ⇒ Seite 187.
18846/P2414 Bank 1 - probe 1			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Voltage too low/air leakage	♦ Voltage supply too low ♦ Lambda probe -G39- defective	♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251
P242B Exhaust gas temperature sender 3 -G527-			
Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ Temperature sender after particulate filter -G527- defective	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– -527- Check ⇒ Seite 259
P242F Particulate filter overloaded	♦ Particulate filter overloaded with soot/carbon	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions	– Check particulate filter ⇒ Seite 265
18885/P2453 Diesel particulate filter pressure difference sender			
Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ -G450- defective ♦ Control lines between -G450- and particulate filter blocked or interchanged	♦ Exhaust gas warning lamp -K83- lights up ♦ Reduced performance ♦ Increased exhaust emissions ♦ Particulate filter regeneration blocked	– -G450- Check ⇒ Seite 261 – Check control lines ⇒ Seite 237, Assembly overview - particulate filter (engine code CBKA) – Check particulate filter ⇒ Seite 265

3.4 Fault code: 19456/P3000...19794/P3338

Appears on display	Possible fault cause	Possible effects	Fault elimination
19456/P3000 Glow period warning lamp -K29-			
Fault message from combi-instrument	♦ Fault in data lines to combi-instrument ♦ Missing communication	♦ Combi-instrument has no function or function is impaired	– Check data bus ⇒ Seite 232
19463/P3007 Camshaft position sensor-G40-			

Appears on display	Possible fault cause	Possible effects	Fault elimination
No signal	♦ Wiring open circuit or wiring short circuit ♦ Hall sender -G40- defective or loose ♦ Metal filings on hub or Hall sender -G40- ♦ Gap between Hall sender -G40-/hub too great ♦ Hub with sender wheel on camshaft is twisted or loose	♦ Increased exhaust emissions ♦ Reduced performance at full throttle ♦ Higher fuel consumption ♦ Engine starts poorly or not at all in cold state	– -G40- Check ⇒ Seite 212 – Check position of camshaft and sender wheel ⇒ Seite 116, Removing, installing, tensioning toothed belt
19464/P3008 Camshaft position sensor- G40- Signal outside tolerance	♦ Wiring open circuit or wiring short circuit ♦ Hall sender -G40- defective or loose ♦ Metal filings on hub or Hall sender -G40- ♦ Gap between Hall sender -G40-/hub too great ♦ Hub with sender wheel on camshaft is twisted or loose	♦ Increased exhaust emissions ♦ Reduced performance at full throttle ♦ Higher fuel consumption ♦ Engine starts poorly or not at all in cold state	– -G40- Check ⇒ Seite 212 – Check position of camshaft and sender wheel ⇒ Seite 116, Removing, installing, tensioning toothed belt
19532/P3076 Engine control unit Fault during coding	♦ Invalid control unit coding for engine control unit -J623-	♦ Glow period warning lamp -K29- lights up ♦ Various running problems ♦ Engine stalls	– -J623- requires coding ⇒ Seite 231
19556/P3100 Intake manifold flap motor -V157- Short to positive	♦ Wire has short to positive ♦ -V157- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Cold starting problems ♦ Cold idling problems ♦ Idling speed problems ♦ Hard load changes ♦ Hard engine stop jolt	– Check -V157- ⇒ Seite 49, final control diagnosis

Appears on display	Possible fault cause	Possible effects	Fault elimination
19557/P3101 Intake manifold flap motor -V157-			
Open circuit/short to earth	♦ Wiring open circuit or wiring short to earth ♦ -V157- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Cold starting problems ♦ Cold idling problems ♦ Idling speed problems ♦ Hard load changes ♦ Hard engine stop jolt	– Check -V157- ⇒ Seite 49, final control diagnosis
19558/P3102 Intake manifold flap motor -V157-			
No signal	♦ Wiring open circuit or wiring short circuit ♦ -V157- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Cold starting problems ♦ Cold idling problems ♦ Idling speed problems ♦ Hard load changes ♦ Hard engine stop jolt	– Check -V157- ⇒ Seite 49, final control diagnosis
19559/P3103 Intake manifold flap motor -V157-			
Defective	♦ Wiring open circuit or wiring short circuit ♦ -V157- defective	♦ Glow period warning lamp -K29- lights up ♦ Exhaust gas warning lamp -K83- lights up ♦ Cold starting problems ♦ Cold idling problems ♦ Idling speed problems ♦ Hard load changes ♦ Hard engine stop jolt	– Check -V157- ⇒ Seite 49, final control diagnosis
19560/P3104 Intake manifold flap motor -N239-			

Appears on display	Possible fault cause	Possible effects	Fault elimination
Short to positive 19561/P3105 Intake manifold flap changeover valve -N239-	♦ Wire has short to positive ♦ -N239- defective	♦ Cold starting problems ♦ Cold idling problems ♦ Idling speed problems ♦ Hard load changes ♦ Hard engine stop jolt	– -N239- Check ⇒ Seite 224
Open circuit/short to earth 19595/P3139 Intake manifold flap for air flow control	♦ Wiring open circuit or wiring short to earth ♦ -N239- defective	♦ Cold starting problems ♦ Cold idling problems ♦ Idling speed problems ♦ Hard load changes ♦ Hard engine stop jolt	– -N239- Check ⇒ Seite 224
Signal outside tolerance 19667/P3211 Exhaust gas - bank 1 - probe 1	♦ Wiring open circuit or wiring short circuit ♦ Intake manifold flap motor -V157- defective	♦ Cold starting problems ♦ Cold idling problems ♦ Idling speed problems ♦ Hard load changes ♦ Hard engine stop jolt	– Check -V157- ⇒ Seite 49, final control diagnosis
Heater reverse coupling 19781/P3325 Voltage supply term. 15	♦ Wiring open circuit or wiring short circuit ♦ Lambda probe -G39- defective	♦ No emissions control ♦ Increased exhaust emissions	– -G39- Check ⇒ Seite 251
Implausible	♦ Wiring open circuit or wiring short to earth ♦ No voltage with ignition on (terminal 15)	♦ Engine does not start ♦ Various running problems to engine stalling	– Check power supply for engine control unit -J623- ⇒ Seite 229

Appears on display	Possible fault cause	Possible effects	Fault elimination
19788/P3332 Misfire detection in overrun mode 19794/P3338 Glow period control unit 1 actuation	♦ Engine control unit -J623- internal fault	♦ Various running problems	– -J623- Renew ⇒ Seite 230
Electrical fault in current circuit	♦ Wiring open circuit or wiring short circuit ♦ Automatic glow period control unit - J179- defective	♦ Engine starts with difficulty or not at all in cold state.	– Check -J179- ⇒ Seite 49, final control diagnosis

4 Final control diagnosis

Perform final control diagnosis:

- Engine codes CBHA, CBJA, CBJB ⇒ Seite 49,
- engine code CBKA ⇒ Seite 52.

4.1 Performing final control diagnosis (engine codes CBHA, CBJA, CBJB)

The final control diagnosis activates the following components in the given order:

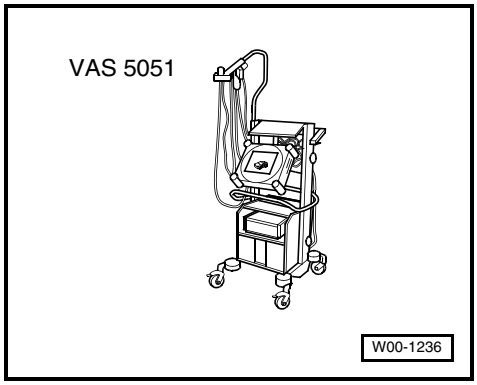
1 - Exhaust gas recirculation valve -N18-
2 - Charge pressure control solenoid valve -N75-
3 - Intake manifold flap changeover valve -N239-
4 - Glow period warning lamp -K29-
5 - Exhaust gas warning lamp -K83-
6 - Automatic glow period control unit -J179-

Hinweis

- *Activation of individual control elements is limited to 30 secs. but can be stopped at any time by pressing the → button.*
- *The ignition must be switched off before repeating the final control diagnosis.*

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -



Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- The coolant temperature must be at least 80 °C, ⇒ display group 1, display zone 4.

Procedure

– Connect vehicle diagnosis, testing and information system -VAS 5051- and select diagnosis function „03-Final control diagnosis“. Engine must be idling to do this. (Connect vehicle diagnosis, testing and information system and select engine control unit⇒ Seite 5.)

Actuate exhaust gas recirculation valve -N18-

Hinweis

Once diagnosis function „03-Final control diagnosis“ has been selected, the first control element is actuated directly, in this instance exhaust gas recirculation valve -N18-.

Exhaust gas recirculation valve - N18- is actuated.

The displays in display zones 3 and 4 must fluctuate in the following control range:

- Specification in display zone 3: 170...520 mg/H
- Specification display zone 4: 95...4 %

Hinweis

Actuation of the valve can also be checked by touch.

If the valve is not actuated:

– Proceed with final control diagnosis until completed.

– Check the exhaust gas recirculation ⇒ Seite 244.

Actuate charge pressure control solenoid -N75-

– Press → button.

Charge pressure control solenoid - N75- is actuated.

The displays in display zones 2, 3 and 4 must fluctuate in the following control range:

Display zone 2: off

- Specification in display zone 3: 900...1050 mbar
- Specification display zone 4: 4...5 %

Display zone 2: on

- Specification in display zone 3: 40 mbar greater than display off
- Specification in display zone 4: at least 95 %

Hinweis

- *Actuation of the valve can also be checked by touch.*
- *During actuation, the charge pressure control linkage of the vacuum unit on the turbocharger should move back and forth (at least 3...4 times while there is a vacuum in the vacuum reservoir).*

If the valve is not actuated:

– Proceed with final control diagnosis until completed.

– Check the charge pressure control ⇒ Seite 187.

Actuate intake manifold flap changeover valve -N239-

– Press → button.

Intake manifold flap changeover valve -N239 - is actuated.

- The engine must stall when the intake manifold flap changeover valve is actuated.

If the engine does not stall:

– Proceed with final control diagnosis until completed.

– Switch off ignition.

– Check intake manifold flap changeover ⇒ Seite 223.

Actuate glow period warning lamp -K29-

– Press → button.

Glow period warning lamp - K29- is actuated.

- The warning lamp must flash.

If the warning lamp does not flash:

– Check glow period warning lamp -K29- using the current flow diagram ⇒ Seite 288, current flow diagrams.

Actuate exhaust gas warning lamp -K83-

– Press → button.

Exhaust gas warning lamp -K83- is actuated.

- The exhaust gas warning lamp must flash.

If the exhaust gas warning lamp does not flash:

– Check exhaust gas warning lamp -K83- using the current flow diagram ⇒ Seite 288, current flow diagrams.

Actuate automatic glow period control unit -J179-

– Press → button.

Automatic glow period control unit -J179- is actuated.

- The control unit must click.

Hinweis

Clicking of the control unit is difficult to hear and is therefore best checked by touch.

– End diagnosis function.

– Switch off ignition.

Final control diagnosis is thereby complete.

If the control unit does not click:

– Check automatic glow period control unit -J179- ⇒ Seite 288, current flow diagrams.

4.2 Performing final control diagnosis (engine code CBKA)

The final control diagnosis activates the following components in the given order:

1 - Exhaust gas recirculation valve -N18-
2 - Charge pressure control solenoid valve -N75-
3 - Intake manifold flap motor -V157-
4 - Glow period warning lamp -K29-
5 - Exhaust gas warning lamp -K83-
6 - Exhaust gas recirculation cooler change-over valve -N345-
7 - Automatic glow period control unit -J179-

Hinweis

- *Activation of individual control elements is limited to 30 secs. but can be stopped at any time by pressing the → button.*
- *The ignition must be switched off before repeating the final control diagnosis.*

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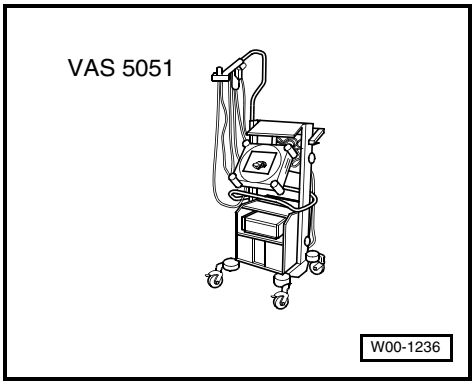
♦ Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -



Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- The coolant temperature must be at least 80 °C, ⇒ display group 1, display zone 4.

Procedure

– Connect vehicle diagnosis, testing and information system -VAS 5051- and select diagnosis function „03-Final control diagnosis“. Engine must be idling to do this. (Connect vehicle diagnosis, testing and information system and select engine control unit⇒ Seite 5.)

Actuate exhaust gas recirculation valve -N18-

Hinweis

Once diagnosis function „03-Final control diagnosis“ has been selected, the first control element is actuated directly, in this instance exhaust gas recirculation valve -N18-.

Exhaust gas recirculation valve - N18- is actuated.

The displays in display zones 3 and 4 must fluctuate in the following control range:

- Specification in display zone 3: 170...520 mg/H
- Specification display zone 4: 95...4 %

Hinweis

Actuation of the valve can also be checked by touch.

If the valve is not actuated:

– Proceed with final control diagnosis until completed.

– Check the exhaust gas recirculation ⇒ Seite 244.

Actuate charge pressure control solenoid -N75-

– Press → button.

Charge pressure control solenoid - N75- is actuated.

The displays in display zones 2, 3 and 4 must fluctuate in the following control range:

Display zone 2: off

- Specification in display zone 3: 900...1050 mbar
- Specification display zone 4: 4...5 %

Display zone 2: on

- Specification in display zone 3: 40 mbar greater than display off
- Specification in display zone 4: at least 95 %

Hinweis

- *Actuation of the valve can also be checked by touch.*
- *During actuation, the charge pressure control linkage of the vacuum unit on the turbocharger should move back and forth (at least 3...4 times while there is a vacuum in the vacuum reservoir).*

If the valve is not actuated:

– Proceed with final control diagnosis until completed.

– Check the charge pressure control ⇒ Seite 187.

Actuate intake manifold flap motor -V157 -

– Press [→] button.

Intake manifold flap motor -V157- is actuated.

- The engine must stall when the intake manifold flap motor is actuated.

If the engine does not stall:

– Proceed with final control diagnosis until completed.

– Switch off ignition.

– Check intake manifold flap motor -V157- ⇒ Seite 226.

Actuate glow period warning lamp -K29-

– Press [→] button.

Glow period warning lamp - K29- is actuated.

- The warning lamp must flash.

If the warning lamp does not flash:

– Check glow period warning lamp -K29- using the current flow diagram ⇒ Seite 288, current flow diagrams.

Actuate exhaust gas warning lamp -K83-

– Press [→] button.

Exhaust gas warning lamp -K83- is actuated.

- The exhaust gas warning lamp must flash.

If the exhaust gas warning lamp does not flash:

– Check exhaust gas warning lamp -K83- using the current flow diagram ⇒ Seite 288, current flow diagrams.

Actuate exhaust gas recirculation cooler changeover valve -N345-

– Press → button.

Exhaust gas recirculation cooler changeover valve -N345- is actuated.

- The valve must click.

Hinweis

Clicking of the valve is difficult to hear and is therefore best checked by touch.

If the valve does not click:

– Proceed with final control diagnosis until completed.

– Check exhaust gas recirculation cooler changeover valve -N345- ⇒ Seite 263.

Actuate automatic glow period control unit -J179-

– Press → button.

Automatic glow period control unit -J179- is actuated.

- The control unit must click.

Hinweis

Clicking of the control unit is difficult to hear and is therefore best checked by touch.

If the control unit does not click:

– Check automatic glow period control unit -J179- ⇒ Seite 288, current flow diagrams.

– End diagnosis function.

– Switch off ignition.

Final control diagnosis is thereby complete.

5 Measured value blocks

Observe safety precautions ⇒ Seite 56

Read measured value block ⇒ Seite 56.

Evaluating measured value blocks:

- at idling speed ⇒ Seite 57,
- at full throttle ⇒ Seite 69.

5.1 Safety precautions

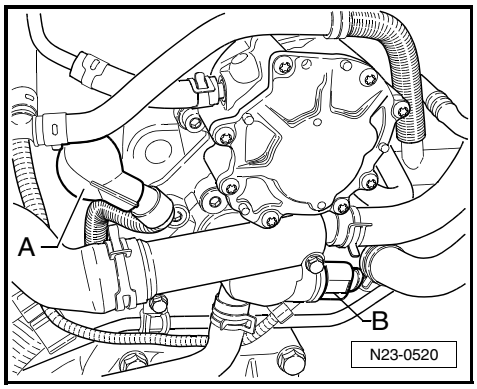
ACHTUNG!

For all assembly work, the following should be observed due to the restricted amount of space available:

- ***Route all the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant, refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***Ensure that there is sufficient clearance to all moving or hot components.***

To prevent injuries to persons and/or damage to the injection and glow plug system, the following must be noted:

- Always switch off the ignition before connecting or disconnecting injection and glow plug system wiring or tester cables.
- If the engine has to be operated at the starting speed without actually starting, e.g. to test compression pressure, detach central connector -A- for the unit injectors.
- Disconnecting and connecting the battery must only be done with the ignition switched off, as otherwise the engine control unit could be damaged.



Observe following if test and measuring instruments are required during a road test:

- The test instruments should always be secured and operated by a second person.

5.2 Read measured value block

Hinweis

The measured values in diagnosis function „08-Read measured value block“ are described with the individual component tests. This table serves only as an overview.

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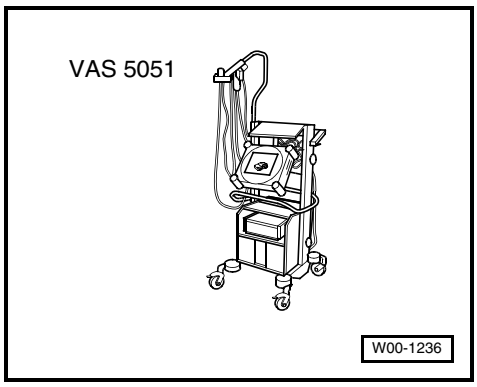
- Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -



Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- Earth connections OK
- All electrical consumers must be switched off.

- No faults must be stored in fault memory ⇒ Seite 9, interrogating fault memory.
- The coolant temperature must be at least 80 °C, ⇒ display group 1, display zone 4.

Test procedure

– Connect vehicle diagnosis, testing and information system -VAS 5051- and select diagnosis function „08-Read measured value block“. Engine must be idling to do this. (Connect vehicle diagnosis, testing and information system and select engine control unit⇒ Seite 5.)

Hinweis

„Display group 1“ is an example for purposes of illustrating the process.

– Select „display group 1“.

Indicated on display: (1...4 = display zones)

Hinweis

On the display of vehicle diagnosis, testing and information system -VAS 5051-, the display zones are shown one below the other, on other diagnosis testers they are side by side.

– To change to another display group, proceed as follows:

Display group	Button
Higher	Press ↑ button
Lower	Press ↓ button
Skip	Press ← button

If specifications are reached in all display zones:

– End diagnosis function.

– Switch off ignition.

5.3 Evaluating measured value blocks at idling speed

Always follow safety precautions ⇒ Seite 56.

Read measured value block ⇒ Seite 56.

Display group:

- 1 - Injection quantity ⇒ Seite 58
- 2 - Idling speed ⇒ Seite 58
- 3 - Exhaust gas recirculation ⇒ Seite 59
- 4 - Unit injector valve (cylinder 1...4) -N240...N243- actuation ⇒ Seite 60
- 5 - Start conditions ⇒ Seite 61
- 6 - Switch positions ⇒ Seite 62
- 7 - Temperatures ⇒ Seite 62

- 8 - Governed torque 1 ⇒ Seite 63
- 9 - Governed torque 2 ⇒ Seite 63
- 10 - Air variables ⇒ Seite 64
- 11 - Charge pressure control ⇒ Seite 64
- 12 - Glow status ⇒ Seite 65
- 13 - Idling speed smooth running control ⇒ Seite 66
- 15 - Fuel consumption ⇒ Seite 67
- 18 - Status of unit injector valves ⇒ Seite 67
- 23 - BIP deviation (solenoid valve switch times) of unit injectors valves ⇒ Seite 68

5.3.1 Display group 1 - Injection quantity

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80 °C.

Display zone	Operating condition or component	Specification	Evaluation
1	Engine speed ♦ Engine codes CBHA, CBJA, CBJB ♦ Engine code CBKA	 770...1200 rpm 870...1200 rpm	---
2	Quantity injected	3.0...11.0 mg/H	⇒ Seite 58
3	Injection period (specified)	3.0...10.0 °CA	---
4	Coolant temperature	80.0...110.0 °C	---

Evaluation: Display group 1, display zone 2 - Injection quantity

Display	Possible fault cause	Fault elimination
Less than specification	♦ Unit injector valves (cylinder 1...4) -N240...N243- defective	– -N240...N243- Check ⇒ Seite 205
Greater than specification	♦ Engine too cold	– Run engine at increased speed to warm up, and repeat test
	♦ Shortage of fuel ♦ Air in fuel system	– Check fuel supply system ⇒ Seite 161, Removing and installing parts of fuel supply system
	♦ Unit injector valves (cylinder 1...4) -N240...N243- defective	– -N240...N243- Check ⇒ Seite 205

5.3.2 Display group 2 - Idling speed

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80 °C.

Display zone	Operating condition or component	Specification	Evaluation
1	Engine speed ♦ Engine codes CBHA, CBJA, CBJB ♦ Engine code CBKA	 770...1200 rpm 870...1200 rpm	---
2	Accelerator pedal position ♦ if accelerator pedal position sender -G79- is installed	0,0 %	⇒ Seite 59
3	Operating condition ♦ Engine code CBKA	 0x1x	⇒ Seite 59
4	Coolant temperature	80.0...110.0 °C	---

Evaluation: Display group 2, display zone 2 - Accelerator pedal position

Display	Possible fault cause	Fault elimination
1,0...100,0 %	♦ Accelerator position sender -G79- defective ♦ Wiring opening circuit to -G79-	– -G79- Check ⇒ Seite 174

Evaluation: Display group 2, display zone 3 - Operating condition

Hinweis

Significance of figures in 4-digit number block for operating condition of engine:

Significance if display = 1				
x	x	x	x	Engine operating condition
1				Idling speed increased because consumer is switched on
	x			Display value without significance
		1		Idling switch closed
			x	Display value without significance

5.3.3 Display group 3 - Exhaust gas recirculation

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80 °C.

Display zone	Operating condition or component	Specification	Evaluation
1	Engine speed ♦ Engine codes CBHA, CBJA, CBJB ♦ Engine code CBKA	 770...1200 rpm 870...1200 rpm	---
2	Air mass drawn in (specified):	---	---
3	Air mass drawn in (actual):	350...500 mg/H[1)]	⇒ Seite 60
4	Duty cycle from exhaust gas recirculation valve	20...100 %	---

[1)] Specification applies on system with exhaust gas recirculation deactivated. (Duty cycle from exhaust gas recirculation valve in display zone 4 at 100 %.

Evaluation: Display group 3, display zone 3 - Air mass drawn in (actual)

Display	Possible fault cause	Fault elimination
Less than specification	♦ Excessive exhaust gas recirculation	– Check exhaust gas recirculation ⇒ Seite 244
	♦ Unmetered air	– Check air intake system for leaks
Greater than specification	♦ Engine too cold	– Run engine at increased speed to warm up, and repeat test
	♦ Insufficient exhaust gas recirculation	– Engine running too long at idling speed, give burst on throttle
	♦ Air mass meter -G70- defective	– -G70- Check ⇒ Seite 220

5.3.4 Display group 4 - Unit injector valve (cylinder 1...4) -N240...N243- actuation

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80 °C.

Display zone	Operating condition or component	Specification	Evaluation
1	Engine speed ♦ Engine codes CBHA, CBJA, CBJB ♦ Engine code CBKA	 770...1200 rpm 870...1200 rpm	---
2	Commencement of delivery (specified):		⇒ Seite 61

Display zone	Operating condition or component	Specification	Evaluation
	♦ Engine codes CBHA, CBJA, CBJB ♦ Engine code CBKA	8.0° before TDC...2.0° after TDC 6.0° before TDC...0.0° after TDC	
3	Injection period (specified):	3.0...10.0 °CA	---
4	Synchronisation angle	-4.0...3.0 °CA	⇒ Seite 61

Evaluation: Display group 4, display zone 2 - Commencement of delivery (specified):

Display	Possible fault cause	Fault elimination
Greater than specification	♦ Engine too cold	– Run engine at increased speed to warm up, and repeat test

Evaluation: Display group 4, display zone 4 - Synchronisation angle

Display	Possible fault cause	Fault elimination
Greater than specification	♦ Hall sender -G40- defective or loose ♦ Metal filings on hub or Hall sender -G40- ♦ Gap between Hall sender -G40-/hub too great	– -G40- Check ⇒ Seite 212
	♦ Hub with sender wheel on camshaft is twisted or loose	– Check position of camshaft and sender wheel ⇒ Seite 116, Removing, installing, tensioning toothed belt

5.3.5 Display group 5 - Starting conditions

Hinweis

The values displayed are of no significance for fault finding in customer service.

Display zone	Operating condition or component	Specification	Evaluation
1	Engine speed	---	---
2	Start quantity	---	---
3	Start synchronisation	---	---
4	Coolant temperature	---	---

5.3.6 Display group 6 - Switch positions

Test prerequisites

- Ignition switched on.
- Engine stationary.

Display zone	Operating condition or component	Specification	Evaluation
1	Speed	---	---
2	Brake pedal monitor	---	---
3	Accelerator pedal position ♦ if accelerator pedal position sender -G79- is installed	0,0 %	⇒ Seite 62
4	Working speed regulator system	xxxx xx00	---

Evaluation: Display group 6, display zone 3 - Accelerator pedal position

Display	Possible fault cause	Fault elimination
1,0...100,0 %	♦ Accelerator position sender -G79- defective ♦ Wiring opening circuit to -G79-	– -G79- Check ⇒ Seite 174

5.3.7 Display group 7 - Temperatures

Test prerequisites

- Ignition switched on.
- Engine stationary and cooled down.

Display zone	Operating condition or component	Specification	Evaluation
1	Fuel temperature	Approx. ambient temperature[1)]	⇒ Seite 62
2	Status of fuel cooling	---	---
3	Intake air temperature	Approx. ambient temperature[1)]	⇒ Seite 63
4	Coolant temperature	Approx. ambient temperature[1)]	⇒ Seite 63

[1)] Details about specifications for temperatures are not possible. When the engine has cooled down, the temperature figures for fuel, intake air and coolant must be roughly at ambient temperature. If a temperature deviates noticeably, then the relevant sender must be checked.

Evaluation: Display group 7, display zone 1 - Fuel temperature

Display	Possible fault cause	Fault elimination
Large deviation from ambient temperature	♦ Short circuit or fuel temperature sender -G81- defective	– -G81- Check ⇒ Seite 218

Evaluation: Display group 7, display zone 3 - Intake air temperature

Display	Possible fault cause	Fault elimination
Large deviation from ambient temperature	♦ Short circuit or intake air temperature sender -G42- defective	– -G42- Check ⇒ Seite 213

Evaluation: Display group 7, display zone 4 - Coolant temperature

Display	Possible fault cause	Fault elimination
Large deviation from ambient temperature	♦ Short circuit or coolant temperature sender -G62- defective	– -G62- Check ⇒ Seite 215

5.3.8 Display group 8 - Governed torque 1

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80 °C.

Display zone	Operating condition or component	Specification	Evaluation
1	Engine speed ♦ Engine codes CBHA, CBJA, CBJB ♦ Engine code CBKA	 770...1200 rpm 870...1200 rpm	---
2	Desired torque	xxx Nm	---
3	Torque restriction	xxx Nm	---
4	Smoke restriction	xxx Nm	---

5.3.9 Display group 9 - Governed torque 2

Hinweis

The values displayed are of no significance for fault finding in customer service.

Display zone	Operating condition or component	Specification	Evaluation
1	Engine speed	---	---
2	Desired torque	---	---
3	Gearbox intervention torque	---	---
4	Governed torque	---	---

5.3.10 Display group 10 - Air variables

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80 °C.

Display zone	Operating condition or component	Specification	Evaluation
1	Air mass drawn in (actual)	xxx mg/H[1)]	---
2	Atmospheric pressure (air pressure)	900...1050 mbar	---
3	Charge pressure (actual)	xxx mbar[1)]	---
4	Accelerator pedal position ♦ if accelerator pedal position sender -G79- is installed	0,0 %	⇒ Seite 64

[1)] The display figures at „idling speed“ have no significance.

Evaluation: Display group 10, display zone 4 - Accelerator pedal position

Display	Possible fault cause	Fault elimination
1,0...100,0 %	♦ Accelerator position sender -G79- defective ♦ Wiring opening circuit to -G79-	– -G79- Check ⇒ Seite 174

5.3.11 Display group 11 - Charge pressure control

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80 °C.

Display zone	Operating condition or component	Specification	Evaluation
1	Engine speed ♦ Engine codes CBHA, CBJA, CBJB ♦ Engine code CBKA	 770...1200 rpm 870...1200 rpm	---
2	Charge pressure (specified)	xxx mbar[1)]	---
3	Charge pressure (actual)	xxx mbar[1)]	---
4	Pulse duty from charge pressure control solenoid valve	xxx %[1)]	---

[1)] The display figures at „idling speed“ have no significance.

5.3.12 Display group 12 - Glow status

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80 °C.

Display zone	Operating condition or component	Specification	Evaluation
1	Status of glow system	1111 1111	⇒ Seite 65
2	Glow period (in seconds)	xx.x s	---
3	Voltage supply from automatic glow period control unit	approx. battery voltage	---
4	Coolant temperature	80.0...110.0 °C	---

Evaluation: Display group 12, display zone 1 - Status of glow system

Hinweis

Significance of figures in 8-digit number block for status of glow system:

Significance if display = 1	
Display	**Status of glow system**
0000 0000	wait for coolant temperature
0001 0000	Preglow
1011 0000	Post glow
1111 0000	Intermediate glow
0011 0000	Ready glow
1011 0001	Wait for post glow
1111 0001	Wait for intermediate glow
0000 0001	Wait for ECO (economy) start request
0101 0000	No preglow
1100 0000	No start glow
1111 1111	No glow period
0111 0000	Start glow
1101 0000	No post glow

5.3.13 Display group 13 - Idling speed smooth running control

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80 °C.

Display zone	Operating condition or component	Specification	Evaluation
1	Injection quantity of idling speed smooth running control through unit injector valve, cylinder 1 -N240-	-2.80...2.80 mg/H	⇒ Seite 66
2	Injection quantity of idling speed smooth running control through unit injector valve, cylinder 2 -N241-	-2.80...2.80 mg/H	⇒ Seite 66
3	Injection quantity of idling speed control through unit injector valve, cylinder 3 -N242-	-2.80...2.80 mg/H	⇒ Seite 66
4	Injection quantity of idling speed smooth running control through unit injector valve, cylinder 4 -N243-	-2.80...2.80 mg/H	⇒ Seite 66

Evaluation: Display group 13, display zone 1...4 - Idling speed control

- The injection system is equipped with an idling speed smooth running control. Power differences between the individual cylinders (component tolerances, nozzle flow rate, compressions, etc.) may be detected and balanced out by way of selective injection quantity allocation.
- Recognition at idling speed is via the signal from the engine speed sender. If the signals are delivered in the same rhythm, then all cylinders are performing in the same way. If one cylinder performance is weaker, the crankshaft takes longer for the next half revolution. Conversely, a more powerful cylinder accelerates the crankshaft so less time is taken.
- If the engine control unit detects a deviation, the affected cylinder is immediately given more or less fuel until the engine runs „evenly“ again.
- +... mg/H: The respective cylinder is less powerful and is therefore supplied with more fuel.
- -... mg/H: The respective cylinder is more powerful and is therefore supplied with less fuel.

5.3.14 Display group 15 - Fuel consumption

Hinweis

The values displayed are of no significance for fault finding in customer service.

Display zone	Operating condition or component	Specification	Evaluation
1	Engine speed	---	---
2	Engine torque	---	---
3	Fuel consumption	---	---
4	Desired torque	---	---

5.3.15 Display group 18 - Status of unit injector valves

Test prerequisites

- Allow engine to run at idle for at least 1 minute, then interrogate specifications.
- Engine warm, coolant temperature not below 80 °C.

Display zone	Operating condition or component	Specification	Evaluation
1	Status of unit injector valve, cylinder 1 -N240-	0	⇒ Seite 68

Display zone	Operating condition or component	Specification	Evaluation
2	Status of unit injector valve, cylinder 2 -N241-	0	⇒ Seite 68
3	Status of unit injector valve, cylinder 3 -N242-	0	⇒ Seite 68
4	Status of unit injector valve, cylinder 4 -N243-	0	⇒ Seite 68

Evaluation: Display group 18, display zone 1...4 - Status of unit injector valves

Display	Possible fault cause	Fault elimination
If a number other than 0 is displayed	♦ Unit injector valves (cylinder 1...4) -N240...N243- defective ♦ Wiring opening circuit to -N240...N243-	– -N240...N243- Check ⇒ Seite 205
	♦ Shortage of fuel ♦ Air in fuel system	– Check fuel supply system ⇒ Seite 161, Removing and installing parts of fuel supply system

5.3.16 Display group 23 - BIP deviation (solenoid valve switch times) of unit injectors valves (cylinder 1...4)

Hinweis

- *Commencement of injection of initiated on actuation of the unit injector valve. A magnetic field is thereby built up in the valve, the current strength rises and the valve closes. When the solenoid needle strikes the seat, there is a noticeable „click" in the current path. This „click" is referred to as BIP.*
- *The BIP (begin of injection period) informs the engine control unit that the unit injector valve has closed completely and thereby commencement of delivery.*

Test prerequisites

- Engine running at idling speed.
- Engine warm, coolant temperature not below 80 °C.

Display zone	Operating condition or component	Specification	Evaluation
1	BIP deviation of unit injector valve, cylinder 1 -N240-	-100...100 ms	⇒ Seite 69
2	BIP deviation of unit injector valve, cylinder 2 -N241-	-100...100 ms	⇒ Seite 69
3	BIP deviation of unit injector valve, cylinder 3 -N242-	-100...100 ms	⇒ Seite 69
4	BIP deviation of unit injector valve, cylinder 4 -N243-	-100...100 ms	⇒ Seite 69

Evaluation: Display group 23, display zone 1...4 - BIP deviation (solenoid valve switch times) of unit injector valves

Display	Possible fault cause	Fault elimination
Less or greater than specification	♦ Unit injector valves (cylinder 1...4) -N240...N243- defective	– -N240...N243- Check ⇒ Seite 205

5.4 Evaluating measured value blocks at full throttle

Observe conditions for measurements at full throttle ⇒ Seite 69.

Display group:

- 1 - Injection quantity ⇒ Seite 70
- 3 - Exhaust gas recirculation ⇒ Seite 71
- 4 - Unit injector valve (cylinder 1...4) -N240...N243- actuation ⇒ Seite 72
- 8 - Governed torque 1 ⇒ Seite 73
- 10 - Air variables ⇒ Seite 74
- 11 - Charge pressure control ⇒ Seite 75
- 18 - Status of unit injector valves ⇒ Seite 76
- 23 - BIP deviation (solenoid valve switch times) of unit injectors valves (cylinder 1...4) ⇒ Seite 77.

5.4.1 Conditions for measurements at full throttle

Always follow safety precautions ⇒ Seite 56.

Read measured value block ⇒ Seite 56.

Hinweis

Due to the different installation conditions of industrial engines, first check whether engine's operating conditions for full throttle measurements to see if it actually reaches full throttle.

– Increase engine speed under load from approx. 1500 rpm at full throttle (accelerator pedal position sender at full throttle stop).
– Have second person read measured values at approx. 2600 rpm.
– End diagnosis function.
– Switch off ignition.

5.4.2 Display group 1 - Injection quantity

Hinweis

- *For the test, the engine is to be accelerated under load from 1500 rpm at full throttle. Please observe conditions for measurements at full throttle* ⇒ *Seite 69**.*
- *The measured values must be read (by 2nd person) once the engine speed reaches 2600 rpm.*

Test prerequisites

- Engine warm, coolant temperature not below 80 °C
- Engine speed 2400...2800 rpm
- Engine in full throttle operation

Display zone	Operating condition or component	Specification	Evaluation
1	Engine speed	2400...2800 rpm	---
2	Quantity injected ♦ Engine codes CBHA, CBJA, CBJB ♦ Engine code CBKA	 27,0...47,0 mg/H 45,0...49,0 mg/H	⇒ Seite 70
3	Injection period (specified) ♦ Engine codes CBHA, CBJA, CBJB ♦ Engine code CBKA	 14...21 °CA 20...22 °CA	---
4	Coolant temperature	80.0...110.0 °C	---

Evaluation: Display group 1, display zone 2 - Injection quantity

Display	Possible fault cause	Fault elimination
Less than specification	♦ Unit injector valves (cylinder 1...4) -N240...N243- defective	– -N240...N243- Check ⇒ Seite 205

Display	Possible fault cause	Fault elimination
Greater than specification	♦ Engine too cold	– Allow engine to warm up and repeat test
	♦ Shortage of fuel ♦ Air in fuel system	– Check fuel supply system ⇒ Seite 161, Removing and installing parts of fuel supply system
	♦ Unit injector valves (cylinder 1...4) -N240...N243- defective	– -N240...N243- Check ⇒ Seite 205

5.4.3 Display group 3 - Exhaust gas recirculation

Hinweis

- *For the test, the engine is to be accelerated under load from 1500 rpm at full throttle. Please observe conditions for measurements at full throttle ⇒ Seite 69.*
- *The measured values must be read (by 2nd person) once the engine speed reaches 2600 rpm.*

Test prerequisites

- Engine warm, coolant temperature not below 80 °C
- Engine speed 2400...2800 rpm
- Engine in full throttle operation

Display zone	Operating condition or component	Specification	Evaluation
1	Engine speed	2400...2800 rpm	---
2	Air mass drawn in (specified): ♦ Engine codes CBHA, CBJA, CBJB ♦ Engine code CBKA	 xxx mg/H[1)] 900...950 mg/H	---
3	Air mass drawn in (actual): ♦ Engine codes CBHA, CBJA, CBJB ♦ Engine code CBKA	 xxx mg/H[1)] approx. air mass drawn in (specified)	 ⇒ Seite 71
4	Duty cycle from exhaust gas recirculation valve: ♦ Engine codes CBHA, CBJA, CBJB ♦ Engine code CBKA	 100 % 80...100 %	⇒ Seite 72

[1)] The display values have no significance for engine codes CBHA, CBJA and CBJB.

Evaluation: Display group 3, display zone 3 - Air mass drawn in (actual) (engine code CBKA)

Display	Possible fault cause	Fault elimination
Less than specification	♦ Excessive exhaust gas recirculation	– Check exhaust gas recirculation ⇒ Seite 244
	♦ Unmetered air	– Check air intake system for leaks
Greater than specification	♦ Engine too cold	– Allow engine to warm up and repeat test
	♦ Insufficient exhaust gas recirculation	– Briefly press accelerator
	♦ Air mass meter -G70- defective	– -G70- Check ⇒ Seite 220

Evaluation: Display group 3, display zone 4 - Pulse duty from exhaust gas recirculation valve

Display	Possible fault cause	Fault elimination
Less than specification	♦ Excessive exhaust gas recirculation	– Check exhaust gas recirculation ⇒ Seite 244
	♦ Unmetered air	– Check air intake system for leaks

5.4.4 Display group 4 - Unit injector valve (cylinder 1...4) -N240...N243- actuation

Hinweis

- *For the test, the engine is to be accelerated under load from 1500 rpm at full throttle. Please observe conditions for measurements at full throttle ⇒ Seite 69.*
- *The measured values must be read (by 2nd person) once the engine speed reaches 2600 rpm.*

Test prerequisites

- Engine warm, coolant temperature not below 80 °C
- Engine speed 2400...2800 rpm
- Engine in full throttle operation

Display zone	Operating condition or component	Specification	Evaluation
1	Engine speed	2400...2800 rpm	---
2	Commencement of delivery (specified):		⇒ Seite 73
	♦ Engine codes CBHA, CBJA, CBJB	11...15° before TDC	
	♦ Engine code CBKA	10...13° before TDC	
3	Injection period (specified):		---

Display zone	Operating condition or component	Specification	Evaluation
	♦ Engine codes CBHA, CBJA, CBJB ♦ Engine code CBKA	14,0...21.0 °CA 20,0...22.0 °CA	
4	Synchronisation angle	-4.0...3.0 °CA	⇒ Seite 73

Evaluation: Display group 4, display zone 2 - Commencement of delivery (specified):

Display	Possible fault cause	Fault elimination
Greater than specification	♦ Engine too cold	– Allow engine to warm up and repeat test

Evaluation: Display group 4, display zone 4 - Synchronisation angle

Display	Possible fault cause	Fault elimination
Greater than specification	♦ Hall sender -G40- defective or loose ♦ Metal filings on hub or Hall sender -G40- ♦ Gap between Hall sender -G40-/hub too great	– -G40- Check ⇒ Seite 212
	♦ Hub with sender wheel on camshaft is twisted or loose	– Check position of camshaft and sender wheel ⇒ Seite 116, Removing, installing, tensioning toothed belt

5.4.5 Display group 8 - Governed torque 1

Hinweis

- *For the test, the engine is to be accelerated under load from 1500 rpm at full throttle. Please observe conditions for measurements at full throttle ⇒ Seite 69.*
- *The measured values must be read (by 2nd person) once the engine speed reaches 2600 rpm.*

Test prerequisites

- Engine warm, coolant temperature not below 80 °C
- Engine speed 2400...2800 rpm
- Engine in full throttle operation

Display zone	Operating condition or component	Specification	Evaluation
1	Engine speed	2400...2800 rpm	---
2	Desired torque	xxx Nm	---
3	Torque restriction	xxx Nm	---
4	Smoke restriction	xxx Nm	---

5.4.6 Display group 10 - Air variables

Hinweis

- *For the test, the engine is to be accelerated under load from 1500 rpm at full throttle. Please observe conditions for measurements at full throttle ⇒ Seite 69.*
- *The measured values must be read (by 2nd person) once the engine speed reaches 2600 rpm.*

Test prerequisites

- Engine warm, coolant temperature not below 80 °C
- Engine speed 2400...2800 rpm
- Engine in full throttle operation

Display zone	Operating condition or component	Specification	Evaluation
1	Air mass drawn in (actual): ♦ Engine codes CBHA, CBJA, CBJB ♦ Engine code CBKA	 700...980 mg/H 900...1000 mg/H	⇒ Seite 74
2	Atmospheric pressure (air pressure)	900...1050 mbar	---
3	Charge pressure (actual) ♦ Engine codes CBHA, CBJA, CBJB ♦ Engine code CBKA	 1800...2100 mbar 2200...2300 mbar	⇒ Seite 75
4	Accelerator pedal position ♦ if accelerator pedal position sender -G79- is installed	100,0 %	⇒ Seite 75

Evaluation: Display group 10, display zone 1 - Air mass drawn in (actual)

Display	Possible fault cause	Fault elimination
Less than specification	♦ Excessive exhaust gas recirculation	– Check exhaust gas recirculation ⇒ Seite 244
	♦ Unmetered air	– Check air intake system for leaks

Display	Possible fault cause	Fault elimination
Greater than specification	♦ Engine too cold	– Allow engine to warm up and repeat test
	♦ Insufficient exhaust gas recirculation	– Briefly press accelerator
	♦ Air mass meter -G70- defective	– -G70- Check ⇒ Seite 220

Evaluation: Display group 10, display zone 3 - Charge pressure (actual)

Display	Possible fault cause	Fault elimination
Less than specification	♦ Leaks between exhaust turbocharger and engine (charge air path) ♦ Charge pressure control defective	– Checking charge air system for leaks ⇒ Seite 185 – Checking charge pressure regulation ⇒ Seite 187.
Greater than specification	♦ Charge pressure control defective ♦ Turbocharger defective	– Checking charge pressure regulation ⇒ Seite 187.
	♦ Charge pressure sender -G31- defective	– -G31- Check ⇒ Seite 192

Evaluation: Display group 10, display zone 4 - Accelerator pedal position

Display	Possible fault cause	Fault elimination
Less than specification	♦ No full throttle	– Repeat test at full throttle
	♦ Accelerator position sender -G79- defective ♦ Wiring opening circuit to -G79-	– -G79- Check ⇒ Seite 174

5.4.7 Display group 11 - Charge pressure control

Hinweis

- *For the test, the engine is to be accelerated under load from 1500 rpm at full throttle. Please observe conditions for measurements at full throttle ⇒ Seite 69.*
- *The measured values must be read (by 2nd person) once the engine speed reaches 2600 rpm.*

Test prerequisites

- Engine warm, coolant temperature not below 80 °C
- Engine speed 2400...2800 rpm
- Engine in full throttle operation

Display zone	Operating condition or component	Specification	Evaluation
1	Engine speed	2400...2800 rpm	---
2	Charge pressure (specified) ♦ Engine codes CBHA, CBJA, CBJB ♦ Engine code CBKA	 1800...2100 mbar 2200...2300 mbar	---
3	Charge pressure (actual)	approx. charge pressure (specified)	⇒ Seite 76
4	Pulse duty from charge pressure control solenoid valve ♦ Engine codes CBHA, CBJA, CBJB ♦ Engine code CBKA	 20...80 % 40...80 %	---

Evaluation: Display group 11, display zone 3 - Charge pressure (actual)

Display	Possible fault cause	Fault elimination
Less than specification	♦ Leaks between exhaust turbocharger and engine (charge air path) ♦ Charge pressure control defective	– Checking charge air system for leaks ⇒ Seite 185 – Checking charge pressure regulation ⇒ Seite 187.
Greater than specification	♦ Charge pressure control defective ♦ Turbocharger defective	– Checking charge pressure regulation ⇒ Seite 187.
	♦ Charge pressure sender -G31- defective	– -G31- Check ⇒ Seite 192

5.4.8 Display group 18 - Status of unit injector valves

Hinweis

- *For the test, the engine is to be accelerated under load from 1500 rpm at full throttle. Please observe conditions for measurements at full throttle ⇒ Seite 69.*
- *The measured values must be read (by 2nd person) once the engine speed reaches 2600 rpm.*

Test prerequisites

- Engine warm, coolant temperature not below 80 °C
- Engine speed 2400...2800 rpm
- Engine in full throttle operation

Display zone	Operating condition or component	Specification	Evaluation
1	Status of unit injector valve, cylinder 1 -N240-	0	⇒ Seite 77
2	Status of unit injector valve, cylinder 2 -N241-	0	⇒ Seite 77
3	Status of unit injector valve, cylinder 3 -N242-	0	⇒ Seite 77
4	Status of unit injector valve, cylinder 4 -N243-	0	⇒ Seite 77

Evaluation: Display group 18, display zone 1...4 - Status of unit injector valves

Display	Possible fault cause	Fault elimination
If a number other than 0 is displayed	♦ Unit injector valves (cylinder 1...4) -N240...N243- defective ♦ Wiring opening circuit to -N240...N243-	– -N240...N243- Check ⇒ Seite 205
	♦ Shortage of fuel ♦ Air in fuel system	– Check fuel supply system ⇒ Seite 161, Removing and installing parts of fuel supply system

5.4.9 Display group 23 - BIP deviation (solenoid valve switch times) of unit injectors valves (cylinder 1...4)

Hinweis

- *Commencement of injection of initiated on actuation of the unit injector valve. A magnetic field is thereby built up in the valve, the current strength rises and the valve closes. When the solenoid needle strikes the seat, there is a noticeable „click" in the current path. This „click" is referred to as BIP.*
- *The BIP (begin of injection period) informs the engine control unit that the unit injector valve has closed completely and thereby commencement of delivery.*
- *For the test, the engine is to be accelerated under load from 1500 rpm at full throttle. Please observe conditions for measurements at full throttle ⇒ Seite 69.*
- *The measured values must be read (by 2nd person) once the engine speed reaches 2600 rpm.*

Test prerequisites

- Engine warm, coolant temperature not below 80 °C
- Engine speed 2400...2800 rpm
- Engine in full throttle operation

Display zone	Operating condition or component	Specification	Evaluation
1	BIP deviation of unit injector valve, cylinder 1 -N240-	-100...100 ms	⇒ Seite 78
2	BIP deviation of unit injector valve, cylinder 2 -N241-	-100...100 ms	⇒ Seite 78
3	BIP deviation of unit injector valve, cylinder 3 -N242-	-100...100 ms	⇒ Seite 78
4	BIP deviation of unit injector valve, cylinder 4 -N243-	-100...100 ms	⇒ Seite 78

Evaluation: Display group 23, display zone 1...4 - BIP deviation (solenoid valve switch times) of unit injector valves

Display	Possible fault cause	Fault elimination
Less or greater than specification	♦ Unit injector valves (cylinder 1...4) -N240...N243- defective	– -N240...N243- Check ⇒ Seite 205

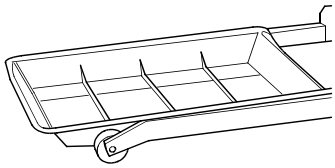
10 – Removing and installing engine

1 Removing and installing engine

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Drip tray -V.A.G 1306- or drip tray -VAS 6208-
- Torque wrench (5...50 Nm) -V.A.G 1331-
- Torque wrench (40...200 Nm) -V.A.G 1332-
- Spring-type clip pliers -VAS 5024-

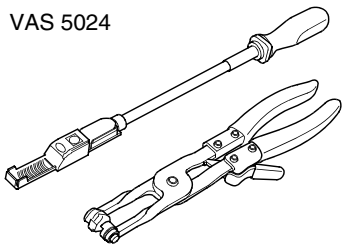
V.A.G 1306



V.A.G 1331

V.A.G 1332

VAS 5024



W10-0074

Not illustrated

- Lifting tackle -2024 A-
- Support clamp -VW 313-
- Engine and gearbox support -VW 540- or engine and gearbox support -VAS 6095-
- Workshop crane -V.A.G 1202 A-
- Container for removed parts -V.A.G 1698-
- Engine bung set -VAS 6122-
- Grease -G 000 100-
- Cable ties

Notes on removing ⇒ Seite 80.

Secure engine to assembly stand ⇒ Seite 81.

Notes on installing ⇒ Seite 82.

Torque settings ⇒ Seite 82.

Additional notes and assembly work for power units with air conditioner ⇒ Seite 82.

1.1 Notes on removing

Hinweis

The following work procedure contains just general notes on removal and installation of the industrial engine. This is because no universal work procedure can be prescribed due to the different installation conditions.

Procedure

ACHTUNG!

For all assembly work, the following should be observed due to the restricted amount of space available:

- ***Route all the various lines (e.g. for fuel, hydraulics, coolant and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***Ensure that there is sufficient clearance to all moving or hot components.***

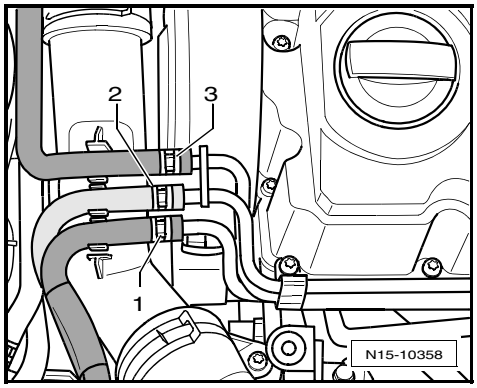
Hinweis

- *All cable ties which are opened or cut through when the engine is removed must be replaced in the same position when the engine is installed.*
- *To prevent damage to removed components, place them in the container for removed parts -V.A.G 1698-.*
- *Some components cannot be removed without difficulty or at all with the engine installed. Therefore, determine which components are defective before removing the engine and then renew them while the engine is removed.*

– Before removing, interrogate the fault memory of the engine control unit ⇒ Seite 9, interrogating fault memory.

– With ignition switched off, disconnect earth strap from battery.

– Disconnect fuel supply hose -2- and fuel return hose -1- from the fuel filter on the engine.



ACHTUNG!

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

– Seal lines so that fuel system is not contaminated by dirt.
– Disconnect coolant hose -3-.
– Observe rules for cleanliness ⇒ Seite 196.
– Drain coolant ⇒ Seite 151.
– Pull coolant hoses off radiator.
– Pull off all coolant hoses to the engine using spring-type clip pliers -VAS 5024-.
– Disconnect all electric wires from gearbox, alternator and starter and lay to side.
– Pull off or disconnect all other electrical connections as necessary from engine and lay to side.
– Pull off necessary vacuum and breather hoses from engine.

Engine codes CBHA, CBJA, CBJB

– Release connecting clamp for front exhaust pipe/front silencer.

Engine code CBKA

– Release connecting clamp for front exhaust pipe/particulate filter.

Continuation for all engine codes

Power units with air conditioning:

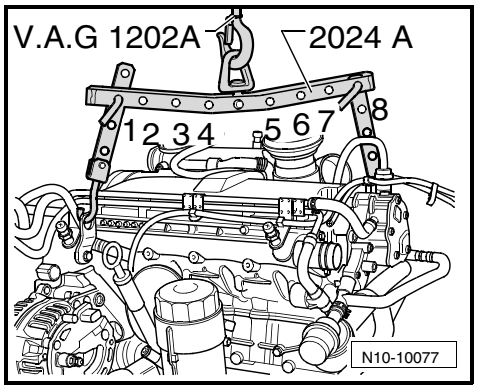
– Observe additional information and installation work ⇒ Seite 82.

1.2 Securing engine to assembly stand

When working on the engine, secure it with engine and gearbox support -VW 540- to support clamp -VW 313- of the assembly stand or to engine and gearbox support -VAS 6095-.

Procedure

– Attach lifting tackle - 2024 A- as follows and lift engine slightly using workshop crane -V.A.G 1202 A-:



Belt pulley end:

♦ 3. hole on support bar in position 1

Flywheel end:

♦ 4. hole on support bar in position 8

ACHTUNG!

The hooks and locating pins must be secured with locking pins.

Hinweis

♦ *The positions marked 1...4 on the bar must be towards the pulley end.*
♦ *The holes in the hooks are counted up from the hook.*

– Using engine and gearbox support -VW 540-, secure engine to support clamp -VW 313- of assembly stand or to engine and gearbox support -VAS 6095-.

1.3 Notes on installing

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

Procedure

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

– Lightly lubricate clutch release bearing, release bearing guide sleeve and splines on input shaft with grease - G 000 100-.

– Check whether dowel sleeves for centring engine and gearbox are in cylinder block and install if necessary.

– Screw in all bolts on assembly mountings by hand approx. 5...6 turns.

– Align assembly mountings stress-free by rocking.

– Fill with coolant ⇒ Seite 151.

– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

1.4 Torque settings

Threaded connection		Torque setting
On cylinder block.	M6	10 Nm
	M7	15 Nm
	M8	20 Nm
	M10	40 Nm
	M12	60 Nm

1.5 Additional notes and assembly work for power units with air conditioner

ACHTUNG!

The air conditioner refrigerant circuit must not be opened.

Hinweis

- *The opening of the refrigerant circuit can only be carried out in workshops, which have trained personnel and the necessary range of tools and workshop equipment.*
- *To prevent damage to condenser or to refrigerant lines and hoses, ensure that lines and hoses are not stretched, kinked or bent.*

To facilitate removing and installing engine without opening refrigerant circuit:

- Remove retaining clamp(s) for refrigerant lines.
- Remove poly V-belt ⇒ Seite 86.
- Remove air conditioner compressor and place to one side so that the refrigerant lines/hoses are relieved of tension ⇒ Seite 85, Assembly overview - poly-V-belt drive.

13 – Crankshaft group

1 Dismantling and assembling engine

Hinweis

- *To carry out assembly work, the engine must be secured on the assembly stand using engine and gearbox support -VW 540- or on engine and gearbox support -VAS 6095-.*
- *All bearing and running surfaces must be oiled before assembly.*
- *Finding metal shavings or a large quantity of small metal particles during engine repair could indicate that the crankshaft bearings or conrod bearings are damaged. To prevent subsequent damage, perform the following work after completing repairs:*
- *Thoroughly clean oil channels.*
- *Renew oil spray jets.*
- *Renew oil cooler*
- *Renew oil filter element*

Assembly overview - poly-V-belt drive ⇒ Seite 85.

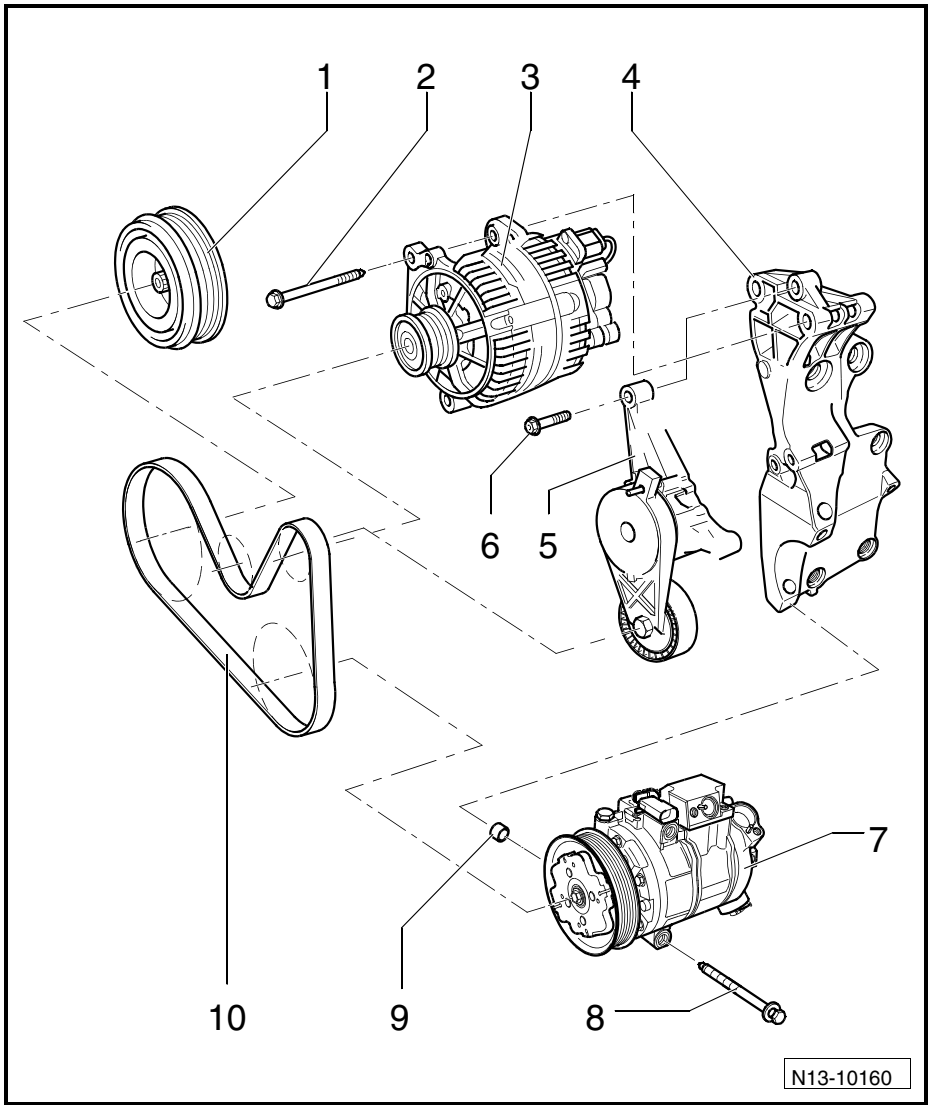
Remove and install poly-V-belt ⇒ Seite 86.

Check poly-V-belt ⇒ Seite 87.

Assembly overview - toothed belt drive ⇒ Seite 88.

Assembly overview - crankcase ⇒ Seite 89.

1.1 Assembly overview - poly-V-belt drive



1 - Belt pulley and vibration damper
- ❑ Can only be installed in one position. Holes are offset

2 - 25 Nm

3 - Alternator -C-
- ❑ Assembly overview ⇒ Seite 275

4 - Compact bracket
- ❑ For alternator and, if fitted, air conditioner compressor
- ❑ Tightening sequence and torque setting of compact bracket to cylinder block ⇒ Seite 276

5 - Poly V-belt tensioning element
- ❑ Swivel with open jaw spanner to relieve tension of poly-V-belt ⇒ Seite 86, Removing and installing poly-V-belt

6 - 25 Nm

7 - Air conditioner compressor
- ❑ If installed

8 - 25 Nm

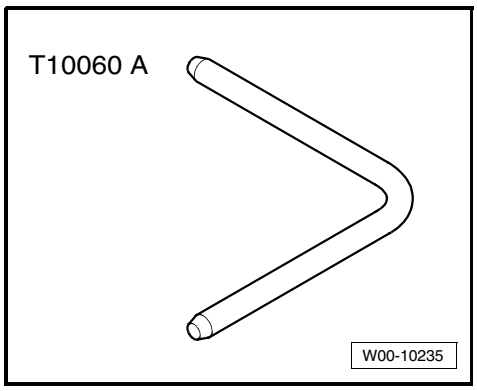
9 - Dowel sleeves

10 - Poly V-belt
- ❑ Mark direction of rotation before removing.
- ❑ Do not kink
- ❑ Removing and installing ⇒ Seite 86.
- ❑ Check for wear ⇒ Seite 87

1.2 Removing and installing poly V-belt

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Locking pin -T10060 A-



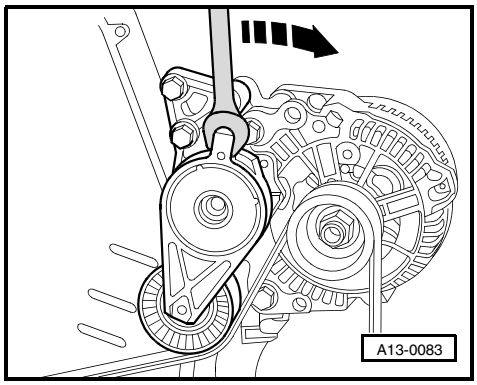
Remove poly V-belt ⇒ Seite 86.

Install poly V-belt ⇒ Seite 86.

1.2.1 Removing poly V-belt

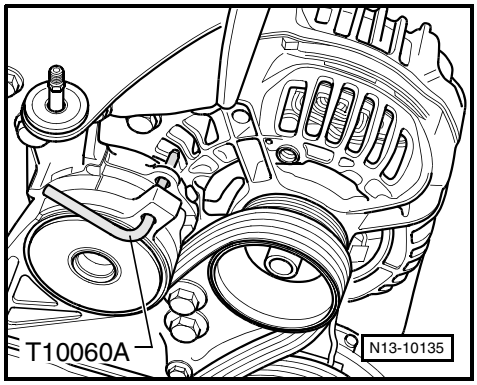
– Mark direction of rotation of poly V-belt.

– Using an open jaw spanner, swing tensioning element in -direction of arrow- to remove tension on poly-V-belt.



– Lock tensioner with locking pin -T10060 A-.

– Remove poly V-belt.



1.2.2 Installing poly V-belt

– Installation is carried out in the reverse order. When installing, note the following:

Hinweis

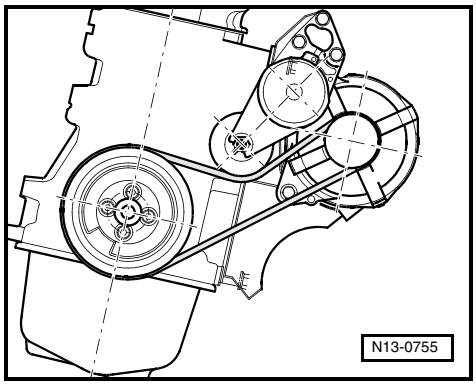
- *Ensure, before installing poly-V-belt, that all ancillaries (alternator, air conditioner compressor) are secured tightly.*
- *When fitting poly V-belt, check direction of belt rotation and proper seating of belt in pulleys.*
- *Lastly, place poly-V-belt on alternator.*

After completing repairs always:

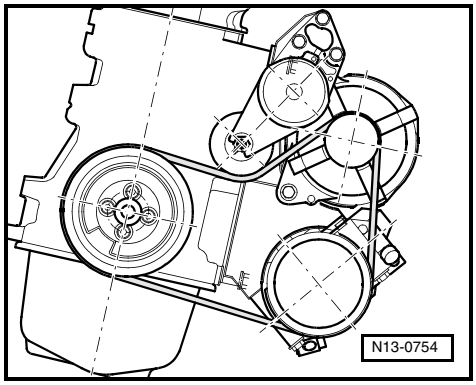
– Start engine and check how belt runs.

1.2.3 Poly V-belt routing

Belt drive without air conditioner compressor.



Belt drive with air conditioner compressor



1.3 Checking poly-V-belt

Hinweis

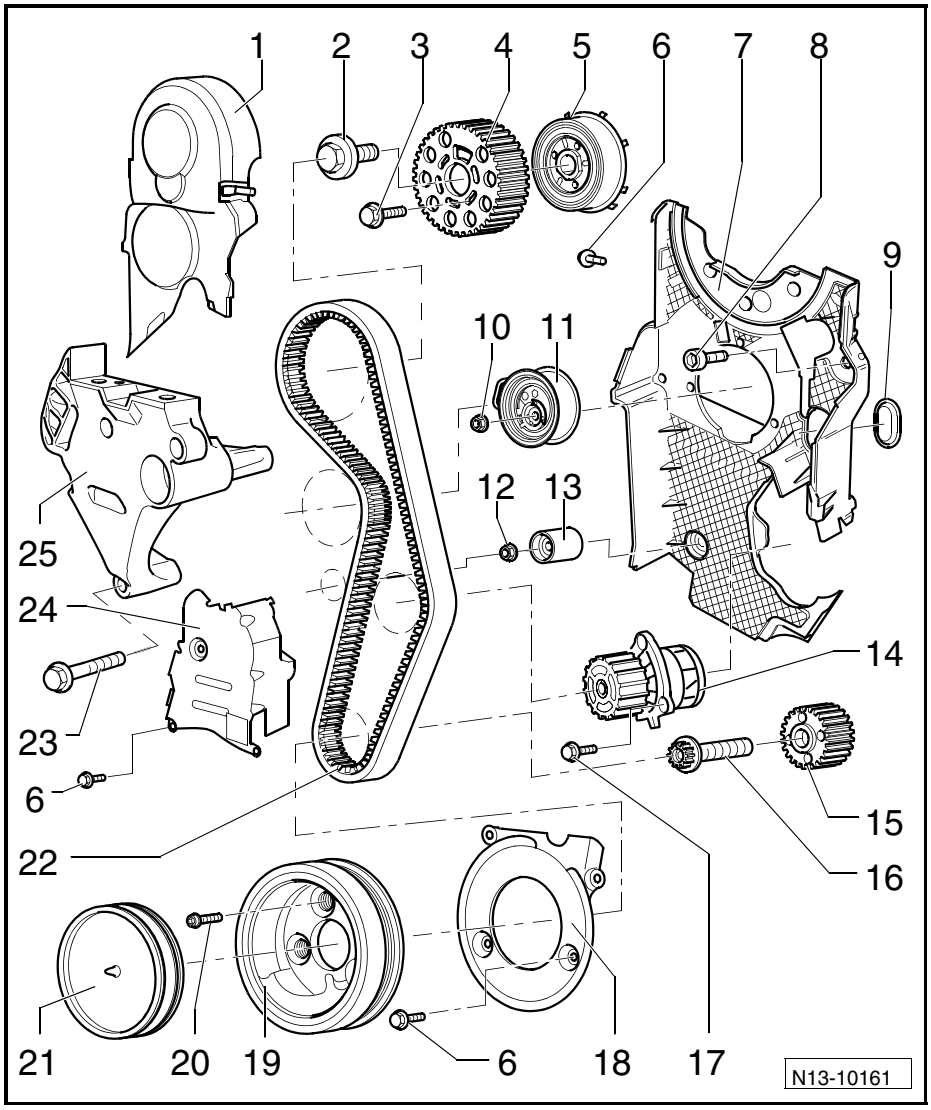
If damage is established, to prevent failure or functional faults the poly-V-belt must be replaced immediately.

Test procedure

– Turn engine over by hand and check poly-V-belt when doing this for:

- Substructure cracks (incipient cracks, core breakages, cross section breakages)
- Layer separation (top coating, cords)
- Breakout on substructure
- Fraying of cords
- Side wear (material wear, frayed sides, hardened sides - glassy-, surface cracks)

1.4 Assembly overview - toothed belt drive



1 - Upper toothed belt guard

2 - 100 Nm

3 - 25 Nm

4 - Camshaft toothed belt pulley

5 - Hub

- ❑ With sender wheel.
- ❑ Use counterhold tool -T10051 - to loosen and tighten.
- ❑ To remove, use puller -T10052-.
- ❑ Removing and installing ⇒ Seite 133, removing and installing camshaft

6 - 10 Nm

- ❑ Renew

7 - Rear toothed belt guard

8 - 25 Nm

9 - Sealing grommet

- ❑ Renew if damaged.

10 - 20 Nm + 1/8 turn (45 °) further

11 - Tensioning roller

12 - 20 Nm

13 - Idler roller

14 - Coolant pump

- ❑ Check for ease of movement
- ❑ Note installation position
- ❑ Removing and installing ⇒ Seite 154.

15 - Crankshaft toothed belt pulley

16 - 120 Nm + 1/4 turn (90°) further

- ❑ Renew
- ❑ Use counterhold tool -3415- to loosen and tighten.
- ❑ Do not additionally oil or grease thread and shoulder
- ❑ Turning further can be done in several stages

17 - 15 Nm

18 - Lower toothed belt guard

19 - Belt pulley and vibration damper

- ❑ Can only be installed in one position. Holes are offset

20 - 10 Nm + 1/4 turn (90°) further

21 - Cover

22 - Toothed belt

- ❑ Mark direction of rotation before removing.
- ❑ Check for wear.
- ❑ Do not kink

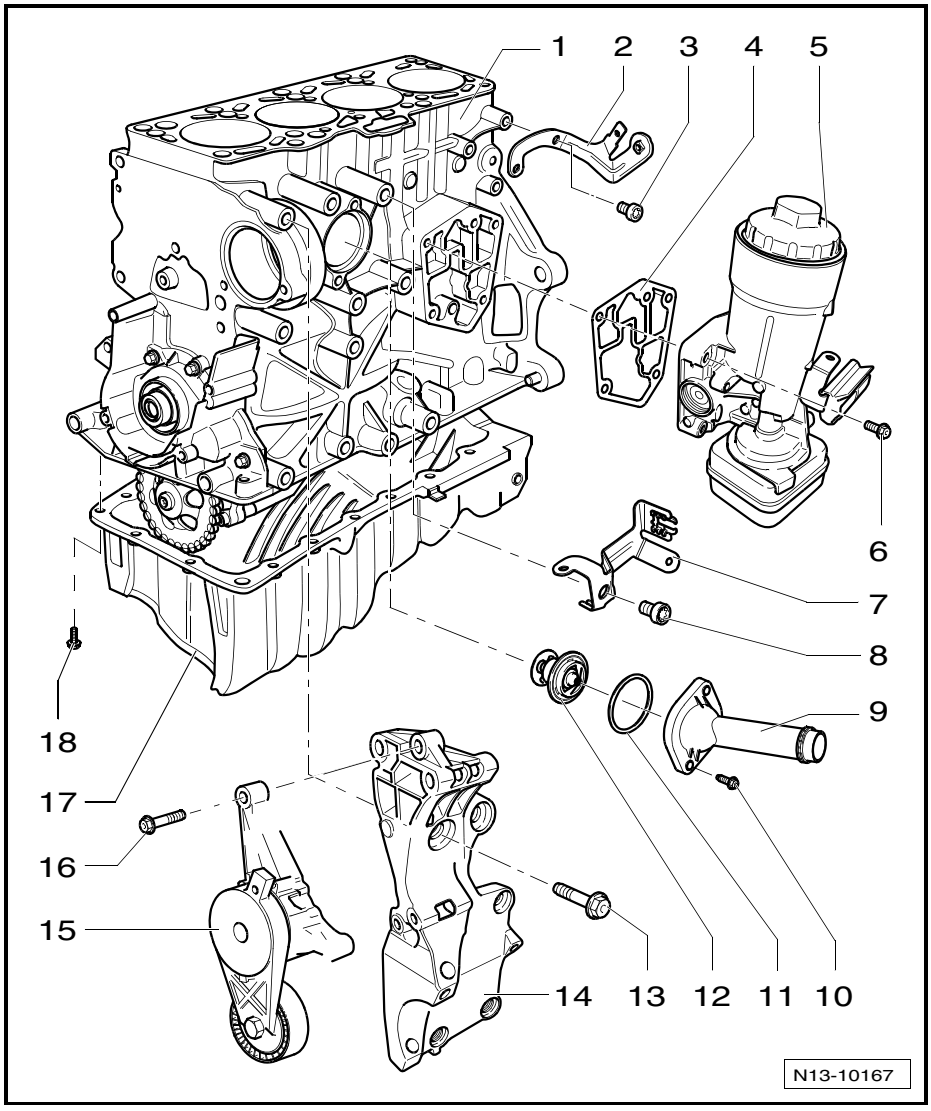
- ❑ Removing, installing and tensioning ⇒ Seite 116

23 - 40 Nm + 1/2 turn (180 °) further

24 - Centre toothed belt guard

25 - Engine bracket

1.5 Assembly overview - crankcase



1 - Cylinder block

- ❑ Removing and installing sealing flange and flywheel ⇒ Seite 90
- ❑ Removing and installing crankshaft ⇒ Seite 103.
- ❑ Dismantling and assembling pistons and conrods ⇒ Seite 106

2 - Bracket

- ❑ Installed on engine codes CBJA, CBJB, CBKA
- ❑ For charge air pipe.

3 - 10 Nm

4 - Gasket

- ❑ Renew

5 - Oil filter bracket

- ❑ Assembly overview - oil filter bracket and oil cooler ⇒ Seite 144.

6 - 15 Nm + 1/4 turn (90°) further

- ❑ Renew
- ❑ First fit upper left and lower right bolts and then tighten all four bolts diagonally

7 - Bracket

8 - 20 Nm

9 - Connection

- ❑ For thermostat

10 - 15 Nm

11 - O-ring

- ❑ Renew

12 - Thermostat

- ❑ Removing and installing ⇒ Seite 156.
- ❑ Observe installation position ⇒ Seite 156, removing and installing thermostat.
- ❑ Checking: heat thermostat in water

- ❑ Opening begins at approx. 85 °C
- ❑ Ends at approx. 105 °C
- ❑ Opening lift min. 7 mm.

13 - Hexagon collar bolt

- ❑ Tightening sequence and torque setting of compact bracket to cylinder block ⇒ Seite 276

14 - Compact bracket

- ❑ For alternator and, if fitted, air conditioner compressor
- ❑ Tightening sequence and torque setting of compact bracket to cylinder block ⇒ Seite 276

15 - Poly V-belt tensioning element

- ❑ Swivel with open jaw spanner to relieve tension of poly-V-belt ⇒ Seite 86, Removing and installing poly-V-belt

16 - 25 Nm

17 - Sump

- ❑ Clean sealing surface before fitting
- ❑ Install with silicone sealant -D176404 A2-
- ❑ Removing and installing ⇒ Seite 142.

18 - 15 Nm

2 Removing and installing sealing flange and flywheel

Hinweis

When working on engine, secure it with engine and gearbox support -VW 540- to assembly stand or to engine and gearbox support -VAS 6095-.

Assembly overview - sealing flange and flywheel ⇒ Seite 91.

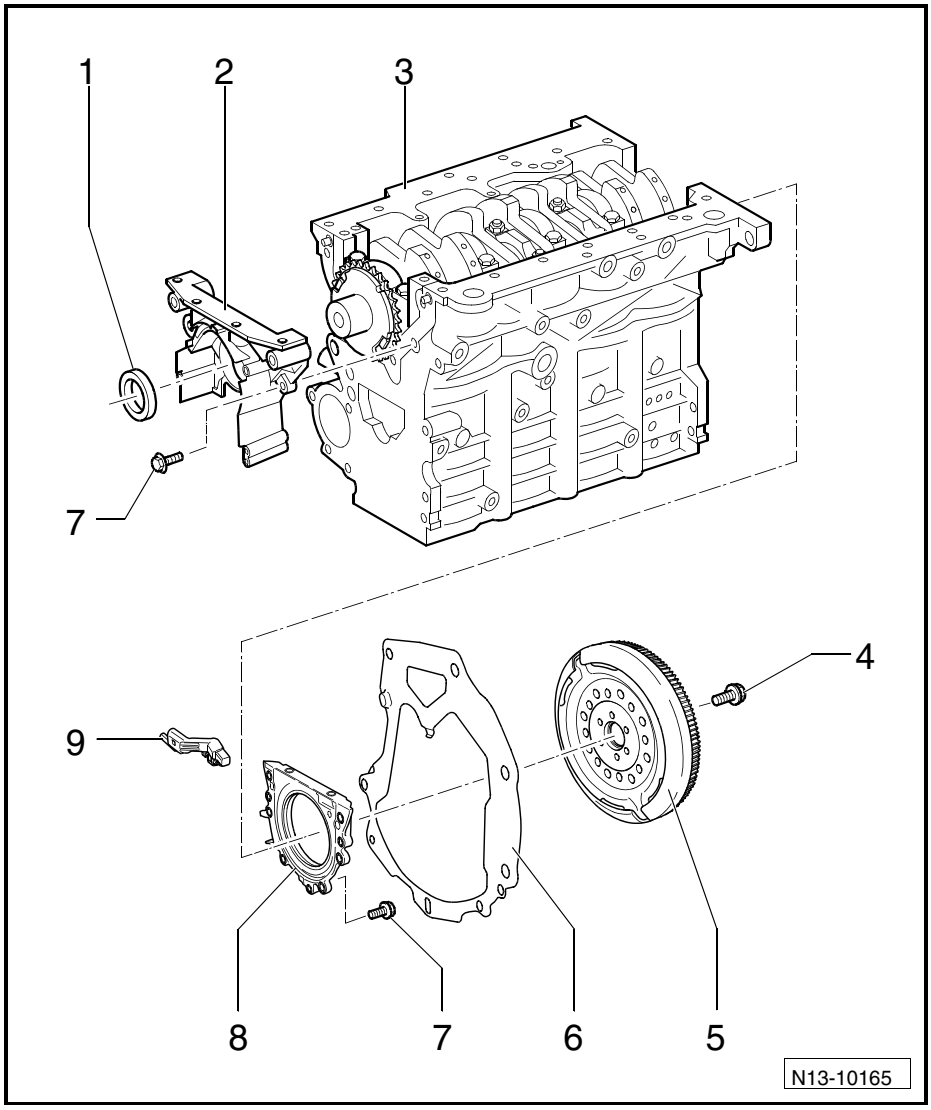
Renewing crankshaft oil seal - belt pulley end ⇒ Seite 92.

Removing and installing crankshaft sealing flange - belt pulley end ⇒ Seite 94.

Renewing crankshaft sealing flange - flywheel end ⇒ Seite 96.

Removing and installing engine speed sender -G28- ⇒ Seite 103.

2.1 Assembly overview - sealing flange and flywheel



1 - **Crankshaft oil seal (belt pulley end)**
- ❑ Do not additionally oil or grease the oil seal sealing lip
- ❑ Before installing, remove oil residue from crankshaft journal using a clean cloth
- ❑ Renewing ⇒ Seite 92

2 - **Crankshaft sealing flange (belt pulley end)**
- ❑ Must seat on dowel sleeves
- ❑ Removing and installing ⇒ Seite 94.

3 - **Cylinder block**
- ❑ Removing and installing crankshaft ⇒ Seite 103.
- ❑ Dismantling and assembling pistons and conrods ⇒ Seite 106

4 - **60 Nm + 1/4 turn (90°) further**

5 - **Flywheel**
- ❑ When removing and installing flywheel, lock with counterhold - 3067-

6 - **Intermediate plate**
- ❑ Must seat on dowel sleeves
- ❑ Do not damage or bend when assembling

7 - **15 Nm**
- ❑ Renew

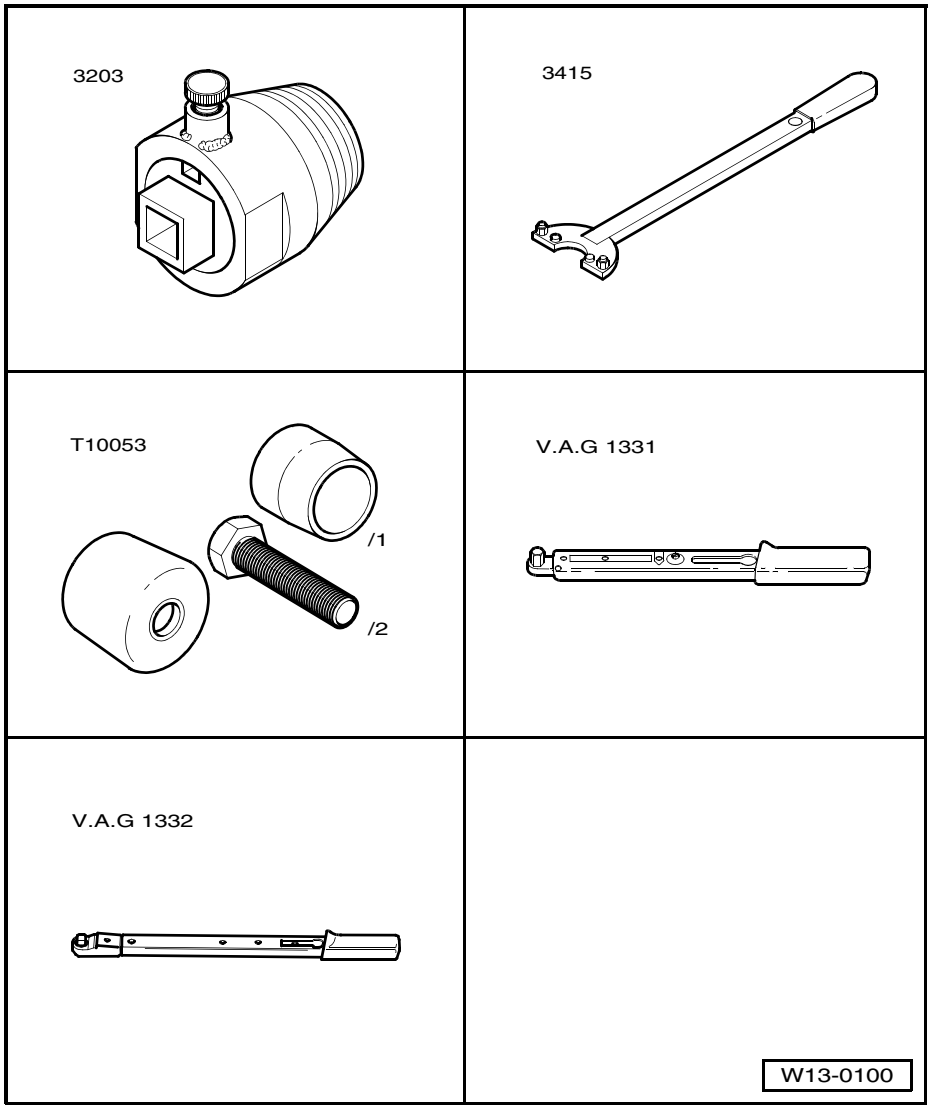
8 - **Crankshaft sealing flange (flywheel end)**
- ❑ With oil seal
- ❑ Do not additionally oil or grease the oil seal sealing lip
- ❑ Before installing, remove oil residue from crankshaft journal using a clean cloth
- ❑ Renew complete with oil seal and sender wheel only
- ❑ Renewing ⇒ Seite 96

9 - **Engine speed sender -G28-, 5 Nm**
- ❑ Checking ⇒ Seite 210.
- ❑ Loosen and tighten using commercially available ball-ended hexagon key
- ❑ Removing and installing ⇒ Seite 103.

2.2 Renewing crankshaft oil seal - belt pulley end

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Oil seal extractor -3203-
- Counterhold tool -3415-
- Assembly tool -T10053-
- Torque wrench (5...50 Nm) -V.A.G 1331-
- Torque wrench (40...200 Nm) -V.A.G 1332-



Removing ⇒ Seite 92.

Installing ⇒ Seite 93.

2.2.1 Removing

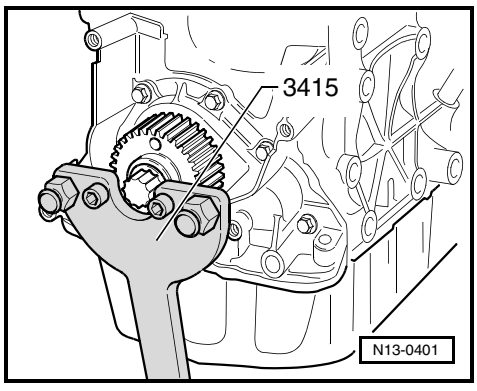
– Remove toothed belt ⇒ Seite 116.

– Remove crankshaft toothed belt pulley. To do this, lock toothed belt pulley using counterhold -3415-.

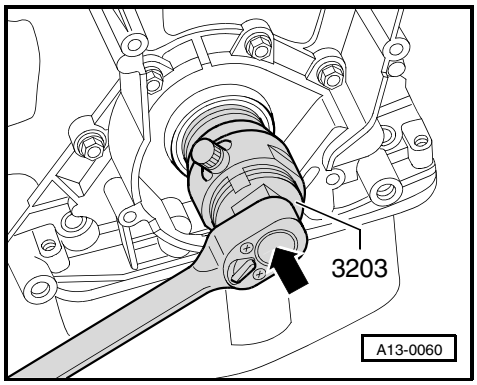
– To guide oil seal extractor -3203-, screw central bolt by hand fully into crankshaft.

– Unscrew inner part of oil seal extractor two turns (approx. 3 mm) out of outer part and lock with knurled screw.

– Oil threaded head of oil seal extractor.



– Using great pressure, screw oil seal extractor as far as possible into oil seal.
– Loosen knurled screw and turn inner part against crankshaft until oil seal is pulled out.

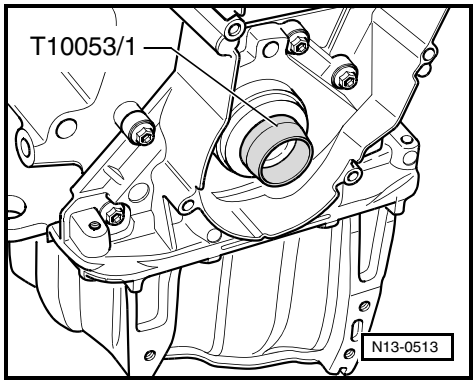


2.2.2 Installing

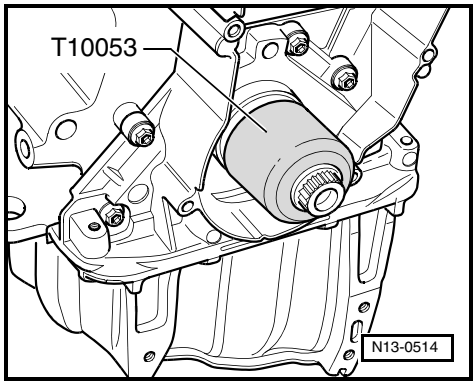
Hinweis

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

– Remove oil residue from crankshaft journal using clean cloth.
– Place guide sleeve -T10053/1 - onto crankshaft journal.
– Slide oil seal over guide sleeve onto crankshaft journal.



– Press oil seal in onto stop using assembly tool -T10053- and centre bolt.

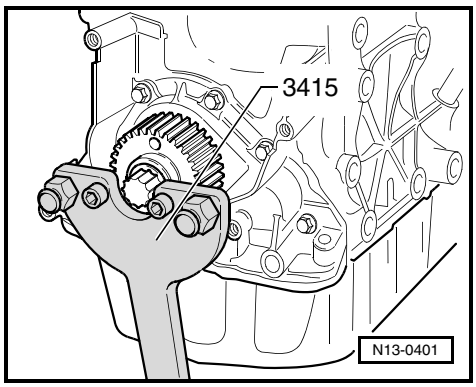


– Install crankshaft toothed belt pulley. To do this, lock toothed belt pulley using counterhold tool -3415-.
– Tighten new centre bolt to 120 Nm and then $^{1}/_{4}$ turn (90°) further (turning further can be done in several stages).

Hinweis

Thread and shoulder must be free of oil and grease.

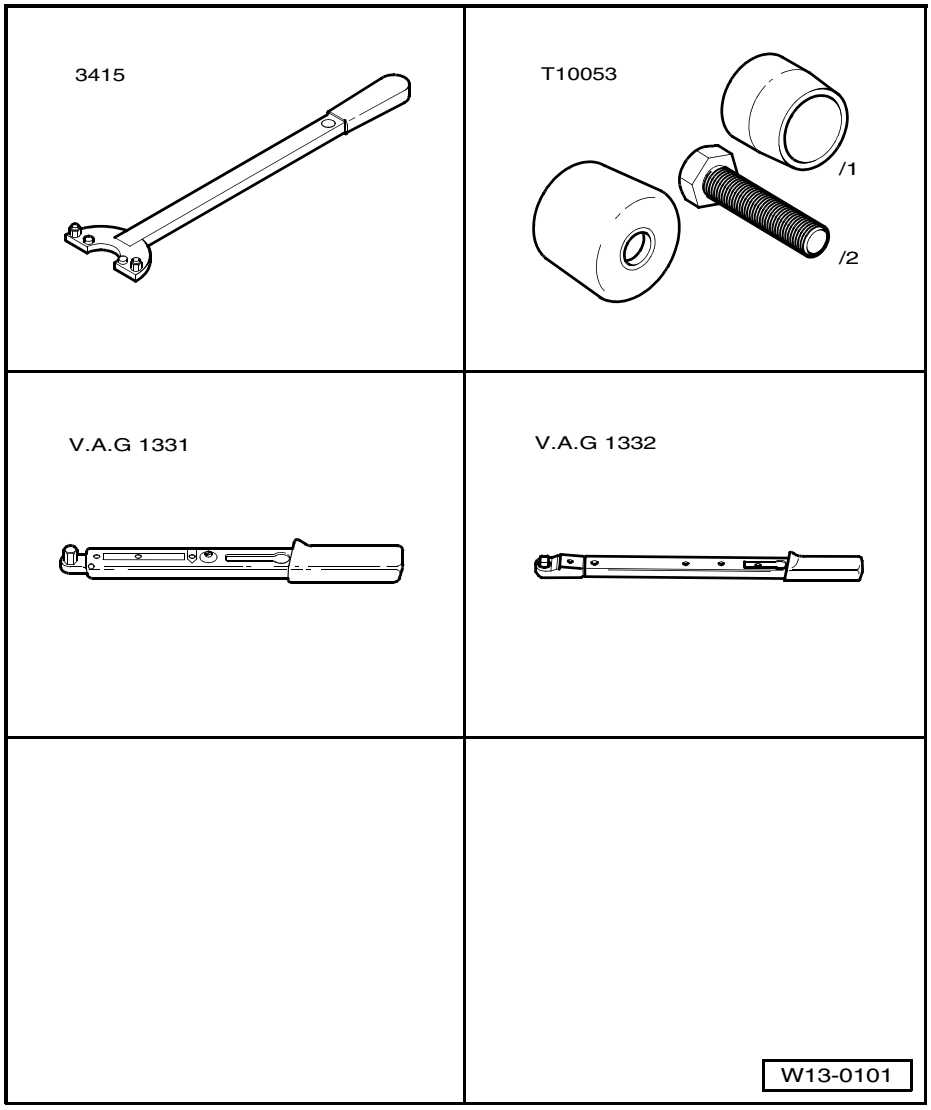
– Install and tension toothed belt ⇒ Seite 116.



2.3 Removing and installing crankshaft sealing flange, belt pulley end

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Counterhold tool -3415-
- Assembly tool -T10053-
- Torque wrench (5...50 Nm) -V.A.G 1331-
- Torque wrench (40...200 Nm) -V.A.G 1332-



Not illustrated

- Silicone sealant -D176404 A-
- Hand drill with plastic brush attachment
- Flat scraper
- Eye protection

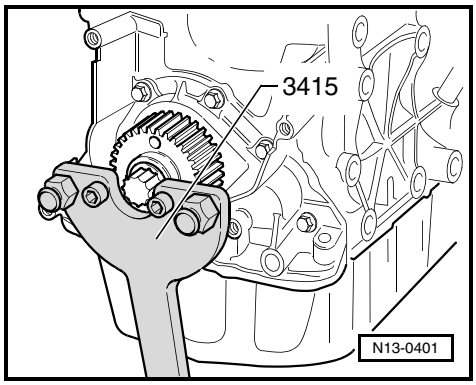
Removing ⇒ Seite 94.

Installing ⇒ Seite 95.

2.3.1 Removing

– Remove toothed belt ⇒ Seite 116.

– Remove crankshaft toothed belt pulley. To do this, lock toothed belt pulley using counterhold -3415-.



– Drain engine oil.

Hinweis

Observe environmental regulations for disposal.

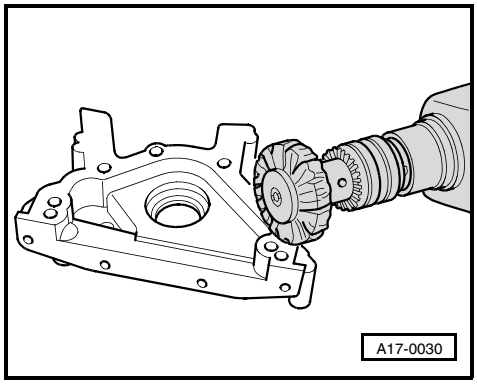
– Remove sump ⇒ Seite 142.

– Unscrew crankshaft sealing flange, belt pulley end.

– Remove sealing flange; if necessary, loosen by applying light blows with a rubber-headed hammer.

– Remove sealant residue on cylinder block with a flat scraper.

– Remove sealant remains from sealing flange using a plastic rotary brush (wear eye protection).



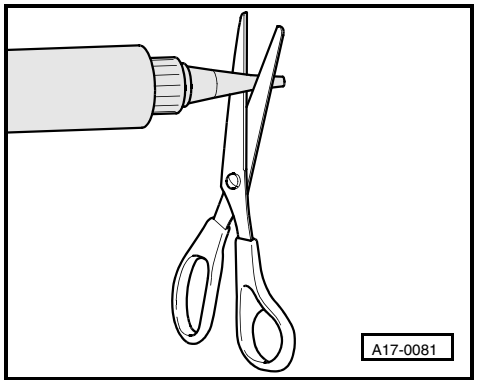
– Clean sealing surfaces. They must be free of oil and grease.

2.3.2 Installing

Hinweis

- *Note the expiration date of the sealant.*
- *The sealing flange must be installed within 5 minutes of applying silicone sealant.*

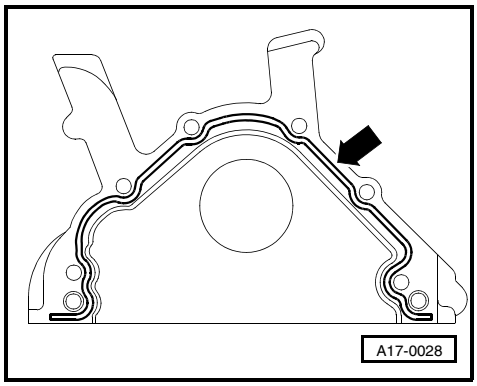
– Cut off tube nozzle at front marking (approx. 3 mm ∅ of nozzle).



Hinweis

- *Sealant bead must not be wider than 2...3 mm, because otherwise excess sealant can enter sump and clog strainer in oil pump suction pipe as well as drip onto crankshaft oil seal.*
- *Before applying sealant bead, cover sealing surface of oil seal with a clean cloth.*

– Apply silicone sealant bead as shown to the clean sealing surface of sealing flange.



– Install sealing flange immediately and tighten all bolts lightly.

Hinweis

When fitting sealing flange with oil seal installed, use guide sleeve -T10053/1-.

– Tighten securing bolts for sealing flange to 15 Nm using alternate and diagonal sequence.

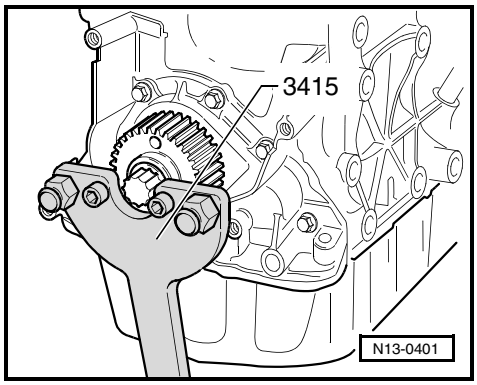
– Remove excess sealant.

– Install sump ⇒ Seite 142.

Hinweis

Sealing compound must dry for approx. 30 minutes after installation. Only then fill with engine oil.

Install crankshaft toothed belt pulley. To do this, lock toothed belt pulley using counterhold tool -3415-.



Tighten new centre bolt to 120 Nm and then $^{1}/_{4}$ turn (90°) further (turning further can be done in several stages).

Hinweis

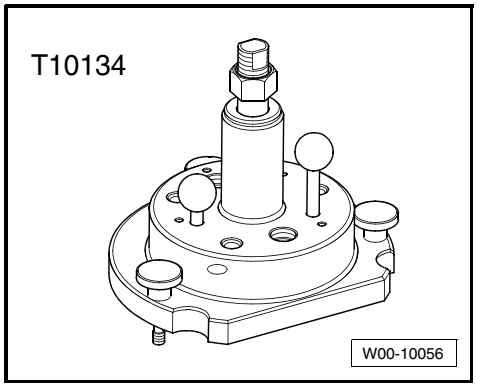
Thread and shoulder must be free of oil and grease.

– Install and tension toothed belt ⇒ Seite 116.

2.4 Renewing crankshaft sealing flange - flywheel end

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Assembly tool -T10134-
- Torque wrench (5...50 Nm) -V.A.G 1331-
- Tool insert -V.A.G 1332/11-
- Vernier gauge
- Three hexagon bolts M6 x 35 mm
- Two hexagon bolts M7 x 35 mm



Pressing out sealing flange with sender wheel ⇒ Seite 96.

Pressing in sealing flange with sender wheel ⇒ Seite 97.

A - Fitting seal with sender wheel on assembly tool - T10134- ⇒ Seite 98.

B - Fitting assembling tool -T10134- with sealing flange on crankshaft flange ⇒ Seite 99.

C - Bolting assembly tool -T10134- onto crankshaft flange ⇒ Seite 100.

D - Pressing sender onto crankshaft flange using assembly tool -T10134- ⇒ Seite 101.

E - Checking installation position of sender wheel on crankshaft ⇒ Seite 101.

F - Re-pressing sender wheel ⇒ Seite 102.

2.4.1 Pressing out sealing flange with sender wheel

Hinweis

For the sake of clarity, the work is performed with the engine removed.

– Remove flywheel ⇒ Seite 91, Assembly overview - sealing flange and flywheel.

– Remove intermediate plate.

– Turn engine to TDC no. 1 cylinder ⇒ Seite 116, Removing and installing toothed belt
– Drain engine oil.

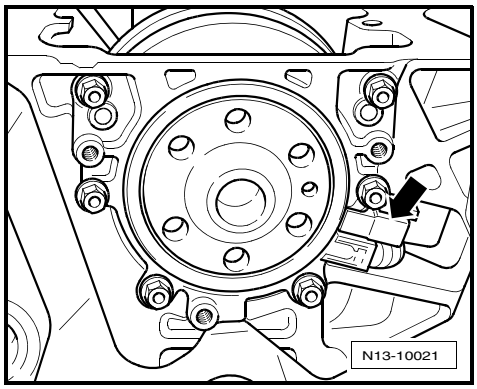
Hinweis

Observe environmental regulations for disposal.

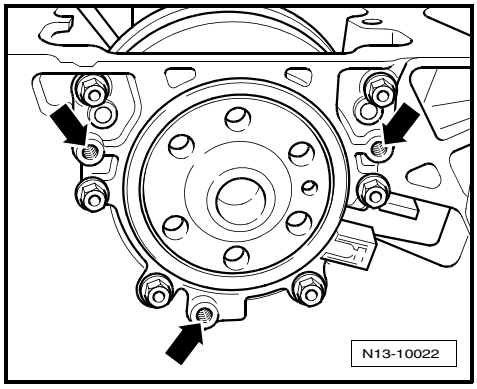
– Remove sump ⇒ Seite 142.
– Remove engine speed sender -G28 - -arrow- using commercially available ball-ended hex key.
– Undo sealing flange securing bolts.

Hinweis

Sealing flange and sender wheel are pressed off the crankshaft together using three M6 x 35 mm bolts.



– Bolt three M6 x 35 mm screws into threaded holes of sealing flange -arrows-.
– Screw bolts alternately (max. $^1/_2$ turn (180 °) for each bolt) into sealing flange and press off sealing flange together with sender wheel from crankshaft.



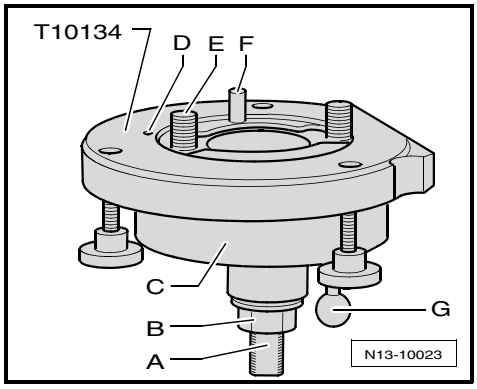
2.4.2 Pressing in sealing flange with sender wheel

Hinweis

- *The sealing flange with a PTFE seal is equipped with a sealing lip support ring. This support ring serves as a fitting sleeve and must not be removed prior to installation.*
- *Sealing flange and sender wheel must not be separated or turned after removal from packaging.*
- *The sender wheel is held in its installation position on the assembly device -T10134- by a locating pin.*
- *Sealing flange and seal are one unit and must be replaced together with the sender wheel only.*
- *The assembly device -T10134- is held in its position relative to the crankshaft by a guide pin inserted into a hole in the crankshaft.*

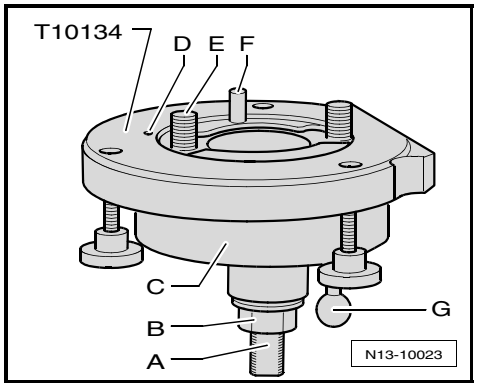
Assembly tool -T10134-

A - Clamping surface
B - Hexagon nut
C - Assembly housing
D - Locating pin
E - Hexagon socket head bolt
F - Guide pin for diesel engines (black knob)
G - Guide pin for petrol engines (red knob)



2.4.3 A - Assembling sealing flange with sender wheel on assembly appliance - T10134-

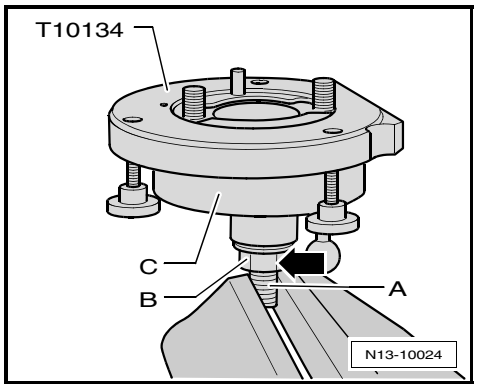
– Screw in hexagon nut -B- to just before clamping surface -A- of threaded spindle.



– Clamp assembly device -T10134- in a vice on clamping surface -A- of threaded spindle.
– Press assembly housing -C- downwards so that it lies on hexagon nut -B- -arrow-.

Hinweis

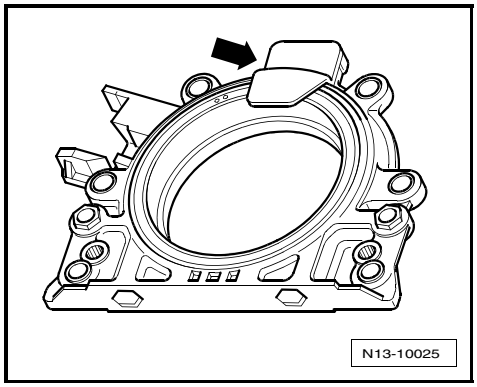
Inner part of assembly tool and assembly housing must be at same height.



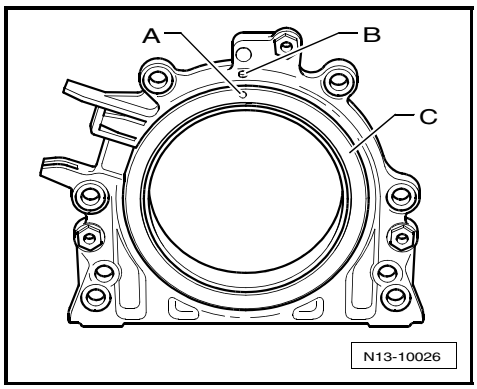
– Remove securing clip -arrow- from new sealing flange.

Hinweis

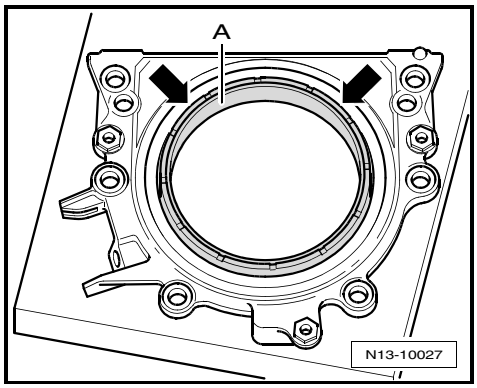
The sender wheel must not be taken out of the sealing flange or turned.



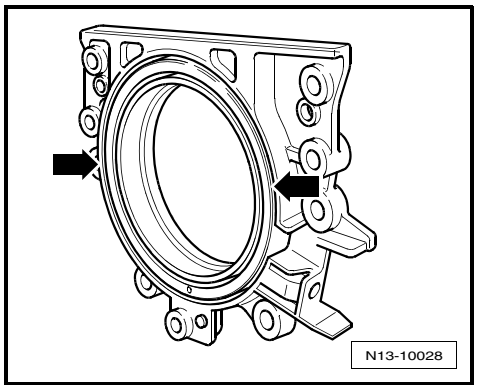
– Locating hole -A- on sender wheel -C- must align with marking -B- on sealing flange.
– Place sealing flange with front side downwards on a clean flat surface.



– Push sealing lip support ring -A- downwards in direction of arrow until it lies on flat surface.



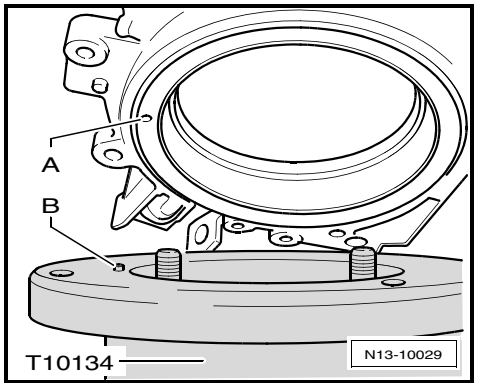
– Upper edge of sender wheel and front edge of sealing flange must align -arrows-.



– Place sealing flange with front side on assembly tool -T10134- so that locating pin -A- can be inserted in sender wheel hole -A-.

Hinweis

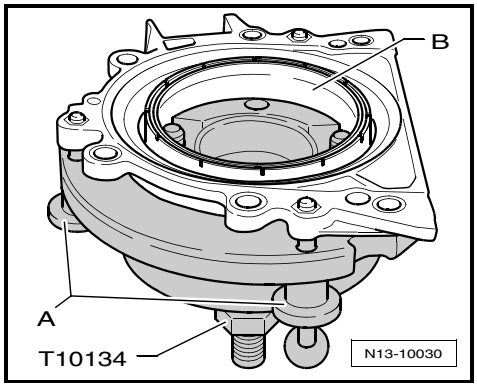
Ensure sealing flange lies flat on assembly tool.



– Push sealing flange and support ring for sealing lip -B- while tightening knurled screws -A- against surface of assembly tool - T10134- so that locating pin cannot slide out of sender wheel hole.

Hinweis

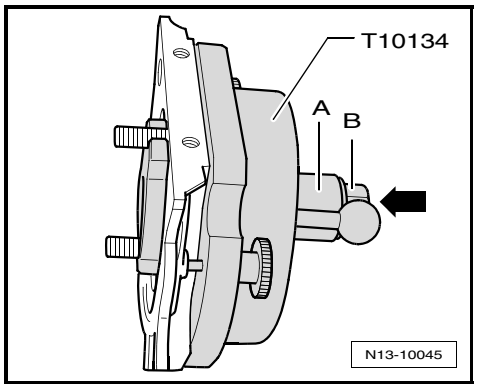
When installing sealing flange, ensure that sender wheel remains fixed in assembly device.



2.4.4 B - Attaching assembling tool -T10134- with sealing flange to crankshaft flange

- Crankshaft flange must be free of oil and grease.
- Engine positioned at TDC No. 1 cylinder.

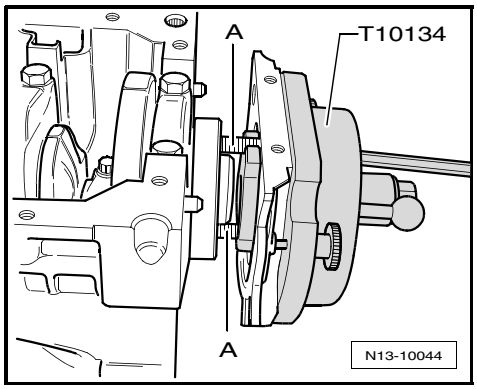
– Screw hexagon nut -B- to end of threaded spindle.
– Press threaded spindle of assembly tool -T10134- in -direction of arrow-, until hexagon nut -B- lies against assembly hub -A-.
– Align flat side of assembly housing on sump side of crankcase sealing surface.



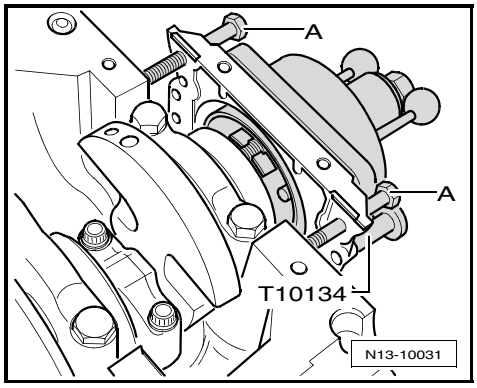
– Secure assembly tool -T10134 -to crankshaft flange using hexagon socket head bolts -A-.

Hinweis

Screw hexagon socket head bolts -A- into crankshaft flange (approx. 5 full turns).



– To guide sealing flange, screw two M7 × 35 mm bolts -A- into cylinder block.



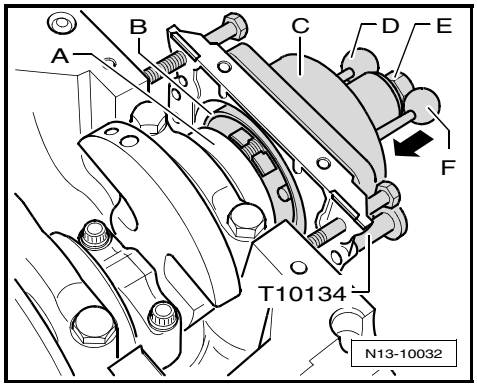
2.4.5 C - Bolting assembly tool -T10134- onto crankshaft flange

– Push assembly hub -C- by hand in -direction of arrow- until sealing lip support ring -B- contacts crankshaft -A-.
– Push guide pin for diesel engines (black knob) -D- into hole in crankshaft. This ensures that the sender wheel reaches its final installation position.

Hinweis

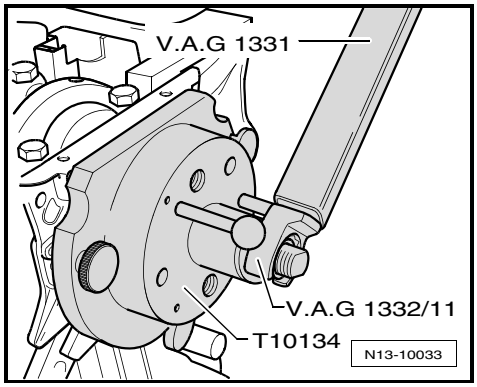
The guide pin for petrol engines (red knob) -F- must not be inserted in threaded hole of crankshaft.

– Hand tighten both hexagon socket head bolts of assembly tool.
– Screw hexagon nut -E- onto threaded spindle by hand until it is in contact with assembly hub -C-.



2.4.6 D - Pressing sender wheel onto crankshaft flange using assembly tool -T10134-

– Tighten hexagon nut of assembly tool -T10134- using torque wrench -V.A.G 1331- and insert -V.A.G 1332/11- to 35 Nm.

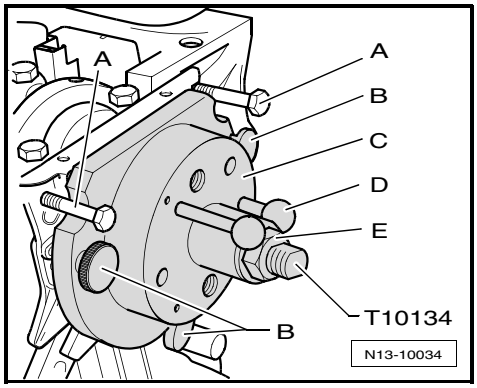


Hinweis

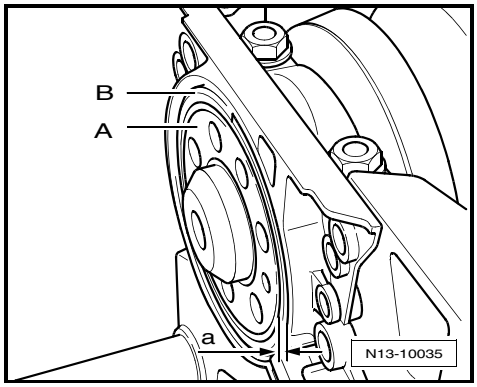
After hexagon nut is tightened to 35 Nm torque, a small air gap must be present between cylinder block and sealing flange.

2.4.7 E - Checking sender wheel installation position on crankshaft

– Screw hexagon nut -E- to end of threaded spindle.
– Remove the two bolts -A- from cylinder block.
– Screw the three knurled screws -B- out of sealing flange.
– Remove assembly tool -T10134-.
– Remove sealing lip support ring.



– The sender wheel is in the correct installation position on the crankshaft if a gap -a- = 0.5 mm exists between crankshaft flange -A- and sender wheel -B-.



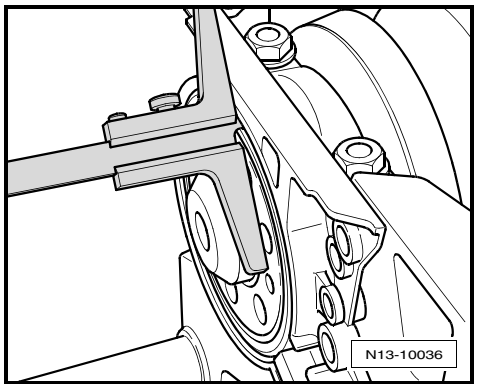
– Set vernier gauge on crankshaft flange.
– Measure distance -a- between crankshaft flange and sender wheel.

If measurement -a- is too small:

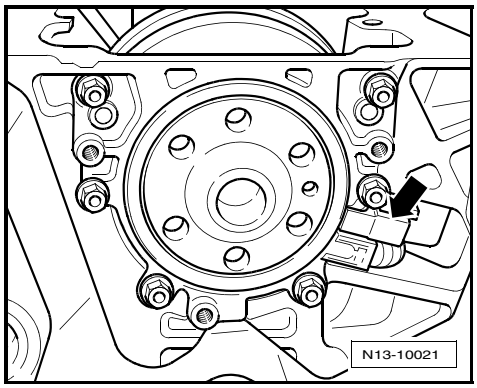
– Re-press sender wheel ⇒ Seite 102.

If dimension -a- is attained:

– Tighten new securing bolts for sealing flange to 15 Nm using alternate and diagonal sequence.

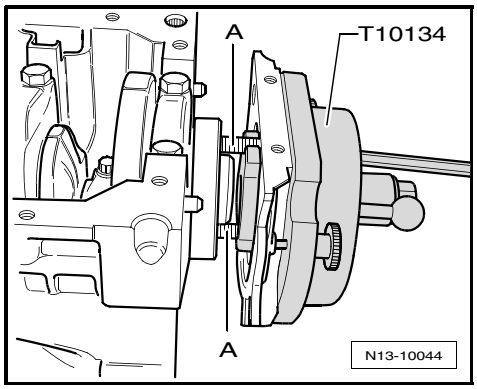


– Install engine speed sender -G28 - -arrow- and tighten securing bolt to 5 Nm.
– Install sump ⇒ Seite 142.
– Install intermediate plate.
– Install flywheel using new bolts. Tighten securing bolts to 60 Nm + $^1/_4$ turn (90°).

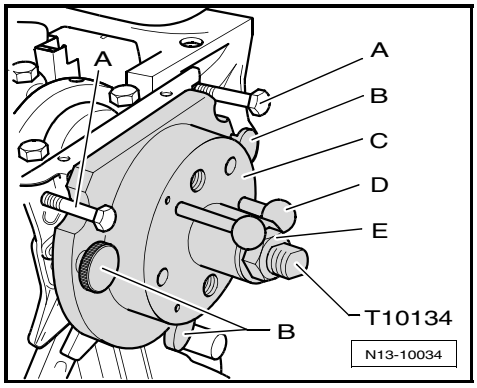


2.4.8 F - Re-pressing sender wheel

– Secure assembly tool -T10134 -to crankshaft flange using hexagon socket head bolts -A-.
– Tighten both hexagon socket head bolts -A- by hand.
– Push assembly tool -T10134- by hand to sealing flange.



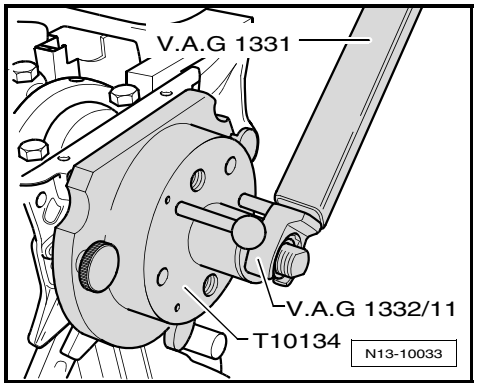
– Screw hexagon nut -E- onto threaded spindle by hand until it is in contact with assembly hub -C-.



– Tighten hexagon nut of assembly tool -T10134- using torque wrench -V.A.G 1331 - and insert -V.A.G 1332/11- to 40 Nm.
– Check installation position of sender wheel on crankshaft again ⇒ Seite 101.

If dimension -a- is too small again:

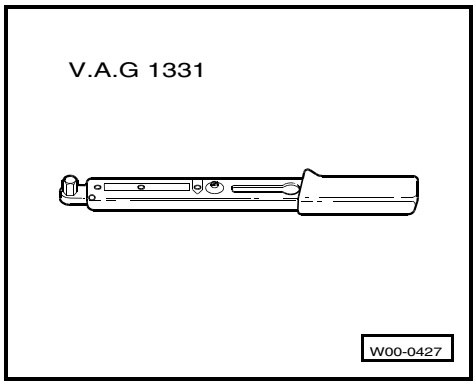
– Tighten hexagon nut for assembly tool -T10134- to 45 Nm.
– Check installation position of sender wheel on crankshaft again ⇒ Seite 101.



2.5 Removing and installing engine speed sender -G28-

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Torque wrench (5...50 Nm) -V.A.G 1331-

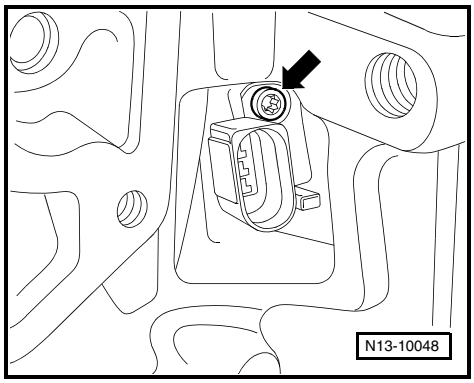


Removing ⇒ Seite 103.

Installing ⇒ Seite 103.

2.5.1 Removing

- Clamp off coolant hoses at oil cooler using hose clamp and pull off hoses.
- Remove oil filter bracket ⇒ Seite 144, Assembly overview - oil filter bracket and oil cooler.
- Pull off 3-pin connector from engine speed sender -G28-.
- Loosen securing bolt in crankcase through opening -arrow- and pull out engine speed sender -G28- using commercially available ball head hexagon key.



2.5.2 Installing

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

- Tighten securing bolt for engine speed sender -G28- to 5 Nm.

3 Removing and installing crankshaft

Hinweis

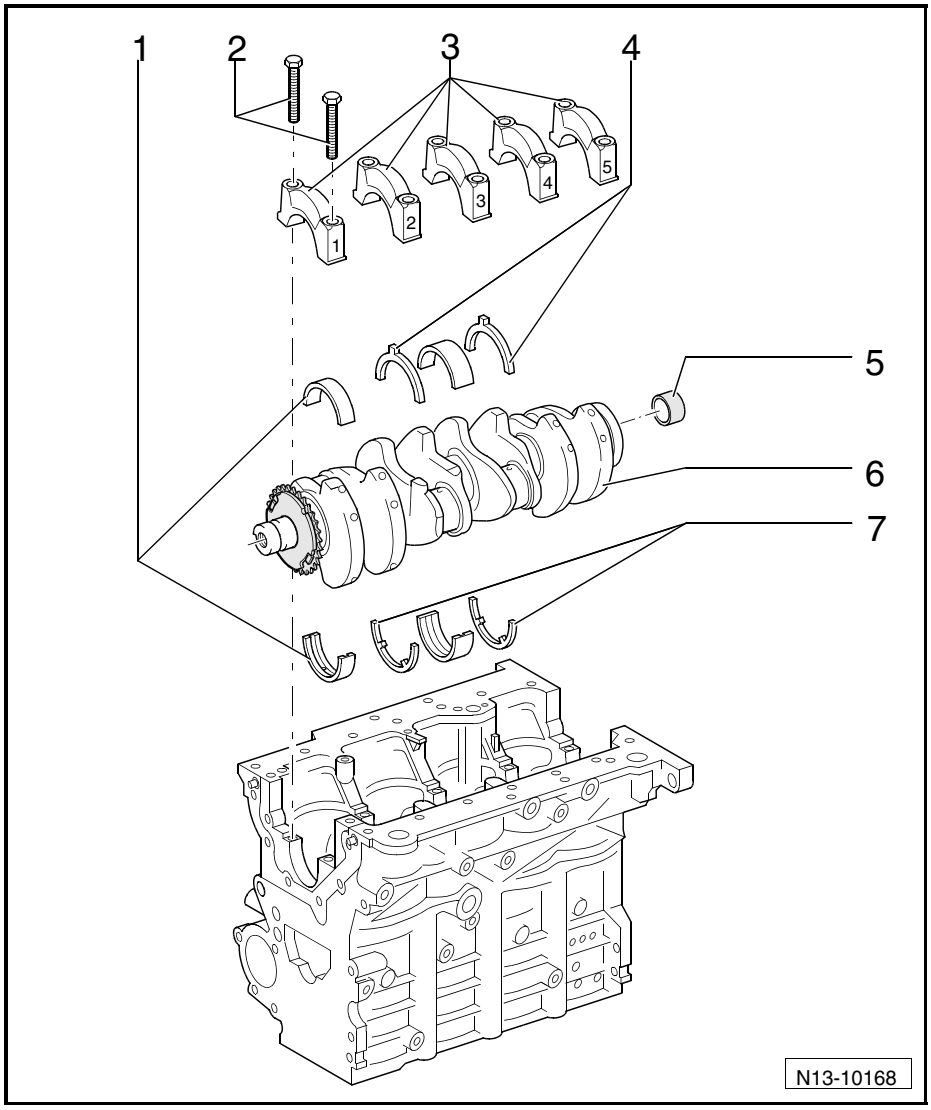
- *When working on engine, secure it with engine and gearbox support -VW 540- to assembly stand or to engine and gearbox support -VAS 6095-.*
- *Finding metal shavings or a large quantity of small metal particles during engine repair could indicate that the crankshaft bearings or conrod bearings are damaged. To prevent subsequent damage, perform the following work after completing repairs:*
- *Thoroughly clean oil channels.*
- *Renew oil spray jets.*
- *Renew oil cooler*
- *Renew oil filter element*

Assembly overview - crankshaft ⇒ Seite 104.

Crankshaft dimensions ⇒ Seite 104.

Pulling out and driving in needle roller bearing from and into crankshaft (if fitted) ⇒ Seite 105.

3.1 Assembly overview - crankshaft



1 - Bearing shells 1, 2, 4 and 5
- ❑ For bearing cap without oil groove
- ❑ For cylinder block with oil groove
- ❑ Do not interchange used bearing shells (mark)

2 - 65 Nm + 1/4 turn (90°) further
- ❑ Renew
- ❑ To measure radial clearance, tighten to 65 Nm but not further

3 - Bearing cap
- ❑ Bearing cap 1: Pulley end
- ❑ Bearing cap 3 with recesses for thrust washers
- ❑ Bearing shell retaining lugs in cylinder block and bearing caps must align.

4 - Thrust washer
- ❑ For bearing cap 3
- ❑ Note fixing arrangement

5 - Needle bearing
- ❑ Not installed on all engines
- ❑ Pulling out and driving in ⇒ Seite 105

6 - Crankshaft
- ❑ Axial clearance new: 0.07...0.17 mm; wear limit: 0.37 mm
- ❑ Check radial clearance using Plastigage new: 0.03...0.08 mm; wear limit: 0.17 mm
- ❑ Do not rotate crankshaft when checking radial clearance
- ❑ Crankshaft dimensions ⇒ Seite 104

7 - Thrust washer
- ❑ For cylinder block, bearing 3

3.2 Crankshaft dimensions

(Dimensions in mm)

Honing dimension	Crankshaft main journal ∅	Conrod journal ∅
Basic dimension	-0,022 54,00 -0,042	-0,022 47,80 -0,042

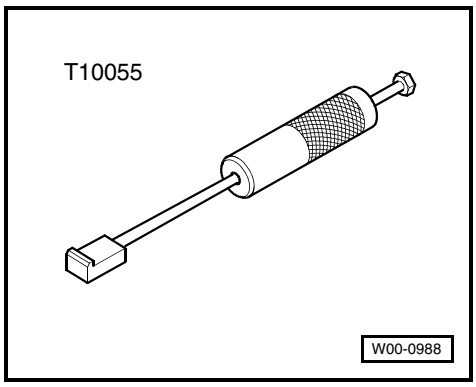
3.3 Pulling out and driving in needle roller bearing from and into crankshaft (if fitted)

Hinweis

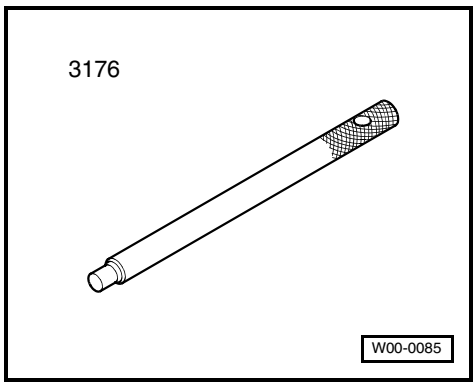
The needle roller bearing in the crankshaft is not installed on all engines.

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Puller -T10055-
- With adapter -T10055/3-



- Centring mandrel -3176-
- or Drift -VW 207 C-
- Puller, e.g. Kukko -21/2-

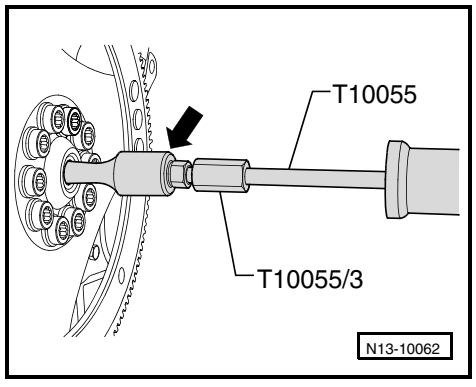


Pulling out ⇒ Seite 105.

Driving in ⇒ Seite 105.

3.3.1 Pulling out

– Extract with commercially available puller, e.g. Kukko - 21/2- -arrow-, adapter -T10055/3 - and puller -T10055-.

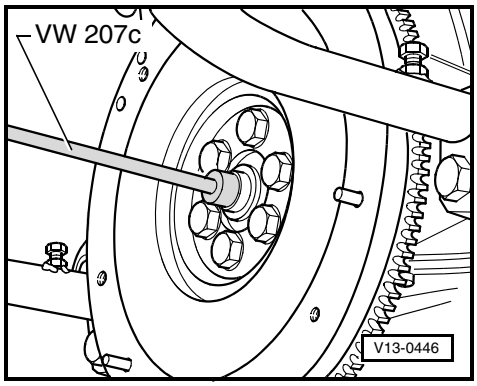


3.3.2 Driving in

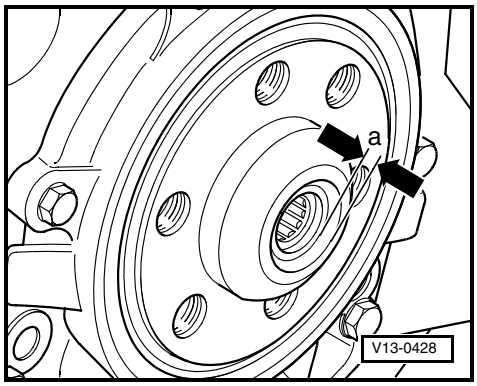
Hinweis

The lettering on the needle bearing must be visible when installed.

– Drive in using drift -VW 207 C- or centring mandrel -3176-.



Installation depth: dimension -a- = 2 mm.



4 Dismantling and assembling pistons and conrods

Hinweis

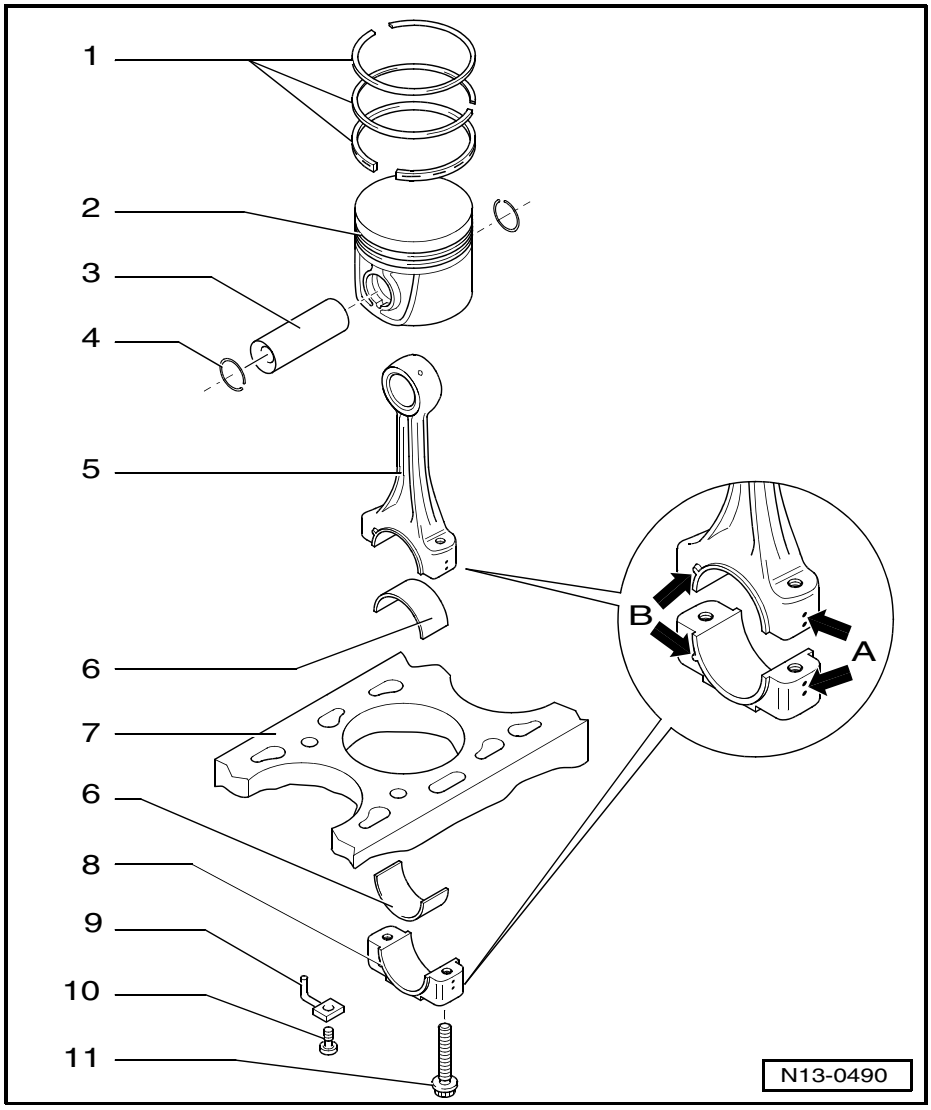
When working on engine, secure it with engine and gearbox support -VW 540- to assembly stand or to engine and gearbox support -VAS 6095-.

Assembly overview - pistons and conrods ⇒ Seite 107.

Checking piston projection at TDC ⇒ Seite 109.

Piston and cylinder dimensions ⇒ Seite 110.

4.1 Assembly overview - pistons and conrods



1 - Piston rings
- ❑ Offset gaps by 120°
- ❑ Remove and install using piston ring pliers
- ❑ „TOP“ faces towards piston crown
- ❑ Checking ring gap ⇒ Abb. auf Seite 108
- ❑ Checking ring-to-groove clearance ⇒ Abb. auf Seite 108

2 - Piston
- ❑ Mark installation position and cylinder number
- ❑ Installation position and allocation of piston to cylinder ⇒ Abb. auf Seite 109.
- ❑ Arrow on piston crown points to belt pulley end
- ❑ Install using piston ring clamp
- ❑ If piston skirt is cracked, renew piston
- ❑ Check piston projection at TDC ⇒ Seite 109.

3 - Piston pin
- ❑ If difficult to remove, heat piston to 60 °C
- ❑ Remove and install with drift -VW 222 a-

4 - Circlip

5 - Conrod
- ❑ Mark with cylinder number -A-
- ❑ Installation position: marking -B- faces towards belt pulley end
- ❑ With industrially cracked conrod bearing cap

6 - Bearing shell
- ❑ Note installation position
- ❑ Do not interchange used bearing shells
- ❑ Insert bearing shells centrally
- ❑ Check for secure seating.
- ❑ Axial clearance wear limit: 0.37 mm
- ❑ Check radial clearance using Plastigage, wear limit: 0.08 mm. Do not rotate crankshaft when checking radial clearance

7 - Cylinder block
- ❑ Checking cylinder bores ⇒ Abb. auf Seite 109
- ❑ Piston and cylinder dimensions ⇒ Seite 110

8 - Conrod bearing cap
- ❑ Note installation position
- ❑ Due to the cracking method used to separate the bearing cap from the conrod in manufacture, the caps only fit in one position and only on the appropriate conrod

9 - Oil spray jet
- ❑ For piston cooling

10 - 25 Nm
- ❑ Insert without sealant

11 - Conrod bolt, 30 Nm + $^1/_4$ turn (90°) further
- ❑ Renew
- ❑ Oil threads and contact surface
- ❑ Use old bolts to measure radial clearance.

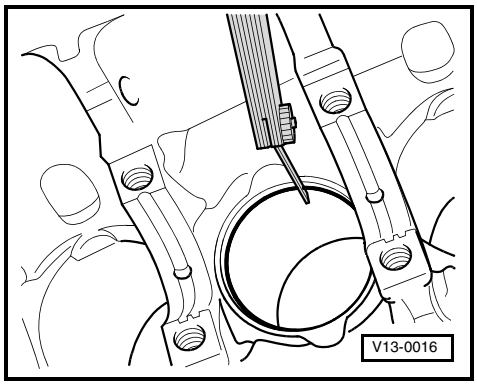
Checking piston ring gap

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Feeler gauges

Test procedure

– Push piston ring squarely from above down to approx. 15 mm from bottom end of cylinder.



Piston ring		Ring gap	
		New	Wear limit
1. compression ring	mm	0,20...0,40	1,00
2. compression ring	mm	0,20...0,40	1,00
Oil scraper ring	mm	0,25...0,50	1,00

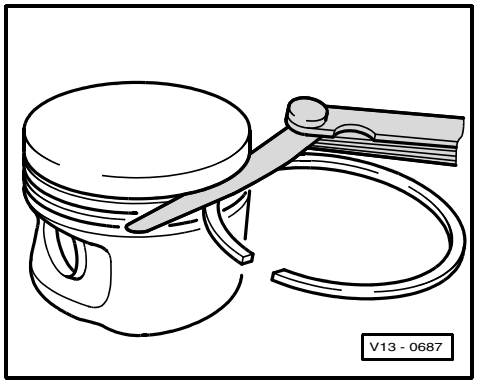
Checking ring-to-groove clearance

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Feeler gauges

Test procedure

– Clean groove in piston before checking clearance.



Piston ring		Ring-to-groove clearance	
		New	Wear limit
1. compression ring	mm	0,06...0,09	0,25
2. compression ring	mm	0,05...0,08	0,25
Oil scraper ring	mm	0,03...0,06	0,15

Checking cylinder bores

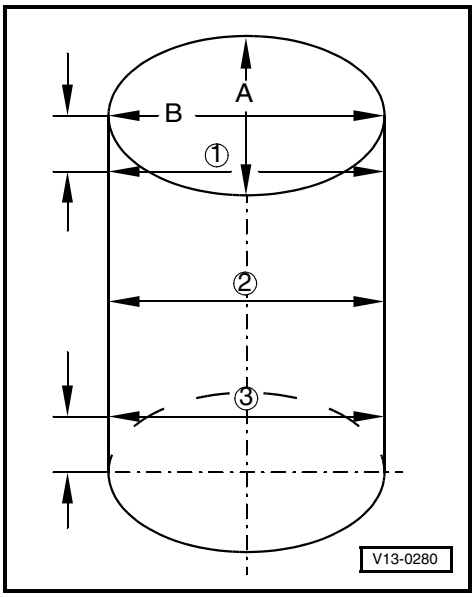
Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Internal dial gauge 50...100 mm

Test procedure

– Take measurements at 3 positions in both transverse -A- and longitudinal -B- directions, as illustrated.

Difference between actual and nominal diameter: not more than 0.10 mm.



Hinweis

Cylinder bores must not be measured when cylinder block is mounted on a repair stand with engine and gearbox support - VW 540-, as measurements may then be incorrect.

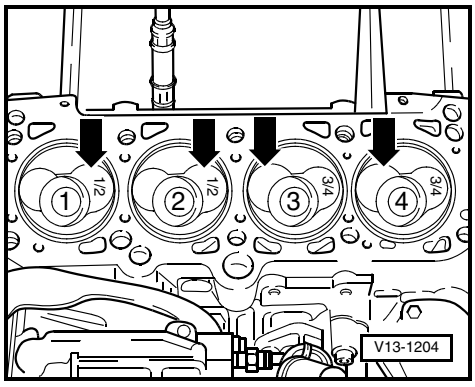
Piston installation position and allocation of piston to cylinder.

Piston in cylinders 1 and 2:

- Larger inlet valve recess -arrows- towards flywheel.

Piston in cylinders 3 and 4:

- Larger inlet valve recess -arrows- towards belt pulley end.



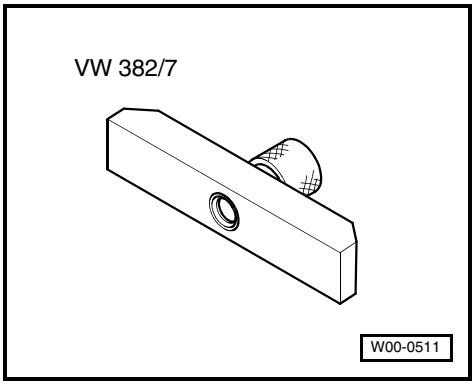
Hinweis

- *New piston allocation to cylinders is shown by a coloured mark stamped on piston crown.*
- *Piston for cylinders 1 and 2: marked 1/2*
- *Piston for cylinders 3 and 4: marked 3/4*

4.2 Checking piston projection at TDC

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Measuring bridge -VW 382/7-

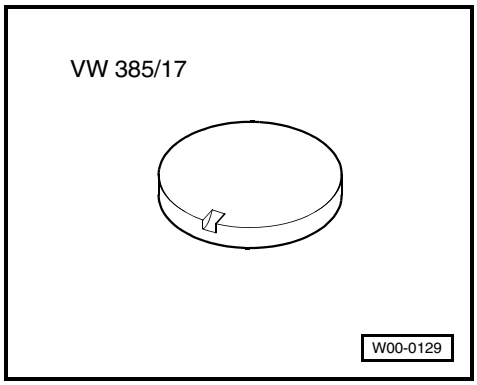


- End dimension plate -VW 385/17-

Not illustrated

- Dial gauge

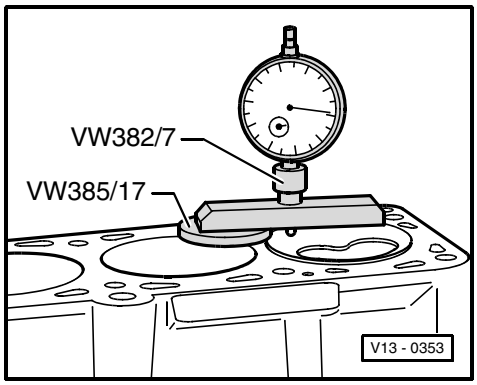
Test procedure



Piston projection at TDC must be measured when installing new pistons or a short engine. Install the appropriate cylinder head gasket depending upon piston projection, according to following table:

Hinweis

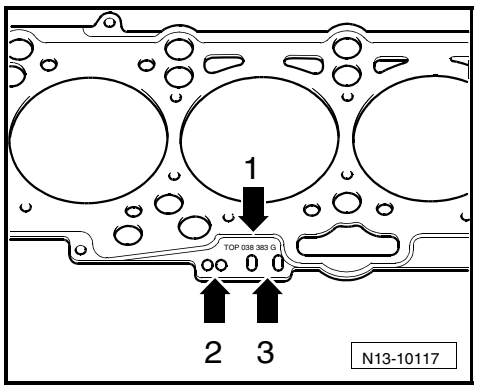
Turn engine clockwise to measure piston projection at TDC.



Piston projection	Identification Holes/notches
0.91 mm ... 1.00 mm	1
1.01 mm ... 1.10 mm	2
1.11 mm ... 1.20 mm	3

Cylinder head gasket identification

- Part no. = -arrow 1-
- Holes = -arrow 2-
- Production control code = -arrow 3- (disregard)



Hinweis

If different values are determined during the projection measurement, use the largest dimension for selecting the gasket.

4.3 Piston and cylinder dimensions

Honing dimension		Piston ∅	Cylinder bore ∅
Basic dimension	mm	80,96	81,01

15 – Cylinder head, valve gear

1 Cylinder head

Hinweis

- *When installing an exchange cylinder head with fitted camshaft, the contact surfaces between the bucket tappets and the cam must be oiled before installing the cylinder head cover.*
- *The plastic packing pieces for protecting the open valves must not be removed until immediately before fitting cylinder head.*
- *If the cylinder head is renewed, all the coolant in the system must also be renewed.*

Observe safety precautions ⇒ Seite 195

Observe rules for cleanliness ⇒ Seite 196

Assembly overview - cylinder head ⇒ Seite 112.

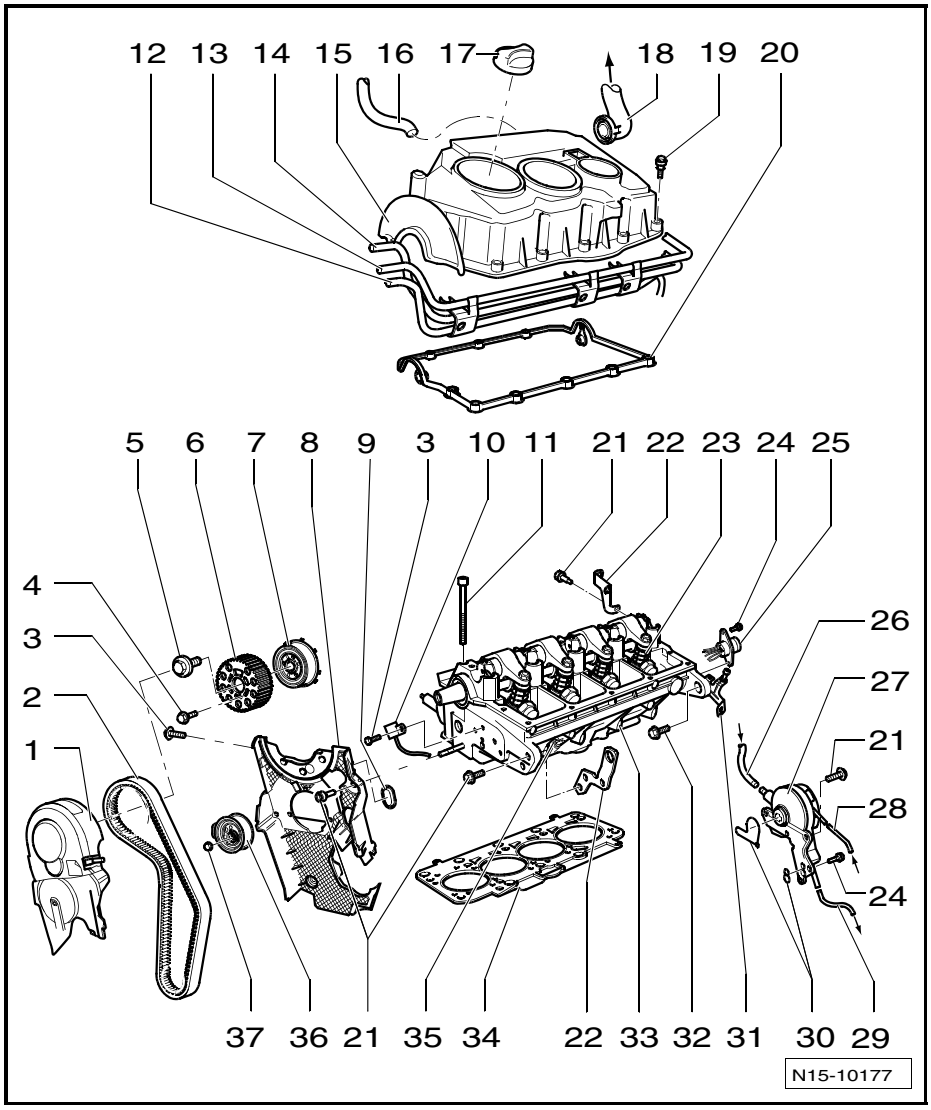
Removing and installing cylinder head cover ⇒ Seite 114.

Removing, installing and tensioning toothed belts ⇒ Seite 116.

Removing and installing cylinder head ⇒ Seite 122.

Checking compression ⇒ Seite 126.

1.1 Assembly overview - cylinder head



1 - Upper toothed belt guard

2 - Toothed belt

- ❑ Mark direction of rotation before removing.
- ❑ Check for wear.
- ❑ Do not kink
- ❑ Removing, installing and tensioning ⇒ Seite 116

3 - 10 Nm

- ❑ Renew

4 - 25 Nm

5 - 100 Nm

6 - Camshaft toothed belt pulley

7 - Hub

- ❑ With sender wheel.
- ❑ Use counterhold tool -T10051 - to loosen and tighten.
- ❑ To remove, use puller -T10052-.
- ❑ Removing and installing ⇒ Seite 133, removing and installing camshaft

8 - Rear toothed belt guard

9 - Sealing grommet

- ❑ Renew if damaged.

10 - Hall sender -G40-

- ❑ For camshaft position
- ❑ Checking ⇒ Seite 212.
- ❑ To remove sealing grommet ⇒ Pos. 9, unbutton from toothed belt guard

11 - Cylinder head bolt

- ❑ Renew
- ❑ Note sequence when loosening and tightening ⇒ Seite 122, removing and installing cylinder head.
- ❑ Before installing, place washers in cylinder head ⇒ Pos. 4 auf Seite 128

12 - Fuel return line

13 - Fuel supply line

14 - Coolant line

- ❑ Check for secure seating.

15 - Cylinder head cover

- ❑ With pressure relief valve for crankcase breather and vacuum reservoir.
- ❑ Thoroughly clean sealant groove and securing bolts before fitting a new gasket
- ❑ Before fitting, thoroughly clean sealing surface of cylinder head with clean cloth
- ❑ Removing and installing ⇒ Seite 114.

16 - Vacuum hose
- ❑ To connecting piece between tandem pump and brake servo.

17 - Cap
- ❑ Renew seal if damaged

18 - To intake hose for air filter/turbocharger

19 - 10 Nm
- ❑ Note tightening sequence ⇒ Seite 114, install cylinder head cover.

20 - Cylinder head cover gasket
- ❑ Renew if damaged.
- ❑ Only replace seal together with cylinder head cover
- ❑ Thoroughly clean sealant groove and securing bolts before fitting a new gasket
- ❑ Before fitting, seal transitions with sealant -AMV 174 004 01- ⇒ Seite 114, Removing and installing cylinder head cover

21 - 20 Nm

22 - Lifting eye

23 - Unit injector
- ❑ Assembly overview - unit injector ⇒ Seite 198

24 - 10 Nm

25 - Central connector
- ❑ For unit injectors

26 - From brake servo
- ❑ If installed

27 - Tandem pump
- ❑ For fuel and vacuum supply
- ❑ Must not be taken apart.
- ❑ Checking ⇒ Seite 169.
- ❑ Removing and installing ⇒ Seite 165.

28 - Fuel supply hose
- ❑ From fuel filter ⇒ Seite 162, Assembly overview - fuel filter
- ❑ Check for secure seating.
- ❑ White or with white marking
- ❑ Secure with spring-type clips

29 - Fuel return hose
- ❑ To fuel filter ⇒ Seite 162, Assembly overview - fuel filter
- ❑ Check for secure seating.
- ❑ Blue or with blue marking
- ❑ Secure with spring-type clips

30 - Gasket
- ❑ Renew

31 - Bracket

32 - 25 Nm

33 - Cylinder head
- ❑ Check for distortion ⇒ Abb. auf Seite 114
- ❑ Removing and installing ⇒ Seite 122.
- ❑ If renewed, change coolant in entire system

34 - Cylinder head gasket
- ❑ Renew
- ❑ Note marking ⇒ Abb. auf Seite 114
- ❑ If renewed, change coolant in entire system

35 - Ceramic glow plug, 15 Nm

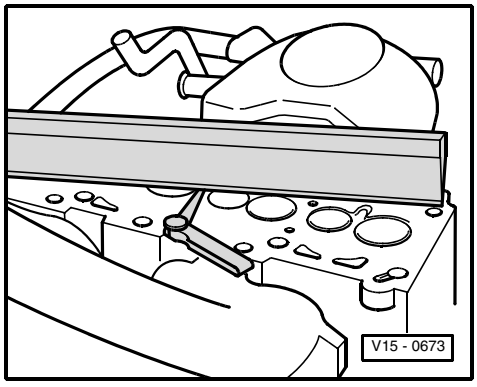
Assembly instructions and characteristics must be observed without fail:

- ❑ Characteristics of ceramic glow plugs ⇒ Seite 321
- ❑ Removing, installing and checking ceramic glow plugs ⇒ Seite 321

36 - Tensioning roller

37 - 20 Nm + $^{1}/_{8}$ turn (45 °) further

Checking cylinder head for distortion



Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

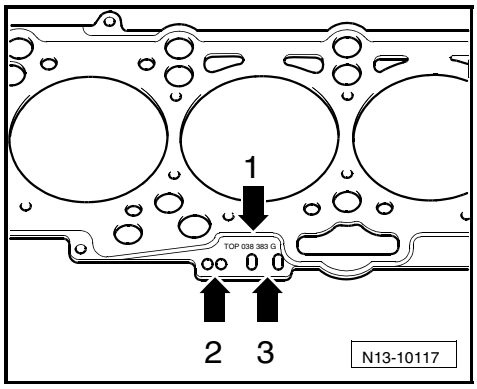
- Straightedge
- Feeler gauges

Max. permissible distortion: 0.1 mm.

Hinweis

Reworking diesel cylinder heads is not permissible.

Cylinder head gasket identification



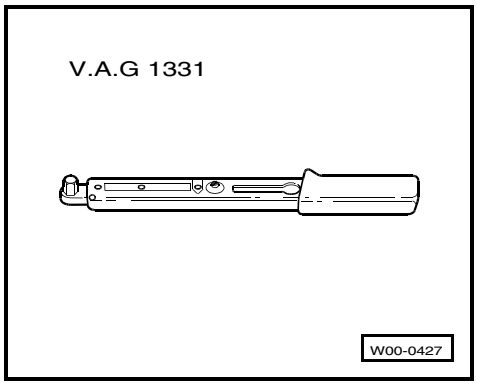
- Part no. = -arrow 1-
- Holes = -arrow 2-
- Production control code = -arrow 3- (disregard)

Hinweis

- *Different thicknesses of cylinder head gasket are fitted depending on the piston projection. When fitting a new cylinder head gasket, install a new gasket with same identification.*
- *Piston projection at TDC must be measured when installing new pistons or a short engine ⇒ Seite 109.*

1.2 Removing and installing cylinder head cover

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel



- Torque wrench (5...50 Nm) -V.A.G 1331-
- Sealant -AMV 174 004 01-

Removing ⇒ Seite 114.

Installing ⇒ Seite 115.

1.2.1 Removing

– Remove upper toothed belt guard.

– Pull crankcase breather hose off cylinder head cover.

– Remove cylinder head cover.

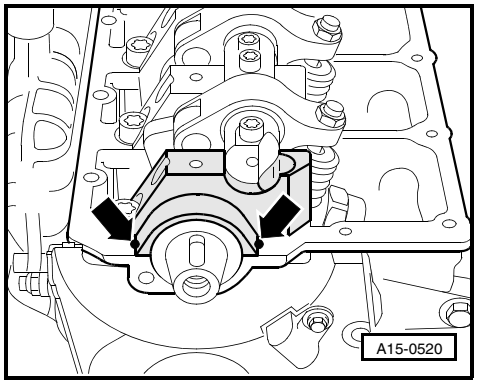
1.2.2 Installing

Installation is carried out in the reverse sequence of removal.
In the process, note the following:

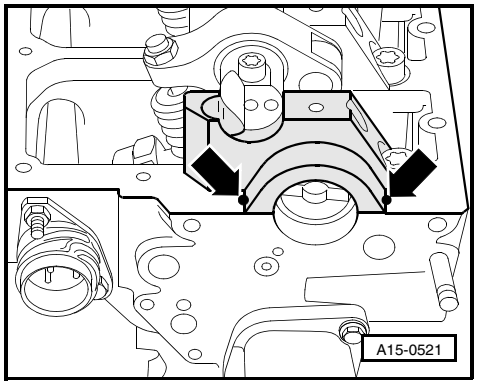
Hinweis

- *Renew cylinder head cover gasket and seal for bolts if damaged.*
- *The cylinder head cover gasket can be renewed only together with the cylinder head cover.*
- *Before fitting new seal, sealing groove and securing bolts should be cleaned thoroughly.*
- *Before fitting cylinder head cover, thoroughly clean sealing surface of cylinder head with clean cloth.*

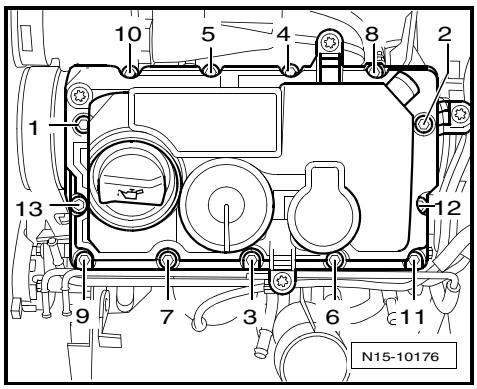
– Place a drop of sealant -AMV 174 004 01- (∅ approx. 5 mm) -arrows- on edges of both sealing surfaces of bearing cap and cylinder head at front of engine.



– Place a drop of sealant -AMV 174 004 01- (∅ approx. 5 mm) -arrows- on edges of both sealing surfaces of bearing cap and cylinder head at rear of engine.



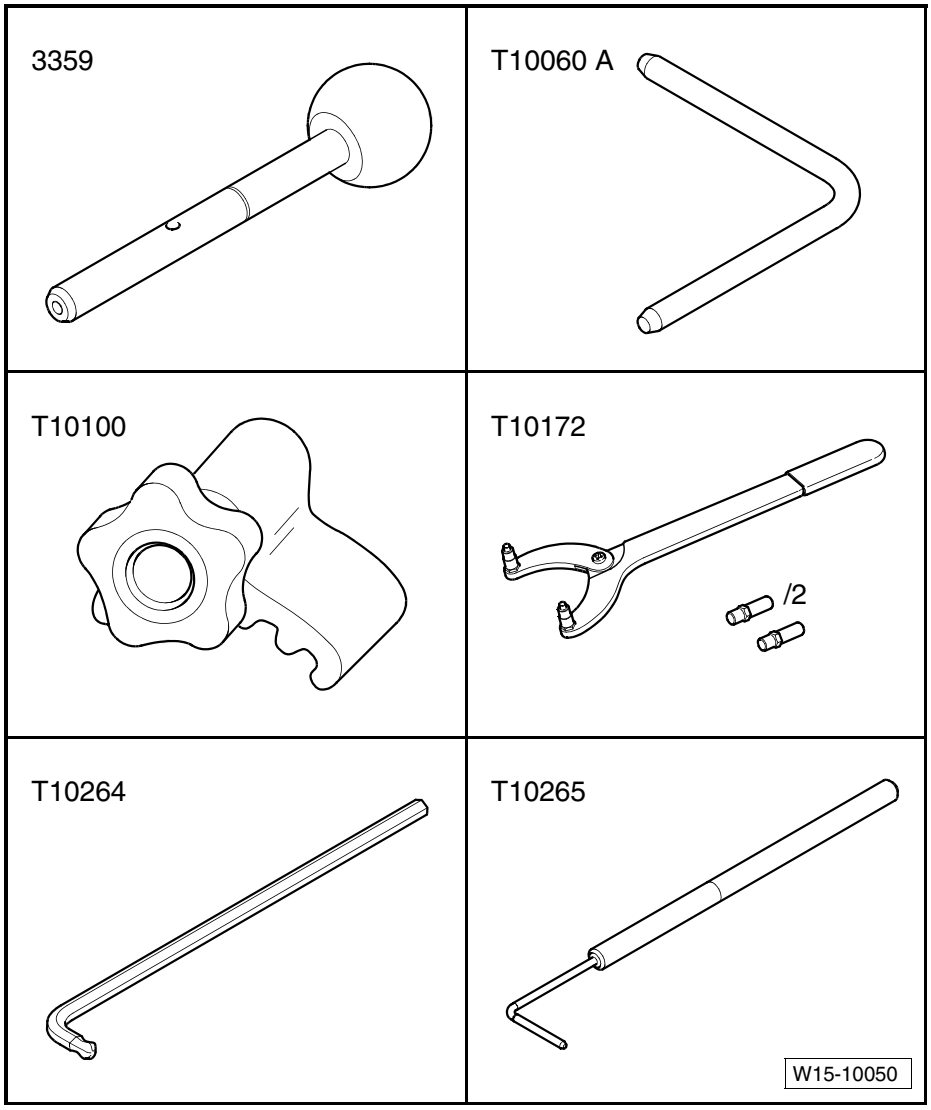
– Fit cylinder head cover, insert securing bolts and tighten by hand in the tightening sequence shown -1...13-.
– Then tighten securing bolts in the tightening sequence shown -1...13- to 10 Nm.



1.3 Removing, installing and tensioning toothed belt

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Diesel injection pump locking pin -3359-
- Locking pin -T10060 A-
- Crankshaft stop -T10100-
- Counterhold tool -T10172-
- Special wrench, long reach -T10264-
- Locking tool -T10265-



Not illustrated

- Torque wrench (5...50 Nm) -V.A.G 1331-
- Spring-type clip pliers -VAS 5024-

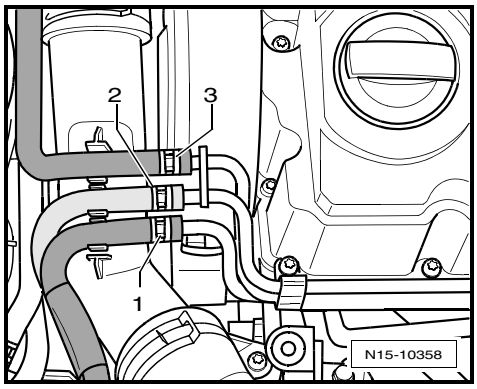
Removing ⇒ Seite 117.

Installing, tensioning ⇒ Seite 119.

1.3.1 Removing

> ***ACHTUNG!***
>
> ***For all assembly work, the following should be observed due to the restricted amount of space available:***
>
> - ***Route all the various lines (e.g. for fuel, hydraulics, coolant and refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
> - ***Ensure that there is sufficient clearance to all moving or hot components.***

– Disconnect fuel supply hose -2- and fuel return hose -1- from the fuel filter on the engine.



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

– Seal lines so that fuel system is not contaminated by dirt.

– Disconnect coolant hose -3-.

Engine codes CBJA, CBJB, CBKA

– Remove connecting pipe between charge air cooler and intake connecting pipe.

Continuation for all engine codes

– Remove poly V-belt ⇒ Seite 86.

– Remove tensioning element for poly-V-belt ⇒ Seite 85 Assembly overview - poly-V-belt drive.

– Remove upper toothed belt guard.

– Remove vibration damper/belt pulley ⇒ Seite 88 Assembly overview - toothed belt drive.

– Remove toothed belt guard middle and lower part.

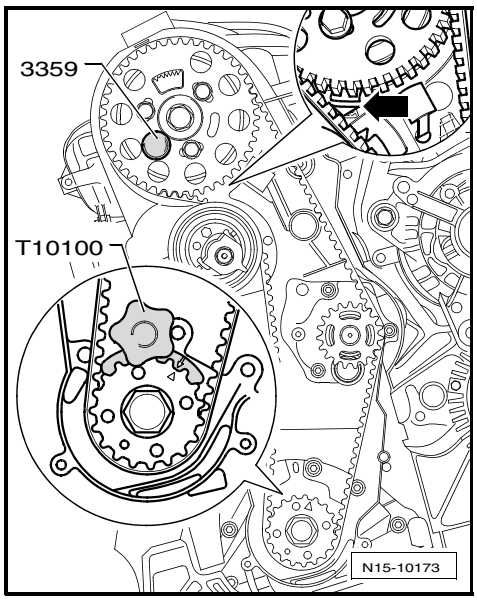
– Turn crankshaft to TDC No. 1 cylinder.

Hinweis

Turn crankshaft until marking on crankshaft pulley and tooth segment of camshaft pulley is on top. The marking on the toothed belt rear guard must align with the marking on the camshaft sender wheel -arrow-.

– Lock hub using locking pin - 3359-. To do this, slide locking pin through the free elongated hole on the left into the hole in the cylinder head.

– Lock crankshaft toothed belt pulley with crankshaft stop -T10100-. To do this, slide crankshaft stop from face side of toothed belt pulley into teeth.

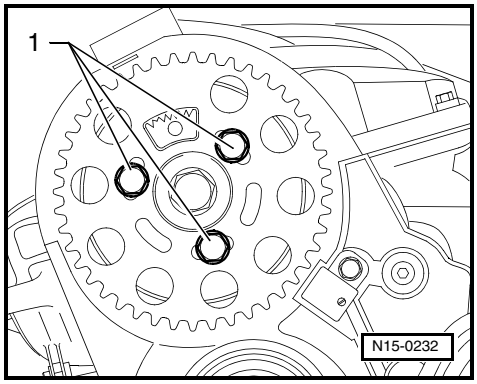


Hinweis

The marks on the crankshaft toothed belt pulley and the crankshaft stop must align. At the same time, the pin of the crankshaft stop must engage in the drilling in the sealing flange.

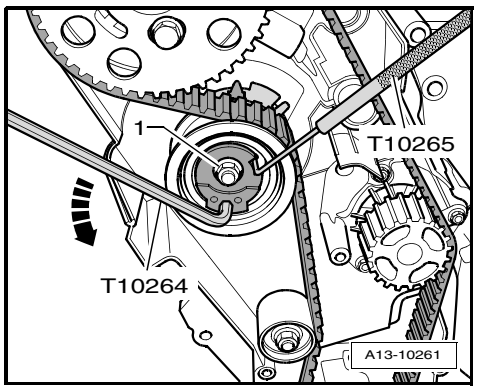
– Mark direction of rotation of toothed belt.

– Loosen securing bolts -1- of camshaft toothed belt pulley until camshaft pulley can be moved within the elongated holes.

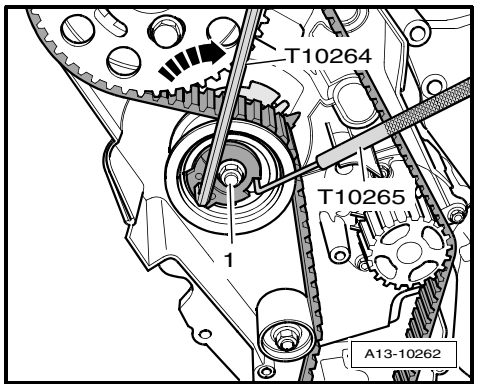


– Loosen tensioning roller securing nut -1-.

– Turn eccentric of tensioning roller using socket -T10264- anti-clockwise -arrow- until the tensioning roller can be locked using locking tool -T10265-.



– Now turn eccentric of tensioning roller clockwise -arrow- to stop and tighten securing nut -1- hand-tight.
– Remove toothed belt first from coolant pump and then from remaining toothed belt pulleys.



1.3.2 Installing, tensioning

Prerequisites

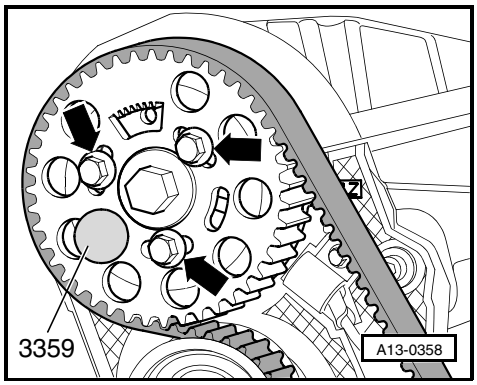
- Camshaft locked with locking pin -3359-.
- Crankshaft locked in position with crankshaft stop -T10100-.
- Tensioning roller locked with locking pin -T10265- and secured to right stop with securing nut.

Procedure

Hinweis

Adjustment work on toothed belts must be performed only on cold engines, as the indicator position on the tensioning element varies depending on the engine temperature.

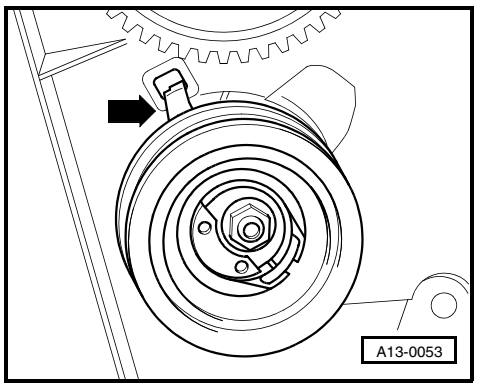
– Turn crankshaft toothed belt pulley in its elongated holes to centre position -arrows-.
– Fit toothed belt onto crankshaft toothed belt pulley, tensioning roller, camshaft toothed belt pulley and idler roller.
– Then fit toothed belt on coolant pump toothed belt pulley.



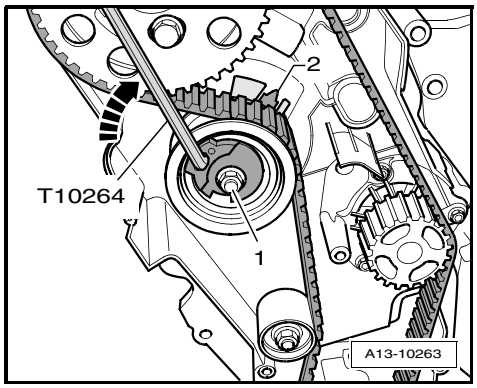
Hinweis

Ensure that tensioning roller seats correctly in rear toothed belt guard -arrow-.

– Remove locking pin -T10265- from tensioning roller.



– Loosen tensioning roller securing nut -1-.
– Turn eccentric of tensioning roller using socket -T10264- clockwise -arrow- until indicator -2- is in middle of gap in base plate.

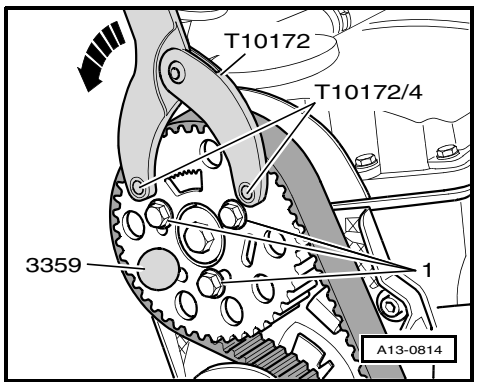


Hinweis

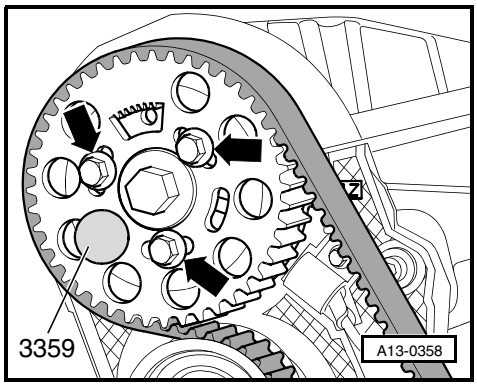
Ensure that securing nut does not turn as well.

– Hold tensioning roller in this position and tighten tensioning roller nut to 20 Nm + 45° ($^1/_8$ turn).

– Fit counterhold tool -T10172- with pin -T10172/4- as shown in illustration, and keep the toothed belt under tension on pulling side, by pressing in -direction of arrow-.
– Tighten bolts -1- of camshaft toothed belt pulley to 25 Nm.
– Remove locking pin -3359- and crankshaft stop -T10100-.
– Turn crankshaft two rotations in engine direction of rotation until the crankshaft is just before TDC again.

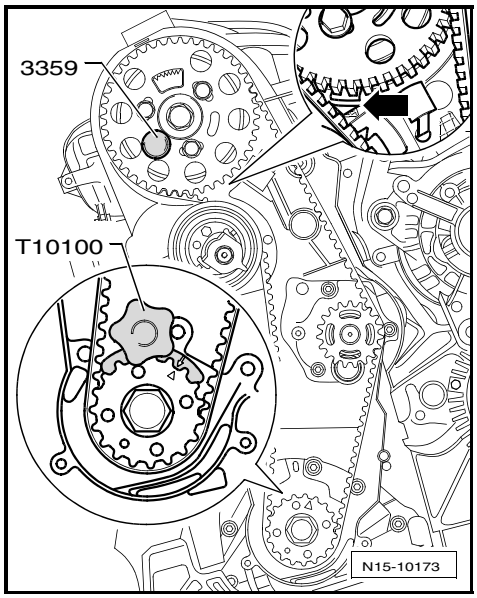


– Lock hub of camshaft with locking pin -3359- whilst turning engine in direction of rotation.

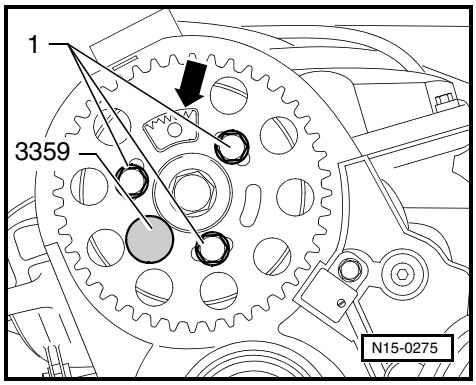


– Check whether crankshaft can be locked with crankshaft stop -T10100-.

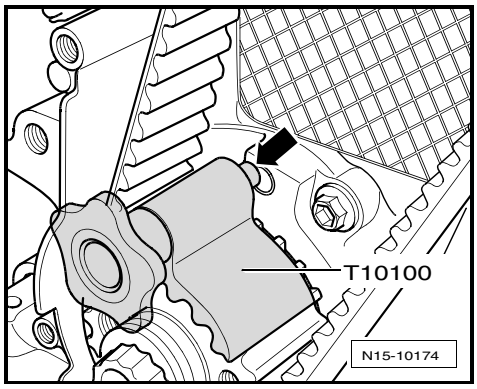
If crankshaft cannot be locked:



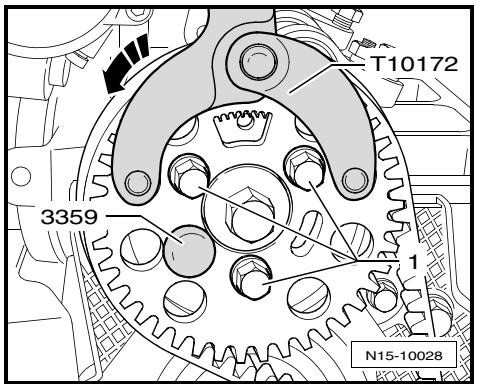
– Loosen securing bolts -1- on camshaft sprocket.



– Turn crankshaft slightly against engine direction of rotation until the pin of the crankshaft stop is positioned just before the hole in the sealing flange -arrow-.
– Now turn crankshaft in engine direction of rotation until pin of crankshaft stop engages in sealing flange from rotational movement.



– Fit counterhold tool -T10172- with pins -T10172/4- as shown. Press counterhold tool -T10172- in -direction of arrow-, keeping camshaft toothed belt pulley under tension.
– In this position, tighten camshaft toothed belt pulley securing bolts -1- to 25 Nm.
– Remove locking pin -3359- and crankshaft stop -T10100-.
– Turn crankshaft two rotations in engine direction of rotation until crankshaft is just before TDC No. 1 cylinder.
– Repeat check and adjustment if necessary.
– Install toothed belt guard middle and lower part.
– Install belt pulley/vibration damper. Torque setting: 10 Nm + 90° (1/4 turn) further.
– Install upper toothed belt guard.
– Install poly V-belt tensioner. Torque setting: 25 Nm.
– Install poly V-belt ⇒ Seite 86.

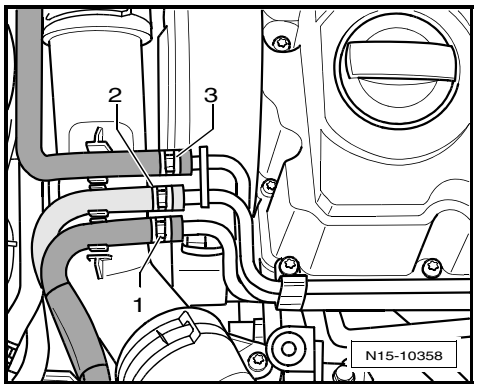


Engine codes CBJA, CBJB, CBKA

– Install connecting pipe between charge air cooler and intake connecting pipe.

Continuation for all engine codes

– Install coolant hose -3-.
– Install fuel supply hose -2- and fuel return hose -1-.

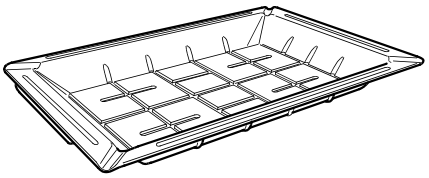


1.4 Removing and installing cylinder head

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Drip tray -V.A.G 1306- or drip tray -VAS 6208-
- Torque wrench (5...50 Nm) -V.A.G 1331-
- Torque wrench (40...200 Nm) -V.A.G 1332-
- Hand vacuum pump with accessories -V.A.G 1390-
- Water drainage container -V.A.G 1390/1-

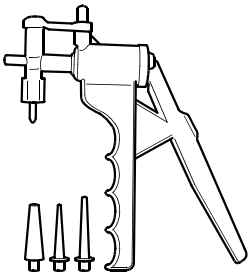
VAS 6208



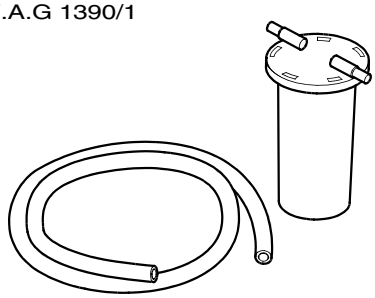
V.A.G 1331

V.A.G 1332

V.A.G 1390



V.A.G 1390/1



W15-10065

Not illustrated

- Container for removed parts -V.A.G 1698-
- Spring-type clip pliers -VAS 5024-

- Engine bung set -VAS 6122-
- Cable ties

Notes on removing ⇒ Seite 123.

Notes on installing ⇒ Seite 124.

1.4.1 Notes on removing

Hinweis

The following work procedure contains just general notes on removal and installation of the cylinder head. This is because no universal work procedure can be prescribed due to the different installation conditions.

ACHTUNG!

For all assembly work, the following should be observed due to the restricted amount of space available:

- ***Route all the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant, refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***Ensure that there is sufficient clearance to all moving or hot components.***

Hinweis

- *All cable ties which are released or cut open when removing must be fitted in the same position when installing.*
- *To prevent damage to removed components, place them in the container for removed parts -V.A.G 1698-.*

– With ignition switched off, disconnect earth strap from battery.

Hinweis

Before removing cylinder head, extract fuel from tandem pump using hand-operated vacuum pump with accessories -V.A.G 1390- and water drainage container -V.A.G 1390/1- ⇒ Seite 165, Removing and installing tandem pump.

Engine code CBKA

– Remove connecting pipe between exhaust manifold and exhaust gas recirculation cooler ⇒ Seite 240, Assembly overview - exhaust gas recirculation cooler.

Continuation for all engine codes

– Drain coolant ⇒ Seite 151.

– Unscrew rear coolant pipe ⇒ Seite 148, Parts of cooling system on engine side.

– Pull off all coolant hoses to cylinder head using spring-type clip pliers -VAS 5024-.

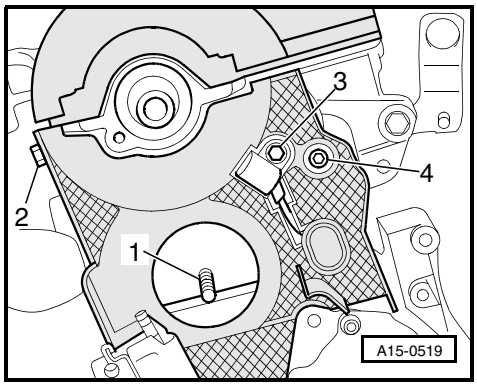
– Unbolt support for turbocharger with oil return line ⇒ Seite 178, Assembly overview - Turbocharger with attachment parts.

Engine code CBKA

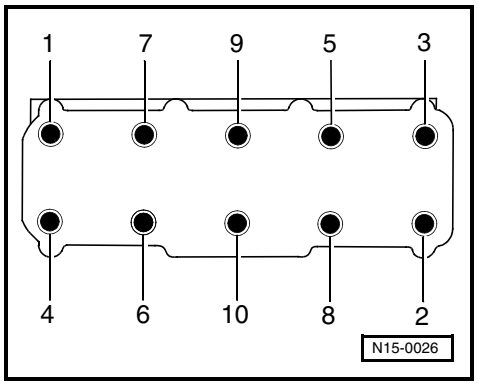
– Remove exhaust gas recirculation cooler ⇒ Seite 240, Assembly overview - exhaust gas recirculation cooler.

Continuation for all engine codes

– Remove toothed belt ⇒ Seite 116, Removing, installing and tensioning toothed belt.
– Remove tensioning roller for toothed belt ⇒ Seite 112, Assembly overview - cylinder head.
– Install hub for camshaft toothed belt pulley ⇒ Seite 133, Removing and installing camshaft.
– Remove rear toothed belt guard securing bolts -2- and -4-.
– Pull off or disconnect all other electrical connections as necessary from cylinder head and lay to one side.
– Pull off appropriate vacuum and breather hoses from cylinder head.
– Remove cylinder head cover ⇒ Seite 114.



– Maintain sequence when loosening cylinder head bolts.
– Lift cylinder head slightly and remove from engine laterally past toothed belt guard.



Hinweis

The cylinder head must be guided carefully to prevent damage.

1.4.2 Notes on installing

Hinweis

- *Always renew cylinder head bolts.*
- *In cases of repair carefully remove gasket remains from cylinder head and cylinder block. Ensure that no long scores or scratches are made on the surfaces. When using abrasive paper do not use a grade less than 100.*
- *Carefully remove emery and abrasive remains.*
- *Remove new cylinder head gasket from packaging, just before installation.*
- *Handle gasket very carefully. Damage to the silicone coating or the indented area will lead to leaks.*

– Set crankshaft to TDC mark before fitting cylinder head.
– Turn crankshaft opposite engine direction of rotation until all pistons are approximately equally placed below TDC.

– Fit cylinder head gasket.

Hinweis

Note identification on cylinder head gasket ⇒ Abb. auf Seite 114.

– Fit cylinder head and tighten all cylinder head bolts hand-tight.
– Tighten cylinder head in four stages in sequence as shown as follows:

1 - Tighten initially with torque wrench

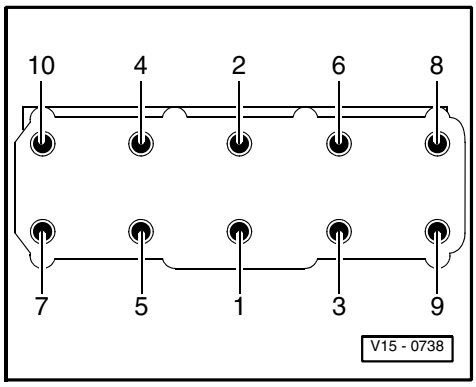
Stage I = 35 Nm

Stage II = 60 Nm

2 - Turn further with rigid wrench

Stage III = $^1/_4$ turn (90°)

Stage IV = $^1/_4$ turn (90°)

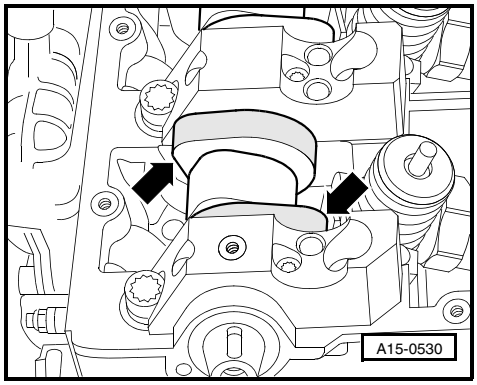


Hinweis

After repair work it is not necessary to retighten the cylinder head bolts.

The remaining installation steps are carried out in the reverse sequence. In the process, note the following:

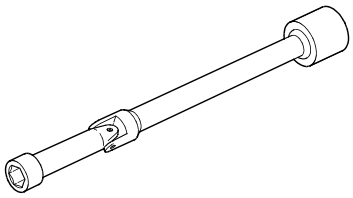
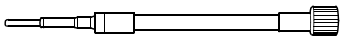
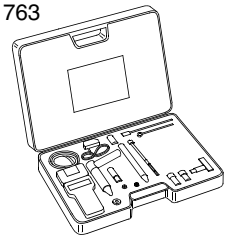
– After tightening cylinder head, turn camshaft so that cams for No. 1 cylinder point equally upwards. Before fitting toothed belt, set crankshaft to TDC by turning in engine direction of rotation ⇒ Seite 116, removing, installing and tensioning toothed belt.
– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.



1.5 Checking compression

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- U/J extension and socket, 10 mm -3220-
- Torque wrench (5...50 Nm) -V.A.G 1331-
- Adapter -V.A.G 1381/12-
- Compression tester -V.A.G 1763-

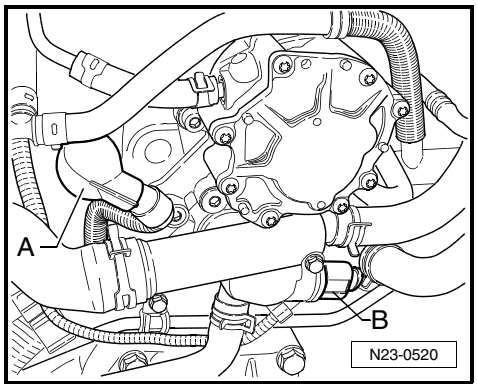
3220 	V.A.G 1331 
V.A.G 1381/12 	V.A.G 1763 
	W15-0002

Test prerequisites

- All electrical consumers must be switched off.
- Check unit injectors are OK ⇒ Seite 205, Checking unit injector valves (cylinder 1...4) - N240...N243-
- Engine oil temperature min. 30 °C.

Test procedure

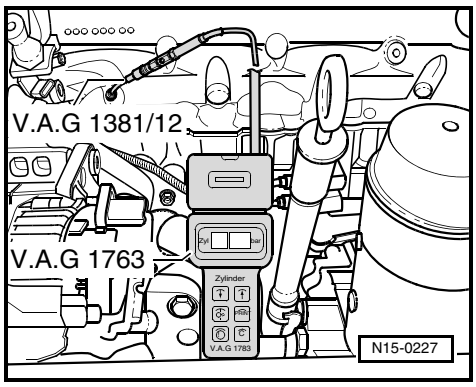
– Pull off central connector -A- for unit injectors.
– Remove all ceramic glow plugs ⇒ Seite 321, Removing, installing and checking ceramic glow plugs.



Hinweis

Observe characteristics of ceramic glow plugs ⇒ Seite 321 without fail.

– Screw in adapter -V.A.G 1381/12- in place of the ceramic glow plugs.
– Check compression using compression tester -V.A.G 1763-.



Hinweis

Using the compression tester ⇒ operating instructions.

– Operate starter until tester shows no further pressure increase.

Compression pressures

- New: 25...31 bar overpressure
- Wear limit: 19 bar
- Maximum permissible difference between all cylinders: 5 bar

– Install all ceramic glow plugs ⇒ Seite 321, Removing, installing and checking ceramic glow plugs.

Hinweis

Observe characteristics of ceramic glow plugs ⇒ Seite 321 without fail.

– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

Hinweis

Disconnecting the central connector for unit injectors causes faults to be stored. Therefore read and erase fault memory.

2 Repairing valve gear

Hinweis

Cylinder heads with cracks between the valve seats may be used without reducing engine life, provided the cracks are small and not more than 0.5 mm wide.

Assembly overview - valve gear ⇒ Seite 128.

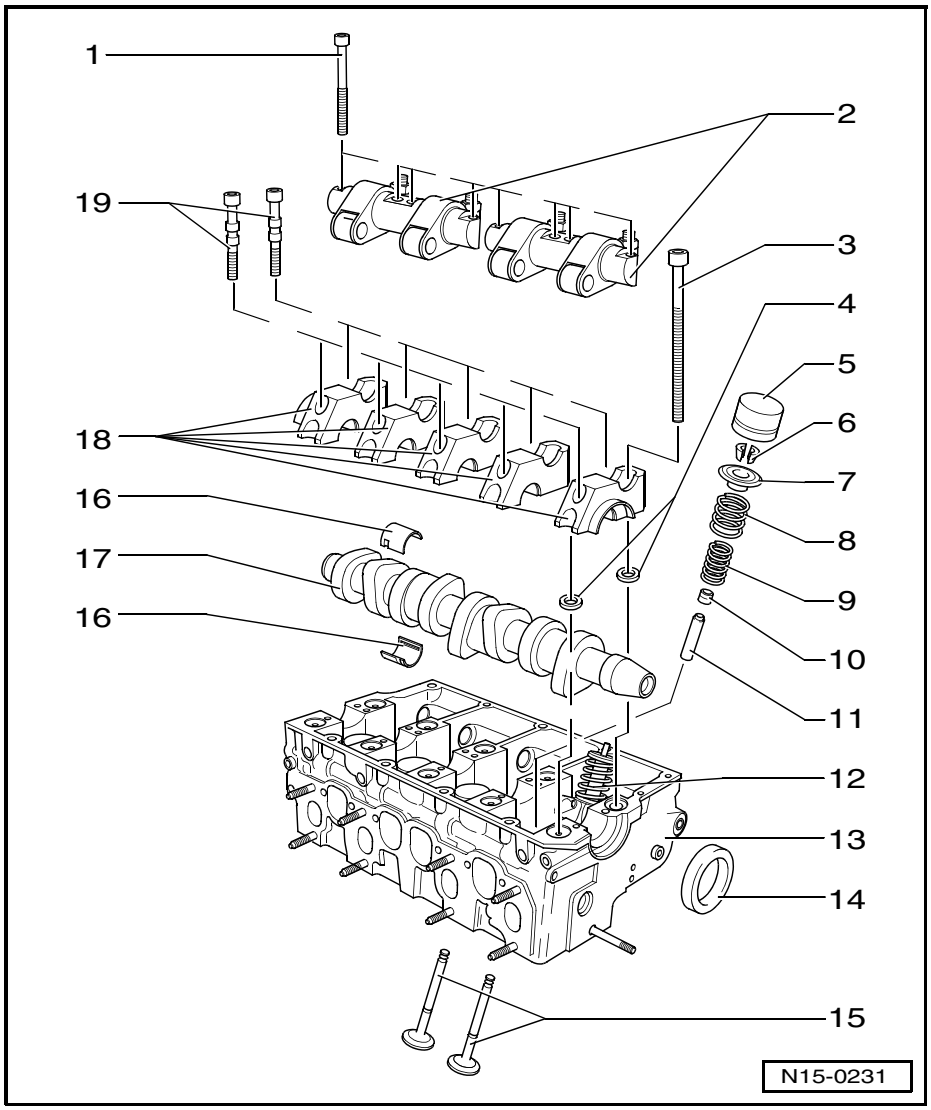
Checking valve guides ⇒ Seite 130.

Renewing valve stem seals ⇒ Seite 131.

Removing and installing camshaft ⇒ Seite 133.

Removing and installing camshaft seal ⇒ Seite 137.

2.1 Assembly overview - valve gear



1 - 20 Nm + 1/4 turn (90°) further
- ❑ Renew
- ❑ Adhere to sequence when loosening and tightening ⇒ Seite 133, removing and installing camshaft

2 - Rocker arm shaft
- ❑ Do not interchange

3 - Cylinder head bolt
- ❑ Renew
- ❑ Note sequence when loosening and tightening ⇒ Seite 122, removing and installing cylinder head.
- ❑ Before installing, insert washers ⇒ Pos. 4 in cylinder head

4 - Washer
- ❑ For cylinder head bolts
- ❑ Insert in cylinder head before installing bearing caps

5 - Bucket tappet
- ❑ Do not interchange
- ❑ With hydraulic valve clearance compensation
- ❑ Store with cam contact surface downwards
- ❑ Before installing, check camshaft axial clearance ⇒ Abb. auf Seite 129
- ❑ Oil contact surface
- ❑ Before removing, remove camshaft bearing caps

6 - Cotters

7 - Valve spring plate

8 - Outer valve spring

Removing and installing
- ❑ Cylinder head removed: with valve spring compressor -2037-
- ❑ Cylinder head in-situ: ⇒ Seite 131, Renewing valve stem seals

9 - Inner valve spring

Removing and installing
- ❑ Cylinder head removed: with valve spring compressor -2037-

- ❑ Cylinder head in-situ: ⇒ Seite 131, Renewing valve stem seals

10 - Valve stem oil seal
- ❑ Renewing ⇒ Seite 131

11 - Valve guide
- ❑ Checking ⇒ Seite 130.

12 - Unit injector
- ❑ Assembly overview - unit injector ⇒ Seite 198

13 - Cylinder head
- ❑ See note ⇒ Seite 127

14 - Seal
- ❑ Do not additionally oil or grease the oil seal sealing lip
- ❑ Before installing, remove residual oil from camshaft journal using a clean cloth
- ❑ To install, tape over groove in taper of camshaft (e.g. using Sellotape)
- ❑ Removing and installing ⇒ Seite 137.

15 - Valves
- ❑ Valve dimensions ⇒ Abb..

16 - Bearing shell
- ❑ Do not interchange used bearing shells (mark)
- ❑ Ensure proper seating of retaining lugs in bearing caps and cylinder head

17 - Camshaft
- ❑ Check axial clearance ⇒ Abb..
- ❑ Removing and installing ⇒ Seite 133.
- ❑ Check radial clearance using Plastigage, wear limit: 0.11 mm
- ❑ Runout: max. 0.01 mm

18 - Bearing cap
- ❑ Installation sequence ⇒ Seite 133, removing and installing camshaft
- ❑ To install, seal parting surfaces of bearing caps 1 and 5 with sealant -AMV 174 004 01- ⇒ Abb..

19 - 8 Nm + $^1/_4$ turn (90°) further
- ❑ Renew

Checking camshaft axial clearance

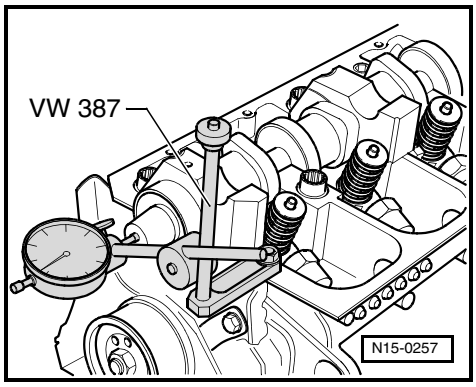
Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- ♦ Universal dial gauge bracket -VW 387-
- ♦ Dial gauge

Test procedure

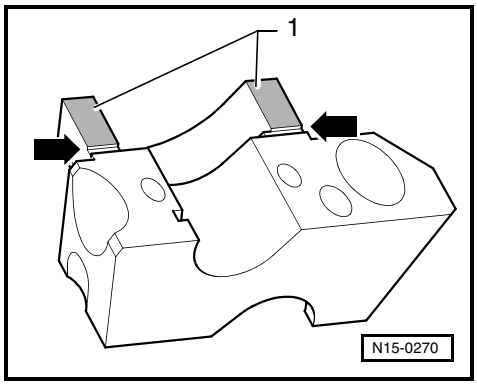
Check with bucket tappets removed and with first, third and last bearing caps fitted.

Wear limit: max. 0,15 mm.



Seal parting surfaces of bearing caps 1 and 5 with sealant -AMV 174 004 01-.

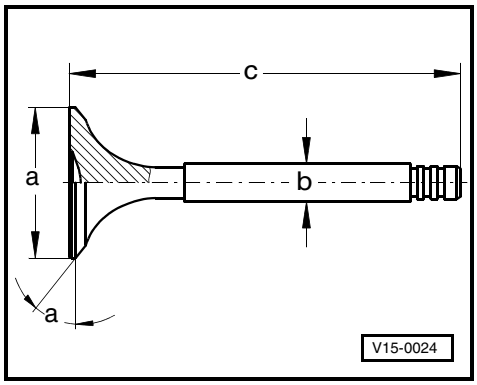
– Apply sealant -AMV 174 004 01 - thinly and evenly to surfaces -1-.



Hinweis

Be careful that no sealant gets into grooves -arrows-.

Valve dimensions



Hinweis

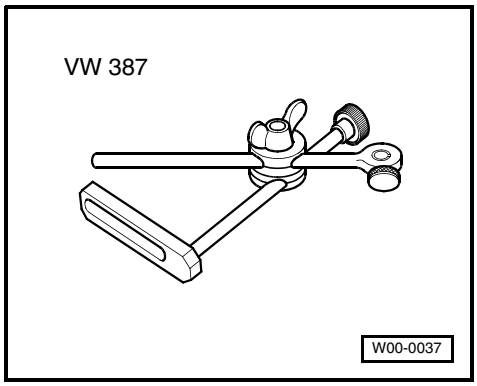
Valves must not be reworked. Only lapping-in is permitted.

Dimension		Inlet valve	Exhaust valve
∅ a	mm	35,950	31,450
∅ b	mm	6,980	6,956
c	mm	89,950	89,950
α	∠°	45	45

2.2 Checking valve guides

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Universal dial gauge bracket -VW 387-
- Dial gauge

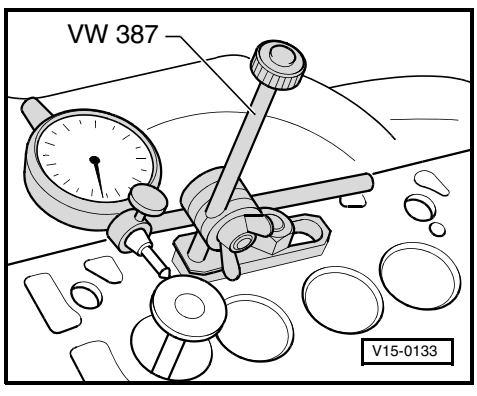


Test procedure

– Insert new valve into guide. The end of the valve stem must be flush with the guide. Due to differences in stem diameters, use only an inlet valve in inlet guide and an exhaust valve in exhaust guide.

– Determine rock. Wear limit: max. 1.3 mm.

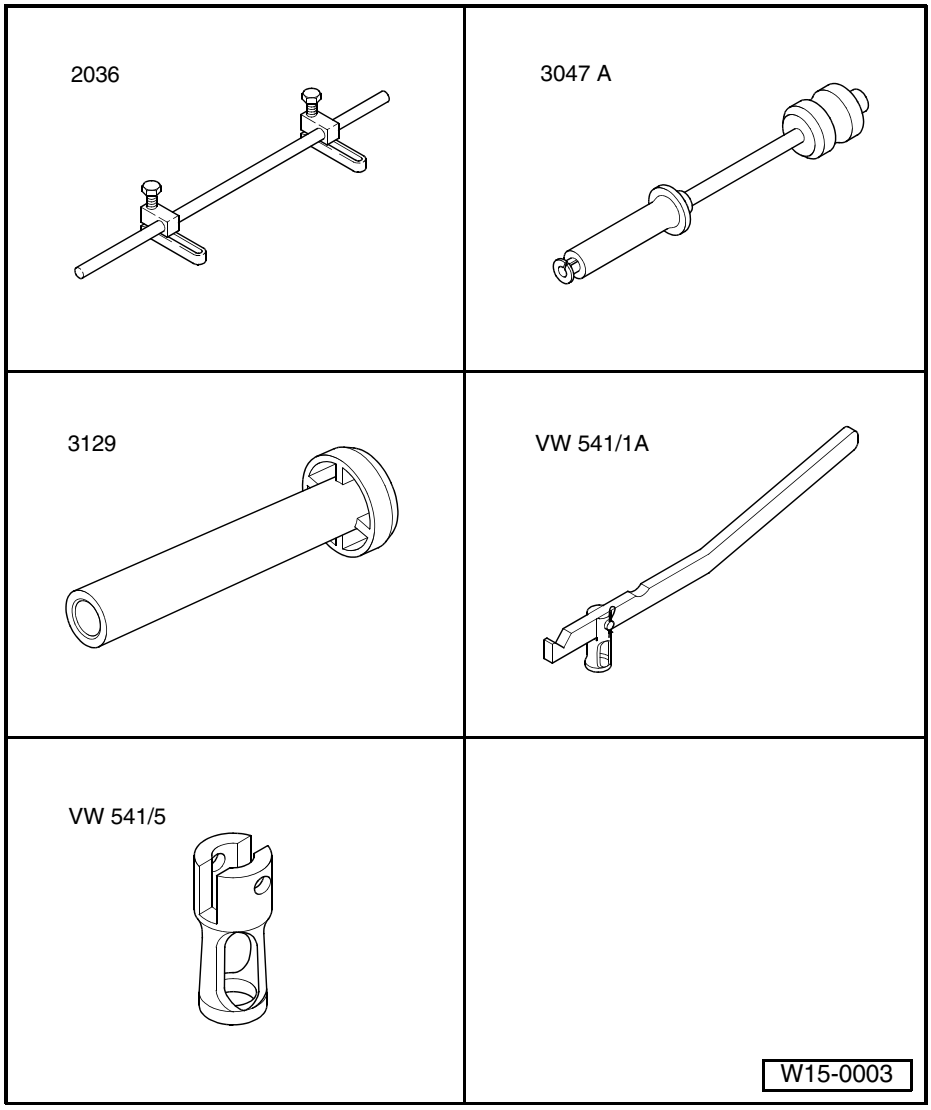
– Cylinder head must be renewed if rock exceeds wear limit.



2.3 Renewing valve stem oil seals

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Valve assembly device -2036-
- Puller -3047 A-
- Fitting tool -3129-
- Valve lever -VW 541/1A-
- Thrust piece -VW 541/5-



Removing ⇒ Seite 131.

Installing ⇒ Seite 132.

2.3.1 Removing

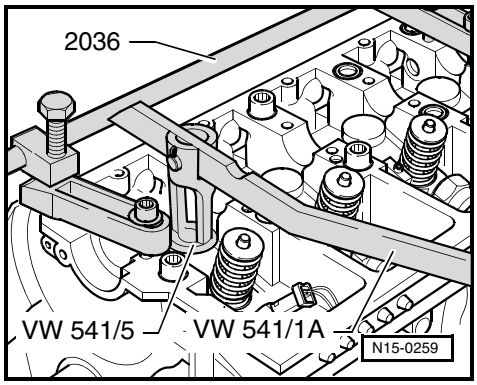
(with cylinder head installed)

– Remove camshaft ⇒ Seite 133.

– Remove bucket tappets and place them with the contact surface downwards. When doing this, ensure that the tappets are not interchanged.

– Set piston of respective cylinder to top dead centre (TDC).

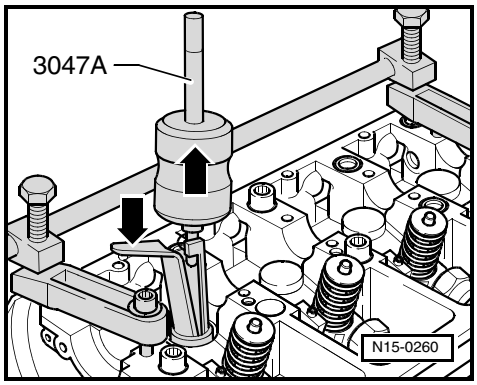
– Insert valve assembly device -2036- and adjust mounting to height of studs.
– Remove valve springs using valve lever - VW 541/1A- and press tool -VW 541/5-.



Hinweis

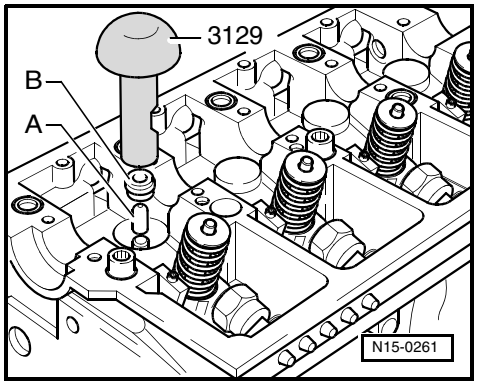
The valves are supported by the piston crown.

– Pull off valve stem seals using puller -3047 A-.



2.3.2 Installing

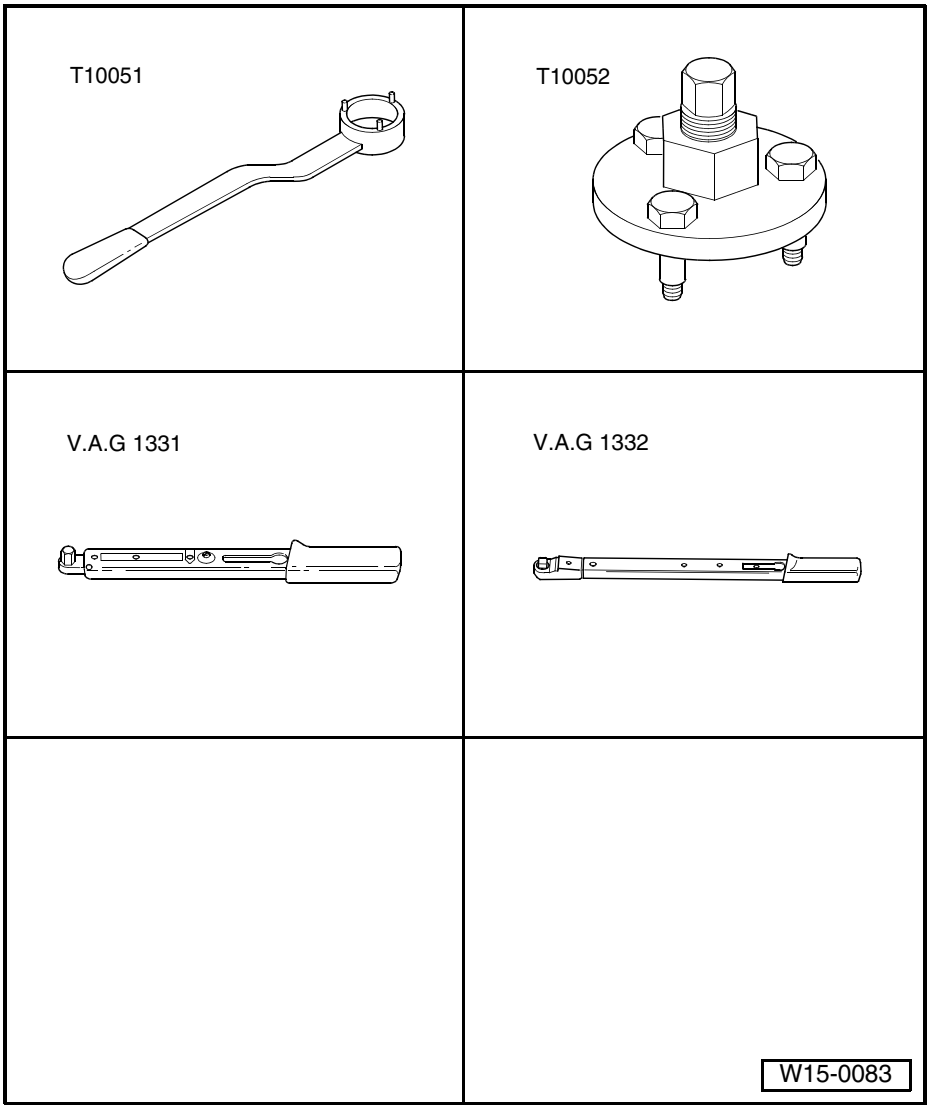
– Place the plastic sleeve -A- supplied on the respective valve stem. This will prevent the new valve stem seal -B- being damaged.
– Insert new valve stem seal -B- in fitting tool -3129-.
– Oil valve stem seal sealing lip -B- and press carefully onto the valve guide.
– Install camshaft ⇒ Seite 133.



2.4 Removing and installing camshaft

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Counterhold tool -T10051-
- Puller -T10052-
- Torque wrench (5...50 Nm) -V.A.G 1331-
- Torque wrench (40...200 Nm) -V.A.G 1332-
- Sealant -AMV 174 004 01-



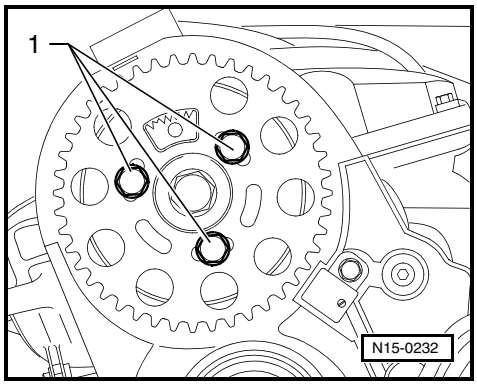
Removing ⇒ Seite 133.

Installing ⇒ Seite 135.

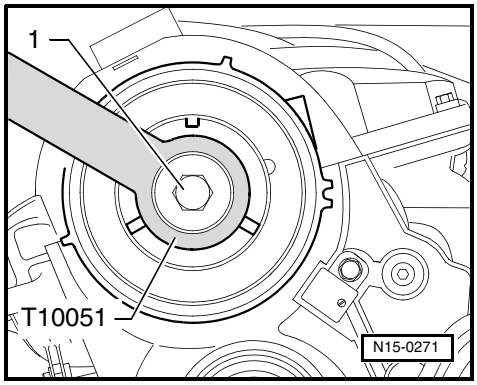
2.4.1 Removing

– Remove toothed belt ⇒ Seite 116, Removing, installing and tensioning toothed belt.

– Remove securing bolts for camshaft toothed belt pulley -1-.
– Pull camshaft toothed belt pulley off hub.



– Loosen hub securing bolt -1-.
– To do this, use counterhold -T10051-.
– Loosen hub securing bolt about 2 turns.

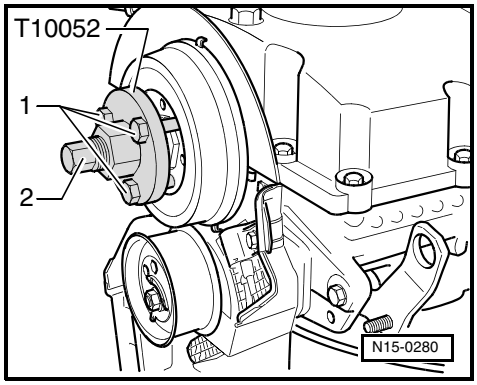


– Fit puller -T10052- and screw securing bolts -1- into hub.
– Apply tension to hub by evenly tightening puller until hub separates from taper of camshaft.

Hinweis

When doing this, hold puller with 30 mm spanner.

– Remove hub from taper of camshaft.
– Remove cylinder head cover ⇒ Seite 114.

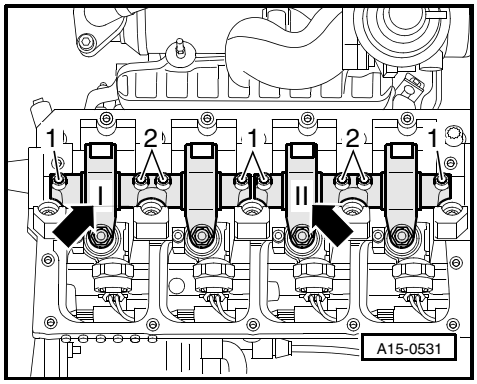


– Mark rocker arm shafts using a permanent felt tip marker to prevent interchanging. This will prevent having to perform basic settings of unit injectors -arrows-.
– Remove rocker arm shafts.

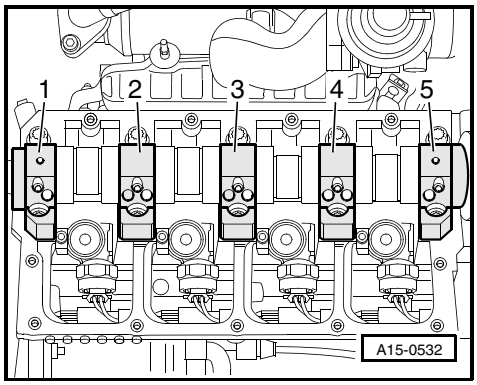
Hinweis

First loosen both outer and then inner securing bolts respectively.

– Remove tandem pump ⇒ Seite 165.



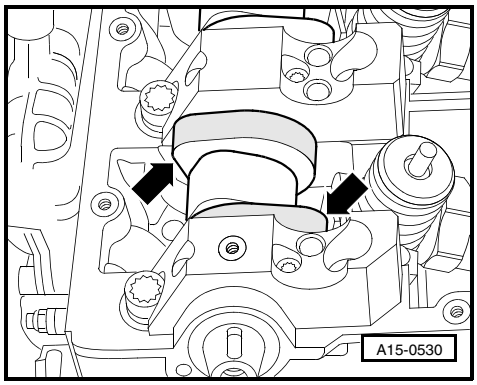
– First remove bearing caps 5, 1 and 3. Then loosen bearing caps 2 and 4 alternately and diagonally.
– Remove camshaft.



2.4.2 Installing

Hinweis

- *When installing camshaft, no. 1 cylinder cams -arrows- must point upwards.*
- *Do not interchange used bearing shells (mark).*
- *When installing the camshaft, ensure proper seating of retaining lugs in bearing caps and cylinder head.*
- *Before installing bearing caps, ensure that cylinder head bolt washers are inserted in the cylinder head.*

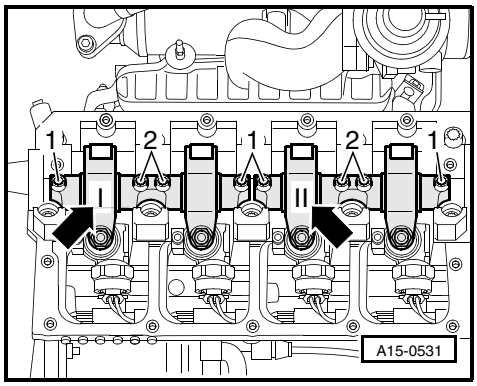


– Oil bearing shell running surface.
– Install bearing caps 2 and 4 using new bolts.
– Tighten bearing caps 2 and 4 diagonally and alternately to 8 Nm + $^1/_4$ turn (90°).
– Install bearing caps 5, 1 and 3 using new bolts.

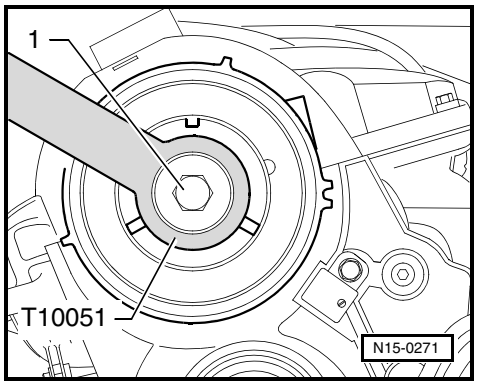
Hinweis

- *Seal parting surfaces of bearing caps 1 and 5 with sealant -AMV 174 004 01- ⇒ Abb. auf Seite 130.*
- *Bearing cap 5 must be flush with outer edge of cylinder head, otherwise leaks can occur at the tandem pump.*

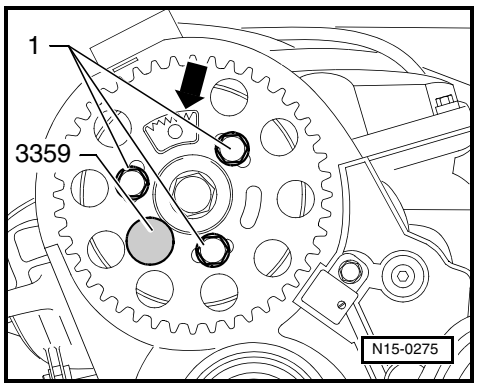
– Tighten bearing caps 5, 1 and 3 likewise to 8 Nm + $^1/_4$ turn (90°).
– Install camshaft oil seal ⇒ Seite 137.
– Install injector rocker arm shafts with new securing bolts and tighten, first the inner -2- and then the outer -1-, alternately and diagonally to 20 Nm + $^1/_4$ turn (90°).
– Place hub on camshaft.



– Tighten hub securing bolt -1- to 100 Nm.
– To do this, use counterhold -T10051-.



– Push camshaft toothed belt pulley onto hub.



Hinweis

The toothed segment -arrow- of the camshaft belt pulley must be on top.

– Align camshaft toothed belt pulley at centre of elongated holes.
– Hand tighten securing bolts -1- to camshaft toothed belt pulley so that there is no play.
– Lock hub using locking pin - 3359-.
– Install and tension toothed belt ⇒ Seite 116.
– Install tandem pump ⇒ Seite 165.

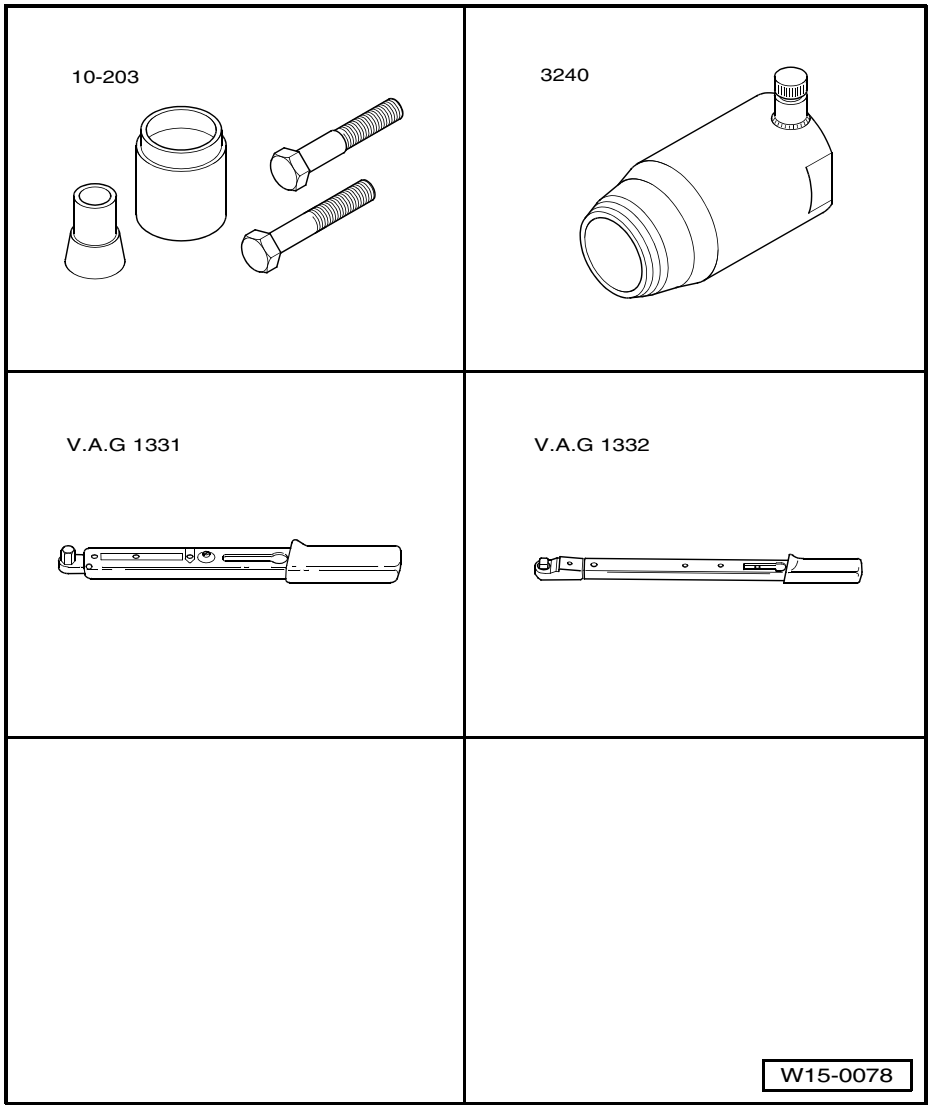
Hinweis

When new bucket tappets have been installed the engine must not be started for about 30 minutes. Hydraulic valve compensation elements have to settle (otherwise valves will strike pistons).

2.5 Removing and installing camshaft oil seal

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Fitting tool -10-203-
- Oil seal extractor -3240-
- Torque wrench (5...50 Nm) -V.A.G 1331-
- Torque wrench (40...200 Nm) -V.A.G 1332-
- Bolt M12×1.5×65



Removing ⇒ Seite 137.

Installing ⇒ Seite 138.

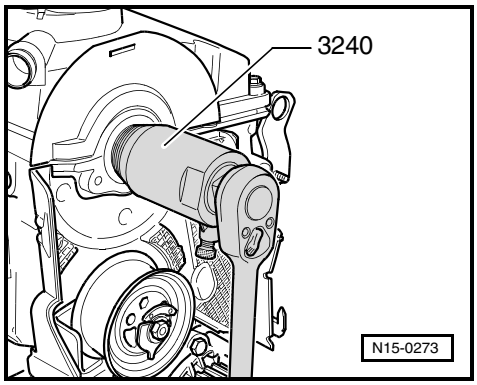
2.5.1 Removing

– Remove toothed belt ⇒ Seite 116, Removing, installing and tensioning toothed belt.

– Remove camshaft toothed belt pulley and hub ⇒ Seite 133, Removing and installing camshaft.

– Unscrew inner part of oil seal extractor - 3240- two turns (approx. 3 mm) out of outer part and lock with knurled screw.

– Lubricate threaded head of oil seal extractor -3240-, place it in position and exerting firm pressure, screw it as far as possible into oil seal.
– Loosen knurled screw and turn inner part against camshaft until the oil seal is pulled out.

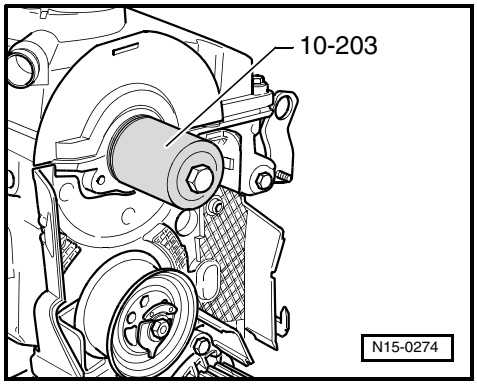


2.5.2 Installing

Hinweis

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

– Remove oil residue from camshaft journal using a clean cloth.
– Tape over groove in taper of camshaft (e.g. with Sellotape).
– Fit oil seal carefully on camshaft.
– Press oil seal in onto stop using press piece from fitting tool -10-203- and bolt M12 x 1.5 x 65.
– Install and tension toothed belt ⇒ Seite 116.



17 – Lubrication

1 Engine oil

Hinweis

The oil level must not be above the max. mark - danger of damage to catalytic converter! Markings ⇒ Seite 139 Checking engine oil level.

Oil capacities ⇒ Seite 139.

Engine oil specifications ⇒ Seite 139.

Checking engine oil level ⇒ Seite 139.

1.1 Oil capacities

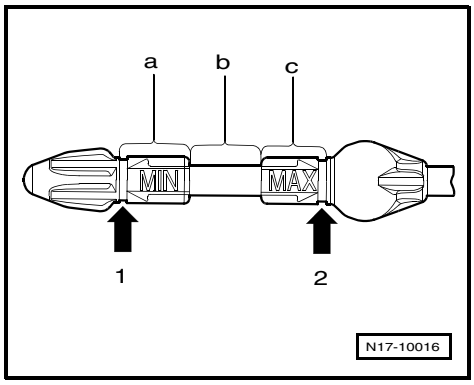
- With oil filter change: 4.3 l
- Without oil filter change: 4.0 l

1.2 Engine oil specification

Only use engine oil conforming to VW standard 50700.

1.3 Checking engine oil level

Markings on oil dipstick



1 - Min. mark
2 - Max. mark
a - Area of min. mark: must be topped-up, max. 0.5 l of engine oil!
b - Oil level in middle range: can be topped-up with engine oil.
c - Area of max. mark: do not add engine oil!

2 Parts of lubrication system

Vorsicht!

Finding metal shavings or a large quantity of small metal particles during engine repair could indicate that the crankshaft bearings or conrod bearings are damaged. To prevent subsequent damage, perform the following work after completing repairs:

Thoroughly clean oil passages,

Renew oil spray jets,

Renew oil cooler,

Renew oil filter element.

Hinweis

When working on engine, secure it with engine and gearbox support -VW 540- to assembly stand or to engine and gearbox support -VAS 6095-.

Observe safety precautions ⇒ Seite 195

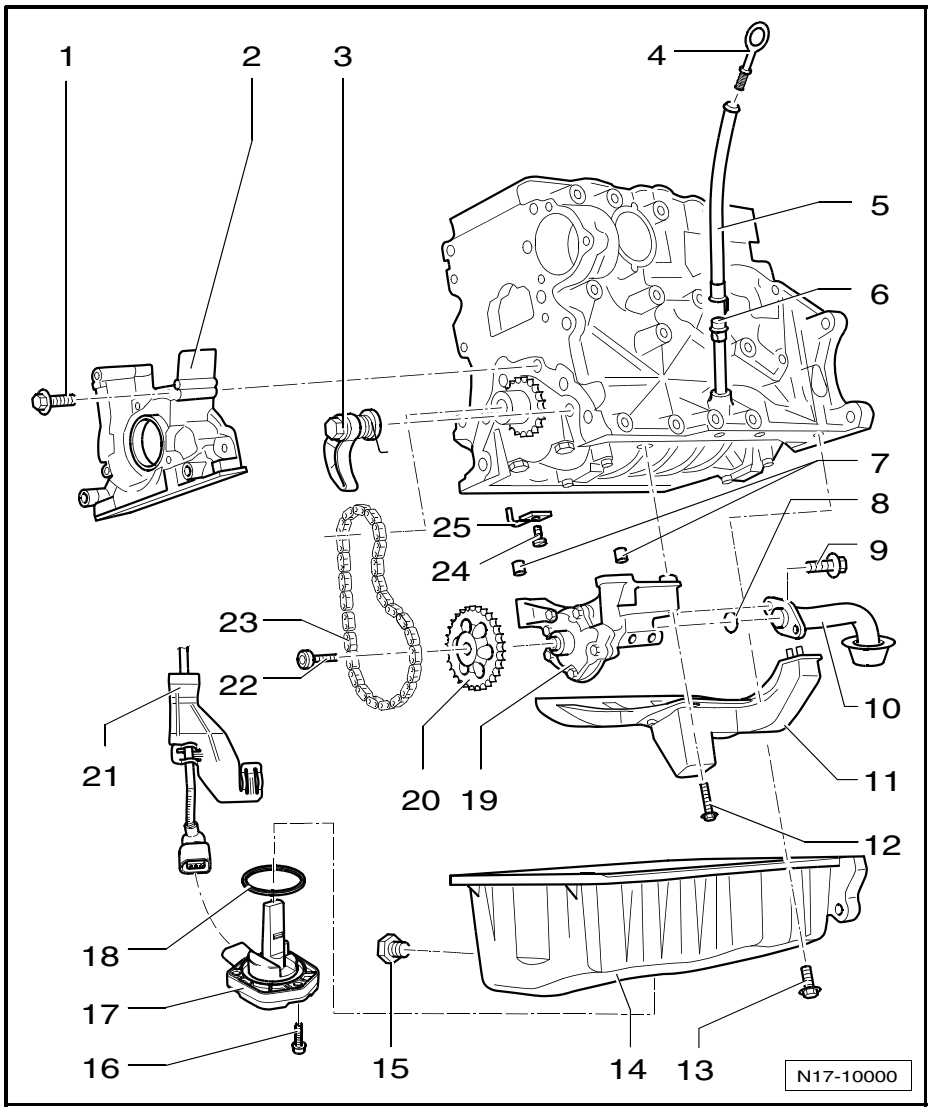
Observe rules for cleanliness ⇒ Seite 196

Assembly overview - oil pump, oil sump ⇒ Seite 140.

Removing and installing sump ⇒ Seite 142.

2.1 Assembly overview - oil pump, oil sump

Assembly overview - oil filter bracket and oil cooler ⇒ Seite 144.



- **1 - 15 Nm**
  - ❑ Renew
- **2 - Crankshaft sealing flange (belt pulley end)**
  - ❑ With oil seal
  - ❑ Must seat on dowel sleeves
  - ❑ Do not additionally oil or grease the oil seal sealing lip
  - ❑ Before installing, remove oil residue from crankshaft journal using a clean cloth
  - ❑ Removing and installing ⇒ Seite 94.
  - ❑ Renewing crankshaft oil seal - belt pulley end ⇒ Seite 92
- **3 - Chain tensioner with tensioning rail, 15 Nm**
  - ❑ When installing, pretension spring and fit.
- **4 - Oil dipstick**
  - ❑ Lugs on dipstick and dipstick guide must align
  - ❑ The oil level must not be above the max. mark!
  - ❑ Markings ⇒ Abb. auf Seite 139
- **5 - Dipstick guide**
  - ❑ Lugs on dipstick and dipstick guide must align
- **6 - Guide tube**

7 - Dowel sleeves

8 - O-ring

- ❑ Renew

9 - 15 Nm

10 - Suction line

- ❑ Clean strainer if soiled

11 - Baffle plate

12 - 15 Nm

13 - 15 Nm

14 - Sump

- ❑ Clean sealing surface before fitting
- ❑ Install with silicone sealant -D176404 A2-
- ❑ Removing and installing ⇒ Seite 142.

15 - Oil drain plug, 30 Nm

- ❑ Renew

16 - 10 Nm

17 - Oil level and oil temperature sender -G266-

- ❑ Not installed on all engines

18 - Seal

- ❑ Renew

19 - Oil pump

- ❑ With pressure relief valve, 12 bar
- ❑ Before installing, check that both dowel sleeves for centring oil pump on cylinder block are fitted
- ❑ Renew if running surfaces and gears are scored.

20 - Oil pump chain sprocket

21 - Bracket

- ❑ For oil level and oil temperature sender -G266- ⇒ Pos. 17

22 - 20 Nm + $^{1}/_{4}$ turn (90°) further

- ❑ Renew

23 - Chain

24 - 25 Nm

- ❑ Insert without sealant.

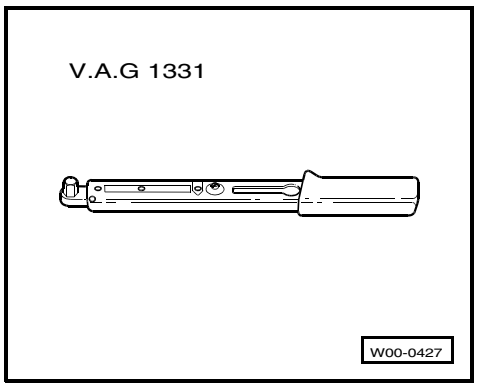
25 - Oil spray jet

- ❑ For piston cooling

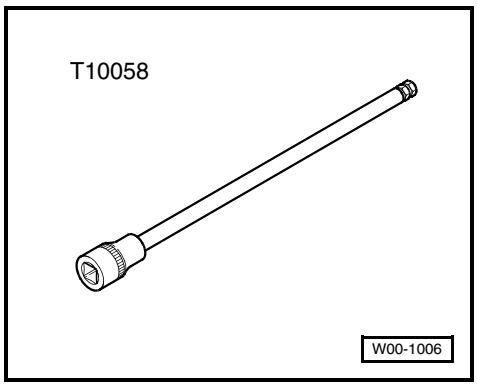
2.2 Removing and installing sump

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Torque wrench (5...50 Nm) -V.A.G 1331-



- special wrench, long reach -T10058-
- Silicone sealant -D176404 A2-
- Hand drill with plastic brush attachment
- Eye protection
- Flat scraper



Removing ⇒ Seite 142.

Installing ⇒ Seite 142.

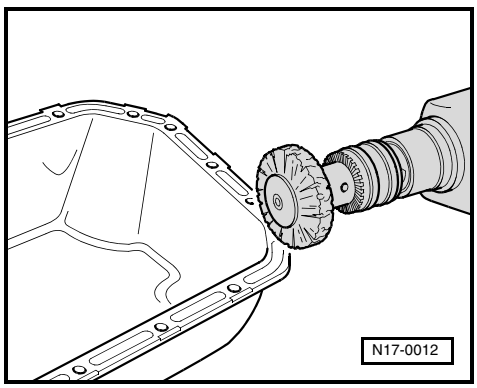
2.2.1 Removing

– Drain engine oil.

Hinweis

Observe environmental regulations for disposal.

– Pull 3-pin connector -if fitted- off oil level and oil temperature sender -G266-.
– Unbolt sump.
– Loosen sump with light blows of a rubber headed hammer if necessary.
– Remove sealant residue on cylinder block with a flat scraper.
– Remove sealant residue on sump with a rotating brush, e.g. a hand drill with a plastic brush (wear eye protection).
– Clean sealing surfaces. They must be free of oil and grease.



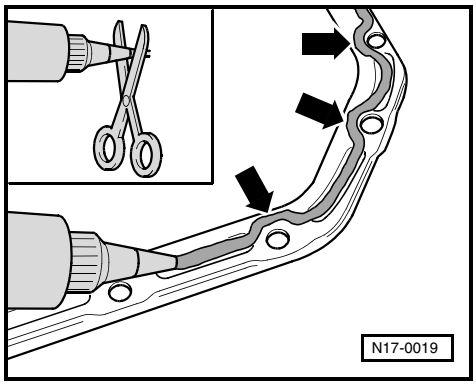
2.2.2 Installing

Hinweis

- *Note the expiration date of the sealant.*
- *The sump must be installed within 5 minutes of applying silicone sealing compound.*

– Cut off tube nozzle at front marking (approx. 3 mm ∅ of nozzle).
– Apply silicone sealant, as shown, to clean sump sealing surface. Sealant bead must be:

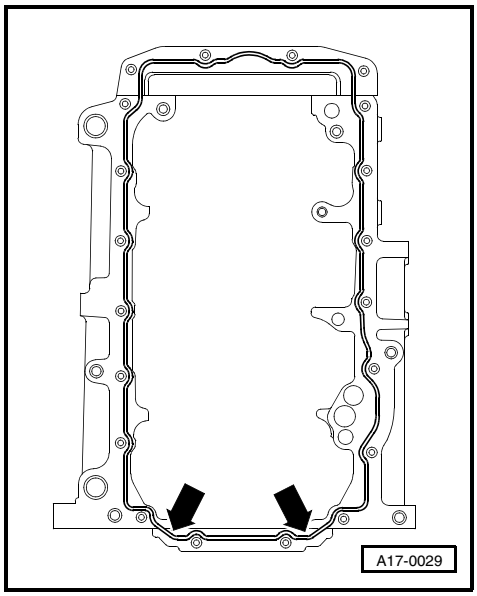
- 2...3 mm thick
- Run bead along inner side of bolt holes -arrows-.



Hinweis

The sealant bead must not be thicker, or excess sealant may enter the sump and block the strainer in the oil suction pipe.

– Apply silicone sealant to clean sealing surface of sump, as shown in illustration. (The figure shows the position of the sealant bead on the cylinder block.)
– Install sump immediately and tighten all sump bolts lightly.



Hinweis

The sump must be flush with cylinder block.

– Tighten sump bolts to 15 Nm.
– Tighten sump/gearbox bolts to 45 Nm.

Hinweis

Let sealing compound dry for approx. 30 minutes after installing oil sump. Only then fill with engine oil.

Further assembly is basically the reverse of the dismantling procedure.

3 Oil filter bracket, oil pressure and oil cooler

Vorsicht!

Finding metal shavings or a large quantity of small metal particles during engine repair could indicate that the crankshaft bearings or conrod bearings are damaged. To prevent subsequent damage, perform the following work after completing repairs:

Thoroughly clean oil passages,

Renew oil spray jets,

Renew oil cooler,

Renew oil filter element.

Hinweis

When working on engine, secure it with engine and gearbox support -VW 540- to assembly stand or to engine and gearbox support -VAS 6095-.

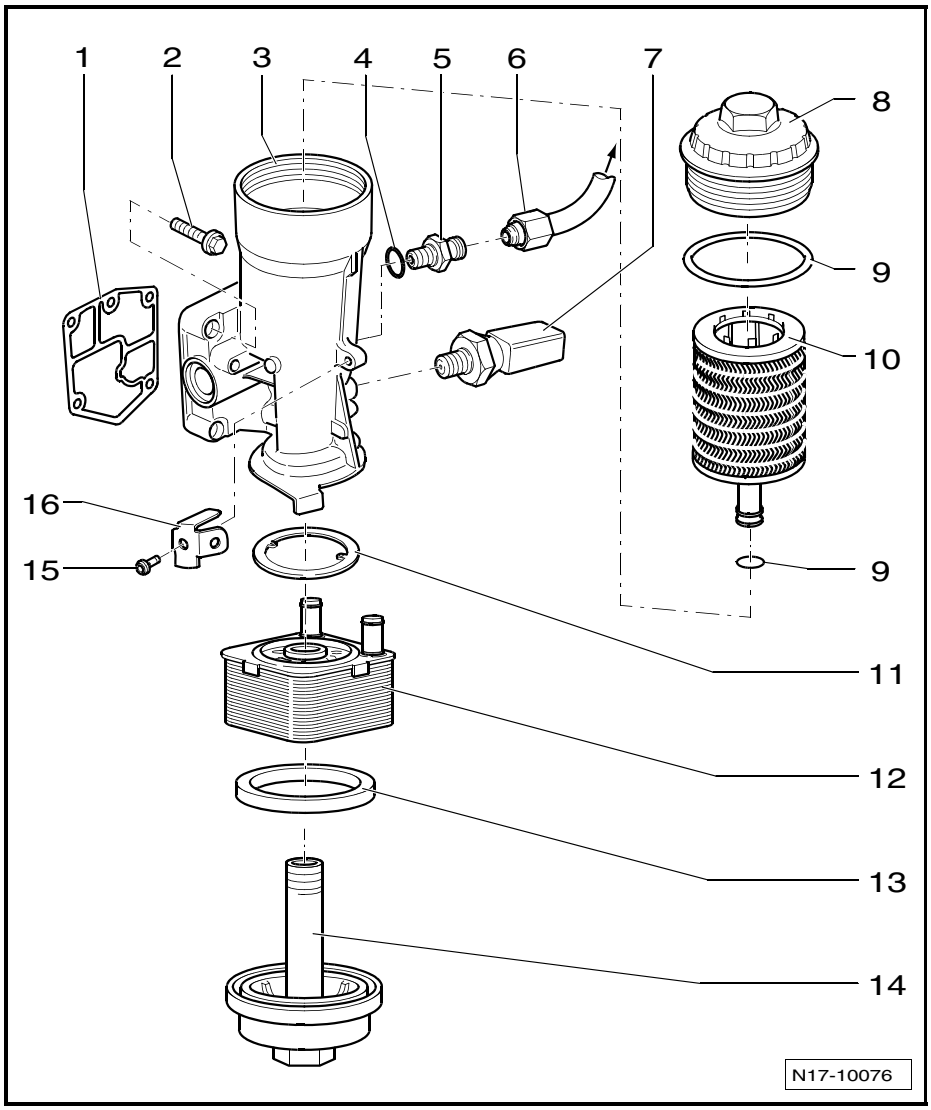
Observe safety precautions ⇒ Seite 195

Observe rules for cleanliness ⇒ Seite 196

Assembly overview - oil filter bracket and oil cooler
⇒ Seite 144.

Checking oil pressure and oil pressure switch -F1-
⇒ Seite 145.

3.1 Assembly overview - oil filter bracket and oil cooler



- **1 - Gasket**
  - ❑ Renew
- **2 - 15 Nm + 1/4 turn (90°) further**
  - ❑ Renew
  - ❑ First fit upper left and lower right bolts and then tighten all four bolts diagonally
- **3 - Oil filter bracket**
- **4 - Seal**
  - ❑ Renew
- **5 - Connection, 30 Nm**
- **6 - Oil supply line, 22 Nm**
  - ❑ To turbocharger.
- **7 - Oil pressure switch -F1-, 20 Nm**
  - ❑ 0.7 bar switch: brown.
  - ❑ If seal is leaking, nip open and renew
  - ❑ Checking ⇒ Seite 145, Checking oil pressure and oil pressure switch
- **8 - Cap, 25 Nm**
  - ❑ Loosen and tighten with socket 36 mm -T10125 -.
- **9 - O-ring**
  - ❑ Renew
- **10 - Oil filter element**
  - ❑ Observe change intervals
  - ❑ Ensure that "Top" is uppermost when fitting.
- **11 - Seal**
  - ❑ Renew
  - ❑ Oil before installing.
  - ❑ Fit into lugs on oil cooler
- **12 - Oil cooler**
  - ❑ Ensure clearance to adjacent components
  - ❑ Checking oil cooler for leaks ⇒ Seite 159
- **13 - Seal**
  - ❑ Renew

14 - Cap, 25 Nm

❑ Loosen and tighten with socket 36 mm -T10125 -.

15 - 10 Nm

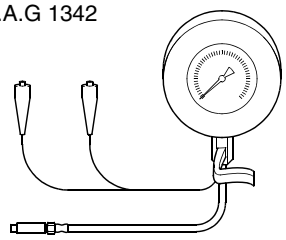
16 - Bracket

3.2 Checking oil pressure and oil pressure switch -F1-

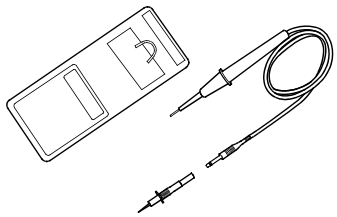
Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Oil pressure tester -V.A.G 1342-
- Diode test lamp -V.A.G 1527 B-
- Adapter set -V.A.G 1594 A-

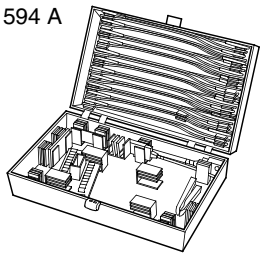
V.A.G 1342



V.A.G 1527 B



V.A.G 1594 A



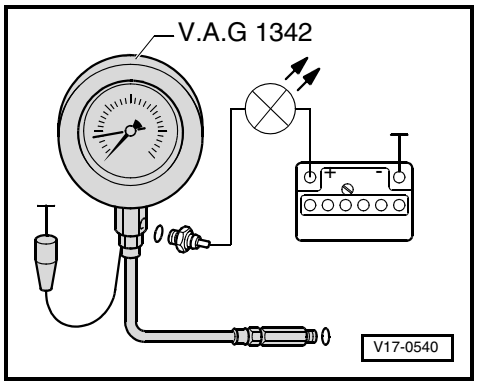
W17-0001

Test procedure

Hinweis

Functional check and repair of optical oil pressure gauge
⇒ Seite 288, Current flow diagrams.

– Remove oil pressure switch -F1- and screw into oil pressure tester.
– Screw oil pressure tester into oil filter bracket in place of oil pressure switch.
– Connect brown wire of oil pressure tester to earth (-).
– Connect diode test lamp -V.A.G 1527 B- with auxiliary cables from auxiliary measuring set -V.A.G 1594 A- to battery positive (+) and oil pressure switch. LED must not light up.



If the LED lights up:

– Renew oil pressure switch -F1- ⇒ Pos. 7 auf Seite 144.

If LED does not light up:

– Start engine and increase speed slowly. At 0.55...0.85 bar pressure the LED must light up, otherwise renew oil pressure switch -F1- ⇒ Pos. 7 auf Seite 144.

Checking oil pressure

– Increase engine speed further. At 2000 rpm and an oil temperature of 80 °C the oil pressure should be at least 2.0 bar.

If the specifications are not achieved:

– Rectify mechanical damage, e.g. damaged bearings.
– Renew oil filter bracket with pressure relief valve or renew oil pump.

At higher engine speeds, the oil pressure must not exceed 7.0 bar.

If the specification is exceeded:

– Check oil channels.
– If necessary, renew oil filter bracket with pressure relief valve.

19 – Cooling

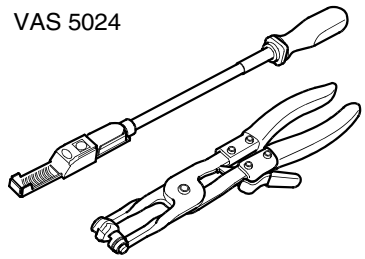
1 Removing and installing parts of cooling system

> ***ACHTUNG!***
>
> ***For all assembly work, the following should be observed due to the restricted amount of space available:***
>
> - ***Route all the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant, refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
> - ***Ensure that there is sufficient clearance to all moving or hot components.***

Hinweis

- *Hoses are secured with spring-type clips. In case of repair, only use spring-type clips.*
- *Spring-type clip pliers -VAS 5024- are recommended for installation of spring-type clips.*
- *When the engine is warm, the cooling system is under pressure. If necessary, release pressure before beginning repair work.*
- *When installing coolant hoses, route stress-free so that they do not come into contact with other components (observe markings on coolant connection and hose).*
- *Perform cooling system leakage test using cooling system tester -V.A.G 1274- and adapters - V.A.G 1274/8- and -V.A.G 1274/9- ⇒ Seite 158.*

VAS 5024



W00-0495

Parts of cooling system - engine side ⇒ Seite 148.

Coolant hose schematic diagram ⇒ Seite 150.

Draining and filling with coolant ⇒ Seite 151

Coolant mixture ratios ⇒ Seite 151, Draining and replenishing coolant.

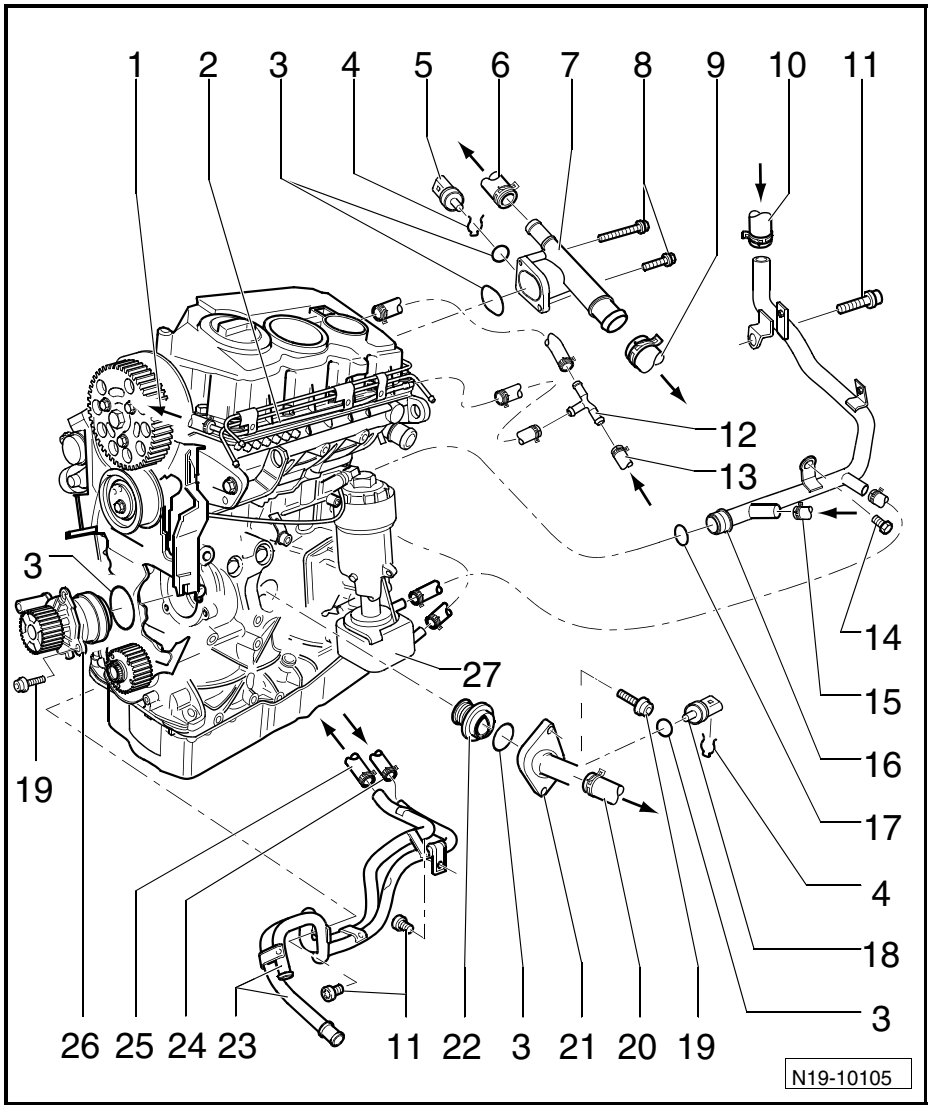
Removing and installing coolant pump ⇒ Seite 154

Removing and installing thermostat ⇒ Seite 156.

Checking cooling system for leaks ⇒ Seite 158.

Checking oil cooler for leaks ⇒ Seite 159.

1.1 Parts of cooling system - engine side



1 - To top of expansion tank
- ❑ Coolant hose schematic diagram ⇒ Seite 150

2 - Upper coolant pipe
- ❑ Bolted to cylinder head cover.
- ❑ Coolant hose schematic diagram ⇒ Seite 150

3 - O-ring
- ❑ Renew

4 - Retaining clip
- ❑ Check for secure seating.

5 - Coolant temperature sender -G62-
- ❑ For engine control unit -J623-.
- ❑ If necessary, release pressure in cooling system before removing
- ❑ Checking ⇒ Seite 215.

6 - To exhaust gas recirculation cooler
- ❑ Installed on engine code CBKA
- ❑ Coolant hose schematic diagram ⇒ Seite 150

7 - Connection

8 - 10 Nm

9 - To top of radiator
- ❑ Coolant hose schematic diagram ⇒ Seite 150

10 - From heat exchanger
- ❑ Coolant hose schematic diagram ⇒ Seite 150

11 - 40 Nm

12 - T-piece

13 - From upper coolant hose T-piece
- ❑ Coolant hose schematic diagram ⇒ Seite 150

14 - 15 Nm

15 - From bottom of expansion tank
- ❑ Coolant hose schematic diagram ⇒ Seite 150

16 - Front coolant pipe
- ❑ Coolant hose schematic diagram ⇒ Seite 150

17 - Seal
- ❑ Renew

18 - Coolant temperature sender on radiator outlet -G83-
- ❑ Not installed.

19 - 15 Nm

20 - To bottom of radiator
- ❑ Coolant hose schematic diagram ⇒ Seite 150

21 - Connection
- ❑ For thermostat
- ❑ Coolant hose schematic diagram ⇒ Seite 150

22 - Thermostat
- ❑ Removing and installing ⇒ Seite 156.
- ❑ Observe installation position ⇒ Seite 156, removing and installing thermostat.
- ❑ Checking: heat thermostat in water
- ❑ Opening begins at approx. 85 °C
- ❑ Ends at approx. 105 °C
- ❑ Opening lift min. 7 mm.

23 - Rear coolant pipe
- ❑ Coolant hose schematic diagram ⇒ Seite 150

24 - From exhaust gas recirculation cooler
- ❑ To circulation pump -V55-.
- ❑ If installed
- ❑ Coolant hose schematic diagram ⇒ Seite 150

25 - To heat exchanger
- ❑ Coolant hose schematic diagram ⇒ Seite 150

26 - Coolant pump
- ❑ Check for ease of movement
- ❑ Note installation position
- ❑ Removing and installing ⇒ Seite 154.

27 - Oil cooler
- ❑ Ensure clearance to adjacent components
- ❑ Checking oil cooler for leaks ⇒ Seite 159
- ❑ Removing and installing ⇒ Seite 144, Assembly overview - oil filter bracket and oil cooler

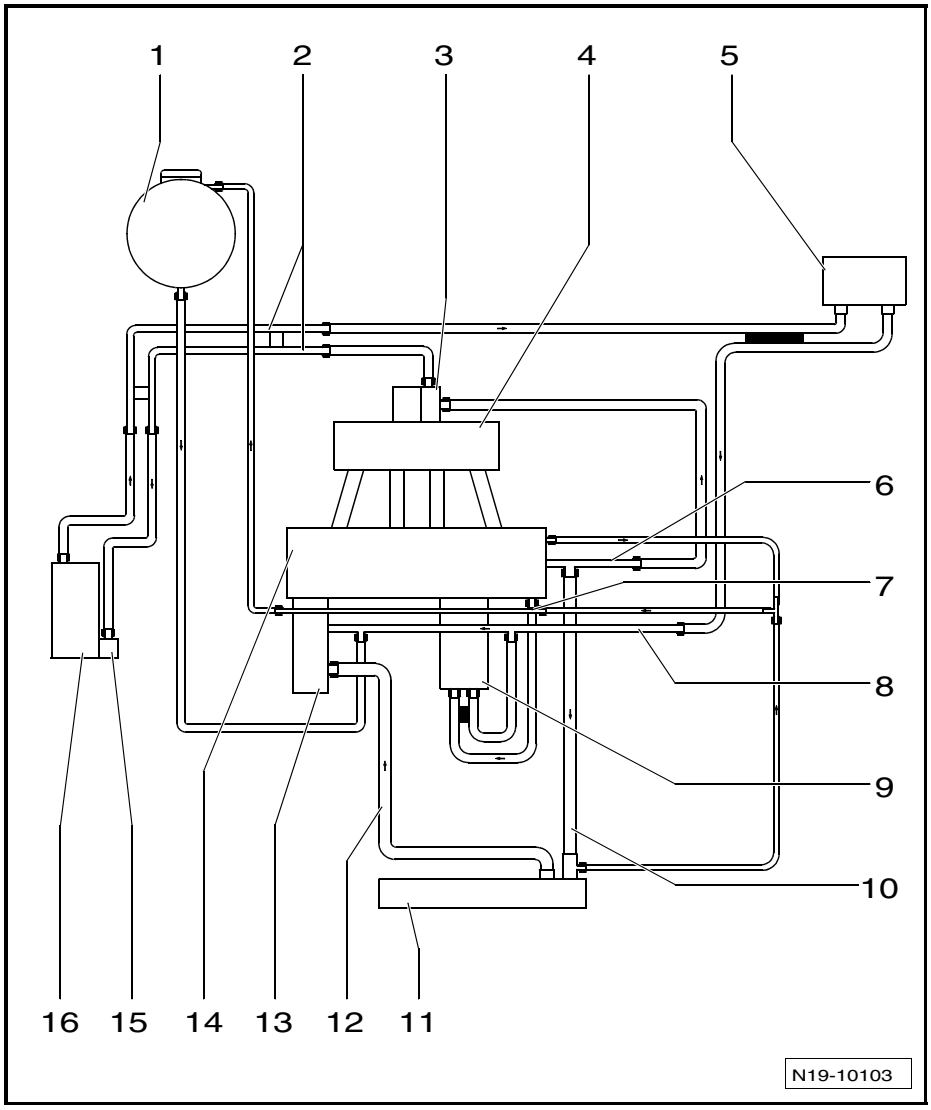
1.2 Coolant hose schematic diagram

1 - Expansion tank
2 - Rear coolant pipe
3 - Exhaust gas recirculation cooler
- ❑ Installed on engine code CBKA

4 - Intake pipe
5 - Heater unit heat exchanger
6 - Connection
7 - Upper coolant pipe
8 - Front coolant pipe
9 - Oil cooler
- ❑ For engine oil

10 - Upper coolant hose
11 - Radiator
12 - Lower coolant hose
13 - Coolant pump and thermostat
14 - Cylinder head/cylinder block
15 - Circulation pump -V55-
- ❑ If installed

16 - Auxiliary heater

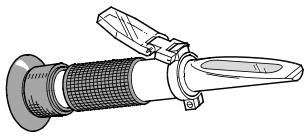


1.3 Draining and filling coolant

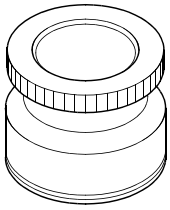
Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Refractometer -T10007-
- Adapter -V.A.G 1274/8-
- Drip tray -V.A.G 1306- or drip tray -VAS 6208-
- Torque wrench (5...50 Nm) -V.A.G 1331-
- Spring-type clip pliers -VAS 5024-

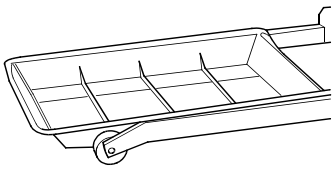
T10007



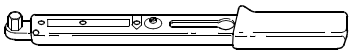
V.A.G 1274/8



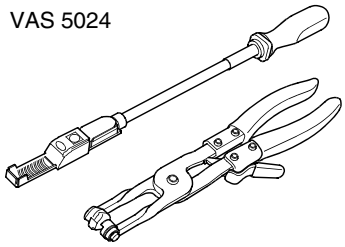
V.A.G 1306



V.A.G 1331



VAS 5024



W19-0038

Not illustrated

- Cooling system charge unit -VAS 6096 -
- Coolant additive -G 12- - as per TL „VW 774 F“

Draining ⇒ Seite 151.

Replenishing ⇒ Seite 152.

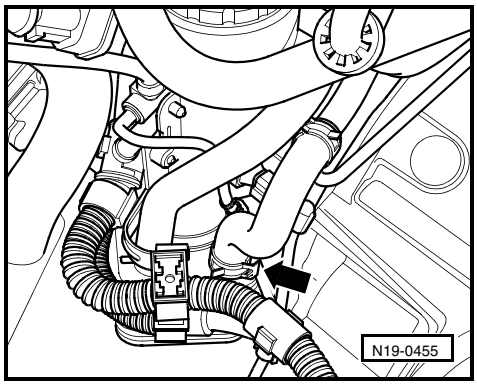
1.3.1 Draining

– Open cap on coolant expansion tank.

> ⚠ ***ACHTUNG!***
>
> ***Hot steam may escape when expansion tank is opened. Place rag over cap and open with caution.***

– Pull off bottom coolant hose on radiator, using spring-type clip pliers -VAS 5024 - if necessary.

– To drain coolant from engine, also remove coolant hose from oil cooler -arrow-.



Hinweis

Follow disposal regulations for coolant!

1.3.2 Filling

Hinweis

- *Use only coolant additive -G 12- that conforms with TL „VW 774 F“. Identification: purple colour.*
- *Coolant additive -G 12- purple (as per TL „VW 774 F“) can be mixed with the previous coolant additive -G 12- red!*
- *Coolant additive -G 12- and coolant additives that show they are compliant with "TL VW 774 F" prevent frost and corrosion damage, scaling and also raise boiling point of coolant. Therefore, the cooling system must be filled all-year-round with frost and corrosion protection additives.*
- *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 climates, down to about -35 °C).*
- *The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The coolant additive must be at least 40 % of mixture.*
- *If for climatic reasons greater frost protection is required, the amount of -G 12- can be increased, but only up to 60% (frost protection to about -40°C). Otherwise frost protection and cooling effectiveness will be reduced.*
- *The refractometer -T10007- is recommended for determining the current anti-freeze density.*
- *If radiator, heat exchanger, cylinder head or cylinder head gasket is replaced, do not reuse old coolant.*

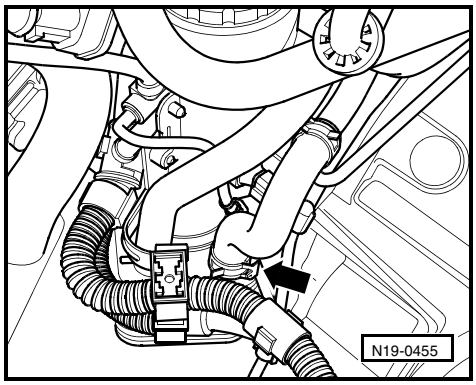
Recommended mixture ratios

Frost protection to	Anti-freeze proportion	-G 12-[1)]	Water[1)]
-25 °C	40 %	3.2 l	4,8 l
-35 °C	50 %	4,0 l	4,0 l

1) The quantity of coolant can vary depending on equipment.

– Secure lower coolant hose onto radiator union.

– Connect coolant hoses -arrow- to oil cooler.



With cooling system charge unit -VAS 6096-

– Screw adapter -V.A.G 1274/8- onto expansion tank.

– Fill coolant circuit using cooling system charge unit -VAS 6096- ⇒ operating instructions for cooling system charge unit -VAS 6096-.

Without cooling system charge unit -VAS 6096-

– Fill with coolant slowly up to max. mark on expansion tank.

With and without cooling system charge unit -VAS 6096-

– Fit expansion tank cap.

– Start engine and maintain an engine speed of about 2000 rpm for about 3 minutes.

– Run engine until radiator fan cuts in.

– Check coolant level and top-up if necessary. When the engine is at normal operating temperature, the coolant level must be on the max. mark; when the engine is cold, between the min. and max. marks.

⚠ ***ACHTUNG!***

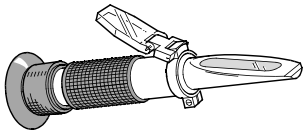
Hot steam may escape when expansion tank is opened. Place cloth over cap and open with caution.

1.4 Removing and installing coolant pump

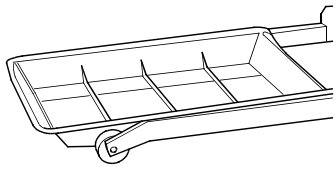
Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Refractometer -T10007-
- Drip tray -V.A.G 1306- or drip tray -VAS 6208-
- Torque wrench (5...50 Nm) -V.A.G 1331-
- Spring-type clip pliers -VAS 5024-

T10007

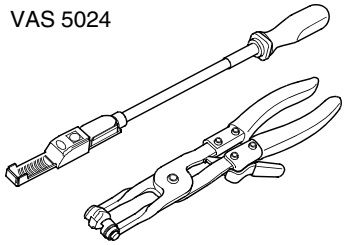


V.A.G 1306



V.A.G 1331

VAS 5024



W19-0019

Removing ⇒ Seite 154.

Installing ⇒ Seite 155.

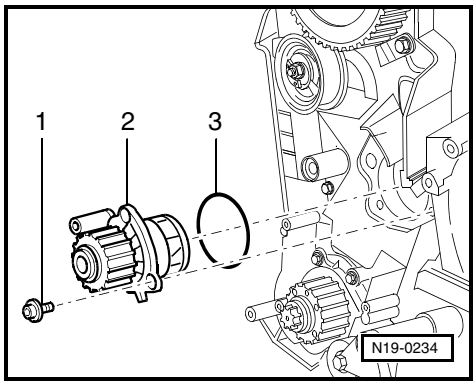
1.4.1 Removing

Hinweis

Always renew seals and gaskets.

- Drain coolant ⇒ Seite 151.
- Remove poly V-belt ⇒ Seite 86.
- Remove toothed belt ⇒ Seite 116, Removing, installing and tensioning toothed belt.

– Remove securing bolts -1- for coolant pump -2- and carefully remove coolant pump.

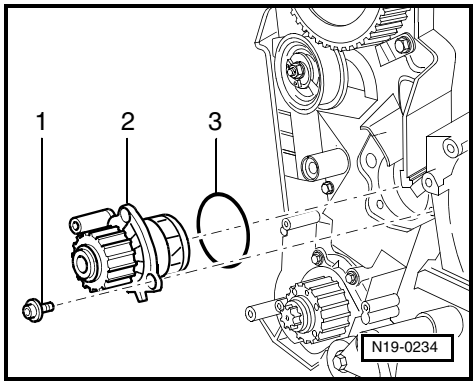


1.4.2 Installing

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

– Moisten new O-ring -3- with coolant.

– Insert coolant pump -2- in cylinder block and tighten securing bolts -1- to 15 Nm.



Hinweis

The coolant pump plug faces downwards.

– Install and tension toothed belt ⇒ Seite 116.

– Install poly V-belt ⇒ Seite 86.

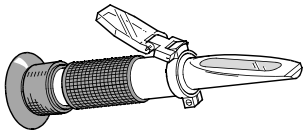
– Fill with coolant ⇒ Seite 151.

1.5 Removing and installing thermostat

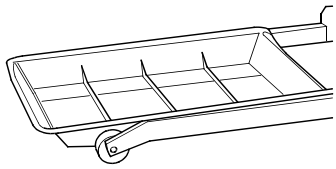
Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Refractometer -T10007-
- Drip tray -V.A.G 1306- or drip tray -VAS 6208-
- Torque wrench (5...50 Nm) -V.A.G 1331-
- Spring-type clip pliers -VAS 5024-

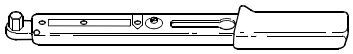
T10007



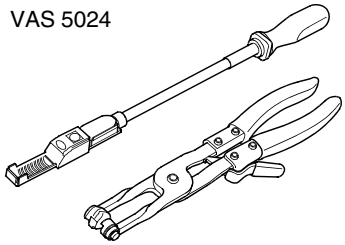
V.A.G 1306



V.A.G 1331



VAS 5024



W19-0019

Removing ⇒ Seite 156.

Installing ⇒ Seite 157.

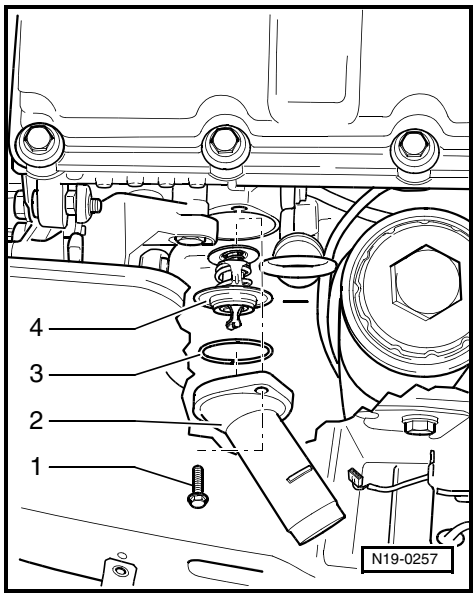
1.5.1 Removing

Hinweis

Always renew seals and gaskets.

– Drain coolant ⇒ Seite 151.
– Remove alternator -C- ⇒ Seite 278.
– Pull coolant hose off connection.

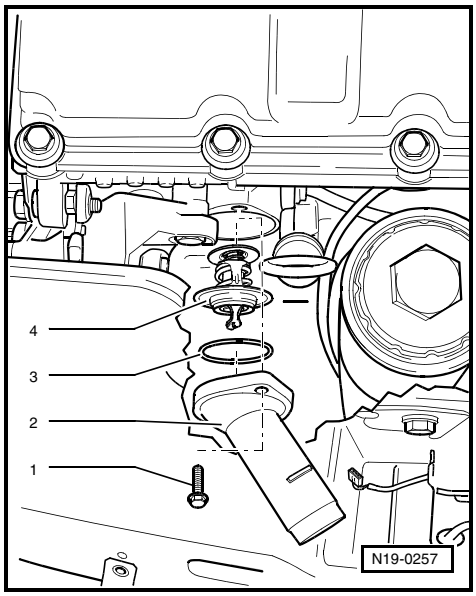
– Remove securing bolts -1- of connection -2- and remove connection -2- with thermostat -4-.
– Turn thermostat -4- $^1/_4$ turn (90°) to left and remove it from connection -2-.



1.5.2 Installing

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

– Moisten new O-ring -3- with coolant.
– Insert thermostat -4- into connection -2- and turn $^1/_4$ turn (90°) to right.



Hinweis

The brace on the thermostat must be almost vertical.

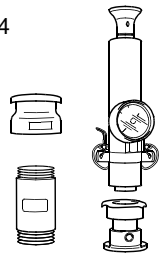
– Insert connection -2- with thermostat -4- in cylinder block.
– Tighten securing bolts -1- to 15 Nm.
– Install alternator -C- ⇒ Seite 278.
– Fill with coolant ⇒ Seite 151.

1.6 Checking cooling system for leaks

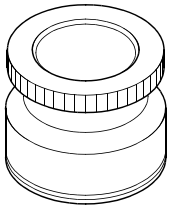
Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- 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-

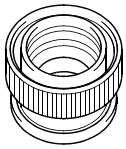
V.A.G 1274



V.A.G 1274/8



V.A.G 1274/9



G19-0002

Test prerequisite

- Engine at operating temperature.

Test procedure

– Open cap on coolant expansion tank.

> ⚠ ***ACHTUNG!***
>
> ***Hot steam may escape when expansion tank is opened. Place rag over cap and open with caution.***

– Attach cooling system tester -V.A.G 1274- with cooling system tester adapter -V.A.G 1274/8- to expansion tank.

– Use hand pump on tester to create a pressure of about 1.0 bar.

If pressure drops:

– Find leaks and rectify.
– Check coolant level, if necessary replenish coolant ⇒ Seite 151.

1.6.1 Checking pressure relief valve in filler cap

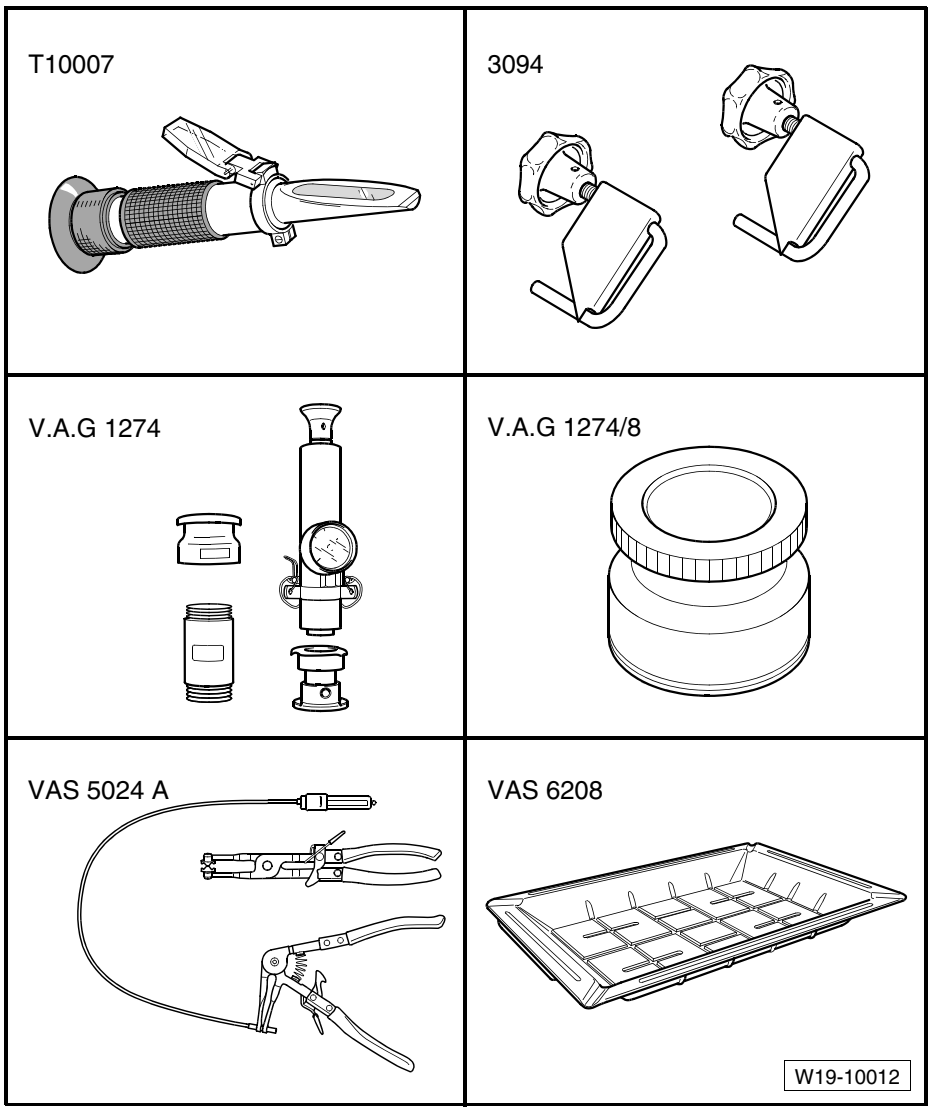
– Attach cooling system tester -V.A.G 1274- with cooling system tester adapter -V.A.G 1274/9- to cover.
– Operate hand pump.

The pressure relief valve must open at a pressure of 1.4...1.6 bar

1.7 Checking oil cooler for leaks

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Refractometer -T10007-
- Hose clamps up to Ø 25 mm -3094-
- Cooling system tester -V.A.G 1274-
- Adapter for cooling system tester -V.A.G 1274/8-
- Spring-type clip pliers -VAS 5024 A-
- Drip tray -V.A.G 1306- or drip tray -VAS 6208-



Not illustrated

- Torque wrench (5...50 Nm) -V.A.G 1331-
- Expansion tank -1K0 121 407 A bzw. 6Q0 121 407 A bzw. 1J0 121 407 B-

- Plug -191 211 343-
- Cap -1J0 121 324-
- Coolant hose -251 265 056-

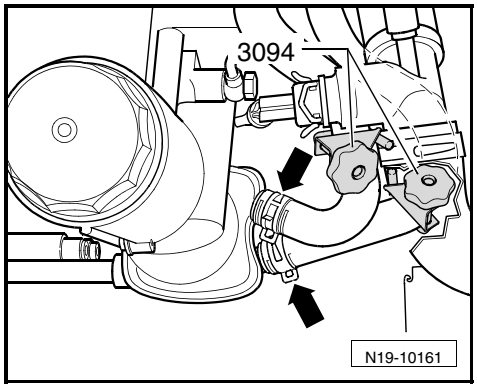
Prerequisites

- Engine cold

Test procedure

– Clamp supply and return lines off oil cooler using hose clamps to Ø 25 mm -VAS 3094-.

– Loosen hose clamps -arrows- using spring type clip pliers -VAS 5024-.



Hinweis

Collect escaping coolant with drip tray - V.A.G 1306- or drip tray -VAS 6208-.

– Pull coolant hoses off oil cooler.

– Slide sealing cap -5- to rear connection of oil cooler -4-.

– Secure sealing plug -2- to breather connection of expansion tank -1-.

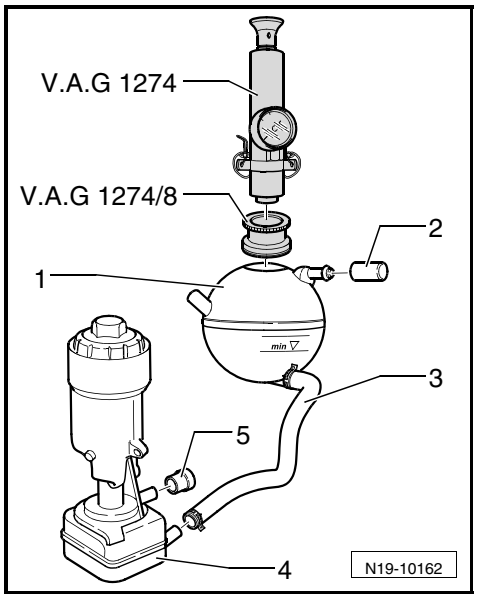
– Secure coolant hose -3- to oil cooler and expansion tank.

– Fill expansion tank up to max marking.

– Place cooling system tester -V.A.G 1274- with cooling system tester adapter -V.A.G 1274/8- on expansion tank.

– Use hand pump on tester to create a pressure of about 1.6 bar.

– Watch pressure drop on pressure gauge. A pressure drop within 10 minutes is not permitted.



If pressure drops:

– Replace oil cooler ⇒ Seite 144, Assembly overview - oil filter bracket and oil cooler.

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

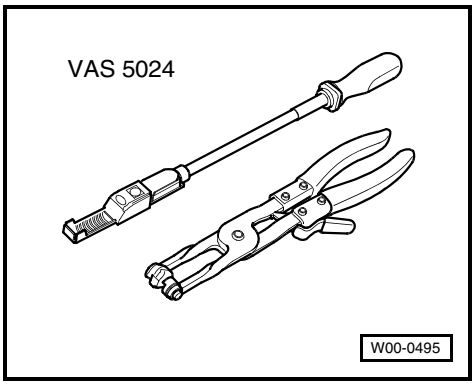
– Check coolant level, if necessary replenish coolant ⇒ Seite 151.

20 – Fuel supply system

1 Removing and installing parts of fuel supply system

Hinweis

- *Hose connections are secured with either spring-type or clamp-type clips.*
- *Always renew clamp-type clips with spring-type clips.*
- *Fuel hoses in engine compartment must be secured only with spring-type clips. The use of clamp or screw-type clips is not permissible.*
- *Spring-type clip pliers -VAS 5024- are recommended for installation of spring-type clips.*



Safety precautions when working on fuel supply system ⇒ Seite 161

Observe rules for cleanliness ⇒ Seite 162

Assembly overview - fuel filter ⇒ Seite 162.

Removing and installing fuel cooler (if fitted) ⇒ Seite 164.

Removing and installing tandem pump ⇒ Seite 165.

Removing and installing fuel delivery unit ⇒ Seite 167.

1.1 Safety precautions when working on fuel supply system

ACHTUNG!

For all assembly work, the following should be observed due to the restricted amount of space available:

- ***Route all the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant, refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***Ensure that there is sufficient clearance to all moving or hot components.***
- ***The fuel and the fuel lines in the fuel system can become very hot (danger of scalding)!***
- ***The fuel system is also under pressure! Before opening the system, place cloths around the connections. Then carefully loosen connection to release the pressure!***
- ***Wear eye and hand protection when performing any type of repair work on the fuel system!***

When working on filled or partly filled fuel tanks, the following must be observed:

- Before beginning work, place an extraction hose close to sender opening in fuel tank to extract escaping fuel fumes and switch on exhaust extraction system. If no exhaust ex-

traction system is available, a radial fan with a displacement greater than 15 m^3/h can be used providing that motor is not in air flow.

- Prevent skin contact with fuel! Wear fuel-resistant gloves!

1.2 Rules for cleanliness

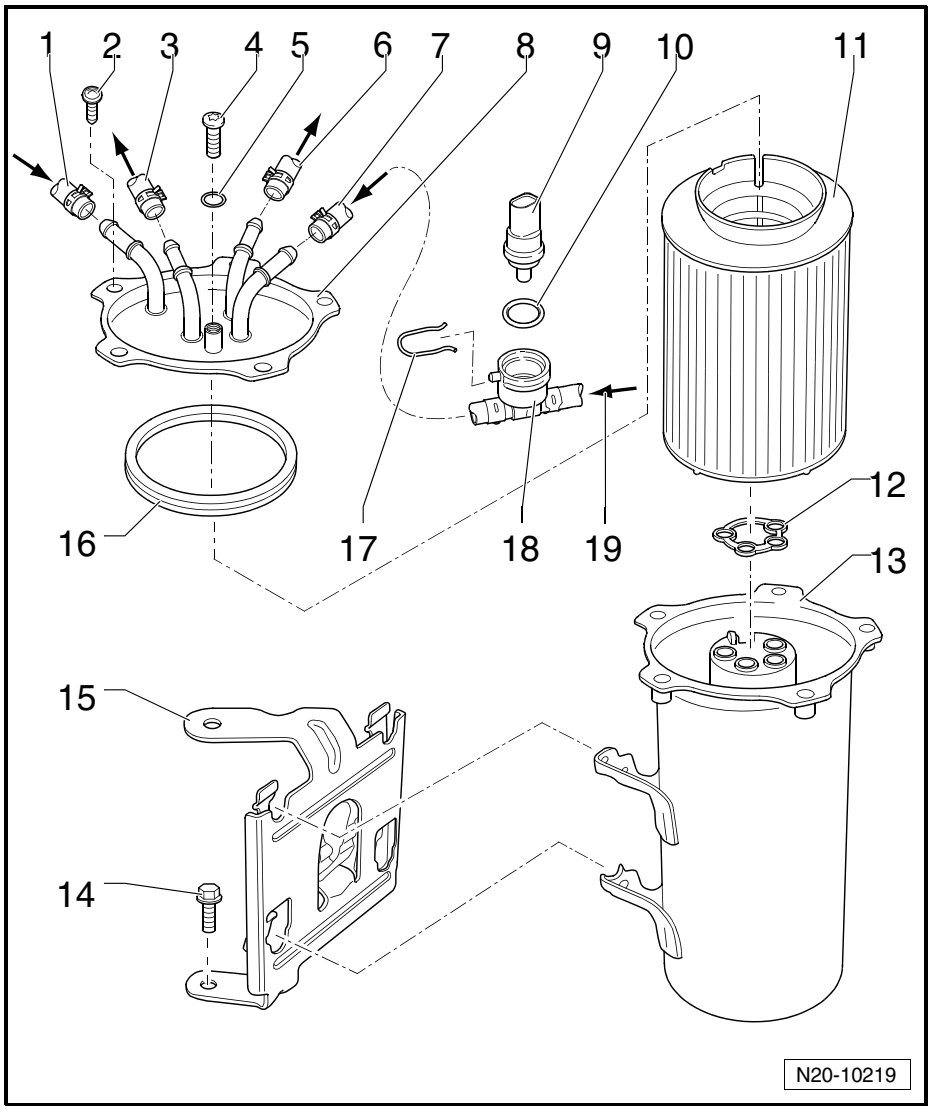
When working on the fuel supply/injection system, pay careful attention to the following „rules“ of cleanliness.

- Thoroughly clean all unions and adjacent areas before disconnecting.
- Place removed parts on a clean surface and cover. Do not use fluffy cloths!
- Carefully cover opened components or seal if repairs cannot be carried out immediately.
- Install clean components only: do not remove replacement parts from packing until immediately before installing. Do not use parts that have not been stored in their packing (e.g. in tool boxes etc.).
- Existing transport and protective packaging and sealing caps must only be removed immediately prior to installation.
- When system is open: do not work with compressed air if this can be avoided. Do not move vehicle unless absolutely necessary.
- Also ensure that no diesel fuel comes into contact with the coolant hoses. If necessary, the hoses must be cleaned immediately. Damaged hoses must be renewed.

1.3 Assembly overview - fuel filter

– Note safety precautions before beginning work ⇒ Seite 161

– Observe rules for cleanliness ⇒ Seite 162



1 - Fuel supply hose
- ❑ From fuel tank
- ❑ Check for secure seating.
- ❑ White or with white marking
- ❑ Secure with spring-type clips

2 - 8 Nm

3 - Fuel return hose
- ❑ To fuel cooler and fuel tank
- ❑ Check for secure seating.
- ❑ Blue or with blue marking
- ❑ Secure with spring-type clips

4 - Plug for water extraction
- ❑ Remove and extract about 100 cm^3 liquid using hand-operated vacuum pump with accessories -V.A.G 1390- and water drainage container -V.A.G 1390/1-

5 - Seal
- ❑ Renew

6 - Fuel supply hose
- ❑ To tandem pump ⇒ Seite 112, Assembly overview - cylinder head
- ❑ Check for secure seating.
- ❑ White or with white marking
- ❑ Secure with spring-type clips

7 - Fuel return hose
- ❑ Check for secure seating.
- ❑ Blue or with blue marking
- ❑ Secure with spring-type clips

8 - Fuel filter upper part

9 - Fuel temperature sender -G81-
- ❑ For engine control unit -J623-.
- ❑ If necessary, release pressure in fuel system before removing
- ❑ Checking ⇒ Seite 218.

10 - O-ring
- ❑ Renew

11 - Fuel filter insert
- ❑ Observe change intervals

12 - Seal
- ❑ Renew

13 - Fuel filter lower part

14 - 8 Nm

15 - Bracket

16 - Seal

- ❑ Renew

17 - Retaining clip

- ❑ Check for secure seating.

18 - Connection

- ❑ For fuel temperature sender - G81-

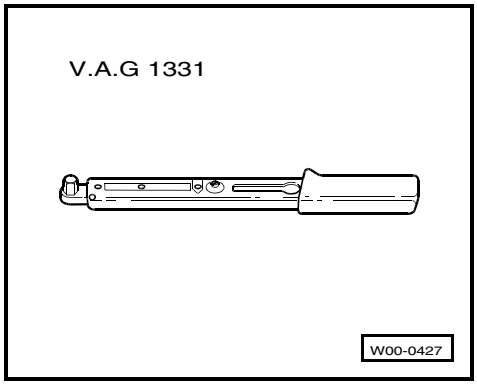
19 - From tandem pump

- ❑ ⇒ Seite 112, Assembly overview - cylinder head

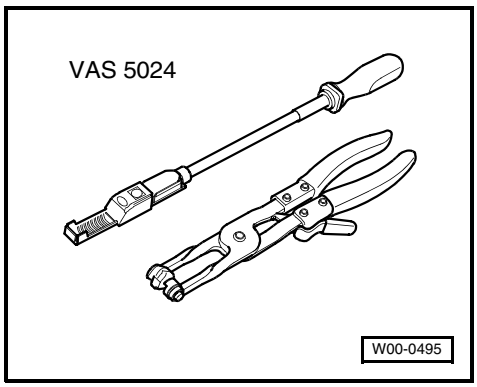
1.4 Removing and installing fuel cooler (if fitted)

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Torque wrench (5...50 Nm) -V.A.G 1331-



♦ Spring-type clip pliers -VAS 5024-



Removing ⇒ Seite 164.

Installing ⇒ Seite 164.

1.4.1 Removing

– Note safety precautions before beginning work ⇒ Seite 161

– Observe rules for cleanliness ⇒ Seite 162

Hinweis

The fuel cooler is located in the return line between fuel filter and fuel tank.

– Separate fuel lines on fuel cooler using spring-type clip pliers -VAS 5024-.

– Unscrew securing nuts on fuel cooler.

1.4.2 Installing

Installation is carried out in the reverse sequence of removal. When doing this, note the following:

– Tighten fuel cooler securing nuts to 15 Nm.

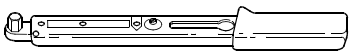
1.5 Removing and installing tandem pump

> ⚠ ***GEFAHR!***
>
> ***The tandem pump may, under no circumstances, be dismantled as the vacuum part could otherwise malfunction. This would result in the failure of the brake servo (if fitted).***

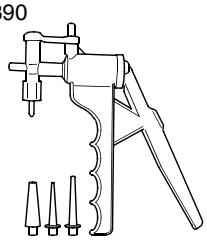
Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Torque wrench -V.A.G 1331-
- Hand vacuum pump with accessories -V.A.G 1390-
- Water drainage container -V.A.G 1390/1-
- Spring-type clip pliers -VAS 5024 A-

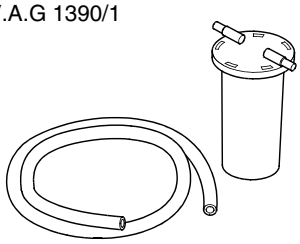
V.A.G 1331



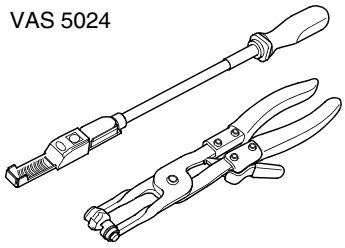
V.A.G 1390



V.A.G 1390/1



VAS 5024



W20-0054

Removing ⇒ Seite 165.

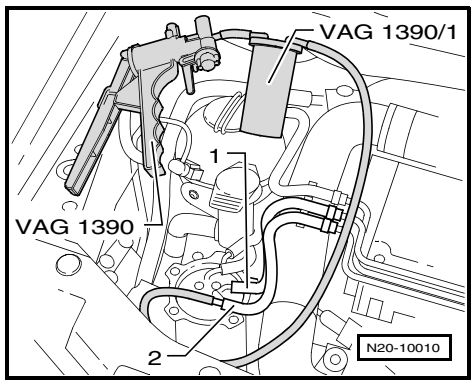
Installing ⇒ Seite 166.

1.5.1 Removing

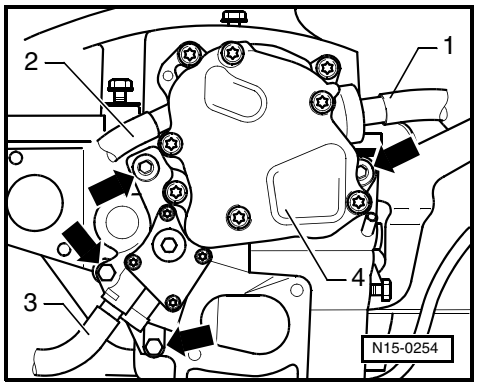
– Note safety precautions before beginning work ⇒ Seite 161

– Observe rules for cleanliness ⇒ Seite 162

– Pull off fuel supply hose -1- (white or white marking) and fuel return hose -2- (blue or blue marking) from fuel filter.
– Connect hand vacuum pump -V.A.G 1390- with water drainage container -V.A.G 1390/1- to fuel return hose -2-.
– Operate hand vacuum pump until no more fuel comes out of fuel return hose. Be careful to ensure that no fuel is sucked into the hand vacuum pump.



– Pull vacuum line -1- off tandem pump -4-.
– Pull off fuel supply hose -2- (white or white marking) and fuel return hose -3- (blue or blue marking) on tandem pump -4-.
– Remove securing bolts -arrows-.
– Remove tandem pump -4- from cylinder head.



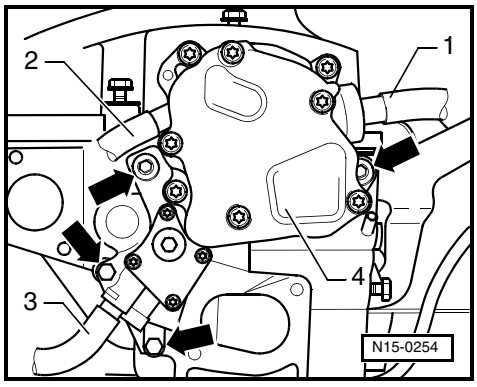
1.5.2 Installing

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

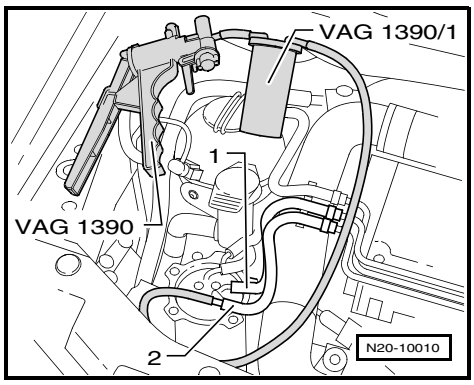
Hinweis

- *Ensure that tandem pump coupling seats properly in camshaft.*
- *Always renew tandem pump seals.*

– Install tandem pump and tighten upper securing bolts to 20 Nm.
– Tighten lower securing bolts to 10 Nm.
– Attach return hose hose (blue or blue marking) to return connection -3- of tandem pump.
– Connect fuel supply hose (white or white marking) to supply connection -2- and vacuum line -1- to tandem pump -4-.



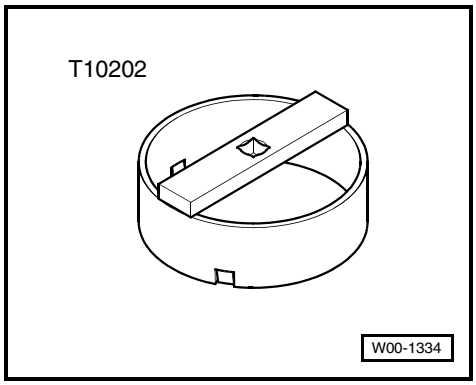
– Attach fuel supply hose -1- (white or white marking) to fuel filter.
– Connect hand vacuum pump with water drainage container -V.A.G 1390/1- to fuel return hose -2-.
– Operate hand vacuum pump until fuel comes out of fuel return hose. Be careful that no fuel is sucked into hand vacuum pump.
– Attach fuel return hose (blue or blue marking) to fuel filter.



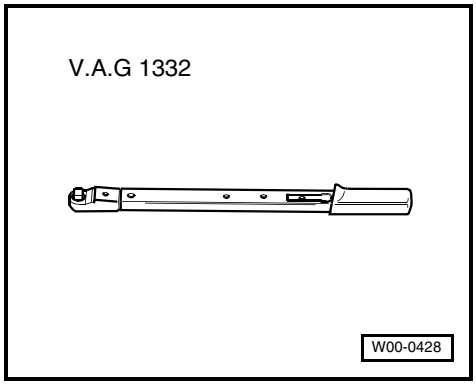
1.6 Removing and installing fuel delivery unit

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Special wrench -T10202-



♦ Torque wrench (40...200 Nm) -V.A.G 1332-

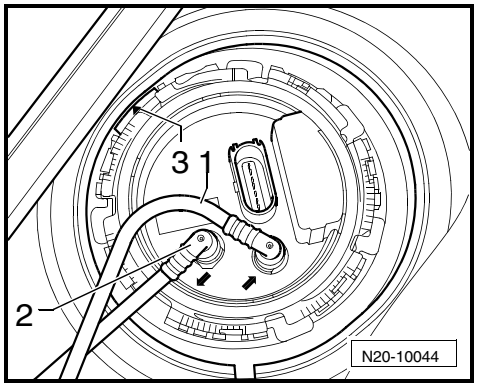


Removing ⇒ Seite 167.

Installing ⇒ Seite 168.

1.6.1 Removing

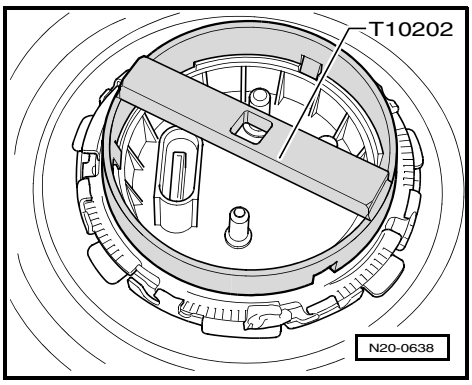
– Note safety precautions before beginning work ⇒ Seite 161
– Observe rules for cleanliness ⇒ Seite 162
– With ignition switched off, disconnect earth strap from battery.
– The fuel tank must not be more than $^3/_4$ full when removing the fuel delivery unit. Drain the fuel tank if necessary.
– Remove cover from fuel delivery unit.
– Pull off fuel return line -1-, fuel supply line -2- and 5-pin connector from fuel delivery unit flange.



Hinweis

Press in securing ring to release fuel lines.

– Open locking ring using wrench -T10202-.
– Mark installation position of fuel delivery unit flange to fuel tank.
– Pull fuel delivery unit with seal out of opening in fuel tank.



Hinweis

If delivery unit is to be renewed, drain old delivery unit before disposal.

1.6.2 Installing

– Installation of fuel delivery unit is carried out in reverse order.

Hinweis

- *When inserting fuel delivery unit, ensure that fuel gauge sender (if fitted) is not bent.*
- *Insert seal for flange or fuel delivery unit dry into opening of fuel tank.*
- *Moisten seal with fuel only when installing flange or fuel delivery unit.*
- *Fuel lines are to be installed free of kinks.*
- *Do not interchange supply and return lines (return line blue or with blue marking, supply line white or with white marking).*
- *Ensure that fuel lines are tight.*
- *Connections for fuel lines must engage audibly when joined.*
- *After installing fuel delivery unit, check that supply and return lines are still clipped onto fuel tank.*
- *Note installation position of fuel delivery unit flange to fuel tank.*

2 Checking components and functions

The component and functional checks listed refer to the series production components and the current flow diagrams from page ⇒ Seite 288.

In the event of component and switch unit deviation, please refer to the instructions of the respective industrial engine customer.

Checking tandem pump ⇒ Seite 169.

Checking fuel supply pump -G6- (if fitted) ⇒ Seite 173.

Checking accelerator pedal position sender -G79- (if fitted) ⇒ Seite 174.

2.1 Checking tandem pump

> ⚠ ***GEFAHR!***
>
> ***The tandem pump may, under no circumstances, be dismantled as the vacuum part could otherwise malfunction. This would result in the failure of the brake servo (if fitted).***

– Note safety precautions before beginning work ⇒ Seite 161

– Observe rules for cleanliness ⇒ Seite 162

Checking delivery pressure ⇒ Seite 169.

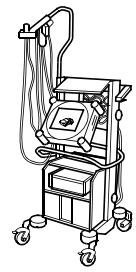
Checking for internal leaks ⇒ Seite 171.

2.1.1 Checking delivery pressure

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -

VAS 5051

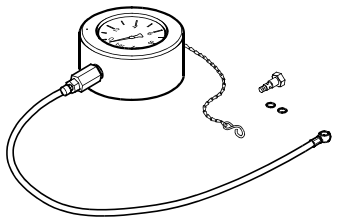


W00-1236

♦ Tandem pump tester -VAS 5187-

♦ Torque wrench (5...50 Nm) -V.A.G 1331-

VAS 5187



W00-0997

Hinweis

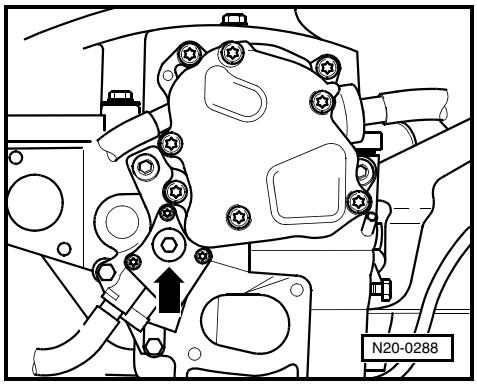
Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

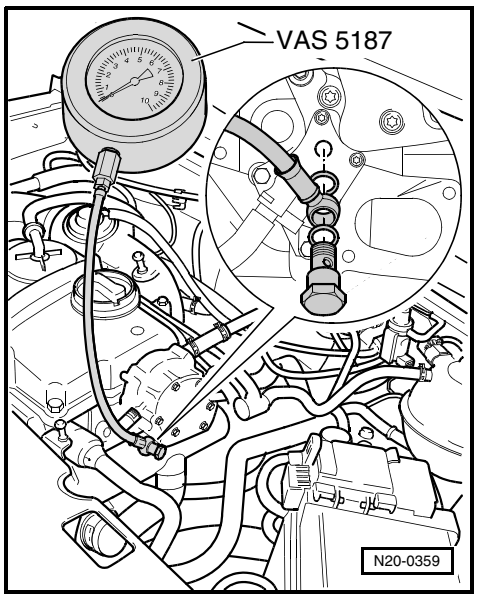
- All electrical consumers must be switched off.
- Check unit injectors are OK ⇒ Seite 205, Checking unit injector valves (cylinder 1...4) - N240...N243-
- Fuel filter and fuel lines must not be blocked.
- The coolant temperature must be at least 85 °C, ⇒ display group 1, display zone 4.

Test procedure

– Remove screw plug -arrow-.



– Connect tandem pump tester -VAS 5187- as shown.



– Connect vehicle diagnosis, testing and information system -VAS 5051- and select diagnosis function „08-Read measured value block“. Engine must be idling to do this. (Connect vehicle diagnosis, testing and information system and select engine control unit⇒ Seite 5.)

– Select „display group 1“.

Indicated on display:

```
Display group 1
880 rpm   xxx.x mg/H   xxx °CA   87.3 °C
```

Hinweis

On the display of vehicle diagnosis, testing and information system -VAS 5051-, the display zones are shown one below the other, on other diagnosis testers they are side by side.

– Check coolant temperature in display zone 4. Specification: at least 85 °C.

Continue with check only once coolant temperature has been reached.

– Read off engine idling speed in display zone 1.

– Increase engine speed to 4000 rpm.

– Observe pressure indicated on pressure gauge. Specification: min. 7.5 bar.

If the specification is reached:

– End diagnosis function.

– Switch off ignition.

Hinweis

After removing tandem pump tester tighten plug to 25 Nm. Always renew seal.

If the specification is not obtained:

- Using a hose clamp, clamp off return line between fuel filter and tandem pump.
- Increase engine speed to 4000 rpm.
- Observe pressure indicated on pressure gauge.

Specification: min. 7.5 bar.

- End diagnosis function.
- Switch off ignition.

If specification is now obtained:

Pressure loss at unit injectors.

- Replace O-rings of unit injectors ⇒ Seite 203, Renewing O-rings and heat insulation seal for unit injector.

If the specification is not obtained:

- Renew tandem pump ⇒ Seite 165, Removing and installing tandem pump.

Hinweis

After removing tandem pump tester tighten plug to 25 Nm. Always renew seal.

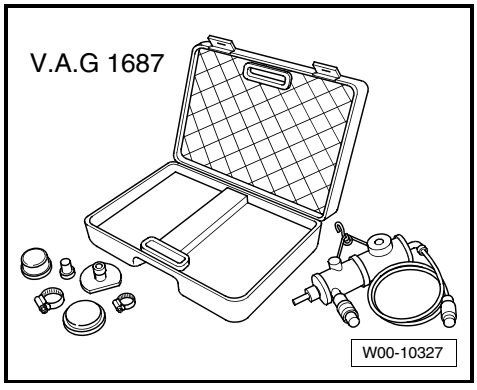
2.1.2 Checking for internal leaks

Hinweis

The tandem pump must be checked for internal leaks between fuel side and oil side after reinstalling a used tandem pump, for example after renewing or repairing a cylinder head and/or when installing a "short" engine. When leaking it is possible for the fuel to mix with the oil which may cause the engine to fail.

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

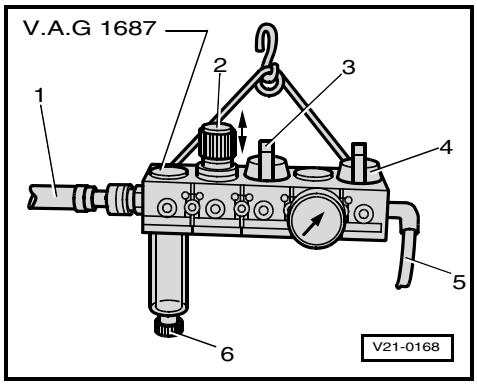
♦ Charge air system tester -V.A.G 1687-



Test procedure

- Pull off fuel supply hose (white or white marking) ⇒ Pos. 28 auf Seite 113 and fuel return hose (blue or blue marking) ⇒ Pos. 29 auf Seite 113 on tandem pump.
- Seal fuel return union on tandem pump with plug. Secure sealing plug with a spring-type clamp.

Prepare charge air system tester -V.A.G 1687- as follows:



– Unscrew pressure regulating valve -2- and close valves -3- and -4-.

Hinweis

To turn the pressure control valve -2- the knob must be pulled upwards.

– Connect test connection -5- to fuel supply union of tandem pump using a commercially available compressed air connection and a fuel hose. Use a spring-type clamp to secure.
– Connect compressed air hose -1- (compressed air source) to tester -V.A.G 1687-.

Hinweis

If there is water in the sight glass, drain at water drain screw -6-.

– Open valve -3-.
– Adjust pressure to 1.0 bar with pressure regulating valve -2-.

Vorsicht!

The maximum test pressure is 1.3 bar and this must not be exceeded. If the pressure is too high this can cause damage to the tandem pump.

– Open valve -4- and wait until the test circuit is filled. If necessary readjust pressure to 1,0 bar.
– Close valve -3- to retain pressure and observe the pressure drop over a period of 1 minute.

If no pressure loss can be detected, the tandem pump can be used again.

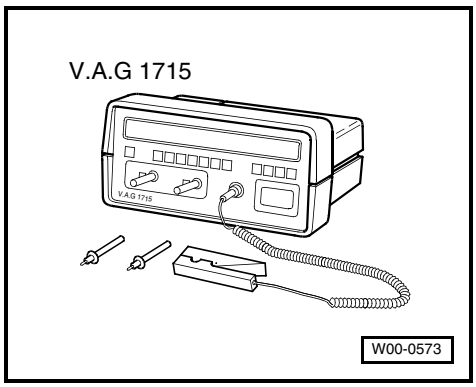
If no pressure loss can be detected:

– Renew tandem pump ⇒ Seite 165, Removing and installing tandem pump.

2.2 Checking fuel supply pump -G6- (if fitted)

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Diode test lamp -V.A.G 1527 B-
- Adapter set -V.A.G 1594 C-
- Current flow diagram



Test prerequisites

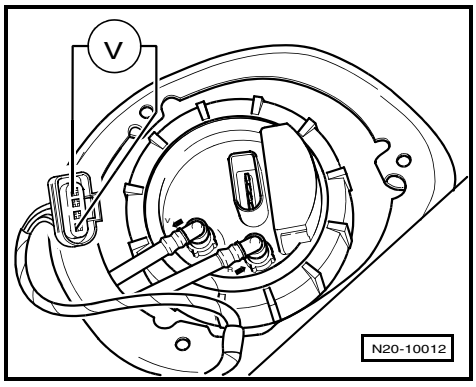
- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK

Checking function and voltage supply

– Note safety precautions before beginning work ⇒ Seite 161
– Observe rules for cleanliness ⇒ Seite 162
– Remove cover from fuel delivery unit.
– Switch on ignition. Fuel supply pump should be heard to run.
– Switch off ignition.

If fuel supply pump fails to run:

– Disconnect 5-pin connector from fuel delivery unit flange.
– Connect diode test lamp - V.A.G 1527 B- to outer contacts of connector using auxiliary cables from auxiliary measuring set -V.A.G 1594 C-.
– Switch on ignition. The LED must light up for about 2 seconds.
– Switch off ignition.



If LED does not light up:

– Check actuation of fuel pump relay -J17- and wiring for open circuit or short circuit ⇒ Seite 288 Current flow diagrams.

If LED lights up (voltage supply OK):

– Remove fuel delivery unit ⇒ Seite 167.
– Check that the electrical wiring between flange and fuel supply pump -G6- is connected and has continuity.

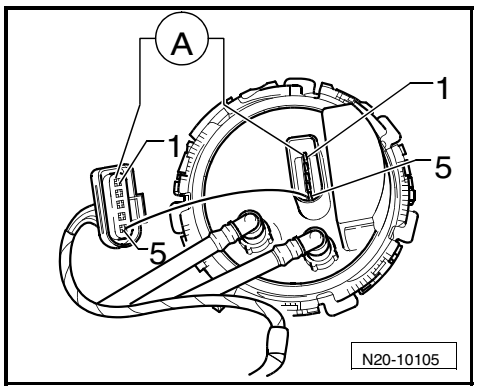
If no open circuit can be found:

– Renew fuel delivery unit.

Check current draw of fuel supply pump

– Remove cover from fuel delivery unit.

– Disconnect 5-pin connector from fuel delivery unit flange.
– Set multimeter -V.A.G 1715- to 20 A measuring range and connect in series using auxiliary cables from auxiliary measuring set -V.A.G 1594 C- between contacts -1- of connector and fuel supply pump.



Hinweis

The trigger clamp of multimeter -V.A.G 1715- can also be attached to an auxiliary lead between contacts -1- of the connector and fuel supply pump.

– Connect contacts -5- of connector and fuel supply pump using an auxiliary cable from auxiliary measuring set -V.A.G 1594 C-.
– Start engine and run at idling speed.
– Check current draw of fuel supply pump: Specification: max. 7.5 A.
– Switch off ignition.

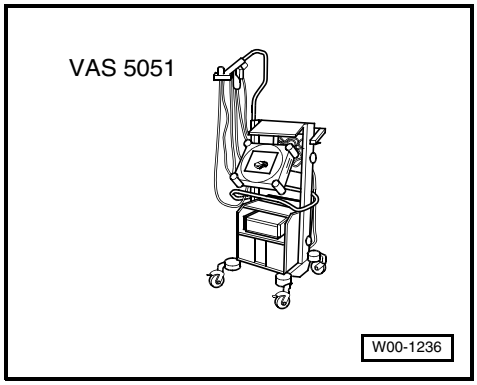
If the specification is exceeded:

– Renew fuel delivery unit ⇒ Seite 167, Removing and installing fuel delivery unit.

2.3 Checking accelerator pedal position sender -G79- (if fitted)

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -
♦ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
♦ Adapter set -V.A.G 1594-
♦ Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-
♦ Current flow diagram



Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK

Test procedure

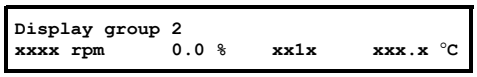
Hinweis

- *Due to the different installation conditions, the following section contains just general instructions for checking the accelerator pedal position sender.*
- *Accelerator pedal position sender -G79- and accelerator pedal position sender 2 -G185- are installed together in one housing in the charge air pipe.*
- *Only gold-plated contacts may be used when repairing the contacts in the connection of the accelerator pedal position sender.*

– Connect vehicle diagnosis, testing and information system -VAS 5051- and select diagnosis function „08-Read measured value block“. Engine must be idling to do this. (Connect vehicle diagnosis, testing and information system and select engine control unit⇒ Seite 5.)

– Select „display group 2“.

– Check accelerator position display in display zone 2. The accelerator pedal must not be pressed. Specification: 0.0 %.



Hinweis

On the display of vehicle diagnosis, testing and information system -VAS 5051-, the display zones are shown one below the other, on other diagnosis testers they are side by side.

– In addition, check the idling speed switch display in display zone 3. The 3rd position from the left must show 1. Display: xx1x

– Press accelerator pedal slowly until fully down, and observe display zones 2 and 3 when doing this.

Display zone 2:

- The accelerator pedal position value must increase continuously. Specification at full throttle position: 100 %

Display zone 3:

- The 3rd position from the left must change to 0. Display: xx0x.

– End diagnosis function.

– Switch off ignition.

If end specification is not achieved:

– Renew accelerator pedal position sender -G79-.

– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

If the display does not change or is erratic:

– Check wiring of accelerator pedal position sender as follows:

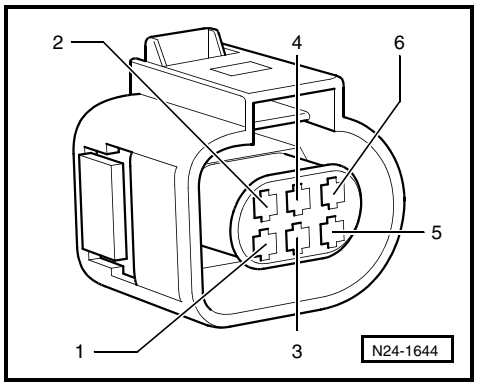
– Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.

– Pull off 6-pin connector from accelerator pedal position sender.

– Check wiring between test box and connector for open circuit using current flow diagram.

♦ Contact 1 + socket 83
♦ Contact 2 + socket 84
♦ Contact 3 + socket 39
♦ Contact 4 + socket 59
♦ Contact 6 + socket 17

• Cable resistance: max. 2.0 Ω



– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω.

If no fault in lines is detected:

– Renew accelerator pedal position sender -G79-.

– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

21 – Turbocharging/supercharging

1 Charge air system with turbocharger

Observe safety measures when working on charge air system with exhaust gas turbocharger ⇒ Seite 177.

Observe rules for cleanliness ⇒ Seite 177

Assembly overview - turbocharger with attachments ⇒ Seite 178.

Removing and installing turbocharger ⇒ Seite 182.

Vacuum hose schematic diagram ⇒ Seite 241.

1.1 Safety measures when working on charge air system with exhaust gas turbocharger

ACHTUNG!

For all assembly work, the following should be observed due to the restricted amount of space available:

- ***Route all the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant, refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***Ensure that there is sufficient clearance to all moving or hot components.***

Observe following if test and measuring instruments are required during a road test:

- The test instruments should always be secured and operated by a second person.

1.2 Rules for cleanliness

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

- Thoroughly clean all unions and adjacent areas before disconnecting.
- Place removed parts on a clean surface and cover. Do not use fluffy cloths!
- Carefully cover opened components or seal if repairs cannot be carried out immediately.
- Install clean components only: do not remove replacement parts from packing until immediately before installing. Do not use parts that have not been stored in their packing (e.g. in tool boxes etc.).
- Existing transport and protective packaging and sealing caps must only be removed immediately prior to installation.

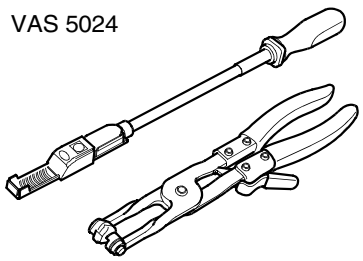
- When making repairs, remove oil from connection and hose ends.
- When system is open: do not work with compressed air if this can be avoided. Do not move vehicle unless absolutely necessary.

1.3 Assembly overview - turbocharger with attachments

Hinweis

- *All hose connections are secured.*
- *Charge pressure system must be free of leaks.*
- *When making repairs, remove oil from connection and hose ends.*
- *All hose connections of charge pressure system are secured by spring-type clips or by hose connections with connector couplings. Observe installation instructions ⇒ Seite 184.*
- *Spring-type clip pliers -VAS 5024- are recommended for installation of spring-type clips.*
- *Self-locking nuts are to be renewed.*
- *Before installing oil supply line ⇒ Pos. 3 auf Seite 179 (engine code CBHA, CBJA, CBJB) and oil supply hose ⇒ Pos. 4 auf Seite 181 (engine code CBKA) to the connection union, fill exhaust gas turbocharger on connection union with engine oil.*
- *After installing the turbocharger, allow engine to idle for about 1 minute to ensure oil is supplied to the turbocharger.*

VAS 5024



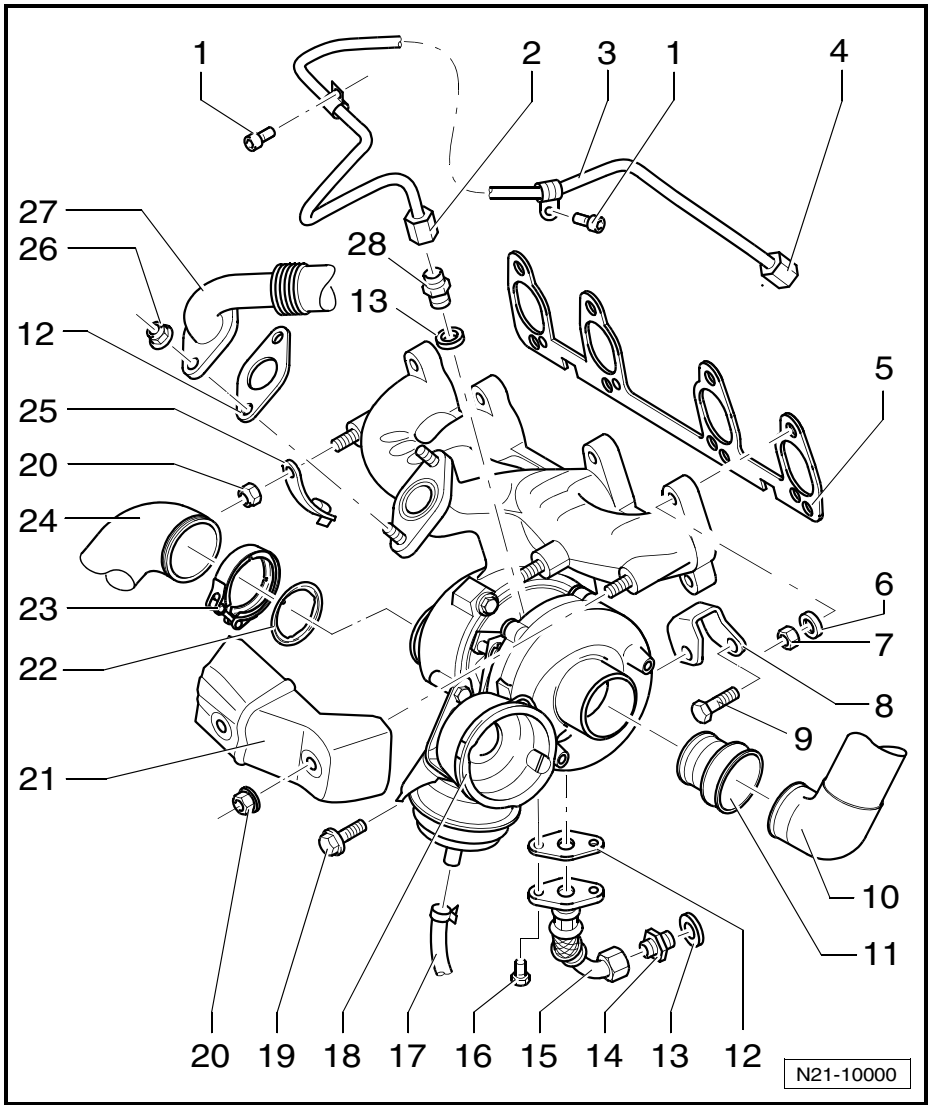
W00-0495

– Note safety precautions before beginning work ⇒ Seite 177
– Observe rules for cleanliness ⇒ Seite 177

Assembly overview - turbocharger with attachments:

- Engine codes CBHA, CBJA, CBJB ⇒ Seite 179,
- Engine code CBKA ⇒ Seite 181.

1.3.1 Assembly overview - exhaust gas turbocharger with attachment parts (engine codes CBHA, CBJA, CBJB)



1 - 10 Nm

2 - Union nut, 22 Nm

3 - Oil supply line
- ❑ Before installing oil supply line, ensure that it is not blocked
- ❑ Before installing, fill turbocharger with engine oil through oil supply line connection

4 - Union nut, 22 Nm

5 - Gasket
- ❑ Renew
- ❑ Note installation position

6 - Washer

7 - 25 Nm
- ❑ Renew

8 - Support
- ❑ Between turbocharger and cylinder block

9 - 40 Nm
- ❑ First hand tighten all bolts

10 - Connecting pipe
- ❑ Air filter/turbocharger

11 - Connector

12 - Gasket
- ❑ Renew

13 - Seal
- ❑ Renew

14 - Connection, 40 Nm

15 - Oil return line
- ❑ To cylinder block
- ❑ Tighten union nut to 30 Nm

16 - 17 Nm

17 - Vacuum hose
- ❑ Check for secure seating.
- ❑ Vacuum connection schematic diagram ⇒ Seite 241

18 - Turbocharger
- ❑ Can only be renewed with exhaust manifold
- ❑ Removing and installing ⇒ Seite 182.

19 - 20 Nm
- ❑ First hand tighten all bolts

20 - 20 Nm
- ❑ Renew

21 - Heat shield

22 - Gasket

- ❑ Renew
- ❑ Note installation position

23 - Clamp, 7 Nm

- ❑ Note installation position

24 - Front exhaust pipe

- ❑ Assembly overview - front exhaust pipe with catalytic converter ⇒ Seite 234

25 - Bracket

- ❑ For oil supply line ⇒ Pos. 3
- ❑ Before installing, secure oil supply line

26 - 22 Nm

- ❑ Renew

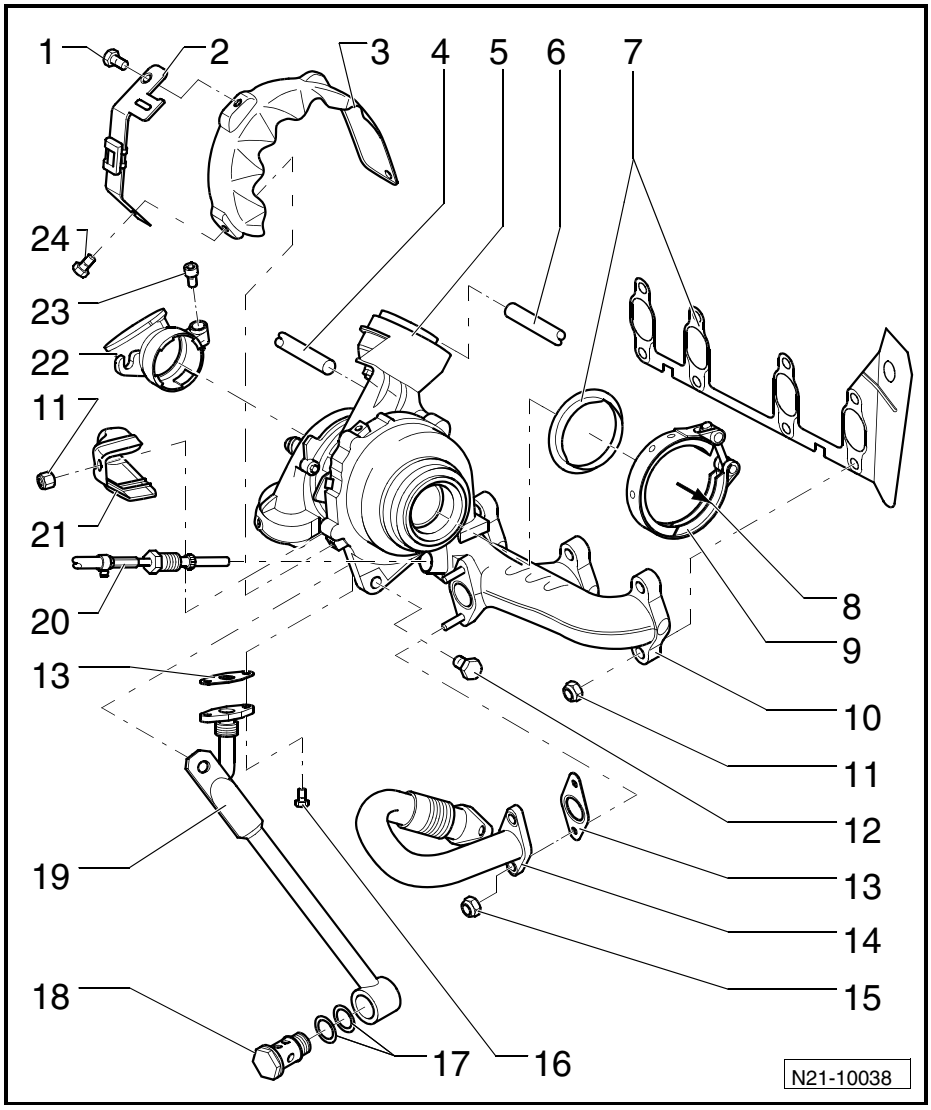
27 - Connecting pipe

- ❑ For exhaust gas recirculation
- ❑ To inlet connection
- ❑ Assembly overview - exhaust gas recirculation ⇒ Seite 238

28 - Connection, 30 Nm

- ❑ Renew
- ❑ Coat threads and bolt head contact surface with high-temperature paste -G 052 112 A3-.

1.3.2 Assembly overview - turbocharger with attachments (engine code CBKA)



1 - 10 Nm

2 - Bracket

3 - Heat shield

4 - Oil supply hose

- ❑ Check for secure seating.
- ❑ To oil supply line connection on turbocharger.
- ❑ Before installing, ensure oil supply hose is not blocked
- ❑ Before installing, fill turbocharger via oil supply hose with engine oil.

5 - Turbocharger

- ❑ Can only be renewed with exhaust manifold
- ❑ Removing and installing ⇒ Seite 182.

6 - Vacuum hose

- ❑ Check for secure seating.
- ❑ Vacuum connection schematic diagram ⇒ Seite 241

7 - Gasket

- ❑ Renew
- ❑ Note installation position

8 - To catalytic converter

- ❑ Assembly overview - front exhaust pipe with catalytic converter ⇒ Seite 234

9 - Clamp, 7 Nm

- ❑ Note installation position

10 - Exhaust manifold

- ❑ Can only be renewed together with turbocharger
- ❑ Removing and installing ⇒ Seite 182, Removing and installing exhaust gas turbocharger

11 - 25 Nm

- ❑ Renew

12 - 25 Nm

13 - Gasket

- ❑ Renew

14 - Connecting pipe

- ❑ For exhaust gas recirculation
- ❑ To exhaust gas recirculation cooler
- ❑ Assembly overview - exhaust gas recirculation ⇒ Seite 238

15 - 25 Nm

- ❑ Renew

16 - 15 Nm

17 - O-ring

- ❑ Renew

18 - Banjo bolt, 60 Nm

19 - Support

- ❑ For turbocharger
- ❑ With oil return line

20 - Exhaust gas temperature sender 1 -G235-, 45 Nm

- ❑ Lubricate thread of sender with high-temperature paste -G 052 112 A3-
- ❑ Checking ⇒ Seite 254.

21 - Heat shield

22 - Connection

- ❑ For intake hose for air filter/turbocharger

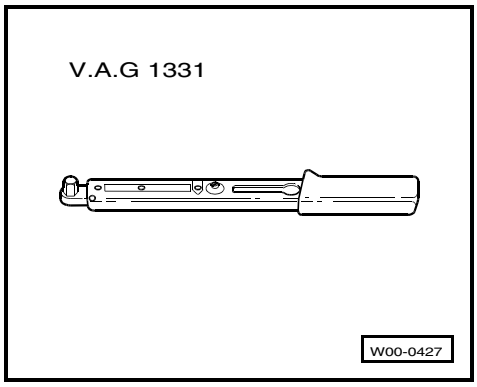
23 - 9 Nm

24 - 10 Nm

1.4 Removing and installing turbocharger

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Torque wrench (5...50 Nm) -V.A.G 1331-



Vorsicht!

If a mechanical fault is found on the turbocharger, e.g. a broken compressor impeller, it is not sufficient to just renew the turbocharger. To prevent this from causing further damage, perform the following repairs:

- ***Check air filter housing, air filter element and intake hoses for soiling.***
- ***Check complete charged air routing and charge air cooler (if fitted) for foreign objects.***

If foreign objects are found in the charge air system, the charged air routing must be cleaned and the charge air cooler must be renewed, if necessary.

Removing ⇒ Seite 182.

Installing ⇒ Seite 183.

1.4.1 Removing

– Note safety precautions before beginning work ⇒ Seite 177

– Observe rules for cleanliness ⇒ Seite 177

Engine codes CBHA, CBJA, CBJB

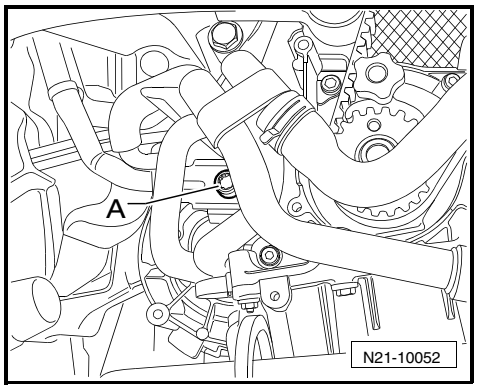
– Remove turbocharger support ⇒ Pos. 8 auf Seite 179.

– Remove oil supply line ⇒ Pos. 15 auf Seite 179.

– Remove exhaust gas recirculation connecting pipe ⇒ Pos. 27 auf Seite 180.
– Loosen charge pressure line on turbocharger.
– Pull vacuum hose ⇒ Pos. 17 auf Seite 179 off turbocharger.
– Loosen oil supply line ⇒ Pos. 3 auf Seite 179 on turbocharger.
– Unscrew securing nuts ⇒ Pos. 7 auf Seite 179 of exhaust manifold.

Engine code CBKA

– Remove exhaust gas pressure sensor 1 -G450 - ⇒ Seite 237, Assembly overview - particulate filter.
– Separate electrical wiring to particulate filter and remove particulate filter ⇒ Seite 237, Assembly overview - particulate filter.
– Loosen attachments -A- of coolant pipes for booster heater.
– Remove support for exhaust gas turbocharger ⇒ Pos. 19 auf Seite 182 and loosen oil supply line on turbocharger.
– Remove exhaust gas recirculation connecting pipe ⇒ Pos. 14 auf Seite 181.
– Loosen charge pressure line on turbocharger.
– Pull vacuum hose ⇒ Pos. 6 auf Seite 181 off turbocharger.
– Loosen oil supply hose ⇒ Pos. 4 auf Seite 181 on turbocharger.
– Unscrew securing nuts ⇒ Pos. 11 auf Seite 181 of exhaust manifold.



Continuation for all engine codes

– Remove turbocharger with exhaust manifold downwards.

1.4.2 Installing

– Installation of the turbocharger is carried out in the reverse order or removal.

Hinweis

- *Before installing oil supply line ⇒ Pos. 3 auf Seite 179 (engine code CBHA, CBJA, CBJB) and oil supply hose ⇒ Pos. 4 auf Seite 181 (engine code CBKA) to the connection union, fill exhaust gas turbocharger on connection union with engine oil.*
- *After installing the turbocharger, allow engine to idle for about 1 minute to ensure oil is supplied to the turbocharger.*

Specified torques

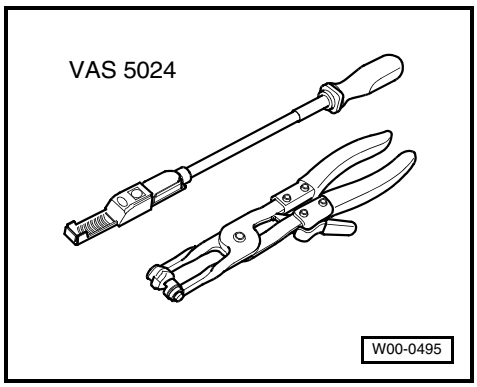
- Engine codes CBHA, CBJA, CBJB ⇒ Seite 179,
- Engine code CBKA ⇒ Seite 181.

– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

2 Checking charge pressure system

Hinweis

- *All hose connections are secured.*
- *Charge pressure system must be free of leaks.*
- *When making repairs, remove oil from connection and hose ends.*
- *All hose connections of charge pressure system are secured by spring-type clips or by hose connections with connector couplings. Observe installation instructions ⇒ Seite 184.*
- *Spring-type clip pliers -VAS 5024- are recommended for installation of spring-type clips.*



Observe safety measures when working on charge air system with exhaust gas turbocharger ⇒ Seite 177.

Observe rules for cleanliness ⇒ Seite 177

Installing hose connections with connector couplings ⇒ Seite 184.

Checking charge air system for leaks ⇒ Seite 185.

Checking charge pressure control ⇒ Seite 187.

Vacuum hose schematic diagram ⇒ Seite 241.

2.1 Disconnecting and reconnecting hose connections with push-in connectors

Vorsicht!

The seal of the connector coupling can be damaged if the securing clip is in locking position when installing. Leaks could occur. Observe installation instructions.

Removal of connector couplings ⇒ Seite 184.

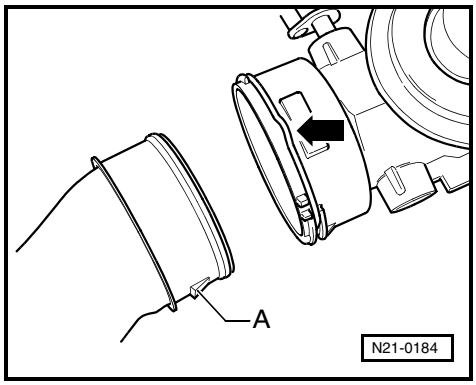
Assembly of connector couplings ⇒ Seite 185.

Assembly of hose connections with spring washer ⇒ Seite 185.

2.1.1 Removal of connector couplings

– Observe rules for cleanliness ⇒ Seite 177

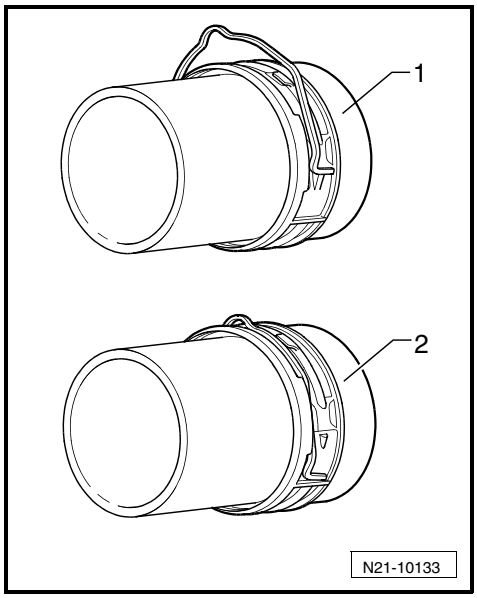
– Release push-on connection by pulling locking clip -arrow-. Separate hose/pipe without using tools.



2.1.2 Assembly of connector couplings

– If renewed, place seal in groove of charge air hose. Ensure the seal is correctly seated in the groove.
– Oil sealing surface and seal.

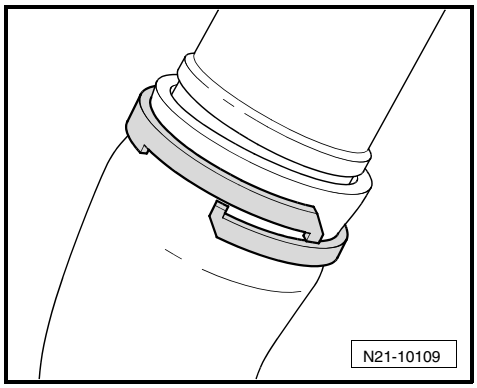
– Bring securing clip to release position -1-.
– Push charge air hose into coupling to stop.
– Set securing clip to locking position -2- and then push charge air hose again.
– Check if connector coupling seats correctly and is properly engaged by pulling hose.



2.1.3 Assembly of hose connections with spring washer

Hinweis

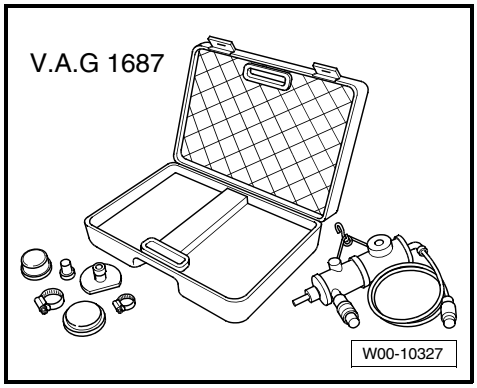
There is a danger of a „hose detaching“ during operation after removing and reinstalling charge pressure lines with spring-type clamps. For this reason, spring band rings are used which can be opened if a defect item requires the charge pressure line has to be disconnected. In cases of repair, destroy the spring band ring using a suitable tool and replace it with a replacement part from ⇒ ETKA (electronic parts catalogue).



2.2 Checking charge air system for leaks

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

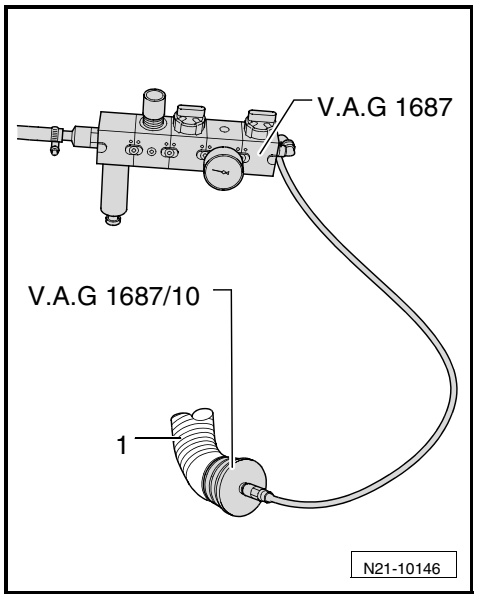
♦ Charge air system tester -V.A.G 1687-
♦ Adapter -V.A.G 1687/10-



Test procedure

– Note safety precautions before beginning work ⇒ Seite 177
– Observe rules for cleanliness ⇒ Seite 177

– Remove intake hose -1- from air filter.
– Connect adapter -1687/10- in intake hose -1- and secure with clip.

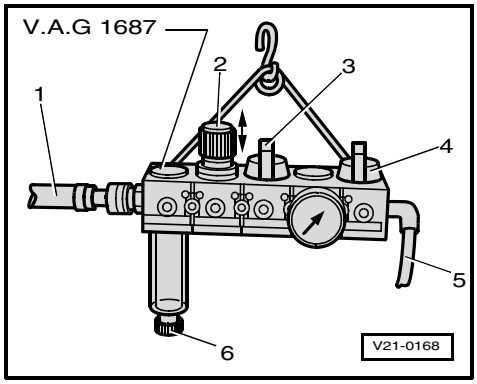


Prepare charge air system tester -V.A.G 1687- as follows:

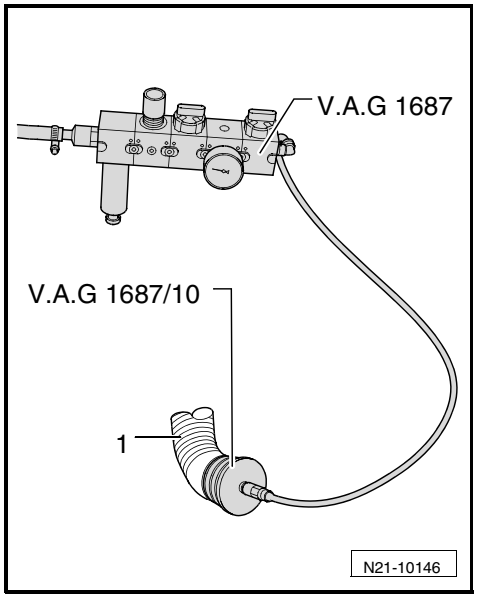
– Unscrew pressure regulating valve -2- and close valves -3- and -4-.

Hinweis

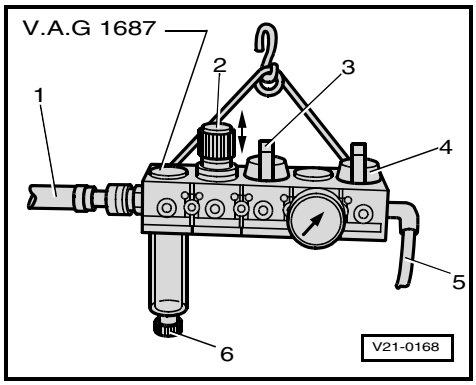
To turn the pressure control valve -2- the knob must be pulled upwards.



– Connect charge air system tester -V.A.G 1687- to adapter -1687/10- as shown.



– Connect compressed air hose -1- (compressed air source) to charge air system tester -V.A.G 1687 -.



Hinweis

If there is water in the sight glass, drain at water drain screw -6-.

– Open valve -3-.

– Adjust pressure to 0,5 bar with pressure regulating valve -2-.

Vorsicht!

The test pressure must not exceed 0.5 bar! If the pressure is too high this can cause damage to the engine.

– Open valve -4- and wait until the test circuit is filled. If necessary readjust pressure to 0.5 bar.

– Check the charge air system for leaks by hearing, touching, with commercially available leak detector spray or using ultrasonic tester -V.A.G 1842-.

Hinweis

- *Operation of ultrasonic tester -V.A.G 1842 - ⇒ operating instructions.*
- *If leaks occur, when doing any repair work observe notes for charge air system ⇒ Seite 184.*
- *Before removing charge air system tester -V.A.G 1687-, relieve pressure from test circuit by pulling off suction hose from stepped adapter -1687/10-.*

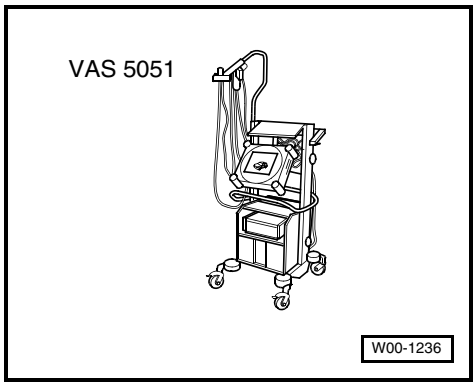
2.3 Checking charge pressure regulation

Hinweis

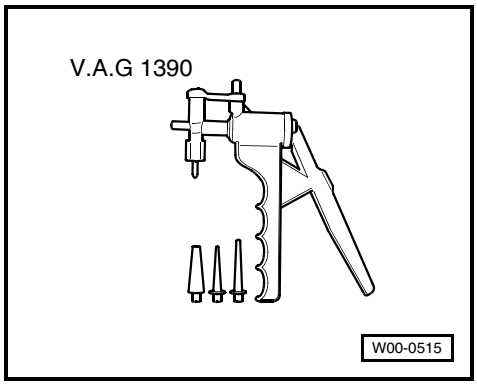
Checking of the charge pressure control system is carried out in diagnosis function „03-Final control diagnosis“. With this approach, the charge pressure control solenoid -N75- is actuated in a pulsed manner so that the extreme values for charge pressure control can be read in the measured value block.

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -



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



Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- No leaks on intake and exhaust systems
- No faults on engine/injection system such as unit injectors or compression pressure.
- No faults must be stored in fault memory ⇒ Seite 9, interrogating fault memory.
- The coolant temperature must be at least 80 °C, ⇒ display group 1, display zone 4.

Test procedure

– Carry out final control diagnosis and activate charge pressure control solenoid -N75- ⇒ Seite 49, Final control diagnosis.

The displays in display zones 2, 3 and 4 must fluctuate in the following control range:

Display zone 2: off

- Specification in display zone 3: 900...1050 mbar
- Specification display zone 4: 4...5 %

Display zone 2: on

- Specification in display zone 3: 40 mbar greater than display off
- Specification in display zone 4: at least 95 %

Hinweis

♦ *Actuation of the valve can also be checked by touch.*

♦ *During actuation, the charge pressure control linkage of the vacuum unit on the turbocharger should move back and forth (at least 3...4 times while there is a vacuum in the vacuum reservoir).*

– Proceed with final control diagnosis until completed.

– End diagnosis function.

– Switch off ignition.

If the linkage moves and the specifications are not reached:

– Turbocharger defective. Renew turbocharger ⇒ Seite 182, Removing and installing turbocharger.

If the linkage does not move because the solenoid is not working:

– Check charge pressure regulation solenoid valve -N75 - ⇒ Seite 189.
– Check vacuum hoses for leaks. Vacuum hose schematic diagram ⇒ Seite 241.

If the linkage does not move but the solenoid is working:

– Pull vacuum hose off charge pressure control vacuum unit:

♦ Engine codes CBHA, CBJA, CBJB ⇒ Pos. 17 auf Seite 179,
♦ Engine code CBKA ⇒ Pos. 6 auf Seite 181.

– Connect hand vacuum pump -V.A.G 1390 - to charge pressure control vacuum unit and check linkage for ease of movement.

If the linkage is not free to move:

– Turbocharger defective. Renew turbocharger ⇒ Seite 182, Removing and installing turbocharger.

3 Checking components and functions

The component and functional checks listed refer to the series production components and the current flow diagrams from page ⇒ Seite 288.

In the event of component and switch unit deviation, please refer to the instructions of the respective industrial engine customer.

Check charge pressure regulation solenoid valve -N75- ⇒ Seite 189.

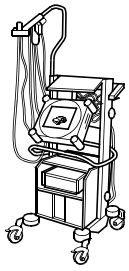
Checking charge pressure sender -G31- ⇒ Seite 192.

3.1 Checking charge pressure regulation solenoid valve -N75-

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -
♦ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
♦ Adapter set -V.A.G 1594-
♦ Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-
♦ Current flow diagram

VAS 5051



W00-1236

Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- The coolant temperature must be at least 80 °C, ⇒ display group 1, display zone 4.

Test procedure

– Carry out final control diagnosis and activate charge pressure control solenoid -N75- ⇒ Seite 49, Final control diagnosis.

The displays in display zones 2, 3 and 4 must fluctuate in the following control range:

Display zone 2: off

- Specification in display zone 3: 900...1050 mbar
- Specification display zone 4: 4...5 %

Display zone 2: on

- Specification in display zone 3: 40 mbar greater than display off
- Specification in display zone 4: at least 95 %

Hinweis

- *Actuation of the valve can also be checked by touch.*
- *During actuation, the charge pressure control linkage of the vacuum unit on the turbocharger should move back and forth (at least 3...4 times while there is a vacuum in the vacuum reservoir).*

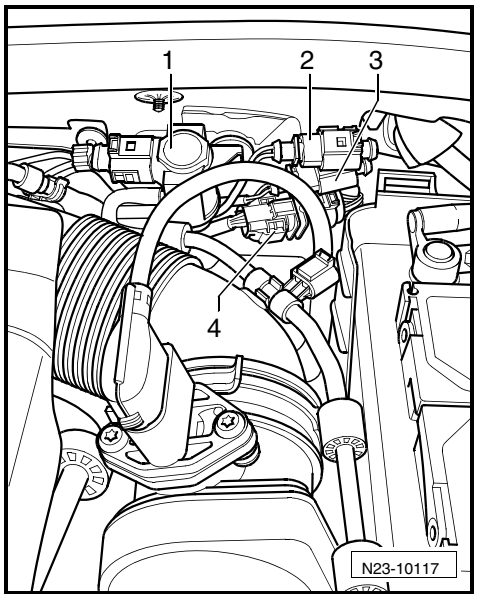
– Proceed with final control diagnosis until completed.

– End diagnosis function.

– Switch off ignition.

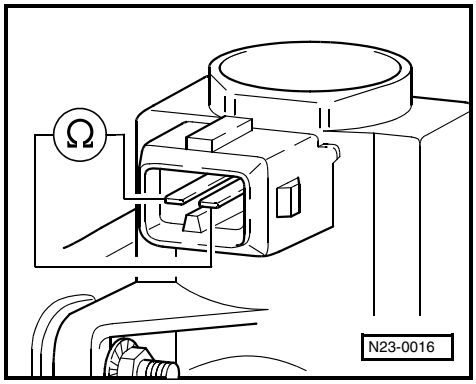
If the valve is not actuated:

– Pull off 2-pin connector from charge pressure control solenoid -N75- -1-.



Check resistance

– Connect multimeter with auxiliary lines from -V.A.G 1594- for resistance measurement to contacts of valve. Specification: 14.0...20.0 Ω.



Hinweis

At room temperature, the resistance is in the lower tolerance range; at operating temperature, the resistance is in the upper tolerance range.

If the specification is not obtained:

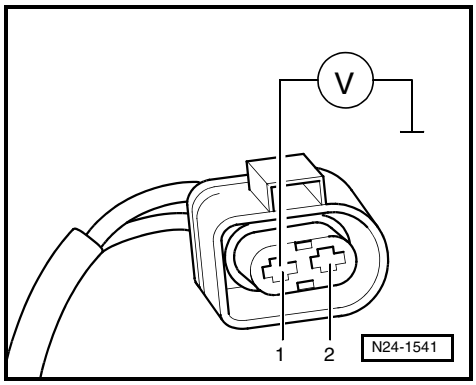
– Renew charge pressure regulation solenoid valve -N75-.

– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

If the specification is reached:

Checking voltage supply

– Connect multimeter with auxiliary lines from -V.A.G 1594- for voltage measurement to contact 1 of connector and engine earth.



– Switch on ignition. Specification: at least 11.5 V.

– Switch off ignition.

If the specification is not obtained:

– Check terminal 30 voltage supply relay -J317- ⇒ Seite 288, Current flow diagrams.

– Check cable connections for open circuit, short circuit and transfer resistance at contacts according to current flow diagram.

If the specification is reached:

– Check wiring of charge pressure control solenoid as follows:

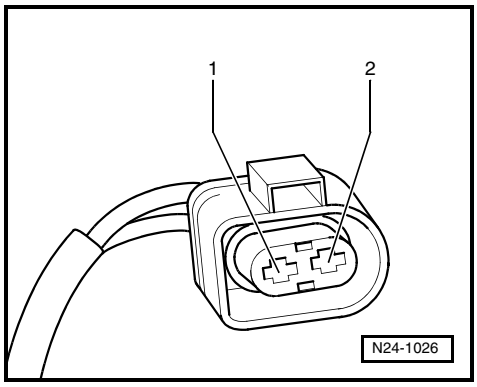
– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-1- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit using current flow diagram.

♦ Contact 2 + socket 29

• Cable resistance: max. 2.0 Ω

– In addition, check wires for short to one another. Specification: ∞ Ω.



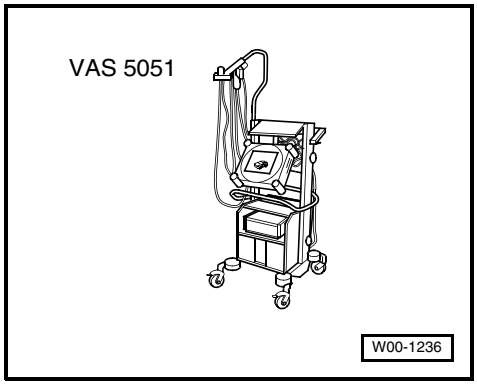
If no wiring fault is detected and voltage supply is OK:

– Renew engine control unit -J623- ⇒ Seite 230.

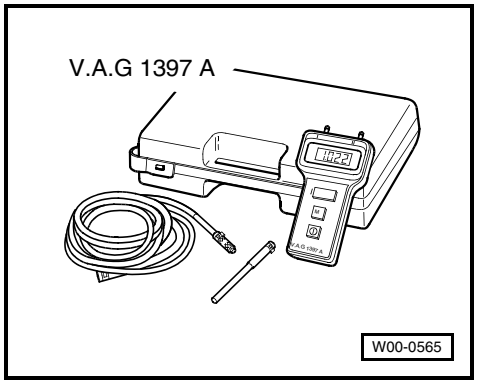
3.2 Checking charge pressure sender -G31-

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -



♦ Turbocharger tester -V.A.G 1397 A-
♦ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
♦ Adapter set -V.A.G 1594-
♦ Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-
♦ Current flow diagram



Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

• Fuses must be OK.
• The battery voltage must be at least 11.5 V.
• All electrical consumers must be switched off.
• Earth connections OK

Test procedure

Hinweis

- *Charge pressure sender -G31- and intake air temperature sender -G42- are installed together in one housing in the charge air pipe.*
- *Only gold-plated contacts may be used when repairing the connector contacts.*

– Connect vehicle diagnosis, testing and information system -VAS 5051- and select diagnosis function „08-Read measured value block“. The ignition must be switched on for this purpose. (Connect fault reader and select engine control unit -J623- ⇒ Seite 5.)

– Select „display group 11“.

Indicated on display:

```
Display group 11
xxx rpm     xxxx mbar     978 mbar     xx %
```

Hinweis

On the display of vehicle diagnosis, testing and information system -VAS 5051-, the display zones are shown one below the other, on other diagnosis testers they are side by side.

– Check specification for charge pressure (actual) in display zone 3.

– Compare displayed charge pressure (actual) with display on turbocharger tester -V.A.G 1397 A-. Specification: Pressures displayed must match (tolerance ± 50 mbar).

Hinweis

The turbocharger tester -V.A.G 1397 A- is required to provide an independent figure for comparison. The turbocharger tester must be set to range I (absolute pressure). A barometer may be used instead.

– End diagnosis function.

– Switch off ignition.

If the specification is not obtained:

– Check wiring of charge pressure sender as follows:

– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-2- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.

– Pull off 4-pin connector from charge pressure sender.

Hinweis

Charge pressure sender -G31- and intake air temperature sender -G42- are installed together in one housing in the charge air pipe.

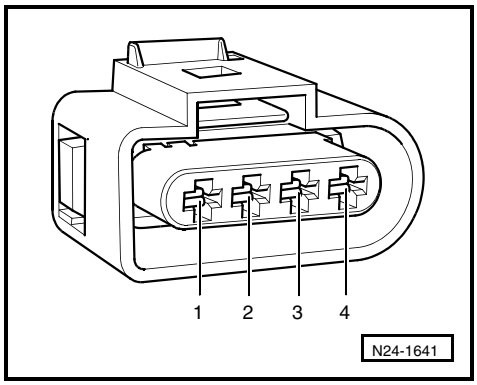
– Check wiring between test box and connector for open circuit using current flow diagram.

♦ Contact 3 + socket 62

♦ Contact 4 + socket 78

• Cable resistance: max. 2.0 Ω

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω.



If no fault in lines is detected:

– Renew charge pressure sender -G31 - with intake air temperature sender - G42-.

– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

23 – Mixture preparation - injection

1 Repairing diesel direct injection system

The engine control unit -J623- is equipped with a fault memory. Before and after repairs, adjustment work and fault finding, interrogate the fault memory ⇒ Seite 9 and perform the final control diagnosis.

Hinweis

- *During some checks, it is possible that the engine control unit will detect and store a fault. Therefore, after completing all checks and repairs, interrogate the fault memory and erase if necessary ⇒ Seite 9, Interrogating fault memory.*
- *For trouble-free operation of electrical components, a voltage of at least 11.5 V is necessary.*
- *Self-locking nuts are to be renewed.*

Observe safety precautions when working on diesel direct injection system ⇒ Seite 195.

Observe rules for cleanliness ⇒ Seite 196

Assembly overview - parts of intake manifold ⇒ Seite 196.

Assembly overview - unit injector ⇒ Seite 198.

Removing and installing unit injector ⇒ Seite 200.

Renewing O-rings and heat insulation seal for unit injector ⇒ Seite 203.

1.1 Safety precautions when working on diesel direct injection system

ACHTUNG!

For all assembly work, the following should be observed due to the restricted amount of space available:

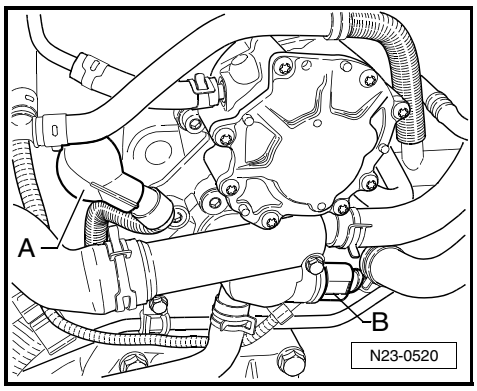
- ***Route all the various lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant, refrigerant, brake fluid and vacuum) and electrical wiring in their original positions.***
- ***Ensure that there is sufficient clearance to all moving or hot components.***

To prevent injuries to persons and/or damage to the injection and glow plug system, the following must be noted:

- Always switch off the ignition before connecting or disconnecting injection and glow plug system wiring or tester cables.
- If the engine has to be operated at the starting speed without actually starting, e.g. to test compression pressure, detach central connector -A- for the unit injectors.
- Disconnecting and connecting the battery must only be done with the ignition switched off, as otherwise the engine control unit could be damaged.

Observe following if test and measuring instruments are required during a road test:

- The test instruments should always be secured and operated by a second person.



1.2 Rules for cleanliness

When working on the fuel supply/injection system, pay careful attention to the following „rules“ of cleanliness.

- Thoroughly clean all unions and adjacent areas before disconnecting.
- Place removed parts on a clean surface and cover. Do not use fluffy cloths!
- Carefully cover opened components or seal if repairs cannot be carried out immediately.
- Install clean components only: do not remove replacement parts from packing until immediately before installing. Do not use parts that have not been stored in their packing (e.g. in tool boxes etc.).
- Existing transport and protective packaging and sealing caps must only be removed immediately prior to installation.
- When system is open: do not work with compressed air if this can be avoided. Do not move vehicle unless absolutely necessary.
- Also ensure that no diesel fuel comes into contact with the coolant hoses. If necessary, the hoses must be cleaned immediately. Damaged hoses must be renewed.

1.3 Assembly overview - parts of intake manifold

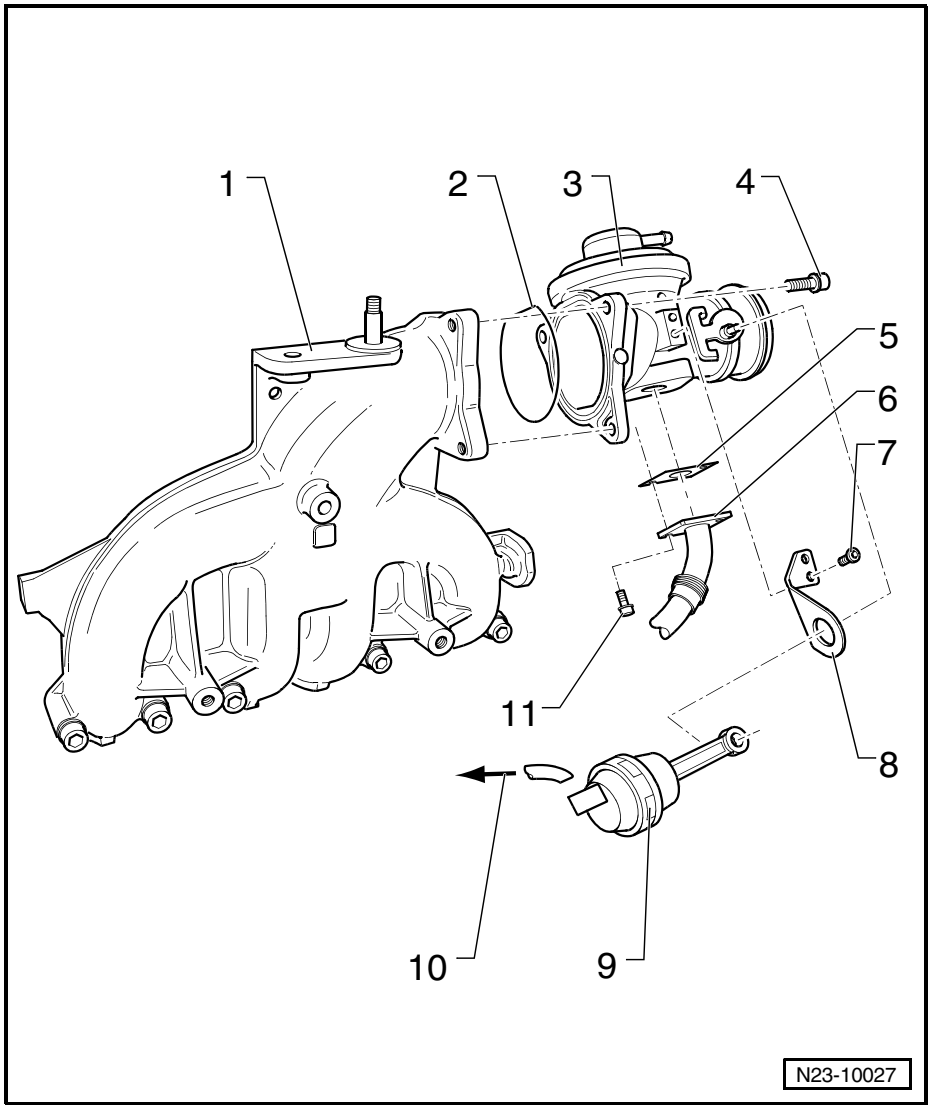
– Note safety precautions before beginning work ⇒ Seite 195

– Observe rules for cleanliness ⇒ Seite 196

Assembly overview - parts of intake manifold:

- Engine codes CBHA, CBJA, CBJB ⇒ Seite 197,
- Engine code CBKA ⇒ Seite 198.

1.3.1 Assembly overview - parts of intake manifold (engine codes CBHA, CBJA, CBJB)



1 - Intake pipe
- ❑ Tighten securing bolts to 22 Nm.

2 - O-ring
- ❑ Renew

3 - Intake connecting pipe
- ❑ With exhaust gas recirculation valve and intake manifold flap
- ❑ Renew complete only
- ❑ Check intake manifold flap changeover ⇒ Seite 223
- ❑ Checking exhaust gas recirculation valve ⇒ Seite 250

4 - 10 Nm

5 - Gasket
- ❑ Renew

6 - Connecting pipe
- ❑ For exhaust gas recirculation
- ❑ From exhaust manifold

7 - 10 Nm

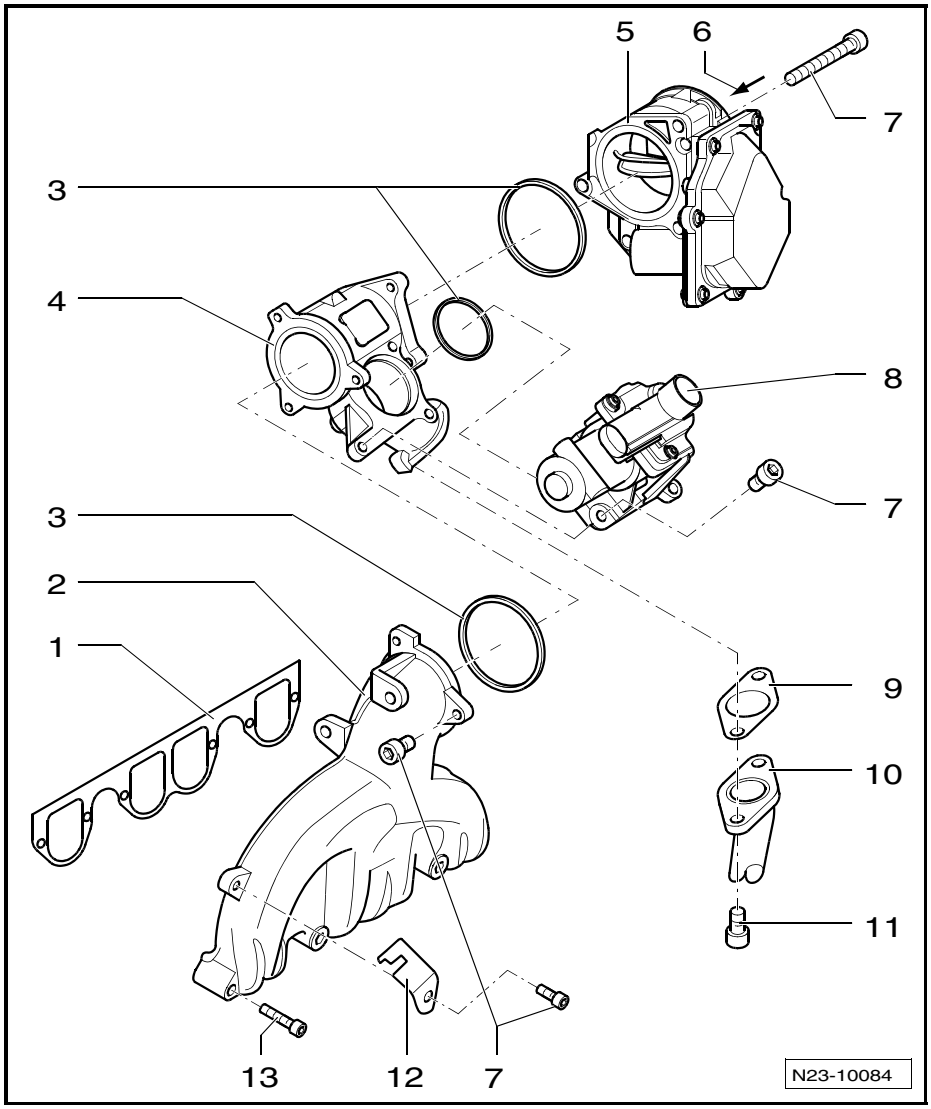
8 - Bracket
- ❑ For vacuum positioner element ⇒ Pos. 9

9 - Vacuum actuator
- ❑ Check intake manifold flap changeover ⇒ Seite 223

10 - To intake manifold flap changeover valve - N239-
- ❑ Check intake manifold flap changeover ⇒ Seite 223
- ❑ Vacuum connection schematic diagram ⇒ Seite 241

11 - 22 Nm

1.3.2 Assembly overview - parts of intake manifold (engine code CBKA)



1 - Gasket
- ❑ Renew

2 - Intake pipe

3 - Seal
- ❑ Renew

4 - Intake connecting pipe

5 - Intake manifold flap motor -V157-
- ❑ The intake manifold flap is closed for approx. 3 seconds when stopping engine and then opens again. This reduces the stop jolt
- ❑ With intake manifold flap potentiometer -G336 -
- ❑ Checking intake manifold flap motor -V157- ⇒ Seite 226
- ❑ Basic setting of intake manifold flap motor -V157- ⇒ Seite 228.

6 - From charge air cooler

7 - 10 Nm

8 - Exhaust gas recirculation valve -N18-
- ❑ Before installing, check sealing surface on intake manifold for contamination and clean if necessary
- ❑ With exhaust gas recirculation potentiometer -G212-
- ❑ Checking exhaust gas recirculation valve -N18 - ⇒ Seite 245
- ❑ Basic setting of exhaust gas recirculation valve -N18- ⇒ Seite 250

9 - Gasket
- ❑ Renew

10 - Exhaust gas recirculation cooler
- ❑ Assembly overview - exhaust gas recirculation cooler (engine code CBKA) ⇒ Seite 240

11 - 22 Nm

12 - Bracket

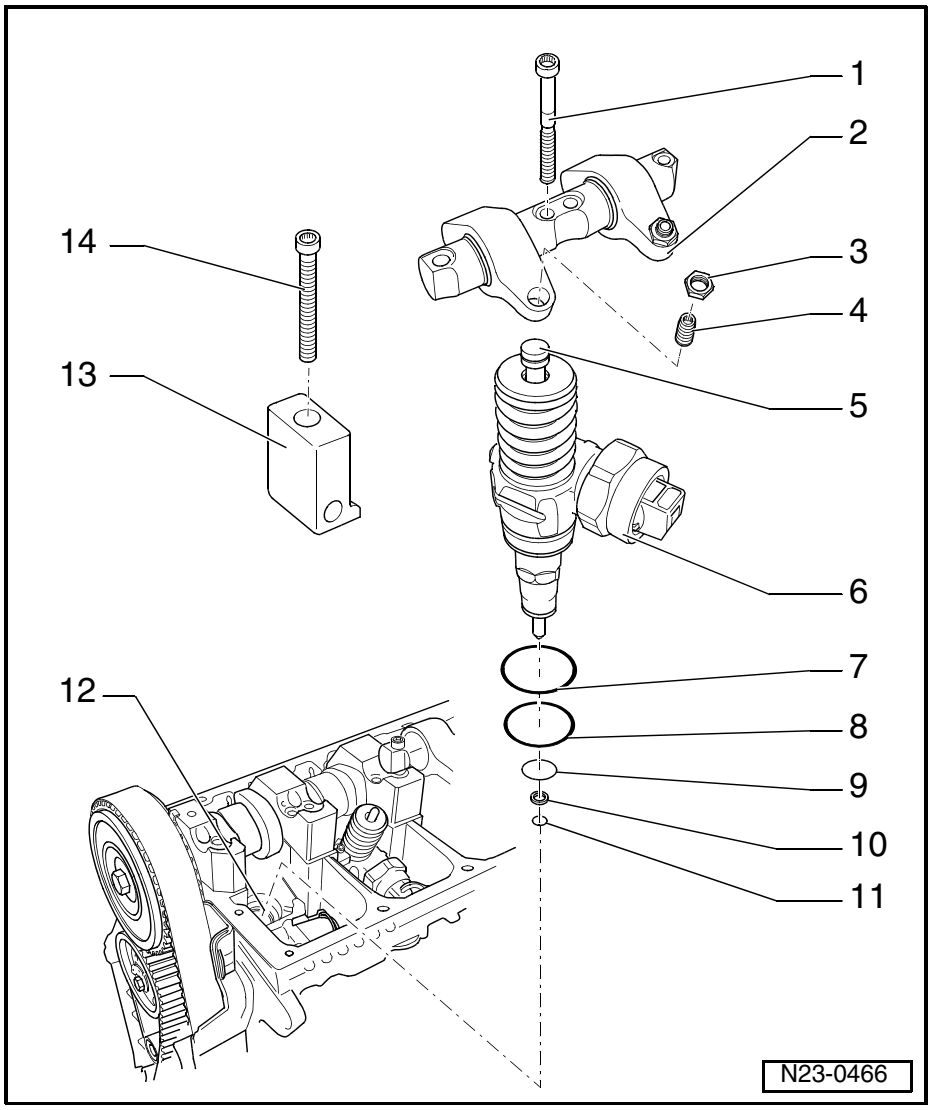
13 - 22 Nm

1.4 Assembly overview - unit injector

Hinweis

Always renew seals and O-rings.

– Observe rules for cleanliness ⇒ Seite 196



1 - 20 Nm + 1/4 turn (90°) further
- ❑ Renew

2 - Rocker arm shaft
- ❑ With rocker arms
- ❑ Removing and installing ⇒ Seite 200, Removing and installing unit injector

3 - Lock nut, 30 Nm

4 - Adjuster screw
- ❑ Renew

5 - Ball stud
- ❑ Renew

6 - Unit injector (cylinders 1...4)
- ❑ Removing and installing ⇒ Seite 200.
- ❑ Check unit injector valve (cylinder 1...4) -N240...N243- ⇒ Seite 205

7 - O-ring
- ❑ Renewing ⇒ Seite 203

8 - O-ring
- ❑ Renewing ⇒ Seite 203

9 - O-ring
- ❑ Renewing ⇒ Seite 203

10 - Heat shield seal
- ❑ Renewing ⇒ Seite 203

11 - Circlip

12 - Cylinder head

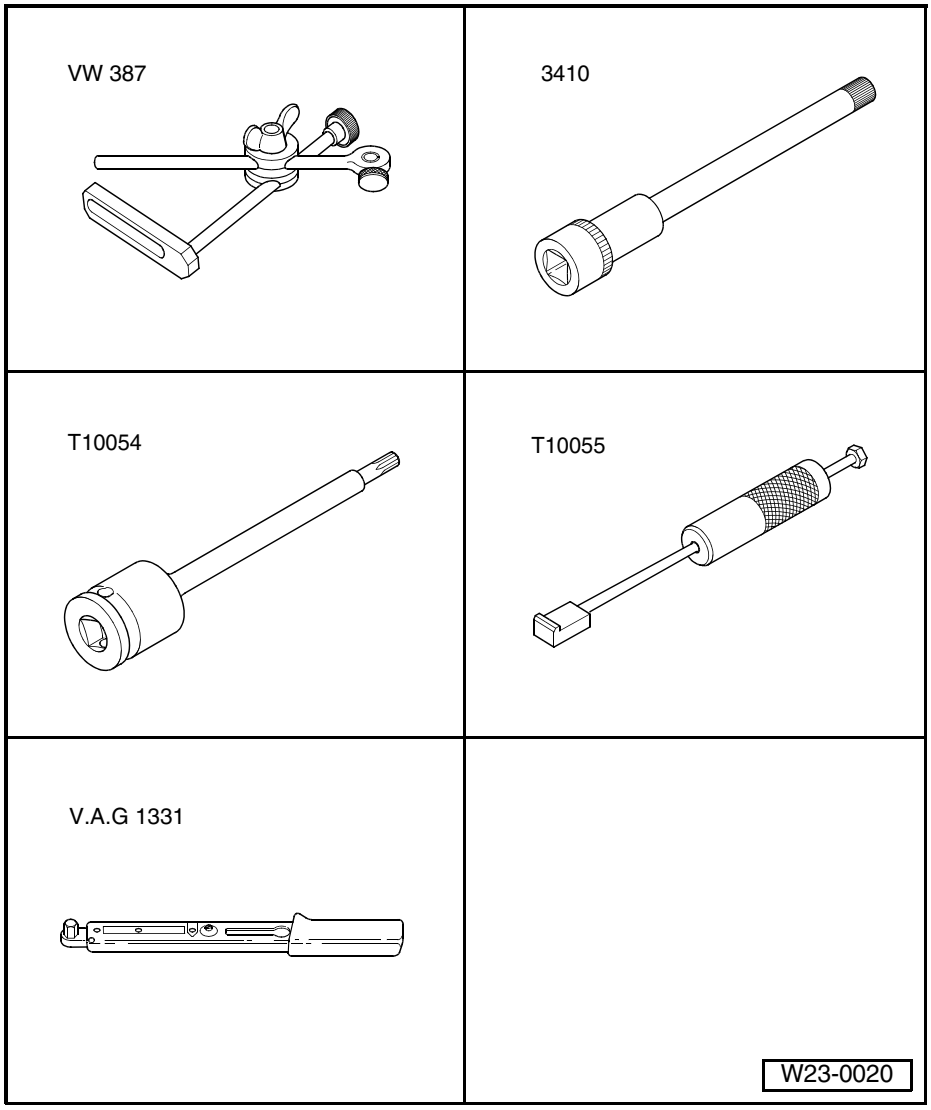
13 - Clamping block

14 - 12 Nm + 3/4 turn (270 °) further
- ❑ Renew

1.5 Removing and installing unit injector

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Universal dial gauge bracket -VW 387-
- special wrench, long reach -3410-
- special wrench, long reach -T10054-
- Puller -T10055-
- Torque wrench (5...50 Nm) -V.A.G 1331-
- Dial gauge



Hinweis

Always renew seals and O-rings.

Removing ⇒ Seite 200.

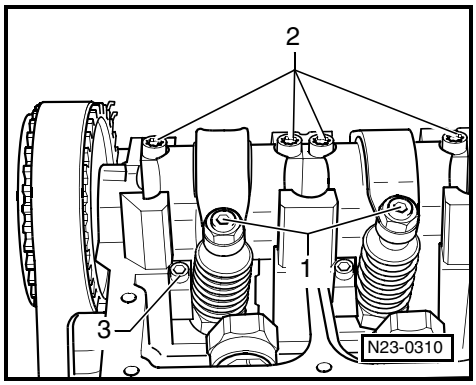
Installing ⇒ Seite 201.

1.5.1 Removing

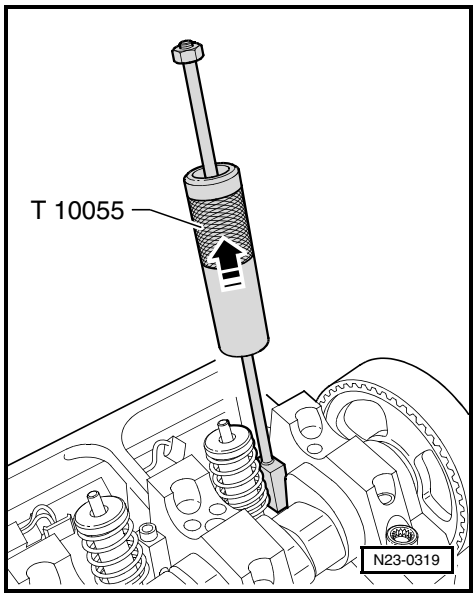
– Observe rules for cleanliness ⇒ Seite 196
– Remove cylinder head cover ⇒ Seite 114.
– Turn crankshaft until the cam pair for the unit injector which is to be removed point uniformly upwards.

– Loosen lock nuts of adjustment screws -1- and remove adjustment screws.
– Remove rocker arm securing bolts -2- (from outwards to inwards) with socket -3410- and take rocker arm shaft off.
– Remove tensioning block securing bolt -3- using special wrench, long reach -T10054- and remove the block.
– Lever 2-pin connector off unit injector using a screwdriver. Support opposite side of connector with light finger pressure to prevent canting.

Observe unit injector cylinder allocation.



– Insert puller -T10055- in place of the clamping block in the slot on the side of the unit injector.
– Pull unit injector out of cylinder head seat with gentle taps.



1.5.2 Installing

Hinweis

- *Each time work is performed which requires adjustment of the unit injector, the adjustment screw in the rocker arm and also the unit injector ball stud must be renewed.*
- *New unit injectors are supplied with O-rings and heat shield seal.*

– Heat insulating seal and O-rings must be renewed if old unit injector is reused ⇒ Seite 203.
– Before installing unit injector, check that the three O-rings, the heat shield seal and securing clip are seated correctly.

Hinweis

The O-rings must not be twisted.

– Oil the O-rings and fit the unit injector into the cylinder head extremely carefully.
– Push the unit injector using uniform pressure into the cylinder head onto its limit stop.
– Insert the clamping block in the slot on the side of the unit injector.

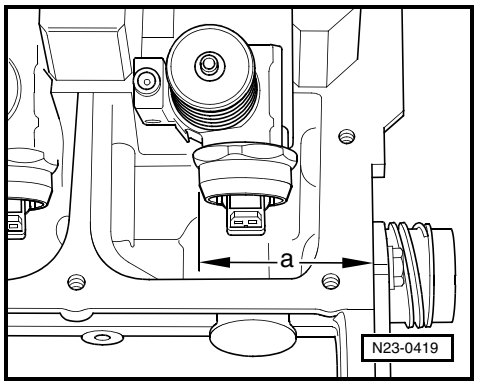
Hinweis

If the unit injector is not at right angles to the tensioning block the securing bolt may loosen and this can damage the unit injector or the cylinder head.

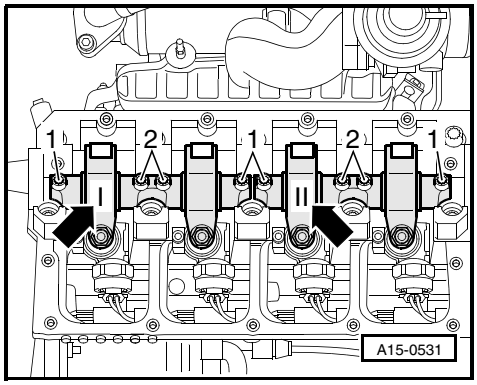
– Therefore align the unit injector as follows.
– Screw the new securing bolt into the tensioning block only so far that the unit injector can still be turned easily.
– Now align unit injector at right angles to camshaft mounting brackets.

– Check dimension „a“ from outer edge of cylinder head to rounded edge of unit injector with a vernier gauge (measuring range at least 400 mm.)

Cylinder	Dimension „a“
1	333,0 ± 0.8 mm
2	245,0 ± 0.8 mm
3	153,6 ± 0.8 mm
4	65,6 ± 0.8 mm



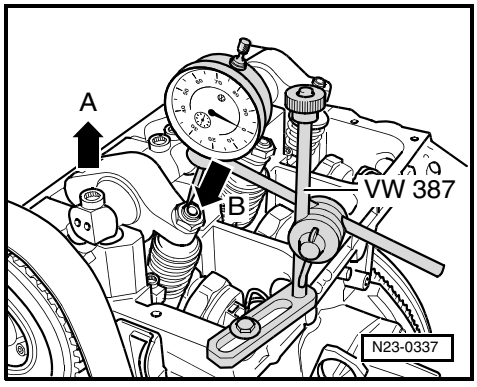
– Align unit injector if necessary and tighten securing bolt as follows: 12 Nm and turn 270° ($^3/_4$) further (turning further can be done in several stages).
– Fit rocker arm shaft and tighten new securing bolts as follows:
– First tighten inner bolts -2- and then outer bolts -1- evenly by hand. Then tighten, in same sequence, to 20 Nm + $^1/_4$ turn (90°) further evenly.

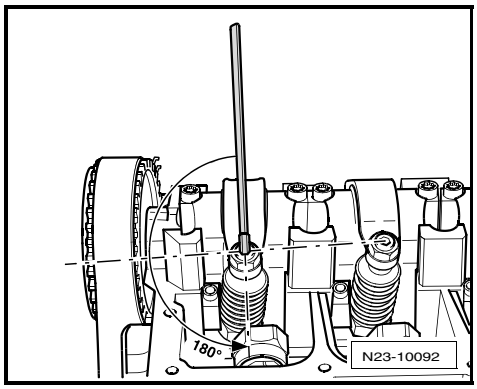


– Fit the dial gauge onto the adjustment screw of the unit injector as shown.
– Turn the crankshaft in engine direction of rotation until the roller of the rocker arm is positioned on the peak of the drive cam.

- Roller side -arrow A- positioned at highest point.
- Dial gauge -arrow B- positioned at lowest point.

– Remove dial gauge.
– Now turn the adjuster screw into rocker arm until significant resistance can be felt (unit injector is at limit stop).
– Turn adjustment screw -180°- back off stop.
– Hold adjuster screw in this position and tighten lock nut to 30 Nm.
– Connect unit injector connector.
– Install cylinder head cover ⇒ Seite 114.

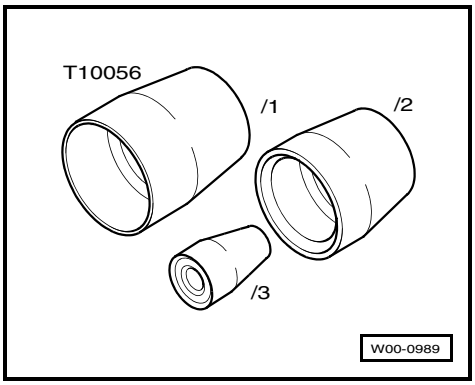




1.6 Renewing O-rings and heat insulation seal for unit injector

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Assembly sleeves -T10056-



Removing ⇒ Seite 203.

Installing ⇒ Seite 203.

1.6.1 Removing

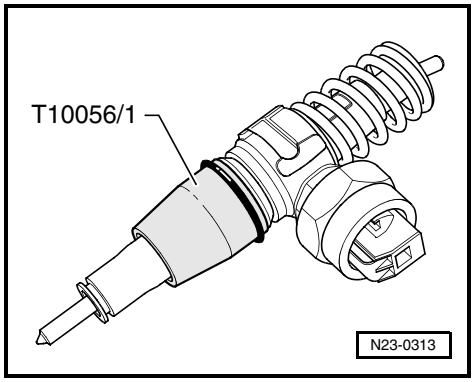
- Observe rules for cleanliness ⇒ Seite 196
- Remove unit injector ⇒ Seite 200.
- Lever old O-rings very carefully out of unit injector.
- Above all ensure that burrs are not caused on O-ring seating.

1.6.2 Installing

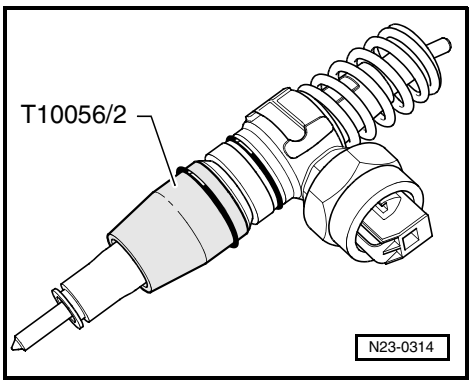
Hinweis

- *Always use assembly sleeves -T10056- to fit the O-rings. There is a danger of damaging the O-rings if the sleeves are not used.*
- *Gradual introduction of O-rings without different coloured markings. Note the correct allocation of O-rings to grooves: the thickness of the rings reduces towards injector nozzle.*
- *Prevent O-rings from rolling when sliding them on. The O-rings must not be twisted in their seats in unit injector.*

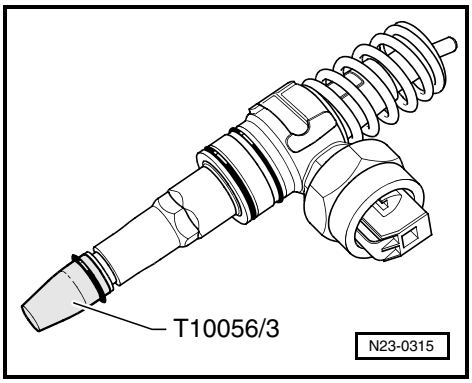
- Remove the insulating seal together with the retaining ring.
- Clean seating surfaces for O-rings on unit injector very carefully.
- Fit assembly sleeve -T10056/1- onto unit injector, pushing it to the limit stop.
- Push the upper, thicker O-ring carefully onto the assembly sleeve and into the seat on the unit injector.
- Remove assembly sleeve.



– Fit assembly sleeve -T10056/2- onto unit injector, pushing it to the limit stop.
– Slide middle, thinner O-ring carefully onto assembly sleeve and into seat on unit injector.
– Remove assembly sleeve.



– Fit assembly sleeve -T10056/3- onto unit injector, pushing it to the limit stop.
– Push lower O-ring carefully onto assembly sleeve and into the seat of the unit injector.
– Remove assembly sleeve.
– Push on a new insulating seal together with the retaining ring.
– Install unit injector ⇒ Seite 200.



2 Checking components and functions

The component and functional checks listed refer to the series production components and the current flow diagrams from page ⇒ Seite 288.

In the event of component and switch unit deviation, please refer to the instructions of the respective industrial engine customer.

Checking unit injector valve (cylinder 1...4) -N240...N243- ⇒ Seite 205.

Checking engine speed sender -G28- ⇒ Seite 210.

Checking Hall sender -G40- ⇒ Seite 212.

Checking intake air temperature sender -G42- ⇒ Seite 213.

Checking coolant temperature sender -G62- ⇒ Seite 215.

Checking fuel temperature sender -G81- ⇒ Seite 218.

Checking air mass meter -G70- ⇒ Seite 220.

Checking intake manifold flap changeover (engine codes CBHA, CBJA, CBJB) ⇒ Seite 223.

Checking intake manifold flap changeover -N239- (engine codes CBHA, CBJA, CBJB) ⇒ Seite 224.

Checking intake manifold flap motor -V157- (engine code CBKA) ⇒ Seite 226.

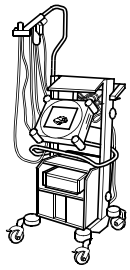
Basic setting of intake manifold flap motor -V157- (engine code CBKA) ⇒ Seite 228.

2.1 Checking unit injector valve (cylinder 1...4) -N240...N243-

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -
- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Adapter set -V.A.G 1594-
- Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-
- Current flow diagram

VAS 5051



W00-1236

Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- Fuel filter and fuel lines must not be blocked.
- The coolant temperature must be at least 80 °C, ⇒ display group 1, display zone 4.

Test procedure

Hinweis

To repair the contacts in the connections of the unit injector valves (cylinder 1...4), only gold plated contacts may be used.

– Connect vehicle diagnosis, testing and information system -VAS 5051- and select diagnosis function „08-Read measured value block“. Engine must be idling to do this. (Connect vehicle diagnosis, testing and information system and select engine control unit⇒ Seite 5.)

Hinweis

If the engine does not start, check resistance of unit injector valves (cylinder 1...4) ⇒ Seite 207.

– Select „display group 1“.

Indicated on display:

```
Display group 1
880 rpm   xxx.x mg/H   xxx CA    87.3 °C
```

Hinweis

On the display of vehicle diagnosis, testing and information system -VAS 5051-, the display zones are shown one below the other, on other diagnosis testers they are side by side.

– Check coolant temperature in display zone 4. Specification: at least 80 °C.

Continue with check only once coolant temperature has been reached.

– Press [←] button.

Check status of unit injector valves (cylinder 1...4)

– Select „display group 18“.

Indicated on display:

```
Display group 18
0            0            0            0
```

– Allow engine to run at idling speed for at least 1 minute.

– Check status of unit injector valves (cylinder 1...4) in display zone 1...4. Specification: 0.

Hinweis

- *Display zone 1 = Status of unit injector valve, cylinder 1 -N240-*
- *Display zone 2 = Status of unit injector valve, cylinder 2 -N241-*
- *Display zone 3 = Status of unit injector valve, cylinder 3 -N242-*
- *Display zone 4 = Status of unit injector valve, cylinder 4 -N243-*

If the specifications are not achieved:

– End diagnosis function.

– Switch off ignition.

– Check resistance of unit injector valves (cylinder 1...4) ⇒ Seite 207.

If the specifications are reached:

Check BIP deviation (solenoid valve switch times) of unit injectors valves (cylinder 1...4)

– Press [←] button.

– Select „display group 23“.

Indicated on display:

```
Display group 23
50 ms        50 ms        50 ms     50 ms
```

– Check BIP deviation of unit injector valves (cylinder 1...4) in display zone 1...4. Specification: -100...100 ms.

Hinweis

- *Display zone 1 = BIP deviation unit injector valve, cylinder 1 -N240-*
- *Display zone 2 = BIP deviation unit injector valve, cylinder 2 -N241-*
- *Display zone 3 = BIP deviation unit injector valve, cylinder 3 -N242-*
- *Display zone 4 = BIP deviation unit injector valve, cylinder 4 -N243-*

If the specifications are not achieved:

– End diagnosis function.
– Switch off ignition.
– Renew relevant unit injector valve (cylinder 1...4) -N240...N243- ⇒ Seite 200, Removing and installing unit injector.
– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

If the specifications are reached:

Check smooth idling regulation

– Press [←] button.
– Select „display group 13“.

Indicated on display:

```
Display group 13
1.4 mg/h   1.4 mg/h   1.4 mg/h   1.4 mg/h
```

Hinweis

- *Display zone 1 = Injection quantity of idling speed smooth running control through unit injector valve, cylinder 1 -N240-*
- *Display zone 2 = Injection quantity of idling speed smooth running control through unit injector valve, cylinder 2 -N241-*
- *Display zone 3 = Injection quantity of idling speed smooth running control through unit injector valve, cylinder 3 -N242-*
- *Display zone 4 = Injection quantity of idling speed smooth running control through unit injector valve, cylinder 4 -N243-*

– Check injection quantity of idling speed smooth running control through unit injector valves (cylinder 1...4) in display zone 1...4. Specification: -2.8...2.8 mg/H.
– End diagnosis function.
– Switch off ignition.

If the specifications are not achieved:

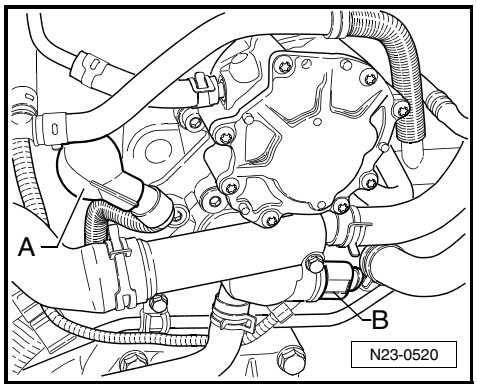
– Check the compression pressure ⇒ Seite 126.

If the compression pressure is OK:

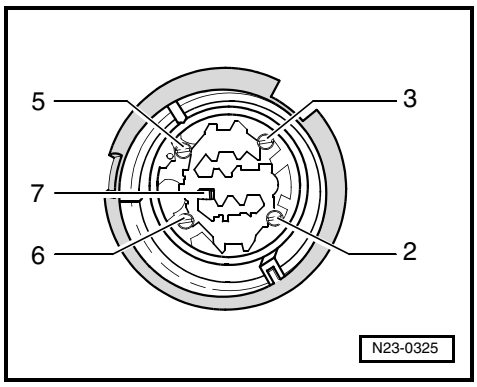
– Renew relevant unit injector valve (cylinder 1...4) -N240...N243- ⇒ Seite 200, Removing and installing unit injector.
– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

Check resistance of unit injector valves (cylinder 1...4)

– Pull off central connector -A- for unit injectors.



– Connect multimeter with auxiliary lines from -V.A.G 1594- for resistance measurement to following contacts of connector (connectors to unit injector valves (cylinder 1...4)):



Unit injector valve (cylinder 1) -N240-:

♦ Contact 7 + 5

Unit injector valve (cylinder 2) -N241-:

♦ Contact 7 + 3

Unit injector valve (cylinder 3) -N242-:

♦ Contact 7 + 2

Unit injector valve (cylinder 4) -N243-:

♦ Contact 7 + 6

- Specification: 0.1...2.0 Ω

Hinweis

At room temperature, the resistance is in the lower tolerance range; at operating temperature, the resistance is in the upper tolerance range.

– Also check wiring for short to one another and short to battery earth/engine earth. Specification: ∞ Ω.

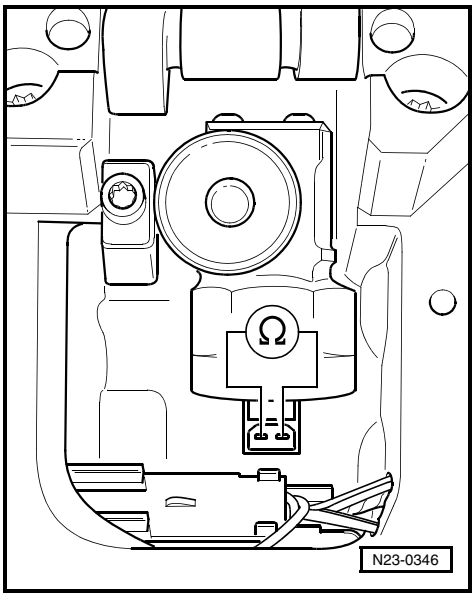
If the specifications are reached:

– Check wiring to engine control unit ⇒ Seite 209.

If the specifications are not achieved:

– Remove cylinder head cover ⇒ Seite 114.
– Lever all 2-pin connectors off unit injectors using a screwdriver. Support opposite side of connector with light finger pressure to prevent canting.

– Connect multimeter with auxiliary lines from -V.A.G 1594- for resistance measurement to contacts of individual valves. Specification: 0.1...1.0 Ω.



Hinweis

At room temperature, the resistance is in the lower tolerance range; at operating temperature, the resistance is in the upper tolerance range.

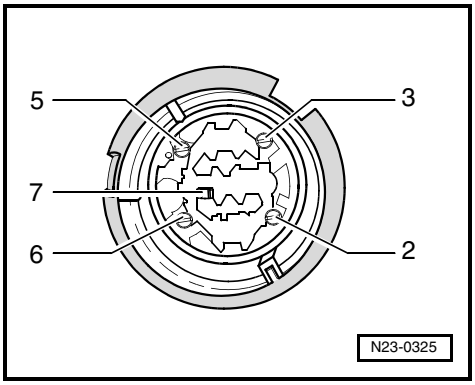
If the specification is not obtained:

– Renew relevant unit injector valve (cylinder 1...4) -N240...N243- ⇒ Seite 200, Removing and installing unit injector.

– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

If the specification is reached:

– Check wiring between central connector for unit injectors and 2-pin connector (contact 2) for open circuit.



Unit injector valve (cylinder 1) -N240-:

♦ Contact 2 + 5

Unit injector valve (cylinder 2) -N241-:

♦ Contact 2 + 3

Unit injector valve (cylinder 3) -N242-:

♦ Contact 2 + 2

Unit injector valve (cylinder 4) -N243-:

♦ Contact 2 + 6

• Cable resistance: max. 2.0 Ω

– Check wiring between central connector for unit injectors and all 2-pin connectors (contact 1) for open circuit.

♦ Contact 7 + 1

• Cable resistance: max. 2.0 Ω

– In addition, check wires for short to one another. Specification: ∞ Ω.

Check wiring to engine control unit

– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-1- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.

– Check wiring between test box and central connector (connector to engine control unit) for open circuit using current flow diagram.

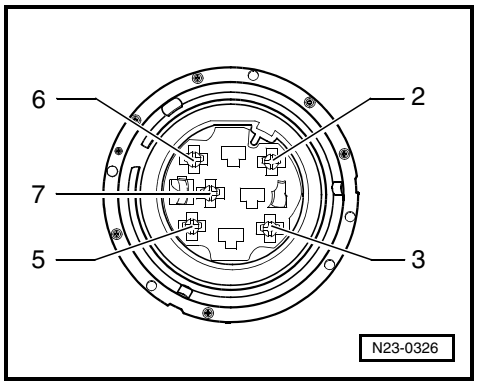
♦ Contact 2 + socket 46
♦ Contact 3 + socket 48
♦ Contact 5 + socket 1
♦ Contact 6 + socket 47
♦ Contact 7 + socket 31
♦ Contact 7 + socket 32

- Cable resistance: max. 2.0 Ω

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω.

If no fault in lines is detected:

– Renew engine control unit -J623- ⇒ Seite 230.



2.2 Checking engine speed sender -G28-

Function

Engine speed sender -G28- is a speed and reference mark sender. The engine will not start if there is no speed signal. If the speed signal fails when the engine is running, it will cause the engine to stall immediately.

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
♦ Adapter set -V.A.G 1594-
♦ Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-
♦ Current flow diagram

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK

Test procedure

Hinweis

Only gold-plated contacts may be used when repairing the contacts in the connections of the engine speed sender.

– Clamp off coolant hoses at oil cooler using hose clamp and pull off hoses.

– Remove oil filter bracket ⇒ Seite 144, Assembly overview - oil filter bracket and oil cooler.

– Pull off 3-pin connector from engine speed sender -G28-.

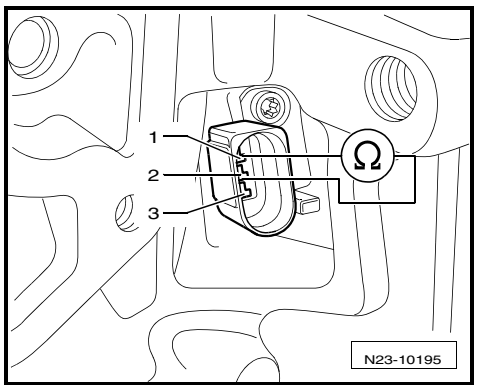
Check resistance

– Connect multimeter with auxiliary lines from -V.A.G 1594- for resistance measurement to contacts 1 + 2 of the sender. Specification: 450,0...650.0 Ω.

– In addition, check the sender for short circuit to the screening.

♦ Contact 1 + 3
♦ Contact 2 + 3

• Specification: ∞ Ω.



If the specifications are not achieved:

– Renew engine speed sender - G28- ⇒ Seite 103.

– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

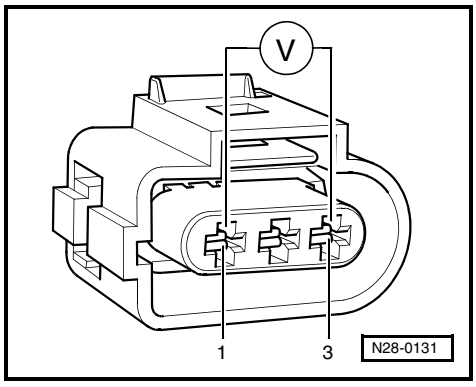
If the specifications are reached:

Checking voltage supply

– Connect multimeter with auxiliary lines from -V.A.G 1594- for resistance measurement to contacts 1 + 3 of the connector.

– Switch on ignition. Specification: at least 4,5 V.

– Switch off ignition.



If the specification is not obtained:

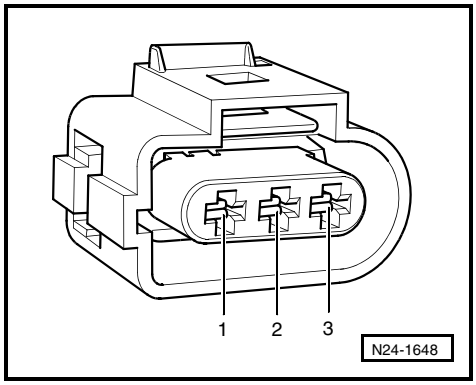
– Check wiring of engine speed sender as follows:

– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-1- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit using current flow diagram.

♦ Contact 1 + socket 42
♦ Contact 2 + socket 58
♦ Contact 3 + socket 57

• Cable resistance: max. 2.0 Ω



– In addition, check wires for short to one another. Specification: ∞ Ω.

If no fault in lines is detected:

– Remove engine speed sender -G28 - ⇒ Seite 103.

– Check sender wheel for:

♦ correct seating,
♦ damage,

- true running,
- metal filings on sender wheel or sender.

If no fault is detected on the sender wheel and in the wiring and voltage was present between contacts 1 + 3:

– Renew engine speed sender - G28-.
– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

If no fault is detected on the sender wheel and in the wiring and no voltage was present between contacts 1 + 3:

– Renew engine control unit -J623- ⇒ Seite 230.

2.3 Checking Hall sender -G40-

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

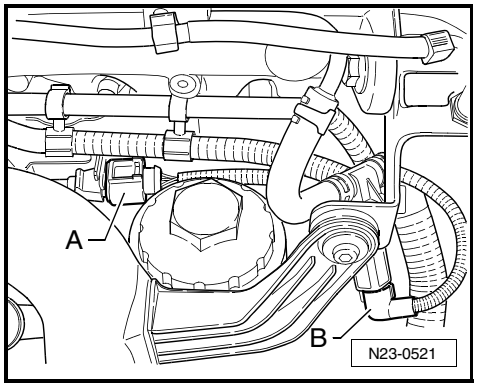
- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Adapter set -V.A.G 1594-
- Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-
- Current flow diagram

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK

Test procedure

– Disconnect 3-pin connector -A- from Hall sender -G40-.



Checking voltage supply

– Connect multimeter with auxiliary lines from -V.A.G 1594- for resistance measurement to contacts 1 + 3 of the connector.
– Switch on ignition. Specification: at least 4,5 V.
– Switch off ignition.

If the specification is not obtained:

– Check Hall sender wiring as follows:
– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-1- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.
– Check wiring between test box and connector for open circuit using current flow diagram.

♦ Contact 1 + socket 27
♦ Contact 2 + socket 28
♦ Contact 3 + socket 12

• Cable resistance: max. 2.0 Ω

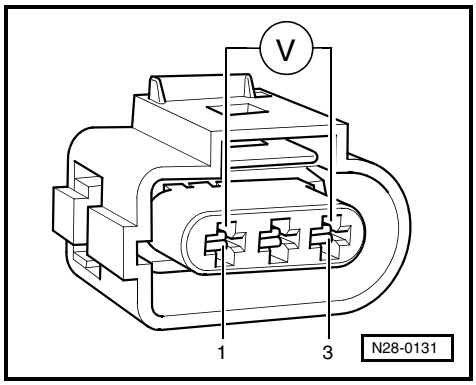
– In addition, check wires for short to one another. Specification: ∞ Ω.

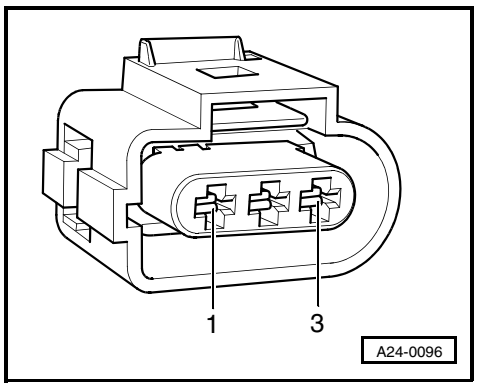
If no wiring fault is detected and voltage was present between contacts 1 + 3:

– Renew Hall sender -G40- ⇒ Seite 112, Assembly overview - cylinder head.
– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

If no wiring fault is detected and no voltage was present between contacts 1 + 3:

– Renew engine control unit -J623- ⇒ Seite 230.

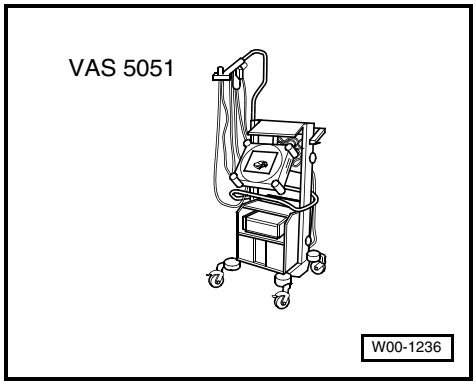




2.4 Checking intake air temperature sender -G42-

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -
♦ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
♦ Adapter set -V.A.G 1594-
♦ Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-
♦ Current flow diagram



Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK

Test procedure

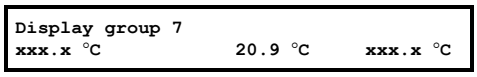
Hinweis

- *Intake air temperature sender -G42- and charge pressure sender -G31- are installed together in one housing in the charge air pipe.*
- *Only gold-plated contacts may be used when repairing the connector contacts.*

– Connect vehicle diagnosis, testing and information system -VAS 5051- and select diagnosis function „08-Read measured value block“. Engine must be idling to do this. (Connect vehicle diagnosis, testing and information system and select engine control unit⇒ Seite 5.)

– Select „display group 7“.

Indicated on display:



Hinweis

On the display of vehicle diagnosis, testing and information system -VAS 5051-, the display zones are shown one below the other, on other diagnosis testers they are side by side.

– Check the intake air temperature in display zone 3. The temperature value must equate to approx. ambient temperature.

– If there is no realistic result in display zone 3, check intake air temperature sender and the wiring connections to the sender as follows:

– End diagnosis function.

– Switch off ignition.

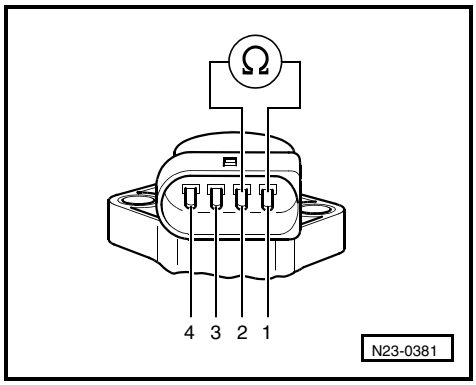
Check resistance

– Pull off 4-pin connector from intake air temperature sender.

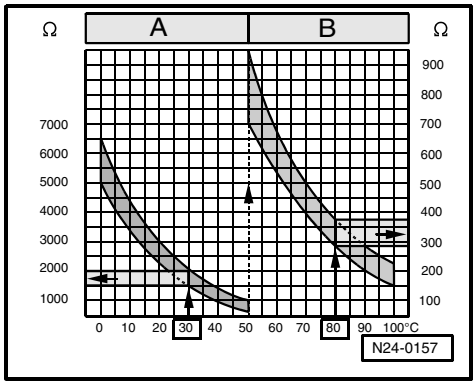
Hinweis

Intake air temperature sender -G42- and charge pressure sender -G31- are installed together in one housing in the charge air pipe.

– Connect multimeter with auxiliary lines from -V.A.G 1594- for resistance measurement to contacts 1 + 2 of the sender.



Scale -A- shows resistance values for temperature range 0...50 °C and scale -B- the values for temperature range 50...100 °C.



Examples:

- 30 °C is in range -A- and corresponds to a resistance of 1500...2000 Ω
- 80 °C is in range -B- and corresponds to a resistance of 275...375Ω

If the specification is not obtained:

– Renew intake air temperature sender -G42- with charge pressure sender -G31 -.

– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

If the specification is reached:

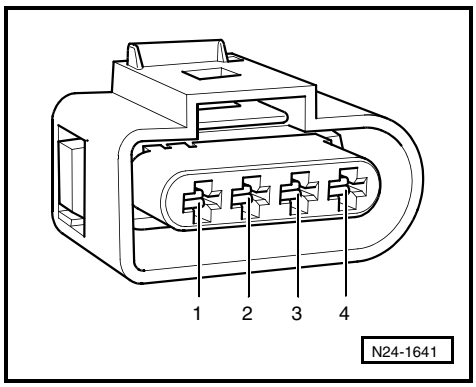
– Check wiring of intake air temperature sender as follows:

– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-2- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit using current flow diagram.

- Contact 1 + socket 76
- Contact 2 + socket 38
- Cable resistance: max. 2.0 Ω

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω.



If no fault in lines is detected:

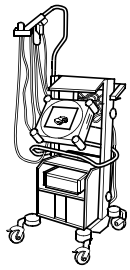
– Renew engine control unit -J623- ⇒ Seite 230.

2.5 Checking coolant temperature sender -G62-

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -
- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Adapter set -V.A.G 1594-
- Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-
- Current flow diagram

VAS 5051



W00-1236

Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- Engine must be cold.

Test procedure

Hinweis

Only gold-plated contacts may be used when repairing the contacts in the connections of the coolant temperature sender.

– Connect vehicle diagnosis, testing and information system -VAS 5051- and select diagnosis function „08-Read measured value block“. Engine must be idling to do this. (Connect vehicle diagnosis, testing and information system and select engine control unit⇒ Seite 5.)

– Select „display group 7“.

Indicated on display:

```
Display group 7
xxx.x °C          xxx.x °C     16.7 °C
```

Hinweis

On the display of vehicle diagnosis, testing and information system -VAS 5051-, the display zones are shown one below the other, on other diagnosis testers they are side by side.

– Check coolant temperature value in display zone 4. The temperature value must Increase uniformly and without interruption.

Hinweis

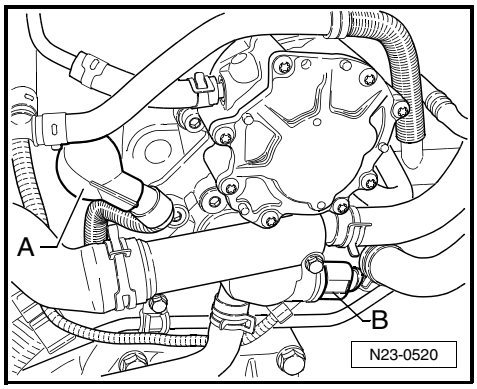
If there is a fault, the fuel temperature will be shown (display zone 1) as a substitute value.

– If there is no realistic result in display zone 4 or the fuel temperature is displayed as a substitute, check coolant temperature sender and wiring connections to sender as follows:

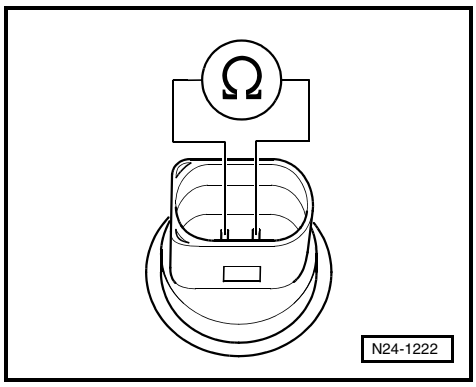
– End diagnosis function.
– Switch off ignition.

Check resistance

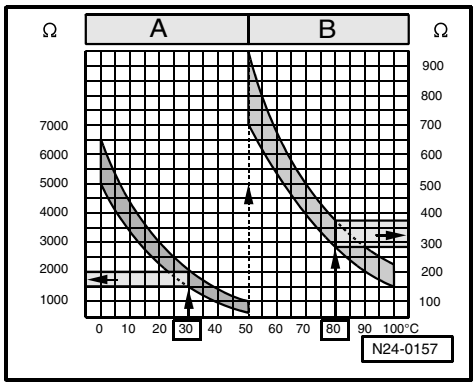
– Pull off 2-pin connector -B- from coolant temperature sender -G62-.



– Connect multimeter with auxiliary lines from -V.A.G 1594- for resistance measurement to contacts of sender.



Scale -A- shows resistance values for temperature range 0...50 °C and scale -B- the values for temperature range 50...100 °C.



Examples:

- 30 °C is in range -A- and corresponds to a resistance of 1500...2000 Ω
- 80 °C is in range -B- and corresponds to a resistance of 275...375Ω

If the specification is not obtained:

– Renew coolant temperature sender -G62- ⇒ Seite 148, Parts of cooling on engine side.
– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

If the specification is reached:

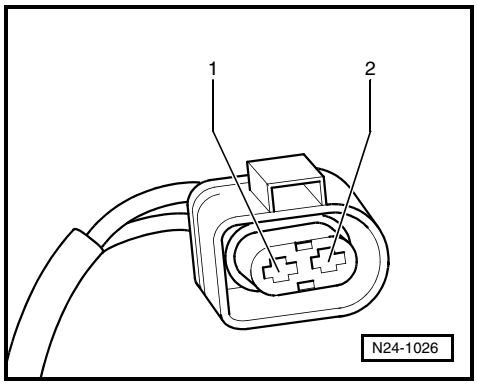
– Check wiring of coolant temperature sender as follows:
– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-1- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit using current flow diagram.

♦ Contact 1 + socket 52
♦ Contact 2 + socket 53

• Cable resistance: max. 2.0 Ω

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω.



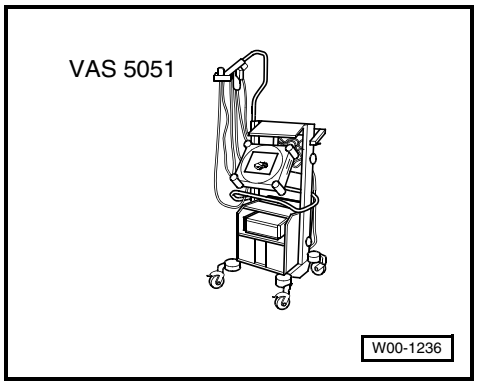
If no fault in lines is detected:

– Renew engine control unit -J623- ⇒ Seite 230.

2.6 Checking fuel temperature sender -G81-

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -
♦ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
♦ Adapter set -V.A.G 1594-
♦ Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-
♦ Current flow diagram



Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

• Fuses must be OK.
• The battery voltage must be at least 11.5 V.
• All electrical consumers must be switched off.
• Earth connections OK

Test procedure

Hinweis

Only gold-plated contacts may be used when repairing the contacts in the connections of the fuel temperature sender.

– Connect vehicle diagnosis, testing and information system -VAS 5051- and select diagnosis function „08-Read measured value block“. Engine must be idling to do this. (Connect vehicle diagnosis, testing and information system and select engine control unit⇒ Seite 5.)

– Select „display group 7“.

Indicated on display:

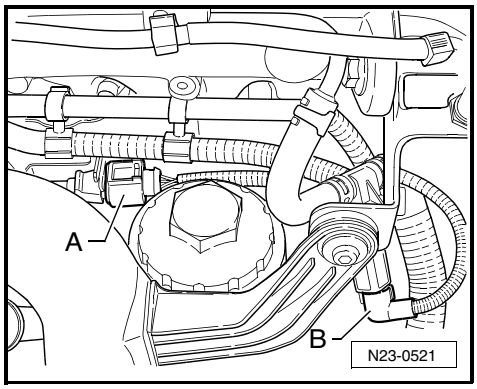
Hinweis

On the display of vehicle diagnosis, testing and information system -VAS 5051-, the display zones are shown one below the other, on other diagnosis testers they are side by side.

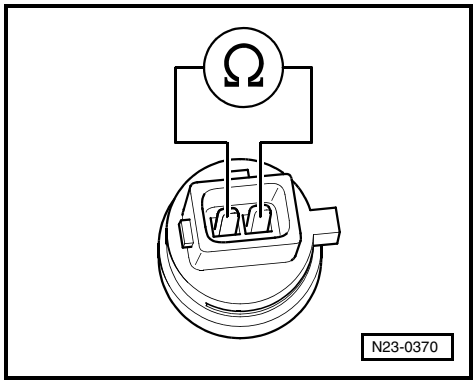
– Check the fuel temperature in display zone 1. The temperature value must equate to approx. ambient temperature.
– If there is no realistic result in display zone 1, check fuel temperature sender and the wiring connections to the sender as follows:
– End diagnosis function.
– Switch off ignition.

Check resistance

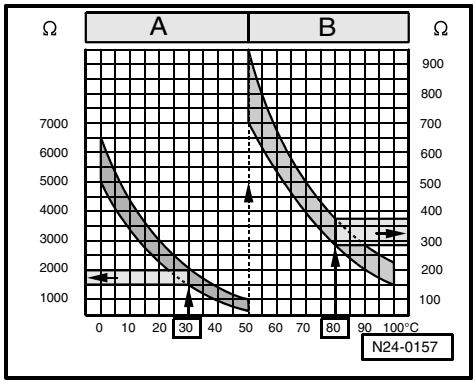
– Pull off 2-pin connector -B- from fuel temperature sender.



– Connect multimeter with auxiliary lines from -V.A.G 1594- for resistance measurement to contacts of sender.



Scale -A- shows resistance values for temperature range 0...50 °C and scale -B- the values for temperature range 50...100 °C.



Examples:

- 30 °C is in range -A- and corresponds to a resistance of 1500...2000 Ω
- 80 °C is in range -B- and corresponds to a resistance of 275...375Ω

If the specification is not obtained:

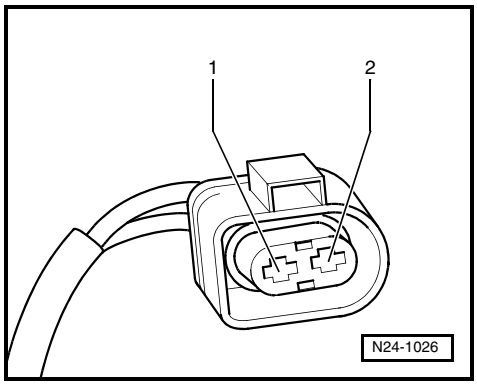
– Renew fuel temperature sender -G81- ⇒ Seite 162, Assembly overview - fuel filter.
– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

If the specification is reached:

– Check wiring of fuel temperature sender as follows:

– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-1- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit using current flow diagram.



♦ Contact 1 + socket 40

♦ Contact 2 + socket 39

• Cable resistance: max. 2.0 Ω

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω.

If no fault in lines is detected:

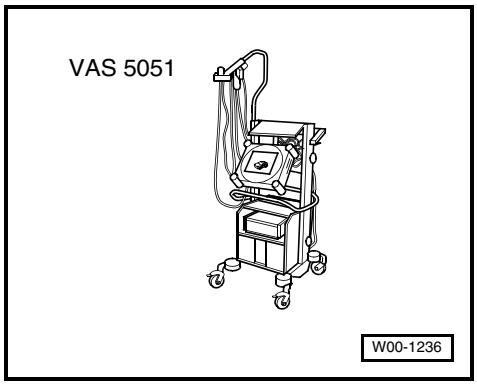
– Renew engine control unit -J623- ⇒ Seite 230.

2.7 Checking air mass meter -G70-

Function

The air mass meter signal is used by the engine control unit to calculate the quantity injected and to control the required exhaust gas recirculation. The smaller the signal from air mass meter, the smaller the quantity of fuel injected.

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel



♦ Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -

♦ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-

♦ Adapter set -V.A.G 1594-

♦ Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-

♦ Current flow diagram

Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

• Fuses must be OK.

• The battery voltage must be at least 11.5 V.

• All electrical consumers must be switched off.

• Earth connections OK

• No leaks on intake and exhaust systems

- No faults must be stored in fault memory ⇒ Seite 9, interrogating fault memory.
- Check charge pressure control is OK ⇒ Seite 187.
- Check exhaust gas recirculation is OK ⇒ Seite 244.
- The coolant temperature must be at least 80 °C, ⇒ display group 1, display zone 4.

Test procedure

Hinweis

Only gold-plated contacts may be used when repairing the air mass meter connector contacts.

– Connect vehicle diagnosis, testing and information system -VAS 5051- and select diagnosis function „08-Read measured value block“. Engine must be idling to do this. (Connect vehicle diagnosis, testing and information system and select engine control unit⇒ Seite 5.)
– Select „display group 1“.

Indicated on display:

```
Display group 1
880 rpm   xxx.x mg/H   xxx CA    87.3 °C
```

Hinweis

On the display of vehicle diagnosis, testing and information system -VAS 5051-, the display zones are shown one below the other, on other diagnosis testers they are side by side.

– Check coolant temperature in display zone 4. Specification: at least 80 °C.

Continue with check only once coolant temperature has been reached.

– Press [←] button.
– Select „display group 10“.

Hinweis

- *For the test, the engine is to be accelerated under load from 1500 rpm at full throttle. Please observe conditions for measurements at full throttle ⇒ Seite 69.*
- *The measured values must be read (by 2nd person) once the engine speed reaches 2600 rpm.*

– Increase engine speed under load from approx. 1500 rpm at full throttle (accelerator pedal position sender at full throttle stop).
– Have second person read measured values at approx. 2600 rpm.

Indicated on display:

```
Display group 10
830 mg/H   xxxx mbar   xxxx mbar   xxx.x %
```

– Check the specification from the air mass meter (air mass drawn in) in display zone 1.

Specification:

- Engine codes CBHA, CBJA, CBJB: 700...980 mg/H.
- Engine code CBKA: 900...1000 mg/H.

– End diagnosis function.

– Switch off ignition.

If the specification is not reached and no constant substitute value is displayed:

– Renew air mass meter -G70-.

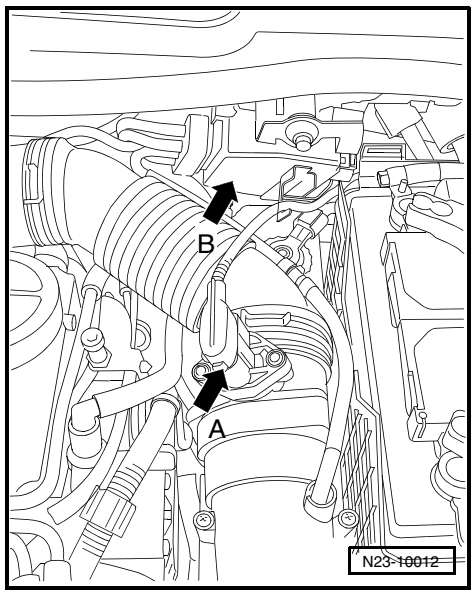
– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

If a constant substitute value is shown in display zone 1:

Checking voltage supply

– Pull off 5-pin connector -A- from air mass meter -G70-.

– Switch on ignition.



– Connect multimeter with auxiliary lines from -V.A.G 1594- for voltage measurement to the following contacts of the connector and to engine earth.

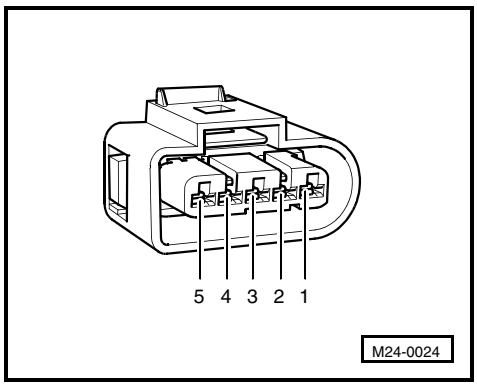
♦ Contact 2 + engine earth
♦ Contact 2 + contact 3

- Specification: at least 11.5 V

♦ Contact 4 + engine earth
♦ Contact 3 + contact 4

- Specification: at least 4,5 V

– Switch off ignition.



If the specifications are not achieved:

– Check air mass meter wiring as follows:

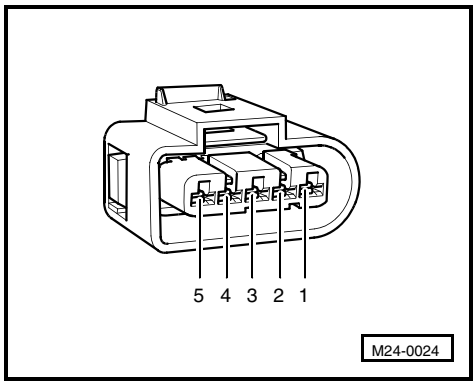
– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-2- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit using current flow diagram.

♦ Contact 3 + socket 60
♦ Contact 4 + socket 40
♦ Contact 5 + socket 82

• Cable resistance: max. 2.0 Ω

– Check wire from 5-pin connector contact 2 to fuse using current flow diagram ⇒ Seite 288.
– In addition, check wires for short to one another. Specification: ∞ Ω.



If no fault in lines is detected:

– Renew engine control unit -J623- ⇒ Seite 230.

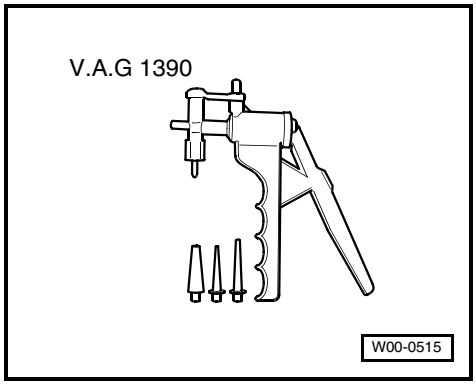
2.8 Checking intake manifold flap changeover (engine codes CBHA, CBJA, CBJB)

Function

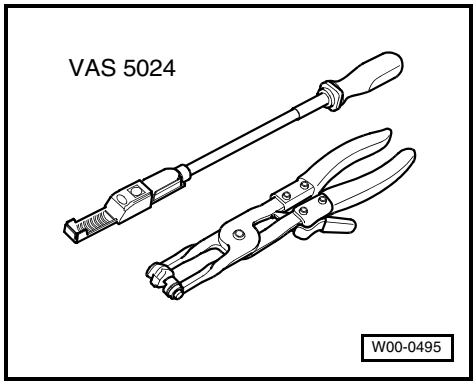
The intake manifold flap is closed for approx. 3 seconds when stopping engine and then opens again. This reduces the stop jolt.

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

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



♦ Spring-type clip pliers -VAS 5024-



Test procedure

– Pull vacuum hose off connection union.
– Start engine and run at idling speed.
– Switch off ignition.
– Observe position of intake manifold flap (2nd person required). When the ignition is switched off, the intake manifold flap must close and open again after approx. 3 seconds.

If changeover does not occur, the following checks must be carried out:

– Check intake manifold flap changeover mechanism for freedom of movement. To do this, operate rods by hand.

– Check function of vacuum positioner element using hand vacuum pump -V.A.G 1390-.
– Check vacuum hoses are connected correctly ⇒ Seite 241, Vacuum hose schematic diagram.

If no fault is found in the mechanical components:

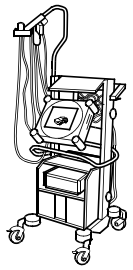
– Check intake manifold flap changeover valve -N239- ⇒ Seite 224.

2.9 Checking intake manifold flap changeover -N239- (engine codes CBHA, CBJA, CBJB)

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -
- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Adapter set -V.A.G 1594-
- Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-
- Current flow diagram

VAS 5051



W00-1236

Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK

Test procedure

Hinweis

The intake manifold flap is closed for approx. 3 seconds when stopping engine and then opens again. This reduces the stop jolt.

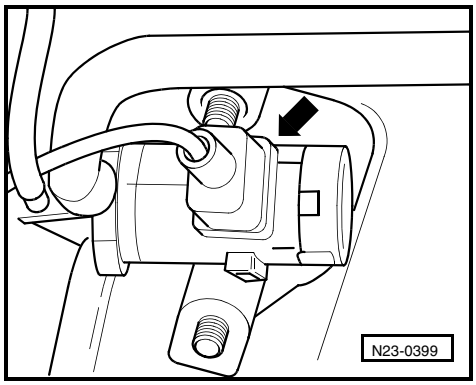
– Carry out final control diagnosis and actuate intake manifold flap changeover valve -N239- ⇒ Seite 49, Final control diagnosis.

- The engine must stall when the intake manifold flap changeover valve is actuated.

– Proceed with final control diagnosis until completed.
– End diagnosis function.
– Switch off ignition.

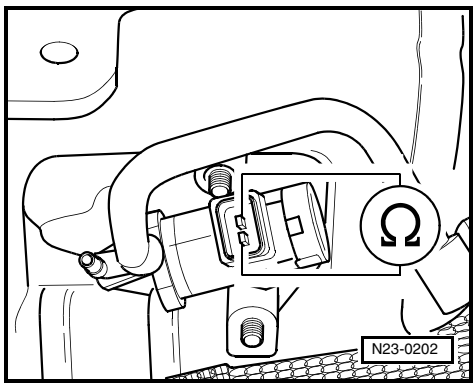
If the engine does not stall when the intake manifold flap changeover valve is actuated:

– Pull off 2-pin connector from intake manifold flap changeover valve -N239- -arrow-.



Check resistance

– Connect multimeter with auxiliary lines from -V.A.G 1594- for resistance measurement to contacts of valve. Specification: 25,0...45.0 Ω.



Hinweis

At room temperature, the resistance is in the lower tolerance range; at operating temperature, the resistance is in the upper tolerance range.

If the specification is not obtained:

– Renew intake manifold flap changeover valve -N239-.

– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

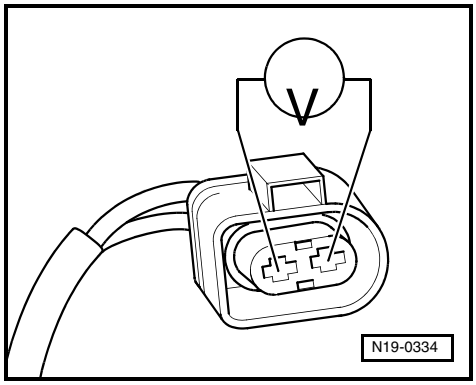
If the specification is reached:

Checking voltage supply

– Connect multimeter with auxiliary lines from -V.A.G 1594- for voltage measurement to contacts of connector.

– Start engine and run at idling speed. Specification: at least 11.5 V.

– Switch off ignition. The voltage value must fall to 0,0 V after approx. 3 seconds.



If the voltage values do not change as described:

– Check terminal 30 voltage supply relay -J317- ⇒ Seite 288, Current flow diagrams.

– Check cable connections for open circuit, short circuit and transfer resistance at contacts according to current flow diagram.

– Check wiring of intake manifold flap changeover valve as follows:

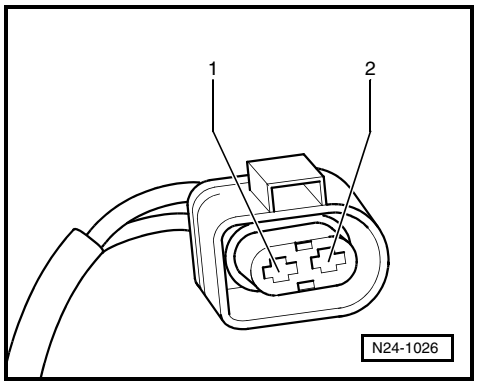
– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-1- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit using current flow diagram.

♦ Contact 2 + socket 60

• Cable resistance: max. 2.0 Ω

– In addition, check wires for short to one another. Specification: ∞ Ω.



If no wiring fault is detected and voltage supply is OK:

– Renew engine control unit -J623- ⇒ Seite 230.

2.10 Checking intake manifold flap motor -V157- (engine code CBKA)

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

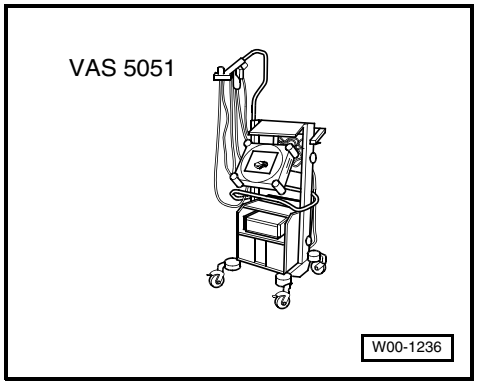
♦ Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -

♦ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-

♦ Adapter set -V.A.G 1594-

♦ Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-

♦ Current flow diagram



Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

• Fuses must be OK.

• The battery voltage must be at least 11.5 V.

• All electrical consumers must be switched off.

• Earth connections OK

• Intake manifold flap not soiled.

Test procedure

Hinweis

♦ *The intake manifold flap is closed for approx. 3 seconds when stopping engine and then opens again. This reduces the stop jolt.*

♦ *Intake manifold flap motor -V157- and intake manifold flap potentiometer -G336- are installed together in one housing.*

♦ *Only gold-plated contacts may be used when repairing the contacts in the connection of the intake manifold flap motor.*

– Carry out final control diagnosis and actuate intake manifold flap motor -V157- ⇒ Seite 49, Final control diagnosis.

- The engine must stall when the intake manifold flap motor is actuated.

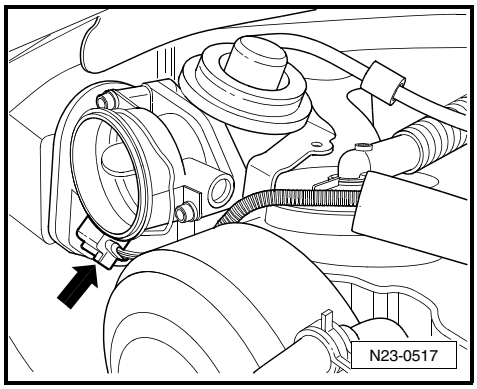
– Proceed with final control diagnosis until completed.

– End diagnosis function.

– Switch off ignition.

If the engine does not stall when the intake manifold flap motor is actuated:

– Pull off 5-pin connector -arrow- from intake manifold flap motor.



Checking voltage supply

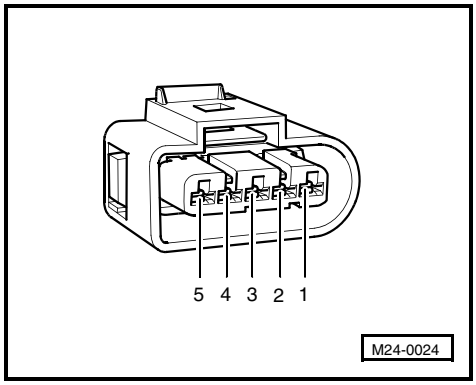
– Switch on ignition.

– Connect multimeter with auxiliary lines from -V.A.G 1594- for voltage measurement to the following contacts of the connector and to engine earth.

♦ Contact 1 + engine earth

♦ Contact 1 + contact 3

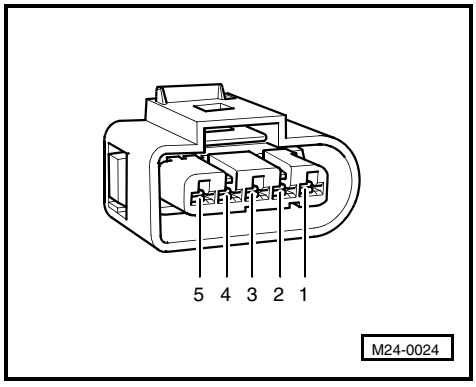
- Specification: at least 4,5 V



– Switch off ignition.

– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-1- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit using current flow diagram.



♦ Contact 1 + socket 19

♦ Contact 2 + socket 56

♦ Contact 3 + socket 41

♦ Contact 4 + socket 30

♦ Contact 5 + socket 4

- Cable resistance: max. 2.0 Ω

– In addition, check wires for short to one another. Specification: ∞ Ω.

If no wiring fault is detected and voltage was present between contacts 1 + engine earth and 1 + 3:

– Renew intake manifold flap motor - V157- ⇒ Seite 196, Assembly overview - parts of intake manifold.

– Carry out basic setting of intake manifold flap motor -V157- ⇒ Seite 228.

– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

If no wiring fault is detected and no voltage was present between contacts 1 + engine earth and 1 + 3:

– Renew engine control unit -J623- ⇒ Seite 230.

2.11 Basic setting of intake manifold flap motor -V157- (engine code CBKA)

Hinweis

If intake manifold flap motor -V157- is renewed, a basic setting must be carried out.

Prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- Earth connections OK
- All electrical consumers must be switched off.

Procedure

Hinweis

Intake manifold flap motor -V157- and intake manifold flap potentiometer -G336- are installed together in one housing.

– Switch ignition off and then on again.
– Wait a minute for the control unit sequence.
– Start engine and let it idle for at least one minute.
– Switch off ignition.
– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

If a fault is stored in the fault memory:

– Erase fault memory ⇒ Seite 10.
– Repeat procedure.

3 Engine control unit -J623-

Checking power supply for engine control unit ⇒ Seite 229.

Renewing engine control unit ⇒ Seite 230.

Coding engine control unit ⇒ Seite 231.

Checking data bus ⇒ Seite 232.

3.1 Checking power supply for engine control unit

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Adapter set -V.A.G 1594-
- Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-
- Current flow diagram

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK

Test procedure

– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-2- to wiring harness and to control unit ⇒ Seite 7.

– Connect multimeter with auxiliary lines from -V.A.G 1594- for voltage measurement between following sockets of test box:

- 1 + 18
- 1 + 49
- 2 + 18
- 2 + 49
- 4 + 18
- 4 + 49

- Specification: approx. 0.0 V

– Switch on ignition.

– Check the voltage again between the sockets of the test box:

- 1 + 18
- 1 + 49
- 2 + 18
- 2 + 49
- 4 + 18
- 4 + 49

- Specification: approx. battery voltage

– Switch off ignition.

If the specifications are not achieved:

– Check terminal 30 voltage supply relay -J317- ⇒ Seite 288, Current flow diagrams.
– Check cable connections for open circuit, short circuit and transfer resistance at contacts according to current flow diagram.

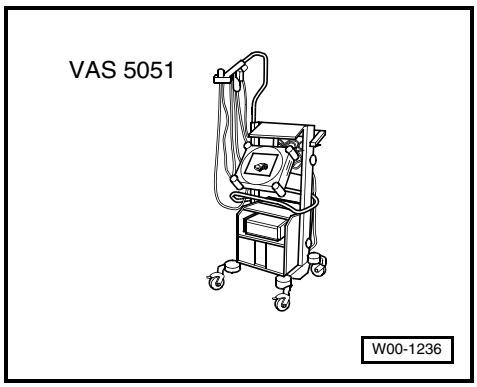
If no fault is found in the wiring and relay:

– Renew engine control unit -J623- ⇒ Seite 230.

3.2 Renewing engine control unit

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -



Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Procedure

– First check the control unit identification and the coding of the previous engine control unit as follows:
– Connect vehicle diagnosis, testing and information system -VAS 5051- and select vehicle system „01-Engine electronics“. The ignition must be switched on for this purpose. (Connect fault reader and select engine control unit -J623- ⇒ Seite 5.)

The control unit identification and coding are indicated on the display of the engine control unit.

Engine code CBKA

– Interrogate the adaption figure for the amount of ash in the particulate filter ⇒ Seite 265, Checking particulate filter.

Continuation for all engine codes

– End diagnosis function.
– Switch off ignition.
– Release both connectors from engine control unit -J623- and pull them off.
– Remove the engine control unit and install the new engine control unit.
– Install connector of engine control unit and lock in place.
– Code the engine control unit ⇒ Seite 231.

Engine code CBKA

– Enter the previously interrogated adaption figure for the ash quantity in the new engine control unit ⇒ Seite 265, Checking particulate filter.

Continuation for all engine codes

– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

3.3 Coding engine control unit

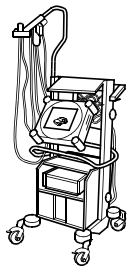
Hinweis

- *During control unit identification, a 6-digit function coding must always be shown ⇒ Seite 231, Function coding of engine control unit.*
- *If the function coding does not correspond to the engine or the engine control unit was replaced, the engine control unit must be coded as follows:*

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -

VAS 5051



W00-1236

Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Procedure

– Connect vehicle diagnosis, testing and information system -VAS 5051- and select diagnosis function „07-Code control unit“. The ignition must be switched on for this purpose. (Connect fault reader and select engine control unit -J623- ⇒ Seite 5.)

Indicated on display:

```
Code control unit
Input code number XXXXXX
```

– Enter the function coding appropriate for this engine. Function coding of engine control unit ⇒ Seite 231.

– Switch off ignition for at least 10 seconds.

– Switch on ignition.

Hinweis

The function coding entered will be activated by switching the ignition off and then on again. If after entering the valid function coding the ignition is not switched off and on again, the fault „Control unit incorrectly coded“ cannot be erased.

– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

Function coding of engine control unit

Engine code	Function coding
CBHA, CBJA, CBJB	170877
CBKA	150550

3.4 Checking data bus

Hinweis

Due to the different installation conditions of industrial engines, the following section only contains general instructions for checking.

Function

The engine control unit communicates with all data bus enabled control units via a CAN data bus.

The data bus enabled components are connected together via two entwined data bus wires (CAN_High and CAN_Low), which exchange information (messages). Missing information on the data bus is recognised as a fault and stored as such.

To ensure the data bus can work without faults, it requires a terminal resistor. This central terminal resistor is located in the engine control unit.

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Adapter set -V.A.G 1594-
- Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-
- Current flow diagram

Test prerequisite

- Ignition switched off.
- A fault has been recognised by the CAN data bus self-diagnosis ⇒ Seite 9, Interrogating fault memory.

Test procedure

– Pull off 94-pin connector from engine control unit -J623-.

– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-2- to control unit and to -connection A and B- of test box. The control unit wiring harness is not connected by this action.

– Check the terminal resistor in the engine control unit:

– Connect multimeter with auxiliary lines from -V.A.G 1594- for resistance measurement between following sockets of test box:

- 66 + 89
- Specification: 60...72 Ω

If the specification is not obtained:

– Renew engine control unit -J623- ⇒ Seite 230.

If the specification is reached:

– Eliminate the fault in the wiring and other data bus components using the current flow diagram ⇒ Seite 288.
– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

26 – Exhaust system

1 Removing and installing parts of exhaust system

Hinweis

- *Due to the different installation conditions of industrial engines, the following section contains general instructions only.*
- *After working on the exhaust system, ensure that the system is not under stress and that there is sufficient clearance to the bodywork. If necessary, align silencer and exhaust pipe so that sufficient clearance is maintained to the structure and the mountings are evenly loaded.*
- *Self-locking nuts are to be renewed.*

Assembly overview - front exhaust pipe with catalytic converter ⇒ Seite 234.

Assembly overview - particulate filter (engine code CBKA) ⇒ Seite 237.

1.1 Assembly overview - front exhaust pipe with catalytic converter

- Engine codes CBHA, CBJA, CBJB ⇒ Seite 235,
- Engine code CBKA ⇒ Seite 236.

1.1.1 Assembly overview - front exhaust pipe with catalytic converter (engine codes CBHA, CBJA, CBJB)

1 - 40 Nm

2 - Support

3 - To silencer.

4 - 7 Nm

5 - From turbocharger

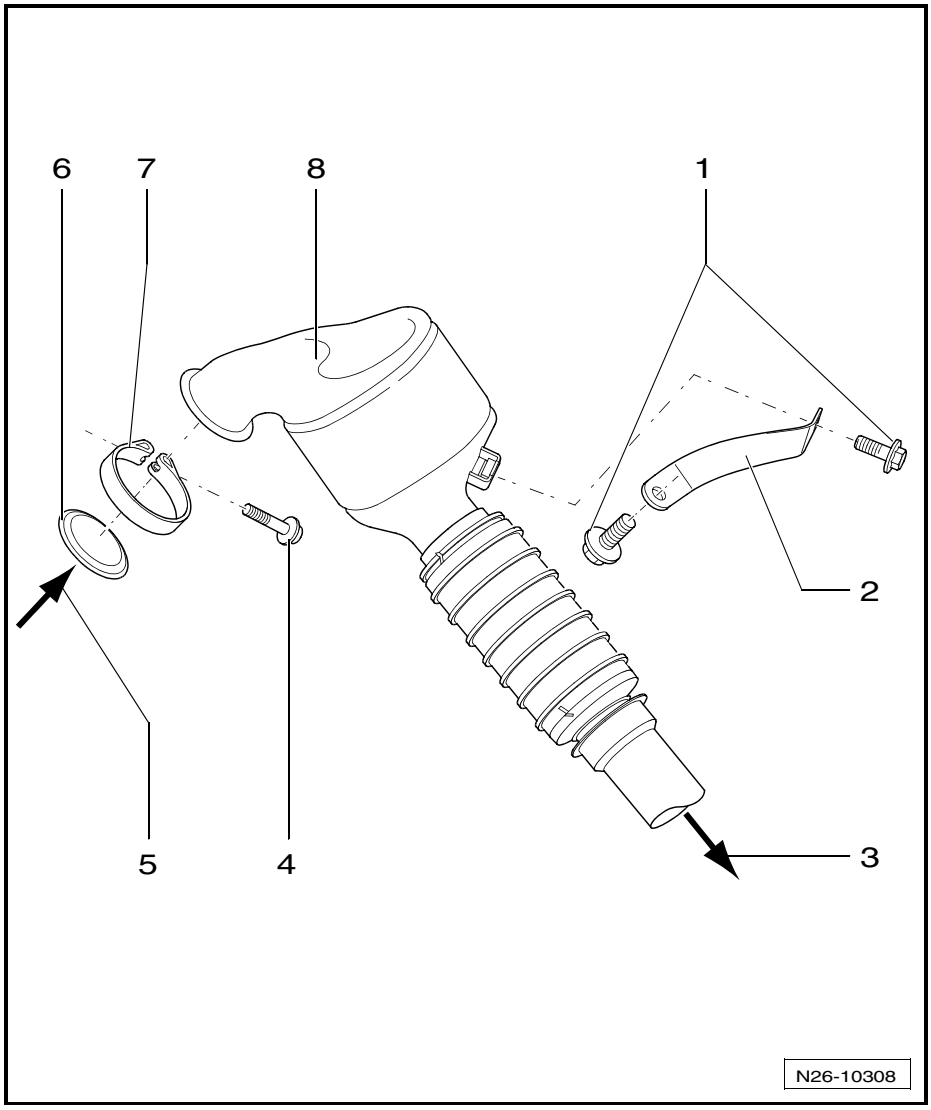
- ❑ Assembly overview - turbocharger with attachments ⇒ Seite 178

6 - Gasket

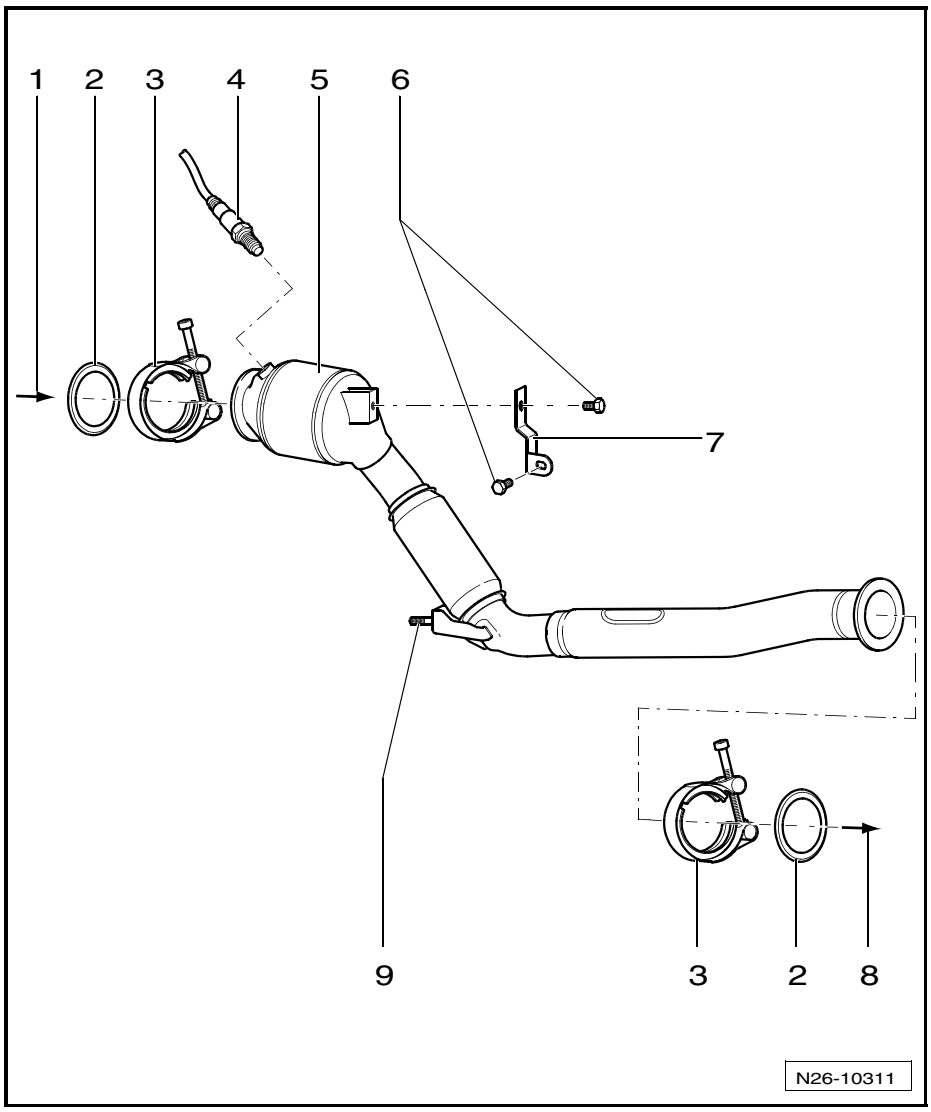
- ❑ Renew
- ❑ Note installation position

7 - Clip

8 - Front exhaust pipe with catalytic converter



1.1.2 Assembly overview - front exhaust pipe with catalytic converter (engine code CBKA)



1 - From turbocharger
- ❑ Assembly overview - turbocharger with attachments ⇒ Seite 178

2 - Gasket
- ❑ Renew
- ❑ Note installation position

3 - Clamp, 7 Nm
- ❑ Note installation position

4 - Lambda probe -G39-, 50 Nm
- ❑ With lambda probe heater -Z19-
- ❑ Only grease the thread of the lambda probe, no high temperature paste -G 052 112 A3- may come into contact with the slits of the sensor body
- ❑ To remove use lambda probe open ring spanner set -3337-
- ❑ Checking lambda probe -G39- ⇒ Seite 251
- ❑ Checking lambda probe heater -Z19- ⇒ Seite 253

5 - Front exhaust pipe with catalytic converter
- ❑ Catalytic converter with connection union for fuel line of metering pump -V54- ⇒ Abb.

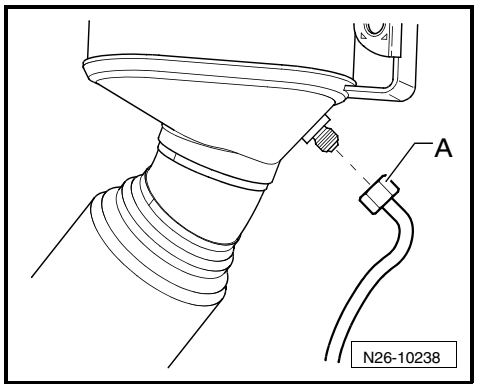
6 - 25 Nm

7 - Bracket

8 - To particulate filter
- ❑ Assembly overview - particulate filter (engine code CBKA) ⇒ Seite 237

9 - Mounting

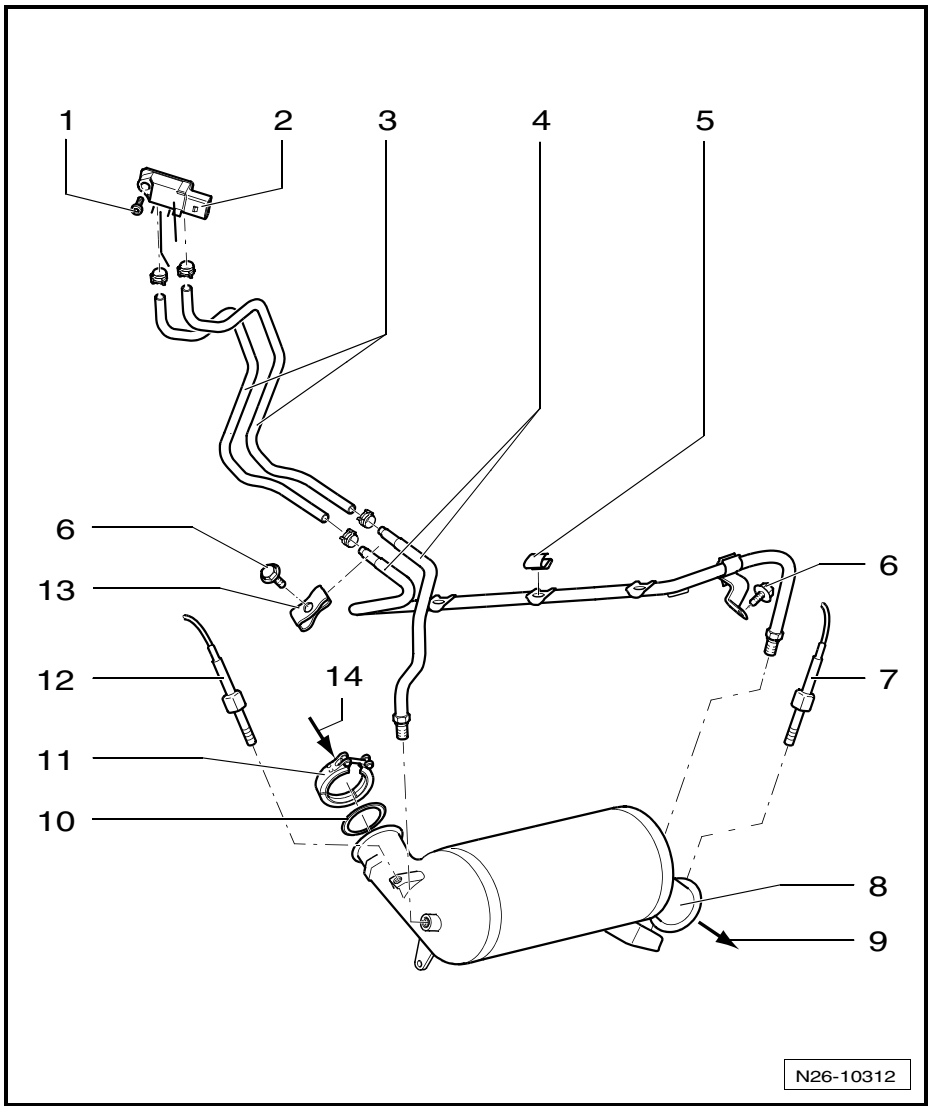
Fuel line from metering pump -V54- on catalytic converter



Hinweis

- *The fuel line -A- of the metering pump is located directly behind the catalytic converter.*
- *The metering pump injects fuel directly behind the catalytic converter. In this way, the exhaust gas temperature is increased to burn off the contents of the particulate filter.*

1.2 Assembly overview - particulate filter (engine code CBKA)



1 - 8 Nm

2 - Exhaust gas pressure sensor 1 -G450-
- ❑ Checking ⇒ Seite 261.

3 - Connecting line
- ❑ Check for secure seating.

4 - Control line, 45 Nm

5 - Clip
- ❑ For control line ⇒ Pos. 4

6 - 9 Nm

7 - Temperature sender after particulate filter -G527-, 45 Nm
- ❑ Lubricate thread of sender with high-temperature paste -G 052 112 A3-
- ❑ Checking ⇒ Seite 259.

8 - Particulate filter
- ❑ Check particulate filter ⇒ Seite 265
- ❑ After renewing the particulate filter, the adaption figure for the ash quantity has to be set to „0“ ⇒ Seite 265, Checking particulate filter

9 - To silencer.

10 - Gasket
- ❑ Renew
- ❑ Note installation position

11 - Clamp, 7 Nm
- ❑ Note installation position

12 - Exhaust gas temperature sender 2 -G448-, 45 Nm
- ❑ Lubricate thread of sender with high-temperature paste -G 052 112 A3-
- ❑ Checking ⇒ Seite 257.

13 - Clip
- ❑ For control line ⇒ Pos. 4

14 - From front exhaust pipe
- ❑ Assembly overview - front exhaust pipe with catalytic converter (engine code CBKA) ⇒ Seite 236

2 Exhaust gas recirculation system

Hinweis

- *Due to the different installation conditions of industrial engines, the following section contains general instructions only.*
- *Self-locking nuts are to be renewed.*

Assembly overview - exhaust gas recirculation ⇒ Seite 238.

Assembly overview - exhaust gas recirculation cooler (engine code CBKA) ⇒ Seite 240.

Vacuum hose schematic diagram ⇒ Seite 241.

2.1 Assembly overview - exhaust gas recirculation

– Note safety precautions before beginning work ⇒ Seite 195

– Observe rules for cleanliness ⇒ Seite 196

Assembly overview - exhaust gas recirculation:

- Engine codes CBHA, CBJA, CBJB ⇒ Seite 238,
- Engine code CBKA ⇒ Seite 239.

2.1.1 Assembly overview - exhaust gas recirculation (engine codes CBHA, CBJA, CBJB)

Hinweis

- *The exhaust gas recirculation system is actuated by the engine control unit -J623- via exhaust gas recirculation valve -N18- (electro-pneumatic) to the exhaust gas recirculation valve (mechanical).*
- *The cone-shaped plunger in the mechanical exhaust gas recirculation valve ensures that various cross sectional openings are possible at different plunger lifts.*
- *Pulsed control enables every conceivable valve position.*
- *Self-locking nuts are to be renewed.*

1 - Intake pipe
- ❑ Tighten securing bolts to 22 Nm.
- ❑ Connection union with exhaust gas recirculation valve and intake manifold flap
- ❑ Renew complete only
- ❑ Check intake manifold flap changeover ⇒ Seite 223
- ❑ Checking exhaust gas recirculation valve ⇒ Seite 250

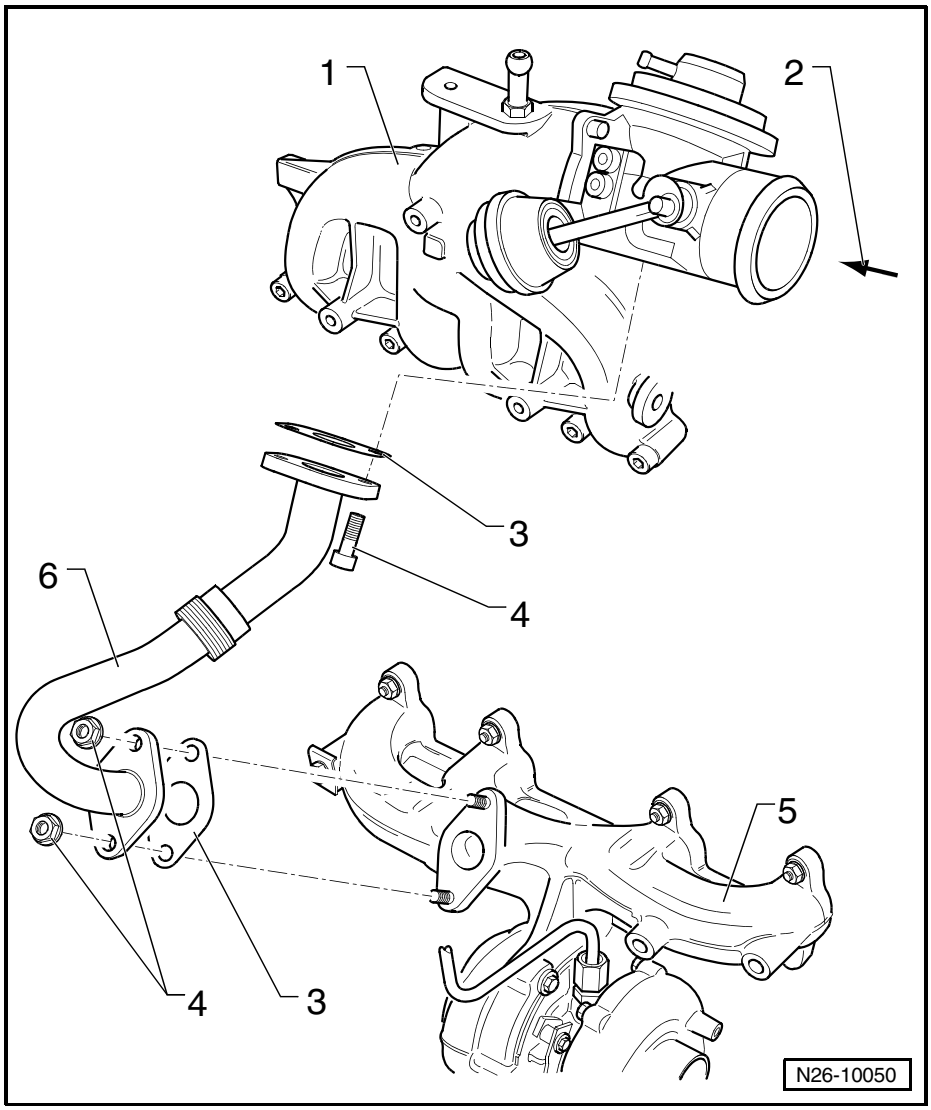
2 - From charge air cooler
- ❑ On engine codes CBJA, CBJB

3 - Gasket
- ❑ Renew

4 - 22 Nm

5 - Exhaust manifold

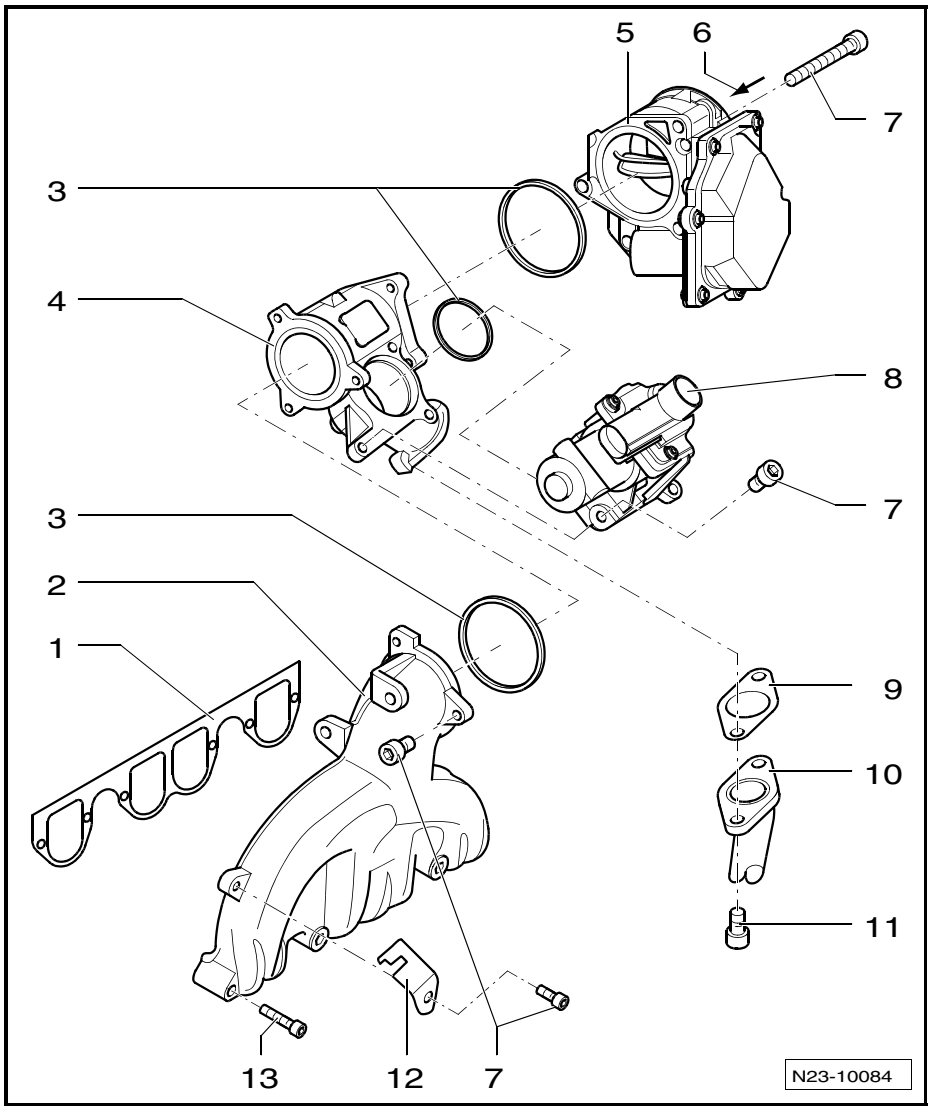
6 - Connecting pipe



2.1.2 Assembly overview - exhaust gas recirculation (engine code CBKA)

Hinweis

- *The exhaust gas recirculation system is actuated by the engine control unit -J623- via the exhaust gas recirculation potentiometer -G212-.*
- *Self-locking nuts are to be renewed.*



1 - **Gasket**
- ❑ Renew

2 - **Intake pipe**

3 - **Seal**
- ❑ Renew

4 - **Intake connecting pipe**

5 - **Intake manifold flap motor -V157-**
- ❑ The intake manifold flap is closed for approx. 3 seconds when stopping engine and then opens again. This reduces the stop jolt
- ❑ With intake manifold flap potentiometer -G336 -
- ❑ Checking intake manifold flap motor -V157- ⇒ Seite 226
- ❑ Basic setting of intake manifold flap motor -V157- ⇒ Seite 228.

6 - **From charge air cooler**

7 - **10 Nm**

8 - **Exhaust gas recirculation valve -N18-**
- ❑ Before installing, check sealing surface on intake manifold for contamination and clean if necessary
- ❑ With exhaust gas recirculation potentiometer -G212-
- ❑ Checking exhaust gas recirculation valve -N18 - ⇒ Seite 245
- ❑ Basic setting of exhaust gas recirculation valve -N18- ⇒ Seite 250

9 - **Gasket**
- ❑ Renew

10 - **Exhaust gas recirculation cooler**
- ❑ Assembly overview - exhaust gas recirculation cooler (engine code CBKA) ⇒ Seite 240

11 - **22 Nm**

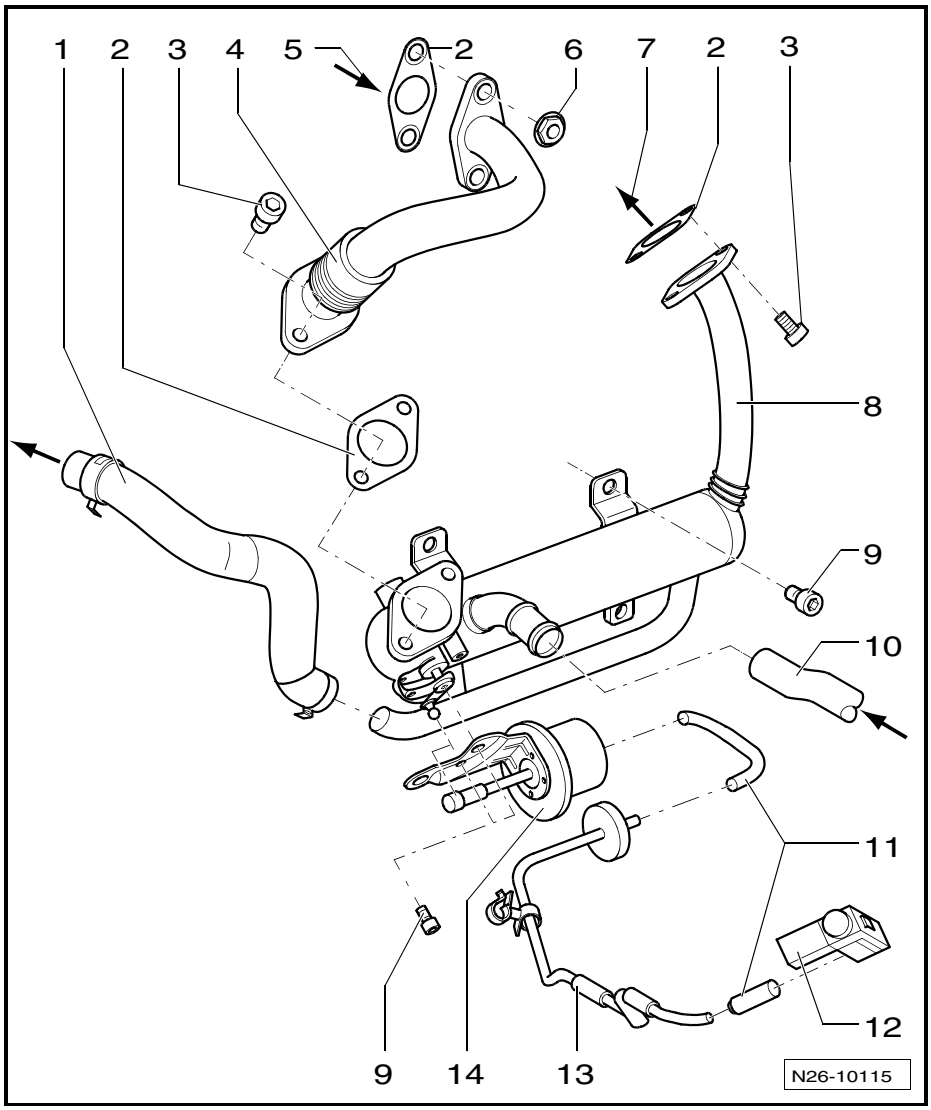
12 - **Bracket**

13 - **22 Nm**

2.2 Assembly overview - exhaust gas recirculation cooler (engine code CBKA)

– Note safety precautions before beginning work ⇒ Seite 195

– Observe rules for cleanliness ⇒ Seite 196



1 - Coolant hose
- ❑ Check for secure seating.
- ❑ To connection union ⇒ Seite 150, Coolant hose schematic diagram

2 - Gasket
- ❑ Renew

3 - 22 Nm

4 - Connecting pipe

5 - From exhaust manifold
- ❑ ⇒ Seite 181, Assembly overview - turbocharger with attachments (engine code CBKA)

6 - 25 Nm
- ❑ Renew

7 - To inlet connection
- ❑ ⇒ Seite 239, Assembly overview - exhaust gas recirculation (engine code CBKA)

8 - Exhaust gas recirculation cooler
- ❑ With bypass flap.
- ❑ Renew only together with vacuum positioner element ⇒ Pos. 14

9 - 10 Nm

10 - Coolant hose
- ❑ Check for secure seating.
- ❑ From rear coolant pipe ⇒ Seite 150, Coolant hose schematic diagram

11 - Connecting hose
- ❑ Check for secure seating.

12 - Exhaust gas recirculation cooler change-over valve -N345-
- ❑ Checking ⇒ Seite 263.

13 - Connecting pipe

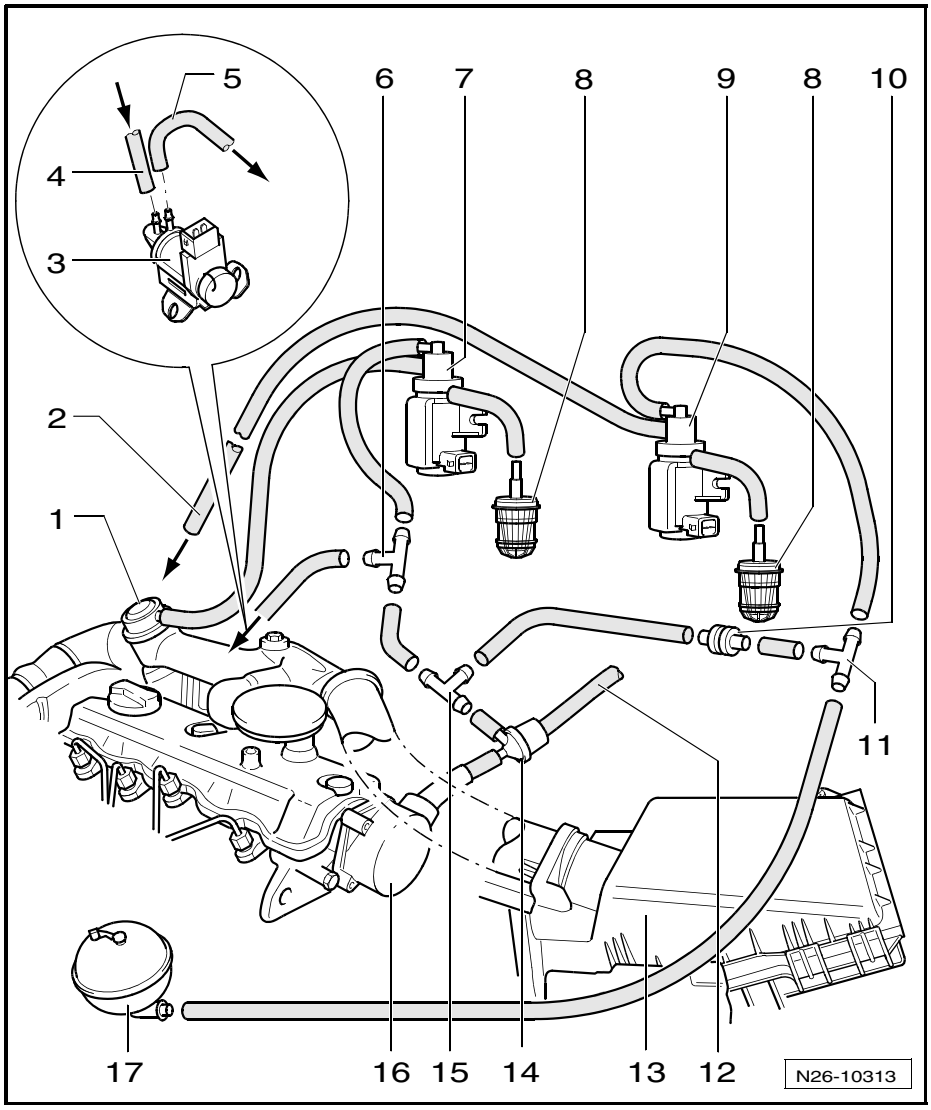
14 - Vacuum actuator
- ❑ For bypass flap
- ❑ Renew only together with exhaust gas recirculation cooler ⇒ Pos. 8
- ❑ With hand vacuum pump with accessories -V.A.G 1390 -

2.3 Vacuum hose schematic diagram

Vacuum hose schematic diagram:

- Engine codes CBHA, CBJA, CBJB ⇒ Seite 242,
- Engine code CBKA ⇒ Seite 243.

2.3.1 Vacuum hose schematic diagram (engine codes CBHA, CBJA, CBJB)



1 - Exhaust gas recirculation valve

2 - Vacuum hose

- ❑ To vacuum unit for charge pressure control on exhaust gas turbocharger ⇒ Seite 179, Assembly overview - exhaust gas turbocharger with attachments (engine codes CBHA, CBJA, CBJB)

3 - Intake manifold flap changeover valve -N239-

4 - Vacuum hose

- ❑ From junction piece ⇒ Pos. 6

5 - Vacuum hose

- ❑ To vacuum positioner element for intake manifold flap ⇒ Seite 197, Assembly overview - parts of intake manifold (engine codes CBHA, CBJA, CBJB)

6 - Junction

7 - Exhaust gas recirculation valve -N18-

8 - Air filter

- ❑ Observe installation position: Filter must hang down vertically

9 - Charge pressure control solenoid valve -N75-

10 - Non-return valve

- ❑ Observe installation position: White connection faces junction piece ⇒ Pos. 11

11 - Junction

12 - Vacuum supply

13 - Air filter

14 - Non-return valve

- ❑ Note installation position

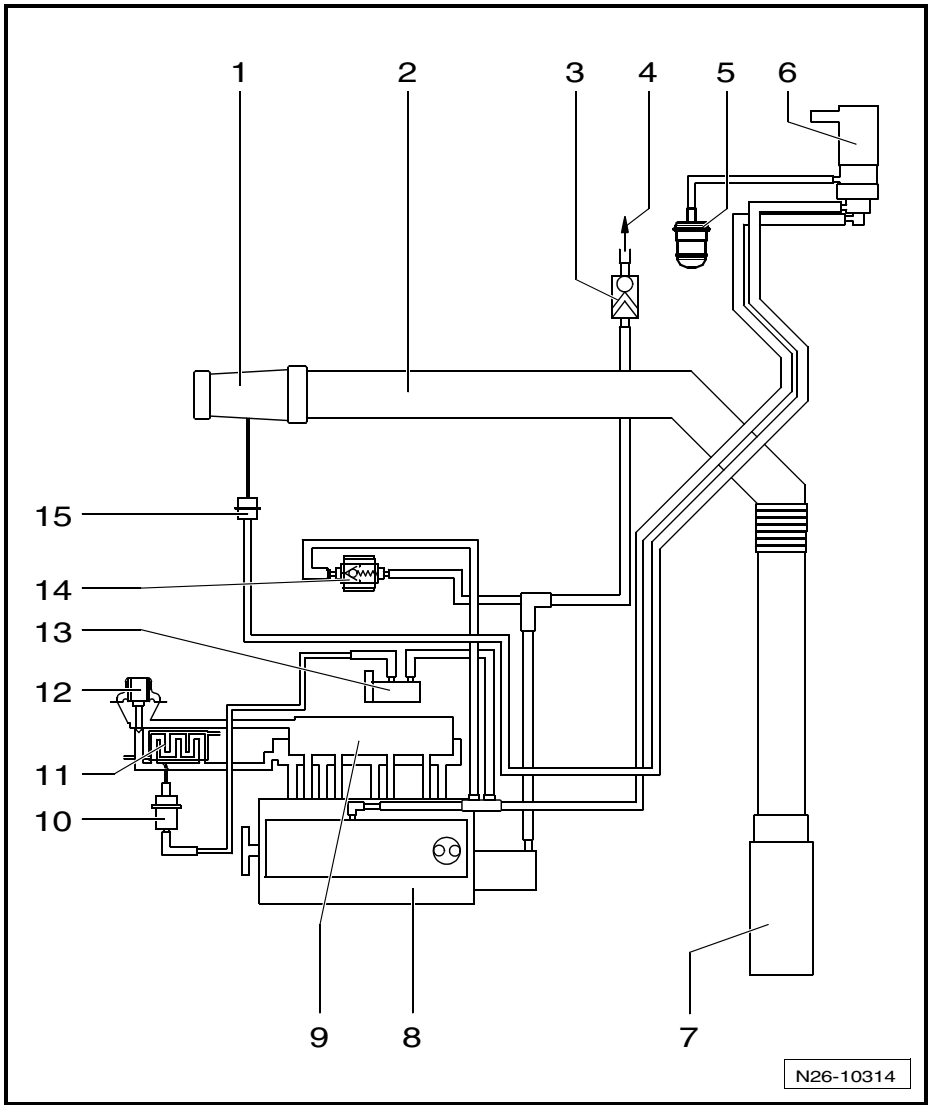
15 - Junction

16 - Tandem pump

- ❑ For fuel and vacuum supply

17 - Vacuum reservoir

2.3.2 Vacuum hose schematic diagram (engine code CBKA)



1 - Turbocharger

2 - Intake hose

- ❑ Between air filter and turbocharger.
- ❑ Check for secure seating.

3 - Non-return valve

- ❑ Note installation position

4 - Vacuum supply

5 - Air filter

- ❑ Observe installation position: Filter must hang down vertically

6 - Charge pressure control solenoid valve -N75-

7 - Air filter

8 - Cylinder head/cylinder block

9 - Intake pipe

10 - Vacuum actuator

- ❑ For bypass flap

11 - Exhaust gas recirculation cooler

- ❑ With bypass flap.

12 - Exhaust gas recirculation valve -N18-

13 - Exhaust gas recirculation cooler change-over valve -N345-

14 - Non-return valve

- ❑ Note installation position

15 - Non-return valve

- ❑ Note installation position

3 Checking components and functions

The component and functional checks listed refer to the series production components and the current flow diagrams from page ⇒ Seite 288.

In the event of component and switch unit deviation, please refer to the instructions of the respective industrial engine customer.

Check exhaust gas recirculation ⇒ Seite 244

Checking exhaust gas recirculation valve -N18 - ⇒ Seite 245.

Basic setting of exhaust gas recirculation valve -N18- (engine code CBKA) ⇒ Seite 250.

Checking exhaust gas recirculation valve (engine codes CBHA, CBJA, CBJB) ⇒ Seite 250.

Checking lambda probe -G39- (engine code CBKA) ⇒ Seite 251.

Checking lambda probe heater -Z19- (engine code CBKA) ⇒ Seite 253.

Checking exhaust gas temperature sender 1 -G235- (engine code CBKA) ⇒ Seite 254.

Checking exhaust gas temperature sender 2 -G448- (engine code CBKA) ⇒ Seite 257.

Checking temperature sender after particulate filter -G527- (engine code CBKA) ⇒ Seite 259.

Checking exhaust gas pressure sender 1 -G450- (engine code CBKA) ⇒ Seite 261.

Checking exhaust gas recirculation cooler changeover valve -N345- (engine code CBKA) ⇒ Seite 263.

Checking particulate filter (engine code CBKA) ⇒ Seite 265.

3.1 Checking exhaust gas recirculation

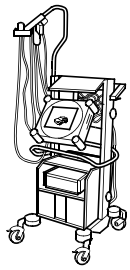
Hinweis

Checking of the exhaust gas recirculation is carried out in diagnosis function „03-Final control diagnosis“. With this approach, the exhaust gas recirculation valve -N18- is actuated in a pulsed manner so that the extreme values for exhaust gas recirculation can be read in the measured value block.

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -

VAS 5051



W00-1236

Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- No leaks on intake and exhaust systems
- No faults on engine/injection system such as unit injectors or compression pressure.

- No faults must be stored in fault memory ⇒ Seite 9, interrogating fault memory.
- The coolant temperature must be at least 80 °C, ⇒ display group 1, display zone 4.

Test procedure

– Carry out final control diagnosis and activate exhaust gas recirculation valve -N18- ⇒ Seite 49, Final control diagnosis.

The displays in display zones 3 and 4 must fluctuate in the following control range:

- Specification in display zone 3: 170...520 mg/H
- Specification display zone 4: 95...4 %

Hinweis

Actuation of the valve can also be checked by touch.

– Proceed with final control diagnosis until completed.

– End diagnosis function.

– Switch off ignition.

If the specifications are not achieved:

Engine codes CBHA, CBJA, CBJB

– Check the mechanical exhaust gas recirculation valve ⇒ Seite 250.

Continuation for all engine codes

– Check exhaust gas recirculation valve -N18- ⇒ Seite 245.

– Check vacuum hoses for leaks. Vacuum hose schematic diagram ⇒ Seite 241.

3.2 Checking exhaust gas recirculation valve -N18-

Checking exhaust gas recirculation valve -N18 -:

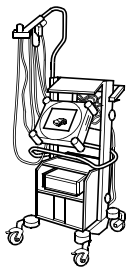
- Engine codes CBHA, CBJA, CBJB ⇒ Seite 246,
- Engine code CBKA ⇒ Seite 248.

3.2.1 Checking exhaust gas recirculation valve -N18- (engine codes CBHA, CBJA, CBJB)

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -
- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Adapter set -V.A.G 1594-
- Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-
- Current flow diagram

VAS 5051



W00-1236

Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- The coolant temperature must be at least 80 °C, ⇒ display group 1, display zone 4.

Test procedure

– Carry out final control diagnosis and activate exhaust gas recirculation valve -N18- ⇒ Seite 49, Final control diagnosis.

The displays in display zones 3 and 4 must fluctuate in the following control range:

- Specification in display zone 3: 170...520 mg/H
- Specification display zone 4: 95...4 %

Hinweis

Actuation of the valve can also be checked by touch.

– Proceed with final control diagnosis until completed.

– End diagnosis function.

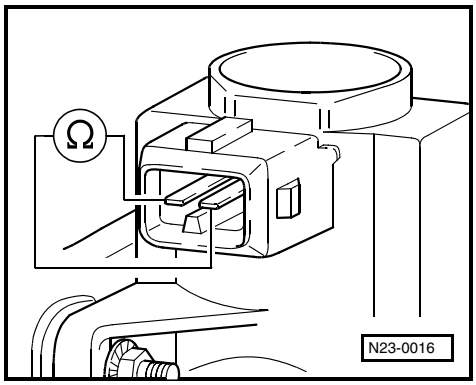
– Switch off ignition.

If the valve is not actuated:

– Pull off 2-pin connector from exhaust gas recirculation valve -N18-.

Check resistance

– Connect multimeter with auxiliary lines from -V.A.G 1594- for resistance measurement to contacts of valve. Specification: 14,0...20.0 Ω



Hinweis

At room temperature, the resistance is in the lower tolerance range; at operating temperature, the resistance is in the upper tolerance range.

If the specification is not obtained:

– Renew exhaust gas recirculation valve -N18-.

– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

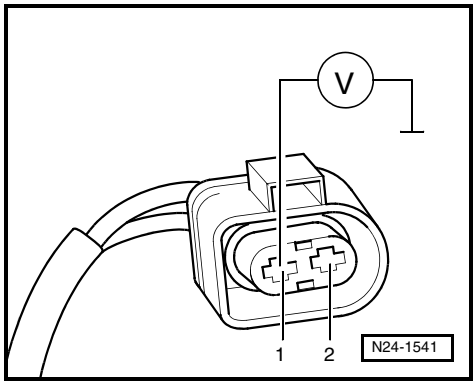
If the specification is reached:

Checking voltage supply

– Connect multimeter with auxiliary lines from -V.A.G 1594- for voltage measurement to contact 1 of connector and engine earth.

– Switch on ignition. Specification: at least 11.5 V

– Switch off ignition.



If the specification is not obtained:

– Check terminal 30 voltage supply relay -J317- ⇒ Seite 288, Current flow diagrams.

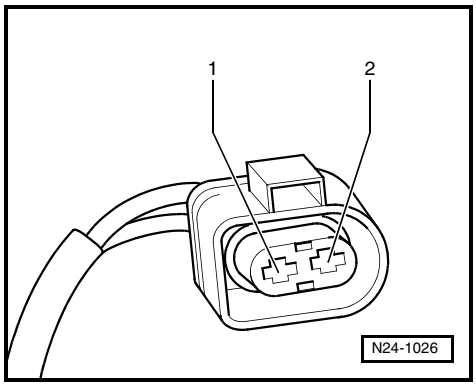
– Check cable connections for open circuit, short circuit and transfer resistance at contacts according to current flow diagram.

If the specification is reached:

– Check wiring of exhaust gas recirculation valve as follows:

– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-2- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit using current flow diagram.



♦ Contact 2 + socket 13

• Cable resistance: max. 2.0 Ω

– In addition, check wires for short to one another. Specification: ∞ Ω.

If no wiring fault is detected and voltage supply is OK:

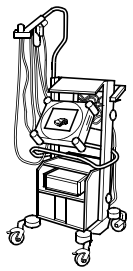
– Renew engine control unit -J623- ⇒ Seite 230.

3.2.2 Checking exhaust gas recirculation valve -N18- (engine code CBKA)

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -
- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Adapter set -V.A.G 1594-
- Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-
- Current flow diagram

VAS 5051



W00-1236

Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- The coolant temperature must be at least 80 °C, ⇒ display group 1, display zone 4.

Test procedure

Hinweis

- *Exhaust gas recirculation valve - N18- and exhaust gas recirculation potentiometer -G212- are installed together in one housing.*
- *Only gold-plated contacts may be used when repairing the contacts in the connection of the exhaust gas recirculation valve.*

– Carry out final control diagnosis and activate exhaust gas recirculation valve -N18- ⇒ Seite 49, Final control diagnosis.

The displays in display zones 3 and 4 must fluctuate in the following control range:

- Specification in display zone 3: 170...520 mg/H
- Specification display zone 4: 95...4 %

Hinweis

Actuation of the valve can also be checked by touch.

– Proceed with final control diagnosis until completed.

– End diagnosis function.

– Switch off ignition.

If the valve is not actuated:

– Pull off 6-pin connector from exhaust gas recirculation valve -N18-.

Checking voltage supply

– Switch on ignition.

– Connect multimeter with auxiliary lines from -V.A.G 1594- for voltage measurement to the following contacts of the connector and to engine earth.

♦ Contact 1 + engine earth

♦ Contact 1 + contact 3

● Specification: at least 4,5 V

– Switch off ignition.

– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-1- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit using current flow diagram.

♦ Contact 1 + socket 26

♦ Contact 2 + socket 50

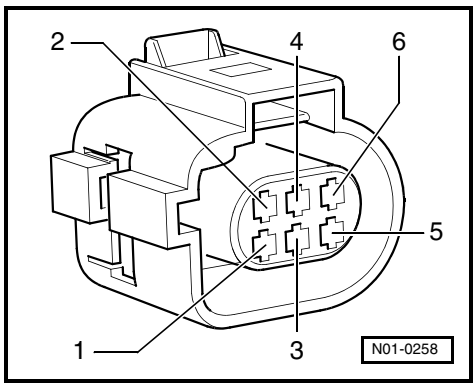
♦ Contact 3 + socket 23

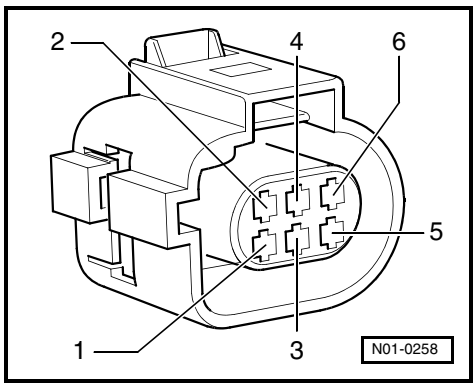
♦ Contact 5 + socket 24

♦ Contact 6 + socket 49

● Cable resistance: max. 2.0 Ω

– In addition, check wires for short to one another. Specification: ∞ Ω.





If no wiring fault is detected and voltage was present between contacts 1 + engine earth and 1 + 3:

– Renew exhaust gas recirculation valve -N18- ⇒ Seite 239, Assembly overview - exhaust gas recirculation (engine code CBKA).

– Carry out basic setting of exhaust gas recirculation -N18- ⇒ Seite 250.

– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

If no wiring fault is detected and no voltage was present between contacts 1 + engine earth and 1 + 3:

– Renew engine control unit -J623- ⇒ Seite 230.

3.3 Basic setting of exhaust gas recirculation valve -N18- (engine code CBKA)

Hinweis

If exhaust gas recirculation valve -N18- is renewed, a basic setting must be carried out.

Prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- Earth connections OK
- All electrical consumers must be switched off.

Procedure

Hinweis

Exhaust gas recirculation valve - N18- and exhaust gas recirculation potentiometer -G212- are installed together in one housing.

– Switch ignition off and then on again.
– Wait a minute for the control unit sequence.
– Start engine and let it idle for at least one minute.
– Switch off ignition.
– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

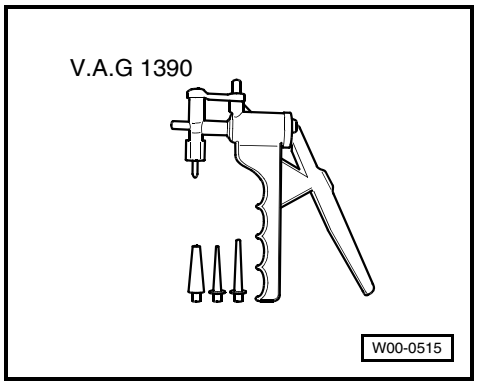
If a fault is stored in the fault memory:

– Erase fault memory ⇒ Seite 10.
– Repeat procedure.

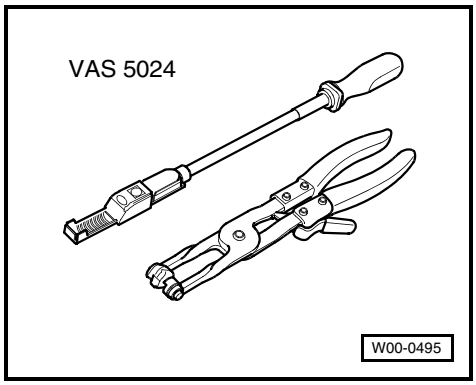
3.4 Checking exhaust gas recirculation valve (engine codes CBHA, CBJA, CBJB)

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

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

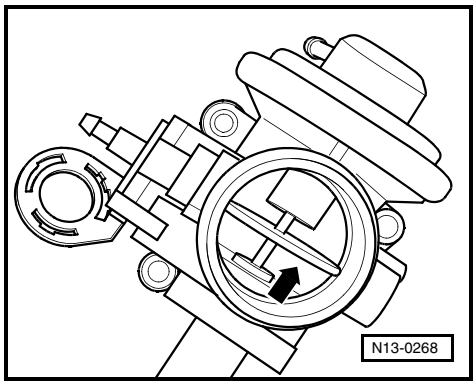


♦ Spring-type clip pliers -VAS 5024-



Test procedure

– Pull vacuum hose off connection union.
– Pull vacuum hose off exhaust gas recirculation valve.
– Connect hand vacuum pump -V.A.G 1390- to valve.



– Operate hand vacuum pump and observe diaphragm rod. The diaphragm rod must move in -direction of arrow-.
– Pull off vacuum hose of hand vacuum pump from exhaust gas recirculation valve. The diaphragm rod must move against -direction of arrow- back to its original position.

3.5 Checking lambda probe -G39- (engine code CBKA)

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
♦ Adapter set -V.A.G 1594-
♦ Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-
♦ Current flow diagram

Test prerequisites

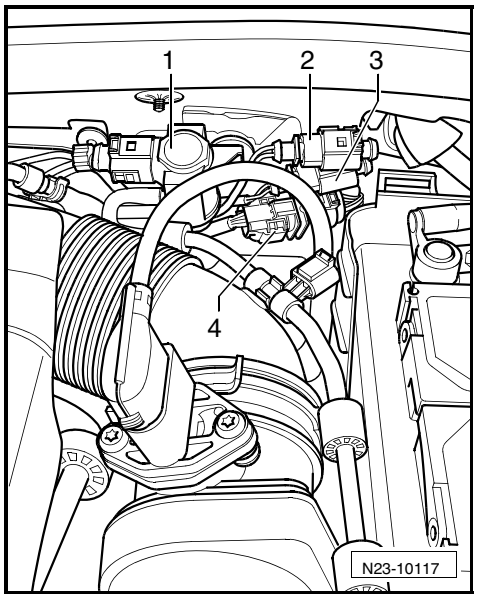
- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- The exhaust system must not leak.
- Checking lambda probe heater -Z19- is OK ⇒ Seite 253.

Test procedure

Hinweis

♦ *Lambda probe -G39- and lambda probe heater -Z19- are installed together in one housing.*
♦ *Only gold-plated contacts may be used when repairing the contacts in the connection of the lambda probe and the lambda probe heater.*

– Disconnect 6-pin connector -4- from lambda probe -G39-.

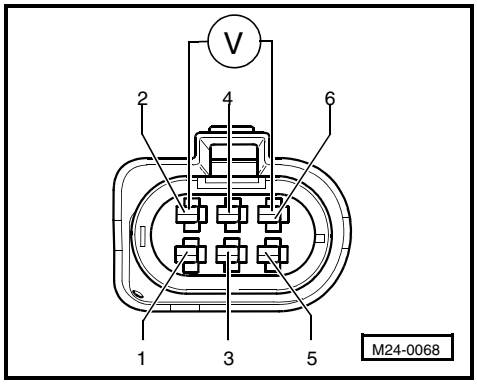


Check basic voltage

– Connect multimeter with auxiliary lines from -V.A.G 1594- for resistance measurement to contacts 2 + 6 of the connector.

– Switch on ignition. Check basic voltage after about 8 seconds. Specification: 0.4...0.5 V.

– Switch off ignition.



If the specification is not obtained:

– Check lambda probe wiring as follows:

– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-2- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit using current flow diagram.

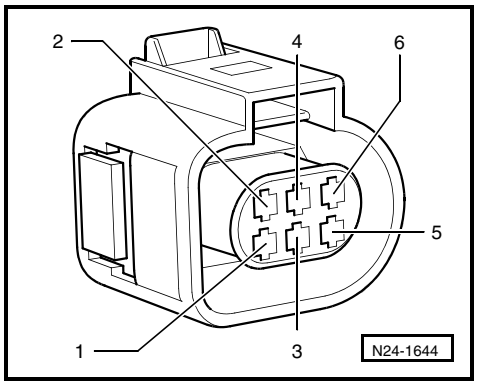
♦ Contact 1 + socket 32

♦ Contact 2 + socket 10

♦ Contact 5 + socket 54

♦ Contact 6 + socket 77

• Cable resistance: max. 2.0 Ω



– In addition, check wires for short to one another. Specification: ∞ Ω.

If no wiring fault is detected and voltage was present between contacts 2 + 6:

– Renew lambda probe -G39- ⇒ Seite 236, Assembly overview - front exhaust pipe with catalytic converter (engine code CBKA).

– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

If no wiring fault is detected and no voltage was present between contacts 2 + 6:

– Renew engine control unit -J623- ⇒ Seite 230.

3.6 Checking lambda probe heater -Z19- (engine code CBKA)

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Adapter set -V.A.G 1594-
- Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-
- Current flow diagram

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK

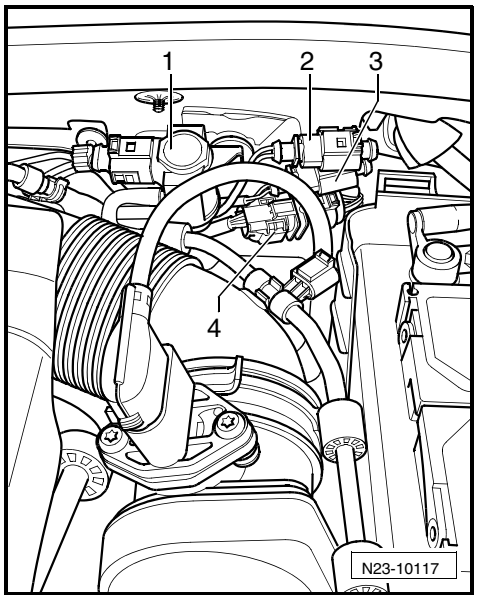
Test procedure

Hinweis

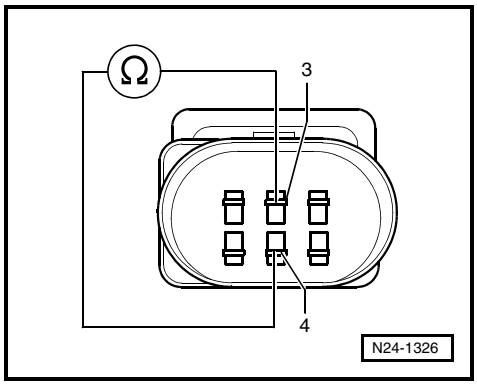
- *Lambda probe heater -Z19- and lambda probe -G39- are installed together in one housing.*
- *Only gold-plated contacts may be used when repairing the contacts in the connection of the lambda probe and the lambda probe heater.*

– Disconnect 6-pin connector -4- from lambda probe -G39-.

Check resistance



– Connect multimeter with auxiliary lines from -V.A.G 1594- for resistance measurement to contacts 3 + 4 of the connector to lambda probe heater. Specification: max. 10.0 Ω (at room temperature).



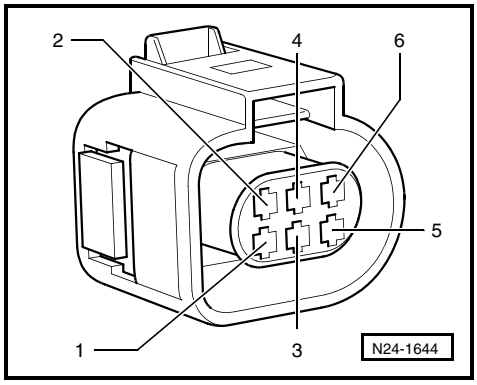
If the specification is not obtained:

– Renew lambda probe -G39- ⇒ Seite 236, Assembly overview - front exhaust pipe with catalytic converter (engine code CBKA).
– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

If the specification is reached:

Checking voltage supply

– Connect multimeter with auxiliary lines from -V.A.G 1594- for voltage measurement to contact 4 of connector and engine earth.
– Switch on ignition. Specification: at least 11.5 V
– Switch off ignition.



If the specification is not obtained:

– Check terminal 30 voltage supply relay -J317- ⇒ Seite 288, Current flow diagrams.
– Check cable connections for open circuit, short circuit and transfer resistance at contacts according to current flow diagram.

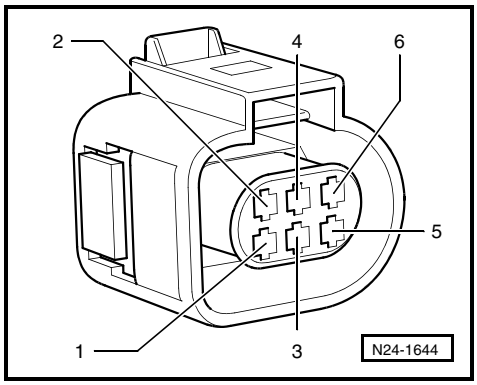
If the specification is reached:

– Check lambda probe heater wiring as follows:
– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-2- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.
– Check wiring between test box and connector for open circuit using current flow diagram.

♦ Contact 3 + socket 51

• Cable resistance: max. 2.0 Ω

– In addition, check wires for short to one another. Specification: ∞ Ω.



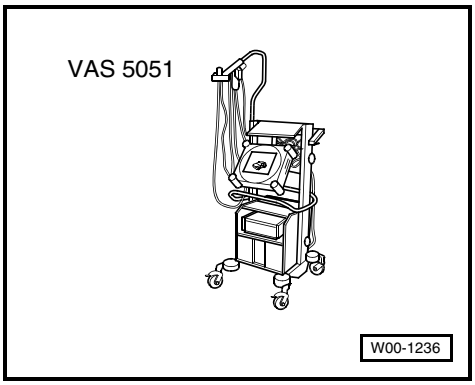
If no wiring fault is detected and voltage supply is OK:

– Renew engine control unit -J623- ⇒ Seite 230.

3.7 Checking exhaust gas temperature sender 1 -G235- (engine code CBKA)

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -
- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Adapter set -V.A.G 1594-
- Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-
- Current flow diagram



Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

- Fuses must be OK.
- The battery voltage must be at least 11.5 V.
- All electrical consumers must be switched off.
- Earth connections OK
- Engine must be cold.

Test procedure

Hinweis

Only gold-plated contacts may be used when repairing the contacts in the connections of exhaust gas temperature sender 1.

– Connect vehicle diagnosis, testing and information system -VAS 5051- and select diagnosis function „08-Read measured value block“. Engine must be idling to do this. (Connect vehicle diagnosis, testing and information system and select engine control unit⇒ Seite 5.)

– Select „display group 75“.

Indicated on display:

```
Display group 75
123.0 °C   114.0 °C    xx %      xxx.x °C
```

Hinweis

On the display of vehicle diagnosis, testing and information system -VAS 5051-, the display zones are shown one below the other, on other diagnosis testers they are side by side.

– Increase engine speed to 2400...2800 rpm.

– Check exhaust gas temperature value in display zone 1. The temperature value must increase uniformly and without interruption.

Hinweis

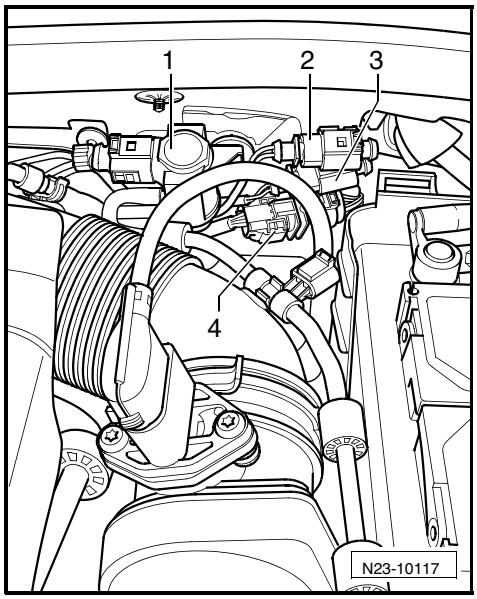
The exhaust gas temperature figure in display zone 1 of exhaust gas temperature sender 1 (exhaust gas temperature value before turbocharger) must be greater than the exhaust gas temperature value in display zone 2 of exhaust gas tempera-

ture sender 2 (exhaust gas temperature value before particulate filter). If this is not the case, both of the senders are interchanged.

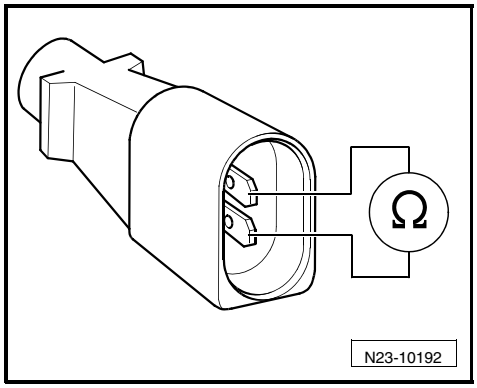
– If there is no realistic result in display zone 1, check exhaust gas temperature sender 1 and the wiring connections to the sender as follows:
– End diagnosis function.
– Switch off ignition.

Check resistance

– Disconnect 2-pin connector -3- from exhaust gas temperature sender 1 -G235-.



– Connect multimeter with auxiliary lines from -V.A.G 1594- for resistance measurement to contacts of connector to sender. Specification: 170,0...850.0 Ω.



If the specification is not obtained:

– Renew exhaust gas temperature sender 1 -G235- ⇒ Seite 181, Assembly overview - exhaust gas turbocharger with attachments (engine code CBKA)
– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

If the specification is reached:

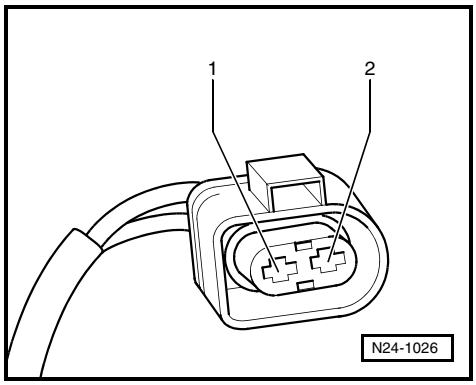
– Check the wiring of exhaust gas temperature sender 1 -G235- as follows:
– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-2- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit using current flow diagram.

♦ Contact 1 + socket 23
♦ Contact 2 + socket 53

• Cable resistance: max. 2.0 Ω

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω.



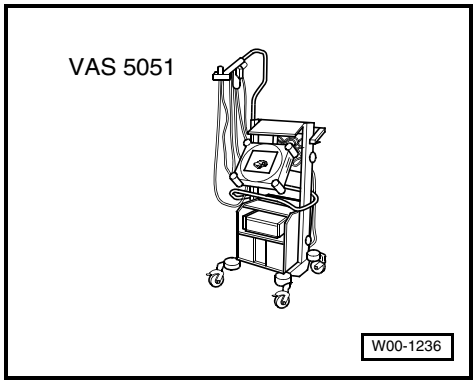
If no fault in lines is detected:

– Renew engine control unit -J623- ⇒ Seite 230.

3.8 Checking exhaust gas temperature sender 2 -G448- (engine code CBKA)

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -
♦ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
♦ Adapter set -V.A.G 1594-
♦ Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-
♦ Current flow diagram



Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

• Fuses must be OK.
• The battery voltage must be at least 11.5 V.
• All electrical consumers must be switched off.
• Earth connections OK
• Engine must be cold.

Test procedure

Hinweis

Only gold-plated contacts may be used when repairing the contacts in the connections of exhaust gas temperature sender 2.

– Connect vehicle diagnosis, testing and information system -VAS 5051- and select diagnosis function „08-Read measured value block“. Engine must be idling to do this. (Connect vehicle diagnosis, testing and information system and select engine control unit⇒ Seite 5.)

– Select „display group 75“.

Indicated on display:

```
Display group 75
123.0 °C   114.0 °C    xx %      xxx.x °C
```

Hinweis

On the display of vehicle diagnosis, testing and information system -VAS 5051-, the display zones are shown one below the other, on other diagnosis testers they are side by side.

– Increase engine speed to 2400...2800 rpm.

– Check exhaust gas temperature value in display zone 2. The temperature value must increase uniformly and without interruption.

Hinweis

The exhaust gas temperature figure in display zone 1 of exhaust gas temperature sender 1 (exhaust gas temperature value before turbocharger) must be greater than the exhaust gas temperature value in display zone 2 of exhaust gas temperature sender 2 (exhaust gas temperature value before particulate filter). If this is not the case, both of the senders are interchanged.

– If there is no realistic result in display zone 2, check exhaust gas temperature sender 2 and the wiring connections to the sender as follows:

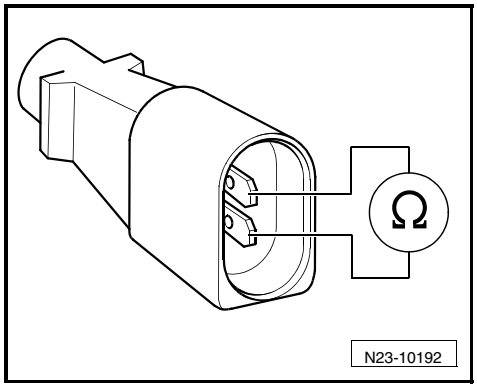
– End diagnosis function.

– Switch off ignition.

Check resistance

– Disconnect 2-pin connector from exhaust gas temperature sender 2 -G448-.

– Connect multimeter with auxiliary lines from -V.A.G 1594- for resistance measurement to contacts of connector to sender. Specification: 170,0...850.0 Ω.



If the specification is not obtained:

– Renew exhaust gas temperature sender 2 -G448- ⇒ Seite 237, Assembly overview - particulate filter (engine code CBKA)

– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

If the specification is reached:

– Check the wiring of exhaust gas temperature sender 2 -G448- as follows:

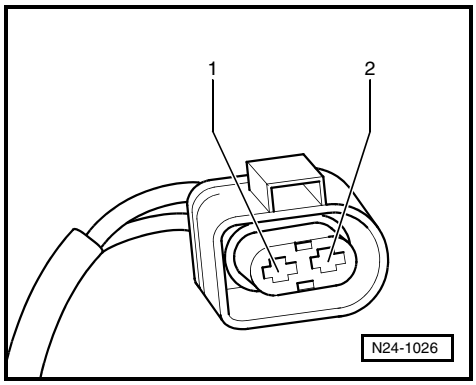
– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-2- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit using current flow diagram.

♦ Contact 1 + socket 9
♦ Contact 2 + socket 75

• Cable resistance: max. 2.0 Ω

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω.



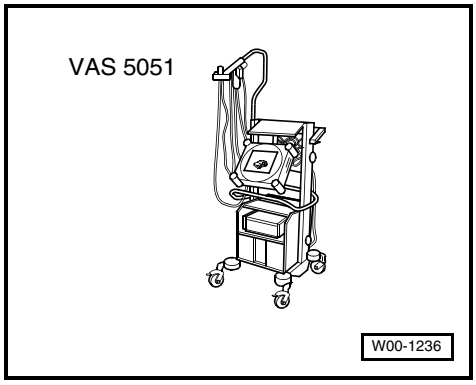
If no fault in lines is detected:

– Renew engine control unit -J623- ⇒ Seite 230.

3.9 Checking temperature sender after particulate filter -G527- (engine code CBKA)

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -
♦ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
♦ Adapter set -V.A.G 1594-
♦ Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-
♦ Current flow diagram



Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

• Fuses must be OK.
• The battery voltage must be at least 11.5 V.
• All electrical consumers must be switched off.
• Earth connections OK
• Engine must be cold.

Test procedure

Hinweis

Only gold-plated contacts may be used when repairing the temperature sender after particulate filter connector contacts.

– Connect vehicle diagnosis, testing and information system -VAS 5051- and select diagnosis function „08-Read measured value block“. Engine must be idling to do this. (Connect vehicle diagnosis, testing and information system and select engine control unit⇒ Seite 5.)

– Select „display group 75“.

```
Display group 75
xxx.x °C   xxx.x °C    xx %      102.0 °C
```

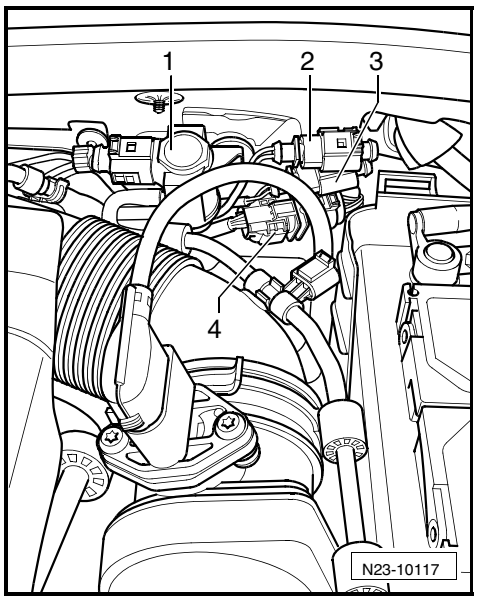
Hinweis

On the display of vehicle diagnosis, testing and information system -VAS 5051-, the display zones are shown one below the other, on other diagnosis testers they are side by side.

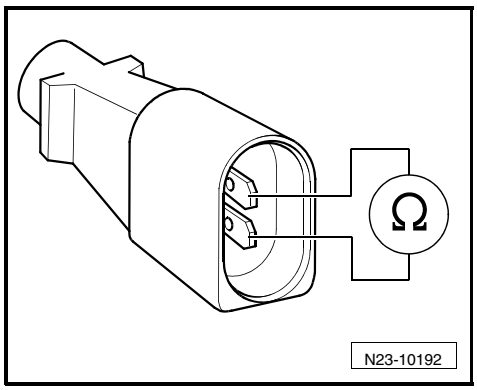
– Increase engine speed to 2400...2800 rpm.
– Check exhaust gas temperature value in display zone 4. The temperature value must increase uniformly and without interruption.
– If there is no realistic result in display zone 4, check temperature sender after particulate filter and the wiring connections to the sender as follows:
– End diagnosis function.
– Switch off ignition.

Check resistance

– Separate 2-pin connector -2- from temperature sender after particulate filter -G527-.



– Connect multimeter with auxiliary lines from -V.A.G 1594- for resistance measurement to contacts of connector to sender. Specification: 170,0...850.0 Ω.



If the specification is not obtained:

– Renew temperature sender after particulate filter -G527- ⇒ Seite 237, Assembly overview - particulate filter (engine code CBKA).
– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

If the specification is reached:

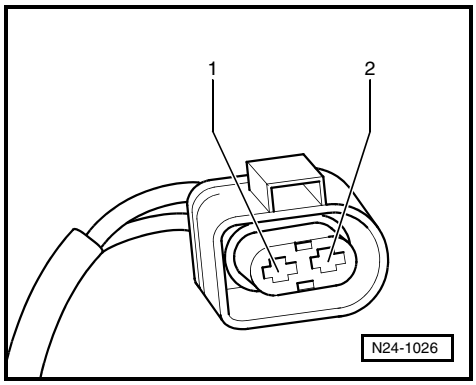
– Check temperature sender after particulate filter -G527- wiring as follows:
– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-1- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit using current flow diagram.

♦ Contact 1 + socket 21
♦ Contact 2 + socket 22

• Cable resistance: max. 2.0 Ω

– Also check wiring for short to one another, short to battery earth/engine earth and short to battery positive. Specification: ∞ Ω.



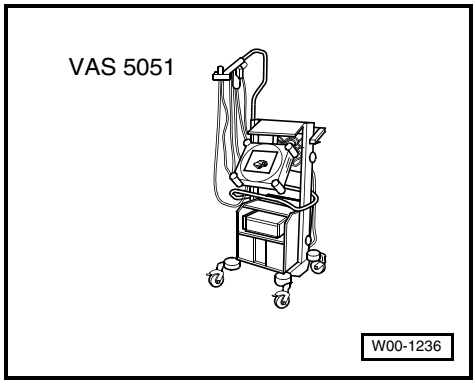
If no fault in lines is detected:

– Renew engine control unit -J623- ⇒ Seite 230.

3.10 Checking exhaust gas pressure sender 1 -G450- (engine code CBKA)

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -
♦ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
♦ Adapter set -V.A.G 1594-
♦ Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-2-
♦ Current flow diagram



Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

• Fuses must be OK.
• The battery voltage must be at least 11.5 V.
• All electrical consumers must be switched off.
• Earth connections OK
• The control lines between exhaust gas pressure sensor 1 and particulate filter must not be blocked. Checking ⇒ Seite 237, Assembly overview - particulate filter (engine code CBKA).

Test procedure

Hinweis

Only gold-plated contacts may be used when repairing the contacts in the connections of exhaust gas pressure sensor 1.

– Connect vehicle diagnosis, testing and information system -VAS 5051- and select diagnosis function „08-Read measured value block“. Engine must be idling to do this.

(Connect vehicle diagnosis, testing and information system and select engine control unit⇒ Seite 5.)

– Select „display group 67“.

Indicated on display:

```
Display group 67
xxx.x °C    xxx.x °C    4.20 mbar    xxx
```

Hinweis

On the display of vehicle diagnosis, testing and information system -VAS 5051-, the display zones are shown one below the other, on other diagnosis testers they are side by side.

– Check the exhaust gas pressure difference (actual) in display zone 3. Specification: 5.00...20.00 mbar.

– Increase engine speed to 2400...2800 rpm.

– Check the exhaust gas pressure difference (actual) in display zone 3. Specification: The exhaust gas pressure difference should rise noticeably.

– End diagnosis function.

– Switch off ignition.

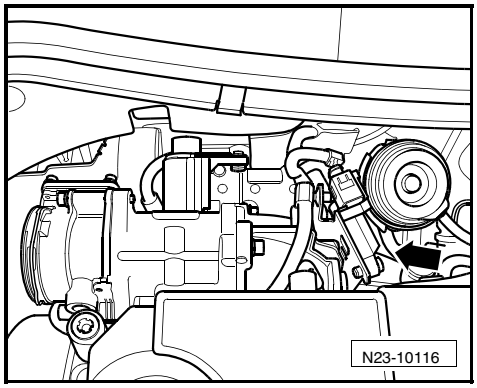
If the exhaust gas pressure difference (actual) in display zone 3 is constantly at 0 mbar:

– Check the particulate filter for cracks ⇒ Seite 237, Assembly overview - particulate filter (engine code CBKA).

If the exhaust gas pressure difference (actual) in display zone 3 is not a constant 0 mbar and the specifications are not reached:

Checking voltage supply

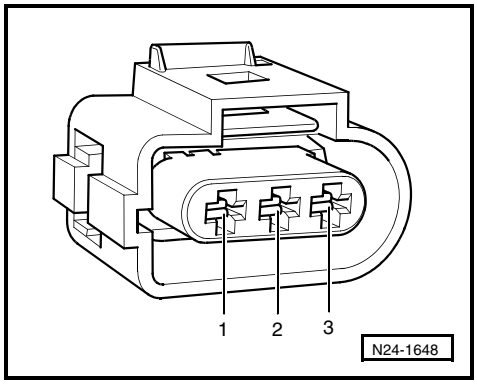
– Pull off 3-pin connector from exhaust gas pressure sensor 1 -G450- -arrow-.



– Connect multimeter with auxiliary lines from -V.A.G 1594- for resistance measurement to contacts 1 + 2 of the connector.

– Switch on ignition. Specification: at least 4,5 V.

– Switch off ignition.



If the specification is not obtained:

– Check wiring of exhaust gas pressure sensor 1 as follows:

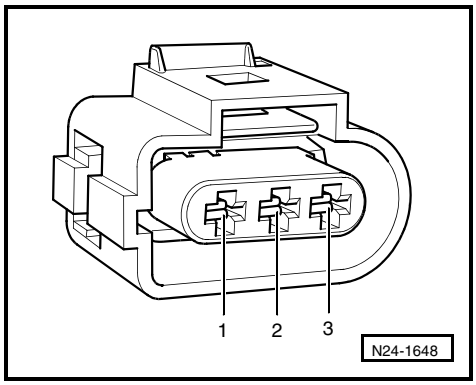
– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-2- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.

– Check wiring between test box and connector for open circuit using current flow diagram.

♦ Contact 1 + socket 58
♦ Contact 2 + socket 12
♦ Contact 3 + socket 11

• Cable resistance: max. 2.0 Ω

– In addition, check wires for short to one another. Specification: ∞ Ω.



If no wiring fault is detected and voltage was present between contacts 1 + 2:

– Renew exhaust gas pressure sensor 1 - G450- ⇒ Seite 237, Assembly overview - particulate filter (engine code CBKA).

– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

If no wiring fault is detected and no voltage was present between contacts 1 + 2:

– Renew engine control unit -J623- ⇒ Seite 230.

3.11 Checking exhaust gas recirculation cooler changeover valve -N345- (engine code CBKA)

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -
♦ Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
♦ Adapter set -V.A.G 1594-
♦ Connect test box -V.A.G 1598/42- with adapter cable -V.A.G 1598/39-1-
♦ Current flow diagram

VAS 5051

Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

• Fuses must be OK.
• The battery voltage must be at least 11.5 V.
• All electrical consumers must be switched off.
• Earth connections OK

Test procedure

– Carry out final control diagnosis and actuate exhaust gas recirculation cooler changeover valve -N345- ⇒ Seite 49, Final control diagnosis.

- The valve must click.

Hinweis

Clicking of the valve is difficult to hear and is therefore best checked by touch.

– Proceed with final control diagnosis until completed.

– End diagnosis function.

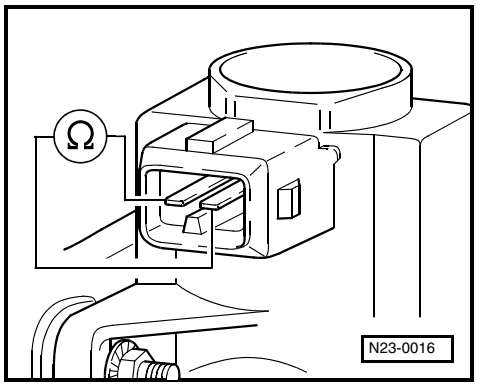
– Switch off ignition.

If the solenoid does not click:

– Pull off 2-pin connector from exhaust gas recirculation cooler changeover valve -N345-.

Check resistance

– Connect multimeter with auxiliary lines from -V.A.G 1594- for resistance measurement to contacts of valve. Specification: 20,0...40.0 Ω



Hinweis

At room temperature, the resistance is in the lower tolerance range; at operating temperature, the resistance is in the upper tolerance range.

If the specification is not obtained:

– Renew exhaust gas recirculation cooler changeover valve -N345- ⇒ Seite 240, Assembly overview - exhaust gas recirculation (engine code CBKA).

– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

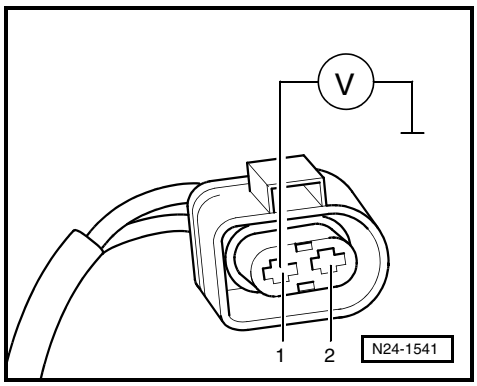
If the specification is reached:

Checking voltage supply

– Connect multimeter with auxiliary lines from -V.A.G 1594- for voltage measurement to contact 1 of connector and engine earth.

– Switch on ignition. Specification: at least 11.5 V

– Switch off ignition.



If the specification is not obtained:

– Check terminal 30 voltage supply relay -J317- ⇒ Seite 288, Current flow diagrams.

– Check cable connections for open circuit, short circuit and transfer resistance at contacts according to current flow diagram.

If the specification is reached:

– Check wiring of exhaust gas recirculation cooler changeover valve as follows:
– Connect test box -V.A.G 1598/42 - with adapter cable -V.A.G 1598/39-1- to wiring harness of control unit ⇒ Seite 7. The engine control unit is not connected by this action.
– Check wiring between test box and connector for open circuit using current flow diagram.

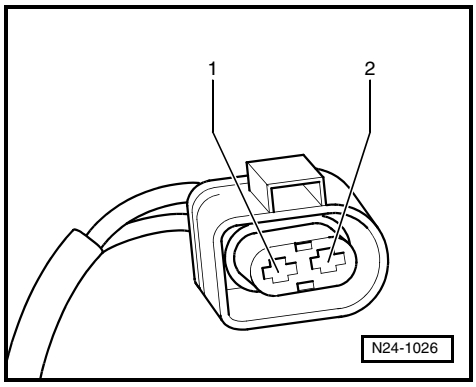
♦ Contact 2 + socket 15

• Cable resistance: max. 2.0 Ω

– In addition, check wires for short to one another. Specification: ∞ Ω.

If no wiring fault is detected and voltage supply is OK:

– Renew engine control unit -J623- ⇒ Seite 230.



3.12 Checking particulate filter (engine code CBKA)

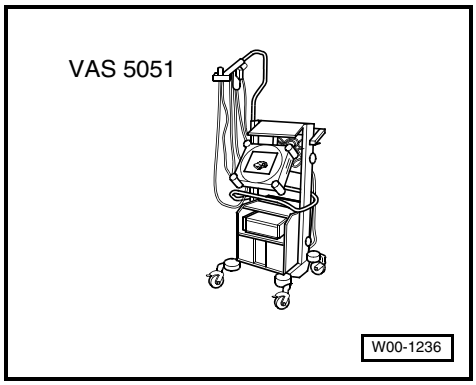
Hinweis

♦ *If the particulate filter is renewed, the adaption figure for the ash quantity has to be set to „0“ ⇒ Seite 268, Renewing particulate filter*

♦ *If the engine control unit is renewed, the adaption figure for the ash quantity has to be set at the previously interrogated adaption figure ⇒ Seite 268.*

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Vehicle diagnosis, testing and information system -VAS 5051- with diagnosis cable -VAS 5051/6A -



Hinweis

Instead of the vehicle diagnosis, testing and information system, other suitable diagnosis tester can also be used.

Test prerequisites

• Fuses must be OK.
• The battery voltage must be at least 11.5 V.
• All electrical consumers must be switched off.
• Earth connections OK
• Check exhaust gas temperature sender 1 -G235- is OK ⇒ Seite 254.
• Check exhaust gas temperature sender 2 -G448- is OK ⇒ Seite 257.
• Check temperature sender after particulate filter -G527- is OK ⇒ Seite 259.

Test procedure

– Connect vehicle diagnosis, testing and information system -VAS 5051- and select diagnosis function „08-Read measured value block“. Engine must be idling to do this. (Connect vehicle diagnosis, testing and information system and select engine control unit⇒ Seite 5.)

Evaluating filter status

– Select „display group 68“.

Indicated on display:

```
Display group 68
15.0 %        45.0 g        xxx
```

Hinweis

On the display of vehicle diagnosis, testing and information system -VAS 5051-, the display zones are shown one below the other, on other diagnosis testers they are side by side.

Soot/carbon level in display zone 1:

– Check soot/carbon level in display zone 1. Specification: max. 60.0 %.

If the soot/carbon level in display zone 1 is higher than 60.0%:

GEFAHR!

Under no circumstances should regeneration be initiated if the soot/carbon level is over 60.0%! Risk of fire!

– End diagnosis function.
– Switch off ignition.
– Renew particulate filter ⇒ Seite 268.

Ash quantity in display zone 2:

– Check ash quantity in display zone 2. Specification: max. 60.0 g.

If the soot/carbon level in display zone 1 is more than 10.0% and the ash quantity in display zone 2 is less than 60.0 g:

– Carry out a regeneration of the particulate filter ⇒ Seite 266.

If the ash quantity in display zone 2 is higher than 60.0 g:

– End diagnosis function.
– Switch off ignition.
– Renew particulate filter ⇒ Seite 268.

Regeneration of particulate filter

Hinweis

- *Regeneration of the particulate filter is only possible from a coolant temperature of at least 50 °C and an exhaust gas temperature before particulate filter of at least 100 °C.*
- *The regeneration time is 30 min.*

– Start engine and run at idling speed.
– Select diagnosis function „08-Read measured value block“.
– Select „display group 1“.

Indicated on display:

```
Display group 1
880 rpm   xxx.x mg/H   xxx CA    53.3 °C
```

– Check coolant temperature in display zone 4. Specification: at least 50 °C.

Continue with check only once coolant temperature has been reached.

– Press ← button.
– Select „display group 75“.

Indicated on display:

```
Display group 75
xxx.x °C   105.2 °C    4.0 %    xxx.x °C
```

– Check the exhaust gas temperature before particulate filter in display zone 2. Specification: at least 100 °C.

Continue with the check only once the exhaust gas temperature before particulate filter has been reached.

Hinweis

- *For the test, the engine has to be accelerated under load from 1500 rpm at full throttle. Please observe conditions for measurements at full throttle* ⇒ *Seite 69**.*
- *The measured values must be read (by 2nd person) once the engine speed reaches 2600 rpm.*
- *The test instruments should always be secured and operated by a second person.*

– Increase engine speed under load from approx. 1500 rpm at full throttle (accelerator pedal position sender at full throttle stop).
– Have second person read measured values at approx. 2600 rpm.

Indicated on display:

```
Display group 75
xxx.x °C   105.2 °C    4.0 %    xxx.x °C
```

– Check soot/carbon level in display zone 3. Specification: less than 10.0 %.

If the specification is reached:

– Press ← button.
– Select „display group 69“.
– Increase engine speed under load from approx. 1500 rpm at full throttle (accelerator pedal position sender at full throttle stop).
– Have second person read measured values at approx. 2600 rpm.

Indicated on display:

```
Display group 69
xxxxxxx    xxxxxxx    xxxxxxx   00000000
```

– Check the regeneration status in display zone 4: Specification 00000000. (Regeneration of the particulate filter was carried out successfully.)
– Then interrogate the fault memory of the engine control unit and erase the fault memory if necessary ⇒ Seite 9, interrogating fault memory.

Renewing particulate filter

– Renew the particulate filter ⇒ Seite 237, Assembly overview - particulate filter (engine code CBKA).

If the particulate filter has been renewed, the adaption figure for the ash quantity must be set to „0“ as follows:

– Switch on ignition.
– Select diagnosis function „10-Adaption“.
– Select „adaption channel 12“.
– Set the adaption figure for the ash quantity to „0“.
– Save this adaption figure.
– End diagnosis function.
– Switch ignition off and after 30 seconds back on again.
– Select diagnosis function „10-Adaption“ again.
– Select „adaption channel 12“ again.
– Check adaption figure of ash quantity. Specification: 0.

If the specification is reached:

– End diagnosis function.
– Switch off ignition.

Setting engine control unit to previously interrogated adaption figure for ash quantity

Prerequisites

- Filter status evaluated ⇒ Seite 266.
- Engine control unit renewed.

Procedure

If the engine control unit was renewed, the adaption figure for the ash quantity must be set to the previously interrogated adaption figure for the ash quantity:

– Switch on ignition.
– Select diagnosis function „10-Adaption“.
– Select „adaption channel 12“.
– Set the adaption figure for the ash quantity to the previously interrogated adaption figure for the ash quantity.
– Save this adaption figure.
– End diagnosis function.
– Switch ignition off and after 30 seconds back on again.
– Select diagnosis function „10-Adaption“ again.

– Select „adaption channel 12“ again.
– Check whether the previously set adaption figure for the ash quantity is displayed.
– End diagnosis function.
– Switch off ignition.

27 – Starter, voltage supply

1 Starter -B-

Observe safety precautions ⇒ Seite 195

Observe rules for cleanliness ⇒ Seite 196

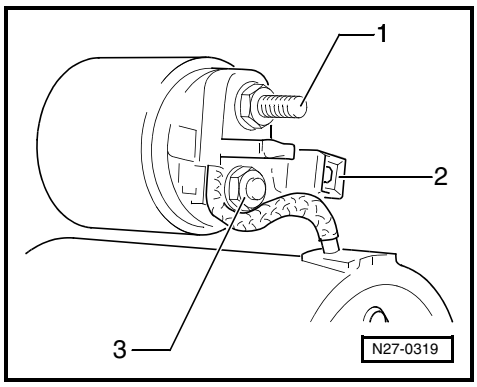
Wiring connections on solenoid switch ⇒ Seite 270.

Starter -B- does not turn ⇒ Seite 270.

Starter -B- turns slowly and does not turn over engine ⇒ Seite 271.

Removing and installing starter -B- ⇒ Seite 272.

1.1 Wiring connections on solenoid switch



1 - Term. 30 - from battery -A-
2 - Term. 50 - from ignition switch -D-
3 - Connection for field winding

1.2 Starter -B- does not turn

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Adapter set -V.A.G 1594-
- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Current flow diagram

Test prerequisites

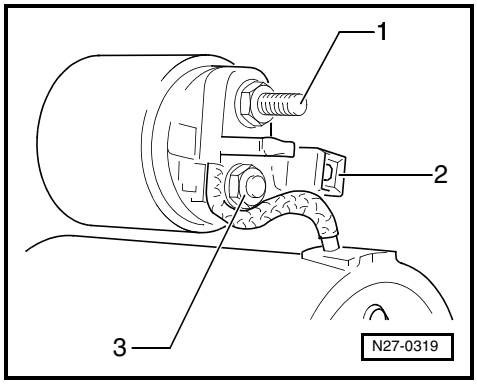
- Fuses must be OK.
- Battery charged and checked.
- Earth connections OK
- All electrical consumers must be switched off.
- Wiring connections on solenoid switch, earth strap -between engine, assembly and battery- must be seated securely and not be corroded.

Test procedure

– Connect multimeter for voltage measurement between terminal 50 -50- (with connector fitted) and battery earth/engine earth.
– Actuate ignition/starter switch and check the voltage supply. Specification: at least 8,0 V

If there is voltage at term. 50 -2- on the solenoid switch:

– Check the voltage at the connection for the field winding -3- and the battery earth/engine earth.



– Actuate ignition/starter switch and check the voltage. Specification: at least 8,0 V

If the specification is reached:

– Repair the starter -B-.

If the specification is not obtained:

– Renew the solenoid switch.

If there is no voltage at term. 50 -2- on the solenoid switch:

– Check the voltage at term. 50 on the ignition/starter switch and battery earth/engine earth using the current flow diagram ⇒ Seite 288, Current flow diagrams.
– Actuate ignition/starter switch and check the voltage. Specification: at least 8,0 V

If the specification is not obtained:

– Renew the ignition/starter switch -D-.

If the specification is reached:

– Check the wiring between ignition/starter switch and starter for open circuit using current flow diagram. Cable resistance: max. 2.0 Ω

1.3 Starter -B- turns slowly and does not turn over engine

Test prerequisites

- Battery charged and checked.
- Poly-V-belt tension and alternator attachment OK
- All electrical consumers must be switched off.
- Wiring connections on solenoid switch, earth strap -between engine, assembly and battery- must be seated securely and not be corroded.

Test procedure

– Actuate the ignition/starter switch.

If the starter does not turn the engine over:

– With ignition switched off, disconnect earth strap from battery.
– Clean the connections on the starter and earth strap between engine and assembly. The earth strap on the assembly should not be loosened when doing this.
– Tighten the connections after cleaning.
– Connect the earth strap to battery.
– Actuate the ignition/starter switch.

If the starter still does not turn the engine over, it may be due to the following fault causes:

♦ Insufficient contact between carbon brushes and collector

– Check carbon brushes for wear and renew if necessary.

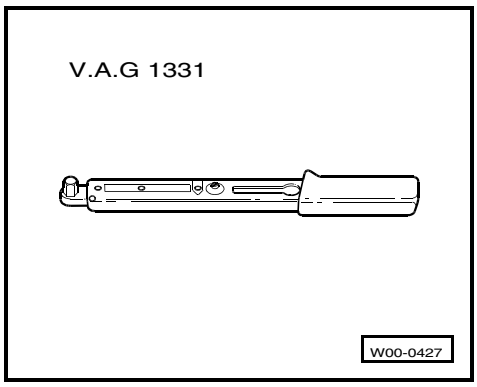
♦ Collector is scored, burnt or contaminated

– Renew the armature.

1.4 Removing and installing starter -B-

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Torque wrench (5...50 Nm) -V.A.G 1331-
♦ Torque wrench (40...200 Nm) -V.A.G 1332-



Removing ⇒ Seite 272.

Installing ⇒ Seite 273.

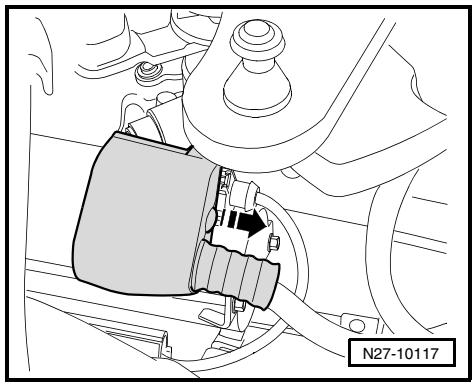
Torque settings ⇒ Seite 274.

1.4.1 Removing

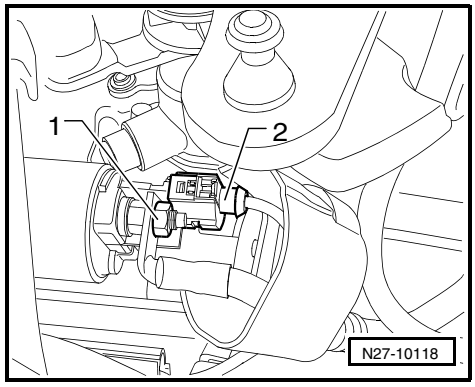
Hinweis

The following work procedure contains just general notes on removal and installation of the starter motor. This is because no universal work procedure can be prescribed due to the different installation conditions.

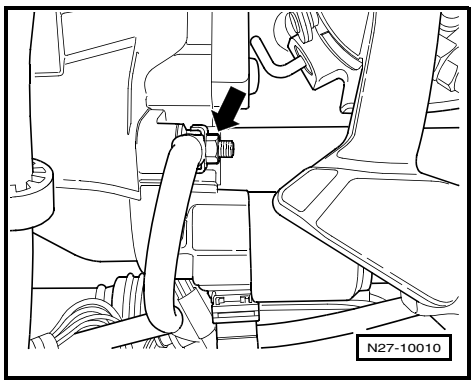
– Note safety precautions before beginning work ⇒ Seite 195
– Observe rules for cleanliness ⇒ Seite 196
– With ignition switched off, disconnect battery.
– Slide down protective cap in -direction of arrow- from solenoid switch.



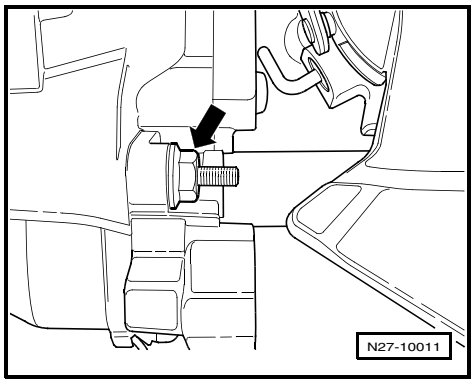
– Unscrew positive wire of term. 30 -1- and separate connector of term. 50 -2-.



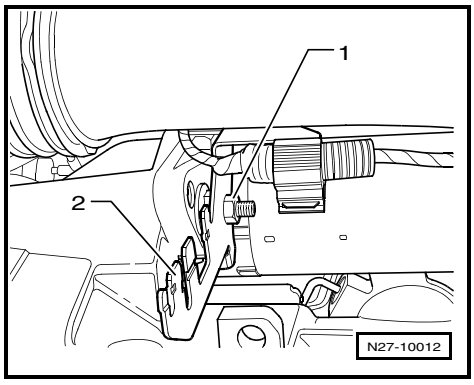
– Unscrew earth lead from securing bolt of starter -arrow-.



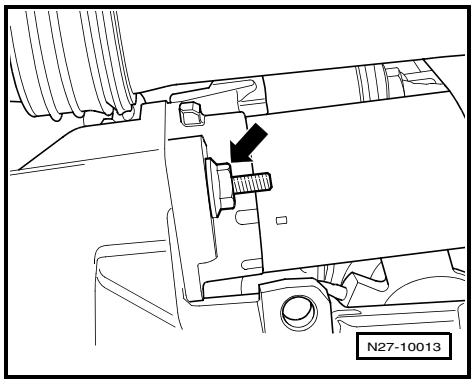
– Unscrew securing bolt of starter -arrow-.



– Unscrew securing nut -1- from lower securing bolt from starter.
– Remove cable holder -2-.



– Unscrew securing bolt of starter -arrow-.
– Remove starter downwards.



1.4.2 Installing

Installation is carried out in the reverse sequence of removal. In the process, note the following:

– Tighten threaded connections to prescribed torque ⇒ Seite 274.
– With ignition switched off, connect battery.

1.4.3 Torque settings

Threaded connection		Torque setting
Starter to assembly	M10	40 Nm
	M12	60 Nm
Earth lead to securing bolt of starter	M8	15 Nm
Cable holder to securing bolt of starter	M8	15 Nm
Positive lead to solenoid switch of starter	M8	15 Nm

2 Alternator -C-

Observe safety precautions ⇒ Seite 195

Observe rules for cleanliness ⇒ Seite 196

Assembly overview - alternator -C- ⇒ Seite 275.

Tightening sequence and torque setting of compact bracket to cylinder block ⇒ Seite 276.

Checking alternator -C- and voltage regulator -C1- ⇒ Seite 277.

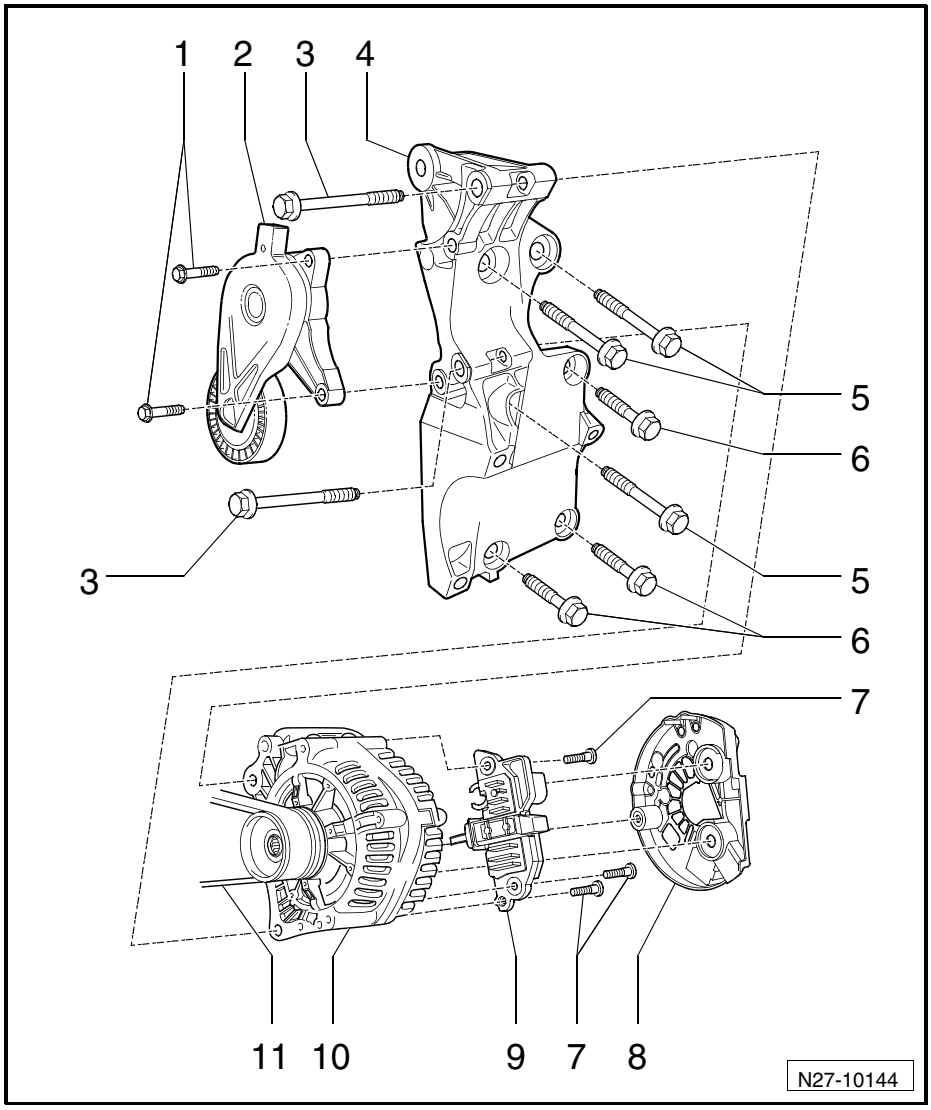
Removing and installing alternator -C- ⇒ Seite 278.

Removing and installing voltage regulator -C1- ⇒ Seite 280.

Removing and installing poly-V-belt pulley ⇒ Seite 283.

Checking function of freewheel coupling ⇒ Seite 287.

2.1 Assembly overview - alternator -C-



1 - 25 Nm

2 - Poly V-belt tensioning element
- ❑ Swivel with open jaw spanner to relieve tension of poly-V-belt ⇒ Seite 86, Removing and installing poly-V-belt

3 - 25 Nm

4 - Compact bracket
- ❑ For alternator and, if fitted, air conditioner compressor
- ❑ Tightening sequence and torque setting of compact bracket to cylinder block ⇒ Seite 276

5 - Hexagon collar bolt
- ❑ M10 x 65
- ❑ Tightening sequence and torque setting of compact bracket to cylinder block ⇒ Seite 276

6 - Hexagon collar bolt
- ❑ M10 x 45
- ❑ Tightening sequence and torque setting of compact bracket to cylinder block ⇒ Seite 276

7 - Cross-head screw, 2 Nm
- ❑ M4 x 20

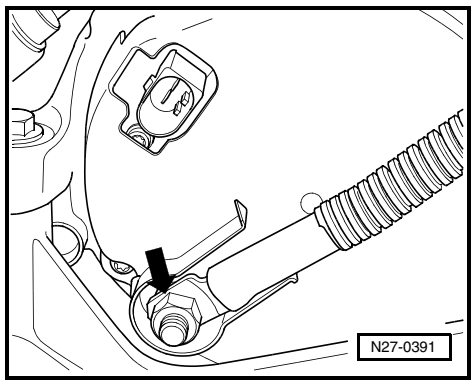
8 - Protective cap

9 - Voltage regulator -C1-
- ❑ Checking ⇒ Seite 277, Checking alternator -C- and voltage regulator -C1-
- ❑ Removing and installing ⇒ Seite 280.

10 - Alternator -C-
- ❑ Securing „B+ wire“ on alternator ⇒ Abb. auf Seite 276
- ❑ Checking ⇒ Seite 277, Checking alternator -C- and voltage regulator -C1-
- ❑ Removing and installing ⇒ Seite 278.
- ❑ Removing and installing poly-V-belt pulley ⇒ Seite 283
- ❑ Checking function of freewheel coupling ⇒ Seite 287

11 - Poly V-belt
- ❑ Mark direction of rotation before removing.
- ❑ Do not kink
- ❑ Removing and installing ⇒ Seite 86.
- ❑ Check for wear ⇒ Seite 87

Securing „B+ wire“ on alternator



Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Torque wrench (5...50 Nm) -V.A.G 1331-

Hinweis

The threaded connection for the + cable is marked on the alternator with „B1+“.

Vorsicht!

If the B+ wire is not secured to the prescribed torque, the system is at risk of the following:

- ***The battery will not be charged completely.***
- ***Complete failure of electrics/electronics.***
- ***Risk of fire due to spark formation.***
- ***Damage from overload to electronic components and control units.***

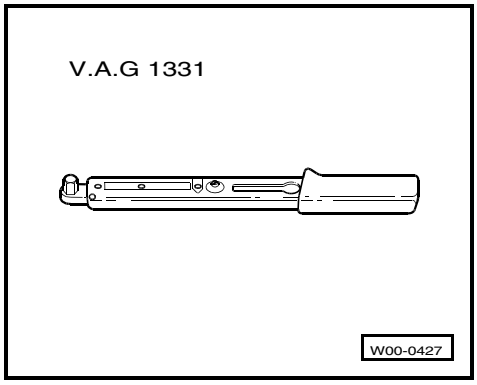
– With ignition switched off, disconnect earth strap from battery.

– Tighten securing nut of „B1+ wire“ -arrow-. Torque setting: 15 Nm.

2.2 Tightening sequence and torque setting of compact bracket to cylinder block

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Torque wrench (5...50 Nm) -V.A.G 1331-



Procedure

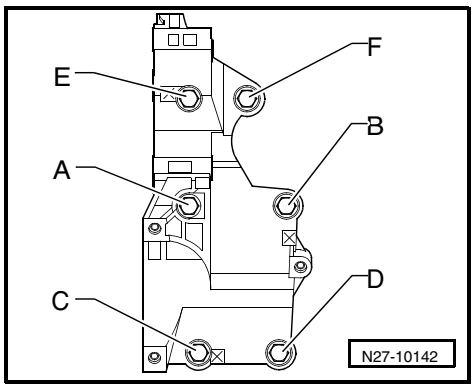
– Place compact bracket on cylinder block.

Hinweis

- *Observe locating sleeve between compact bracket and cylinder block.*
- *Before tightening to prescribed torque, start all bolts a few threads.*

– Tighten hexagon collar bolts of compact bracket in the following sequence:

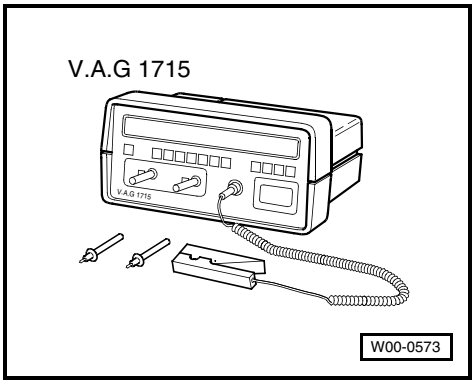
A - M10 x 65, 40 Nm
B - M10 x 45, 40 Nm
C - M10 x 45, 40 Nm
D - M10 x 45, 40 Nm
E - M10 x 65, 40 Nm
F - M10 x 65, with locating sleeve, 40 Nm



2.3 Checking alternator -C- and voltage regulator -C1-

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Multimeter -V.A.G 1715-
♦ Adapter set -V.A.G 1594 C-

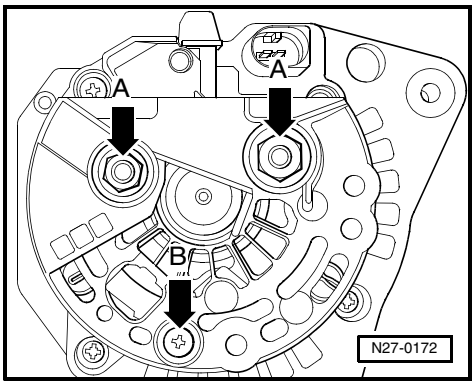


Test prerequisites

- Fuses must be OK.
- Battery charged and checked.
- Earth connections OK
- Poly-V-belt tension and alternator attachment OK
- No faults must be stored in fault memory ⇒ Seite 9, interrogating fault memory.

Test procedure

– Unscrew securing nuts -arrows A- and securing bolt -arrow B- of protective cap and remove protective cap.
– Switch on multimeter -V.A.G 1715-.
– Connect black earth wire (-) to battery earth strap.
– Connect red earth wire (+) to „term. D+“ on the alternator.
– Switch on all electrical consumers.
– Start the engine and allow to run at 1500...2000 rpm for several seconds.



If the display of multimeter -V.A.G 1715- shows „not OK“:

– As a trial and error measure, replace the voltage regulator - C1- ⇒ Seite 280, Removing and installing voltage regulator -C1-.
– Repeat test procedure.

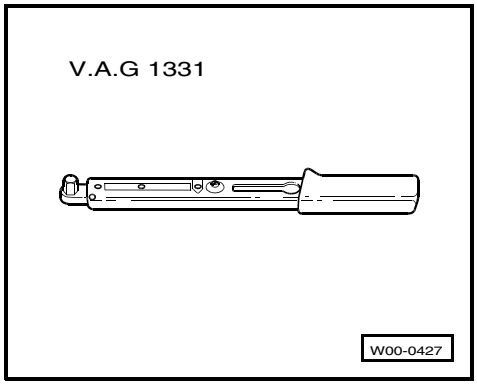
If the display of multimeter -V.A.G 1715 - shows „not OK“ again:

– Renew the alternator -C- ⇒ Seite 278, Removing and installing alternator -C-

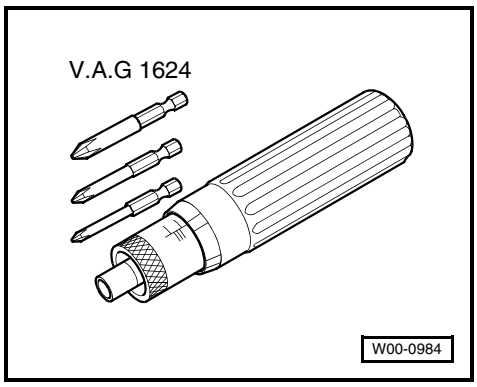
2.4 Removing and installing alternator -C-

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Torque wrench (5...50 Nm) -V.A.G 1331-



- Torque screwdriver (1...5 Nm) -V.A.G 1624-



Removing ⇒ Seite 278.

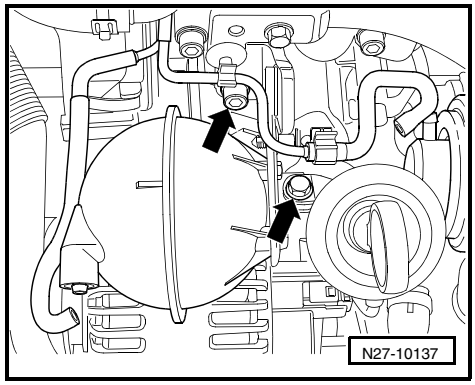
Installing ⇒ Seite 279.

2.4.1 Removing

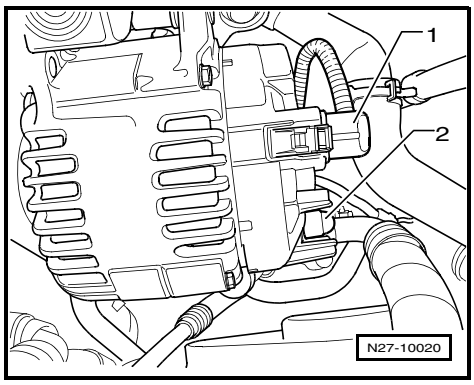
Hinweis

The following work procedure contains just general notes on removal and installation of the alternator. This is because no universal work procedure can be prescribed due to the different installation conditions.

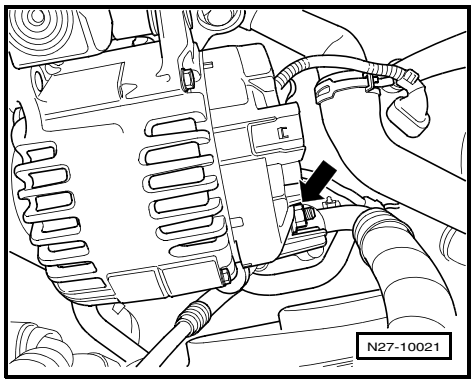
- Note safety precautions before beginning work ⇒ Seite 195
- Observe rules for cleanliness ⇒ Seite 196
- Remove poly V-belt ⇒ Seite 86.
- With ignition switched off, disconnect battery.
- Remove securing bolts -arrows-.



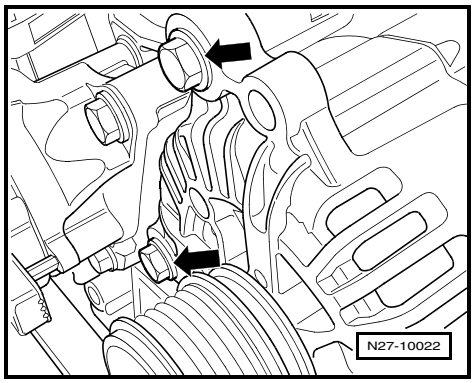
– Separate the connection of the DF wire -1- and pull off the protective cap -2-.



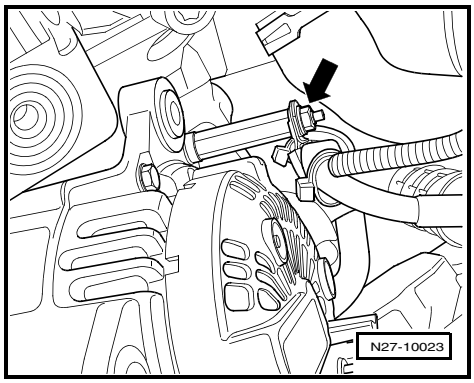
– Unscrew the „B1 + wire“ -arrow- from the alternator.
– If necessary, pull out fuel filter from bracket and place to one side. When doing this, the fuel hoses can remain connected ⇒ Seite 162, Assembly overview - fuel filter.



– Unscrew securing bolts of alternator -arrows-.



– Unbolt cable holder -arrow- from alternator.
– Remove alternator.

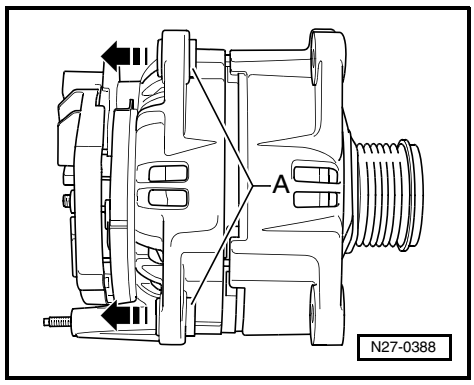


2.4.2 Installing

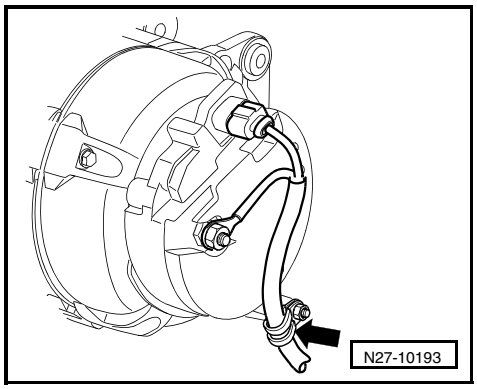
Installation is carried out in the reverse sequence of removal. In the process, note the following:

– To avoid damage to the cylinder block and the compact bracket, it is essential that the tightening sequence and the torque setting of the compact bracket are adhered to ⇒ Seite 276.

– Drive out the threaded bushes -A- about 4 mm in -direction of arrow- from the housing of the alternator.
– Tighten the „B1 + wire“ -arrow- from the alternator ⇒ Abb. auf Seite 276.



– Tighten the cable holder -arrow- on the reverse of the alternator in the 9 o'clock position to 3 Nm.
– Tighten the threaded connections to the torque settings given in the assembly overview ⇒ Seite 275.
– With ignition switched off, connect battery.
– Install poly V-belt ⇒ Seite 86.



2.5 Removing and installing voltage regulator -C1-

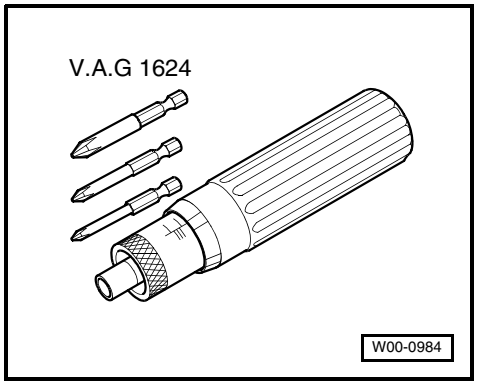
Removing and installing voltage regulator -C1-:

- Manufacturer Bosch ⇒ Seite 280
- Manufacturer Valeo ⇒ Seite 282

2.5.1 Removing and installing voltage regulator -C1- (Bosch)

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Torque screwdriver (1...5 Nm) -V.A.G 1624-



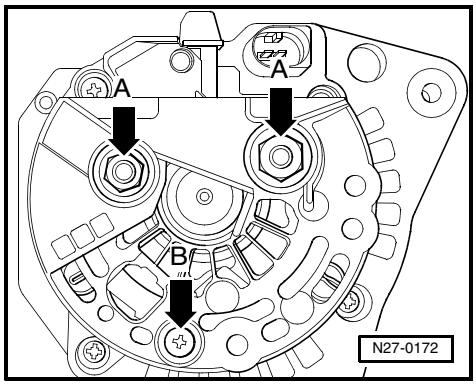
Removing ⇒ Seite 280.

Installing ⇒ Seite 281.

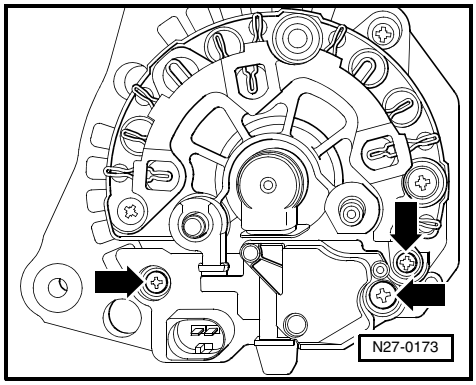
Removing

– Removing alternator -C- ⇒ Seite 278.

– Unscrew securing nuts -arrows A- and securing bolt -arrow B- of protective cap and remove protective cap.



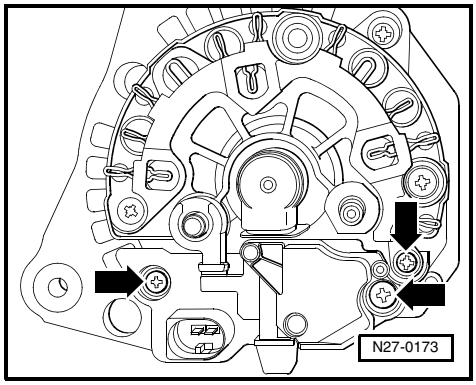
– Unscrew securing bolts -arrows- of voltage regulator and remove voltage regulator.



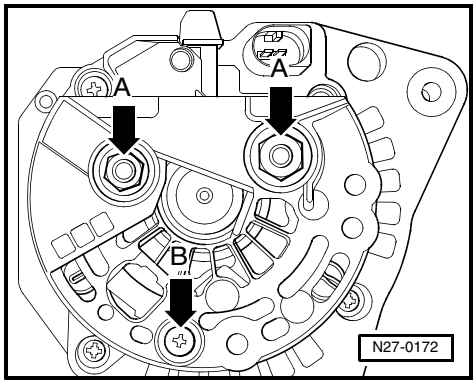
Installing

Installation is carried out in the reverse sequence of removal. In the process, note the following:

– Tighten the securing bolts -arrows- of the voltage regulator on the alternator to 2 Nm.



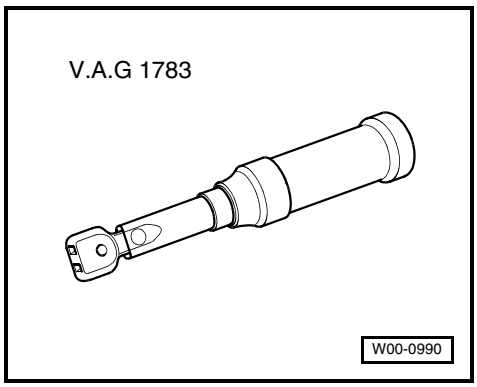
– Install protective cap and tighten securing nuts -arrow A- and securing bolt -arrow B- to 25 Nm.
– Install the alternator -C- ⇒ Seite 278.



2.5.2 Removing and installing voltage regulator -C1- (Valeo)

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Torque wrench (2...10 Nm) -V.A.G 1783-



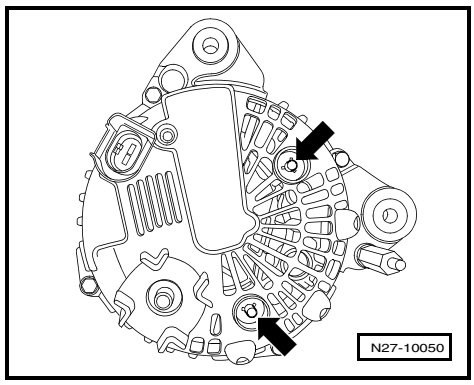
Removing ⇒ Seite 282.

Installing ⇒ Seite 282.

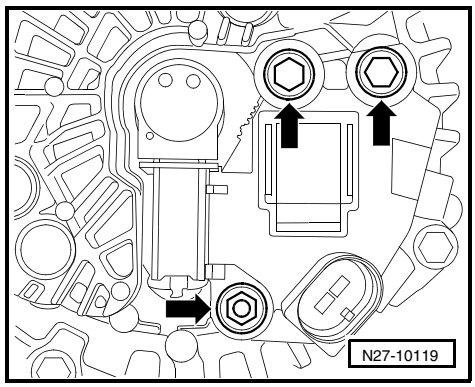
Removing

– Removing alternator -C- ⇒ Seite 278.

– Remove the clamp rings -arrows- and take the protective cap off the alternator.



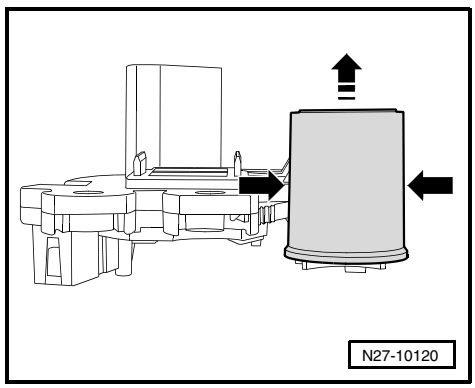
– Unscrew securing bolts and securing nuts -arrows- of voltage regulator and remove voltage regulator.



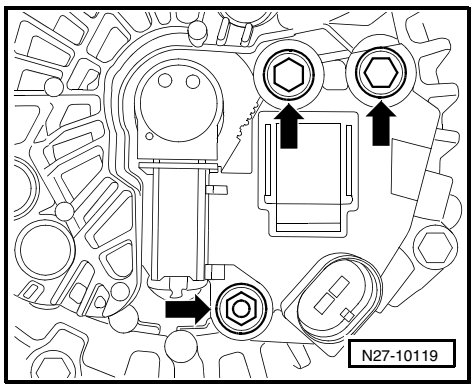
Installing

Installation is carried out in the reverse sequence of removal. In the process, note the following:

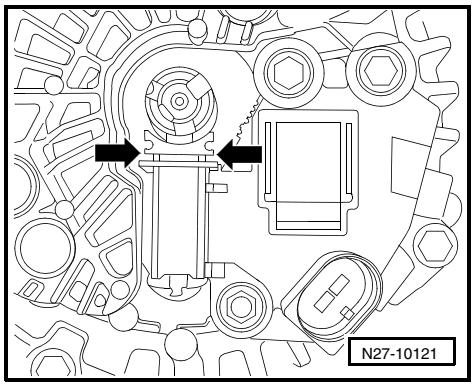
– Release locking lugs -arrows- and pull off protective cap from voltage regulator.
– Push carbon brushes in the housing of the voltage regulator and insert the voltage regulator in the alternator.



– Tighten the securing bolts and securing nut -arrows- of the voltage regulator on the alternator to 2 Nm.



– Slide the protective cap in the guide rails -arrows- until they can be heard to engage.
– Install the alternator -C- ⇒ Seite 278.



2.6 Removing and installing poly-V-belt pulley

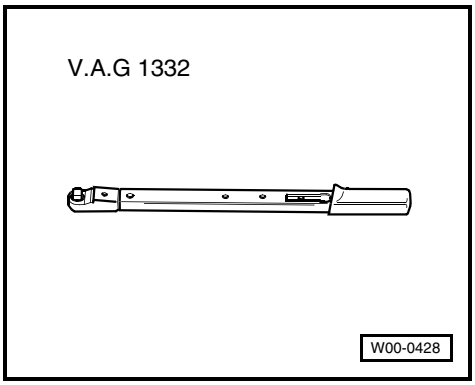
Removing and installing poly-V-belt pulley:

- Without freewheel ⇒ Seite 283.
- With freewheel (Bosch) ⇒ Seite 284.
- With freewheel (Valeo) ⇒ Seite 286.

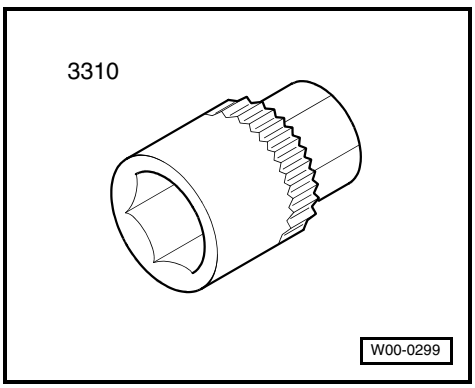
2.6.1 Removing and installing poly-V-belt pulley without freewheel

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Torque wrench (40...200 Nm) -V.A.G 1332-



- special wrench, long reach -3310-



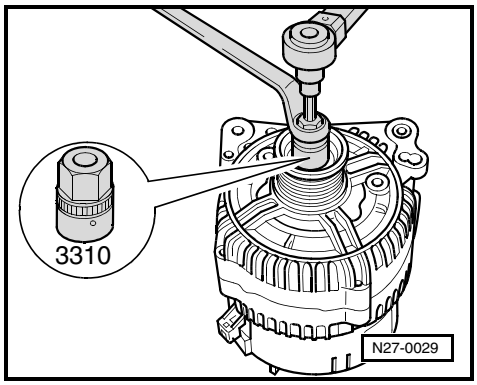
Removing ⇒ Seite 283.

Installing ⇒ Seite 284.

Removing

– Removing alternator -C- ⇒ Seite 278.
– Clamp the alternator at the securing points in the vice.

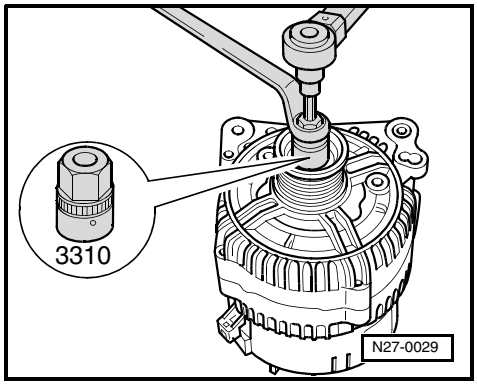
– Use special tool -VAS 3310- to unscrew the securing nut of the poly-V-belt pulley from the alternator shaft.



Installing

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

– Tighten the securing nut of the poly-V-belt pulley on the alternator shaft to 65 Nm.

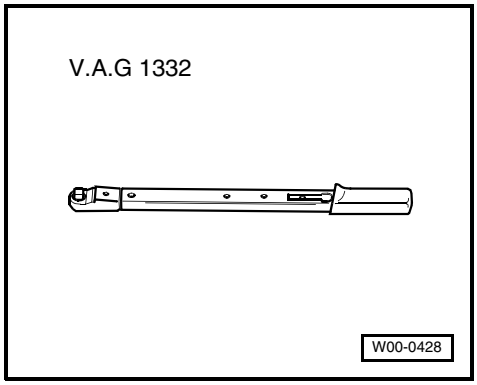


– Install the alternator -C- ⇒ Seite 278.

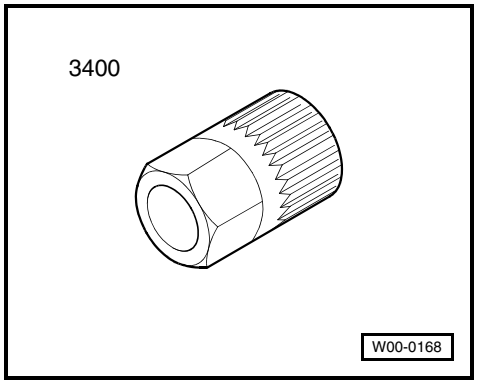
2.6.2 Removing and installing poly-V-belt pulley with freewheel (Bosch)

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Torque wrench (40...200 Nm) -V.A.G 1332-



♦ Multipoint adapter -3400-



Removing ⇒ Seite 284.

Installing ⇒ Seite 285.

Removing

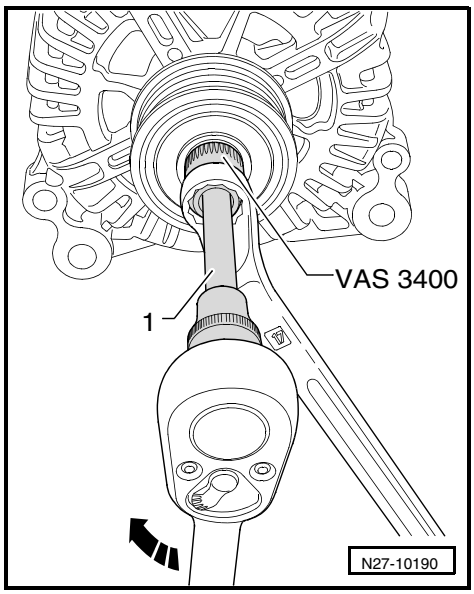
– Removing alternator -C- ⇒ Seite 278.

– Clamp the alternator at the securing points in the vice.

– Remove the protective cap from the poly-V-belt pulley with freewheel.

– Insert multipoint adapter -3400- with ring spanner (AF 17) in the poly-V-belt pulley with freewheel of the alternator.

– Insert the multipoint socket M10 -1- in the alternator shaft.
– Loosen the threaded connection by turning clockwise while counterholding with the ring spanner.
– Hold the poly-V-belt pulley with freewheel by hand and turn the drive shaft of the alternator until the poly-V-belt pulley with freewheel can be removed.



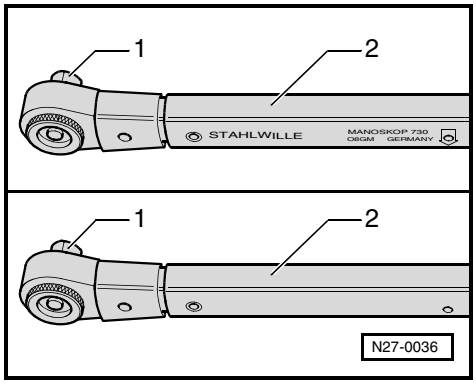
Installing

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

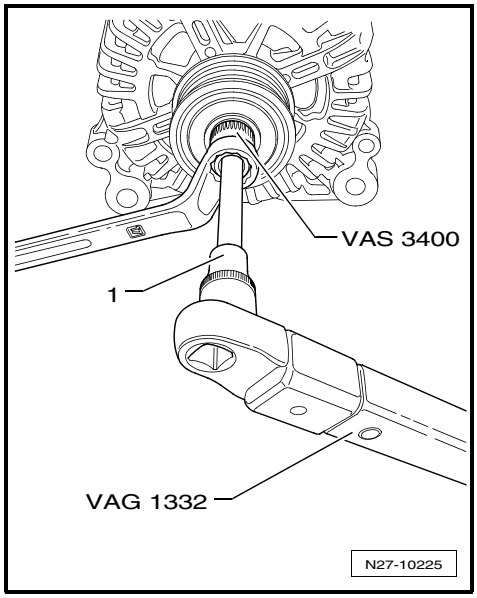
– Screw the poly-V-belt pulley with freewheel by hand first on the drive shaft of the alternator onto stop.

The torque wrench must be converted for assembly of the poly-V-belt pulley with freewheel as follows:

– Disengage the insert -1- and pull it off the handle -2-.
– Turn the handle -2- of the torque wrench by 180° and replace the insert.
– Set the direction of rotation of the torque wrench on the insert to anti-clockwise.



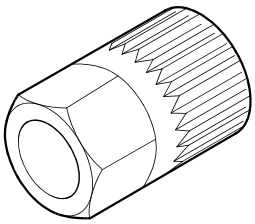
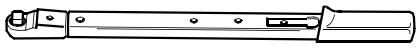
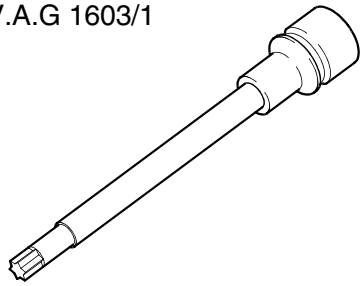
– Insert the multipoint socket M10 -1- in the alternator shaft.
– Counterhold the multipoint adapter -3400- using the ring spanner (AF 17).
– Tighten the poly-V-belt pulley with freewheel by turning the drive shaft of the alternator anti-clockwise using the torque wrench -V.A.G 1332-.
– Tighten the threaded connection of the poly-V-belt pulley on the alternator shaft to 80 Nm.
– Install the alternator -C- ⇒ Seite 278.



2.6.3 Removing and installing poly-V-belt pulley with freewheel (Valeo)

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Multipoint adapter -3400-
- Torque wrench (40...200 Nm) -V.A.G 1332-
- TORX screw bit -V.A.G 1603/1-

3400 	V.A.G 1332 
V.A.G 1603/1 	
	W27-10006

Removing ⇒ Seite 286.

Installing ⇒ Seite 287.

Removing

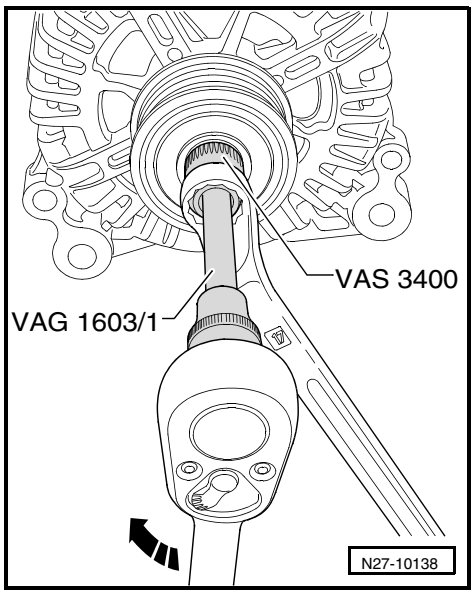
– Removing alternator -C- ⇒ Seite 278.

– Clamp the alternator at the securing points in the vice.

– Remove the protective cap from the poly-V-belt pulley with freewheel.

– Insert multipoint adapter -3400- with ring spanner (AF 17) in the poly-V-belt pulley with freewheel of the alternator.

– Insert TORX screw bit - V.A.G 1603/1- into the alternator shaft.
– Loosen the threaded connection by turning clockwise while counterholding with the ring spanner.
– Hold the poly-V-belt pulley with freewheel by hand and turn the drive shaft of the alternator until the poly-V-belt pulley with freewheel can be removed.



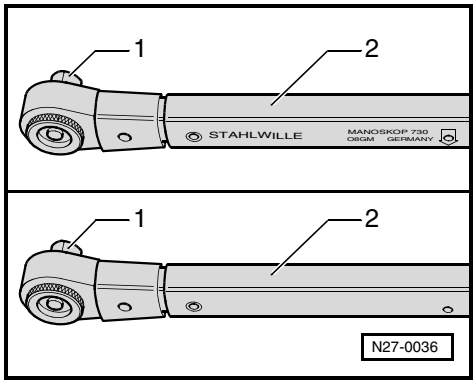
Installing

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

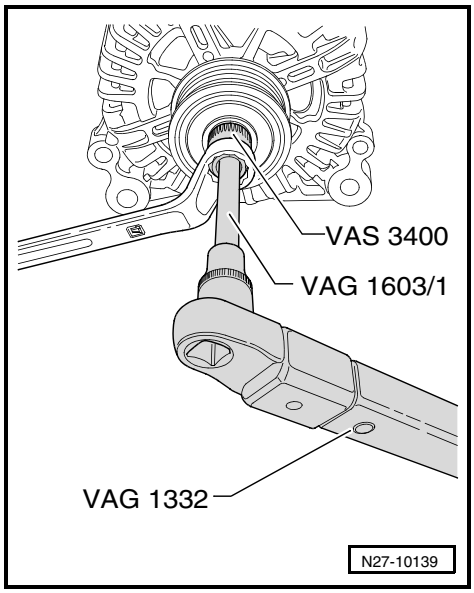
– Screw the poly-V-belt pulley with freewheel by hand first on the drive shaft of the alternator onto stop.

The torque wrench must be converted for assembly of the poly-V-belt pulley with freewheel as follows:

– Disengage the insert -1- and pull it off the handle -2-.
– Turn the handle -2- of the torque wrench by 180° and replace the insert.
– Set the direction of rotation of the torque wrench on the insert to anti-clockwise.



– Insert TORX screw bit - V.A.G 1603/1- into the alternator shaft.
– Counterhold the multipoint adapter -3400- using the ring spanner (AF 17).
– Tighten the poly-V-belt pulley with freewheel by turning the drive shaft of the alternator anti-clockwise using the torque wrench -V.A.G 1332-.
– Tighten the threaded connection of the poly-V-belt pulley on the alternator shaft to 80 Nm.
– Install the alternator -C- ⇒ Seite 278.



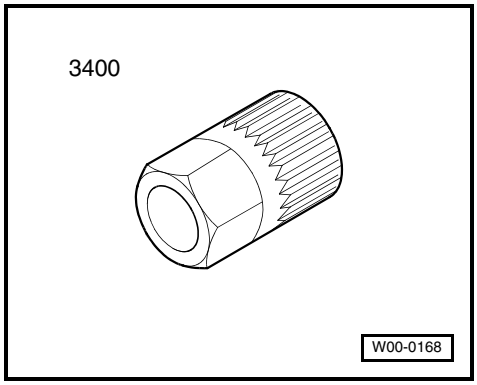
2.7 Checking function of freewheel coupling

Hinweis

On alternators 05.99 ➢ the poly-V-belt pulley with freewheel is the same on all alternators (different manufacturers).

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

♦ Multipoint adapter -3400-



Test prerequisite

• Poly-V-belt tension and alternator attachment OK

Test procedure

– Remove the protective cap from the poly-V-belt pulley with freewheel.

– Insert multipoint adapter -3400- in the poly-V-belt pulley with freewheel of the alternator.

– Turn the drive shaft of the alternator with the poly-V-belt pulley using a ring spanner (AF 17) anti-clockwise on multipoint adapter -3400-.

If only the drive shaft can be turned in the poly-V-belt pulley and the surface of the V-belt stays in position:

– Renew the poly-V-belt pulley with freewheel ⇒ Seite 283, Removing and installing poly-V-belt pulley.

If the surface of the poly-V-belt pulley turns together with the drive shaft in the poly-V-belt:

– Unclip protective cap on poly-V-belt pulley with freewheel.

– Check the alternator -C- and voltage regulator -C1- ⇒ Seite 277.

3 Current flow diagrams

Hinweis

♦ *Due to the different installation conditions of industrial engines, the following current flow diagrams contain just example circuitry.*

♦ *Cross section details are minimum sizes. Greater cross sections depend on the equipment and are to be observed in the event of repair.*

ACHTUNG!

Before working on the electrical system, disconnect battery earth strap.

Observe safety precautions ⇒ Seite 195

Observe rules for cleanliness ⇒ Seite 196

Current flow diagrams:

♦ Engine codes CBHA, CBJA, CBJB ⇒ Seite 289.

♦ Engine code CBKA ⇒ Seite 303.

3.1 Current flow diagrams: Engine codes CBHA, CBJA, CBJB

Battery, starter, alternator, voltage regulator, ignition/starter switch ⇒ Seite 290.

Fuel presupply pump, fuel pump relay, automatic glow period control unit, glow plugs ⇒ Seite 291.

term. 30 voltage supply relay, engine control unit ⇒ Seite 292.

Coding bridges, engine control unit ⇒ Seite 293.

Charge pressure sender, intake air temperature sender, coolant temperature sender, fuel temperature sender, engine control unit ⇒ Seite 294.

Engine speed sender, Hall sender, engine control unit ⇒ Seite 295.

Accelerator pedal position sender, unit injector valves, engine control unit ⇒ Seite 296.

Air mass meter, heater resistor for crankcase breather, engine control unit ⇒ Seite 297.

Exhaust gas recirculation valve, charge pressure control solenoid, intake manifold flap changeover valve ⇒ Seite 298.

Brake light switch, brake pedal switch, working speed governor switch, brake light warning lamp, engine control unit ⇒ Seite 299.

Button to resume governed working speed, switch for working speed governor, button for working speed governor, alternator warning lamp, engine control unit ⇒ Seite 300.

Switch for fixed speed 1...3, warning lamps, engine control unit ⇒ Seite 301.

Coding bridges, oil pressure switch, oil pressure control delay relay, oil pressure warning lamp, engine control unit ⇒ Seite 302.

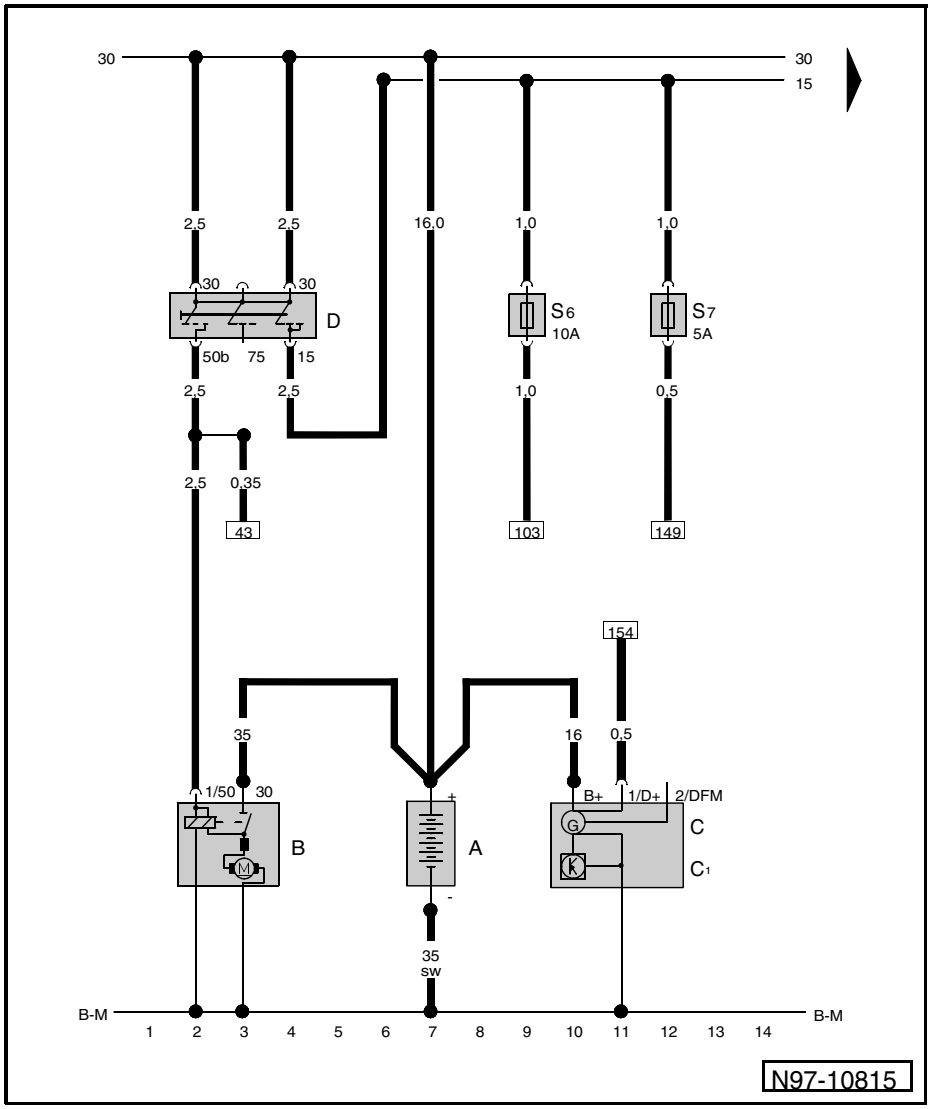
Diagnosis connection, engine control unit ⇒ Seite 303.

3.1.1 Battery, starter, alternator, voltage regulator, ignition/starter switch

A - Battery
B - Starter
C - Alternator
C1 - Voltage regulator
D - Ignition/starter switch
S6 - Circlip
- ❑ 10 A
- ❑ In fuse carrier

S7 - Circlip
- ❑ 5 A
- ❑ In fuse carrier

B-M - Battery earth/engine earth



3.1.2 Fuel presupply pump, fuel pump relay, automatic glow period control unit, glow plugs

G6- Fuel presupply pump
- ❑ * If installed

J17- Fuel pump relay

J179- Automatic glow period control unit

Q10- Glow plug 1

Q11- Glow plug 2

Q12- Glow plug 3

Q13- Glow plug 4

S1- Circlip
- ❑ 50 A
- ❑ In fuse carrier

S10- Circlip
- ❑ 15 A
- ❑ In fuse carrier
- ❑ * If installed

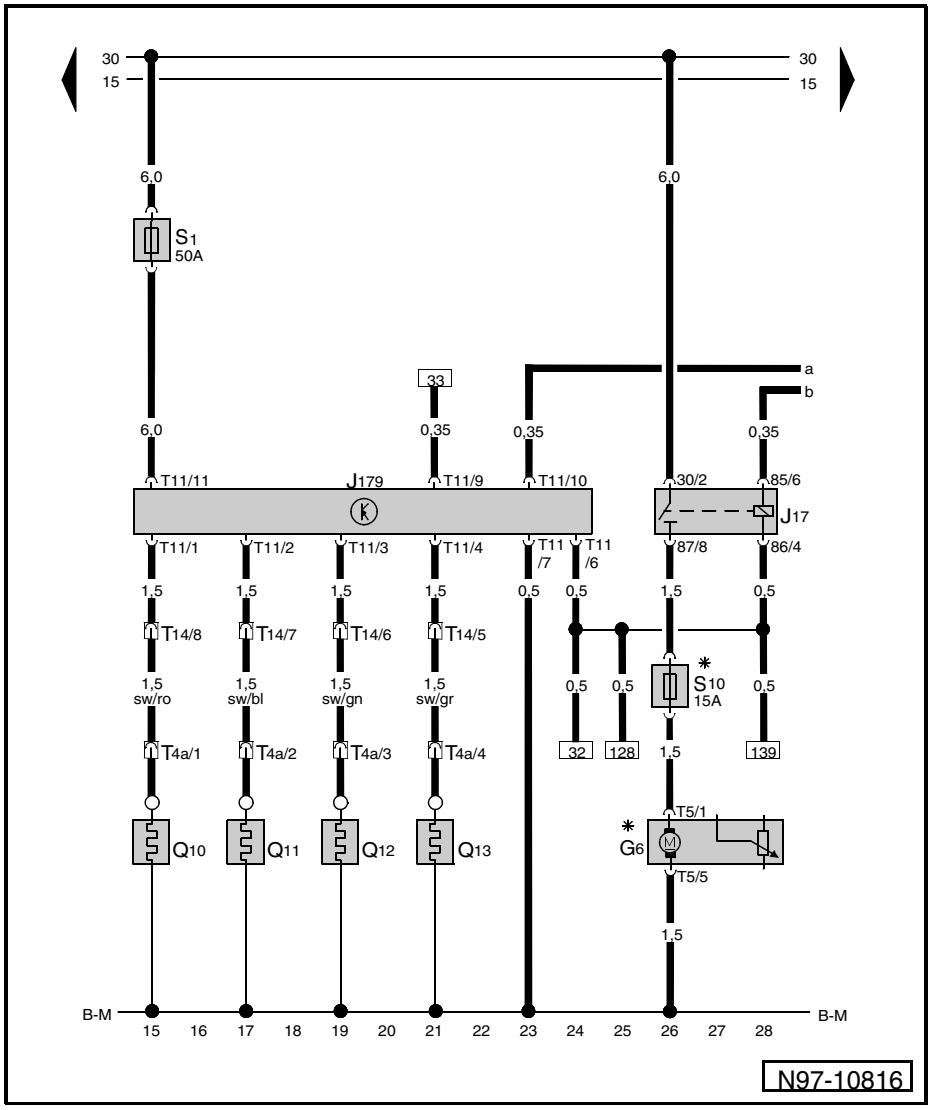
T4a- Connector, 4-pin

T5- Connector, 5-pin

T11- Connection, 11-pin

T14- Connection, 14-pin

B-M- Battery earth/engine earth



3.1.3 Term. 30 voltage supply relay, engine control unit

J317-Terminal 30 voltage supply relay

J623-Engine control unit

S2 - Circlip
- ❑ 30 A
- ❑ In fuse carrier

S3 - Circlip
- ❑ 5 A
- ❑ In fuse carrier

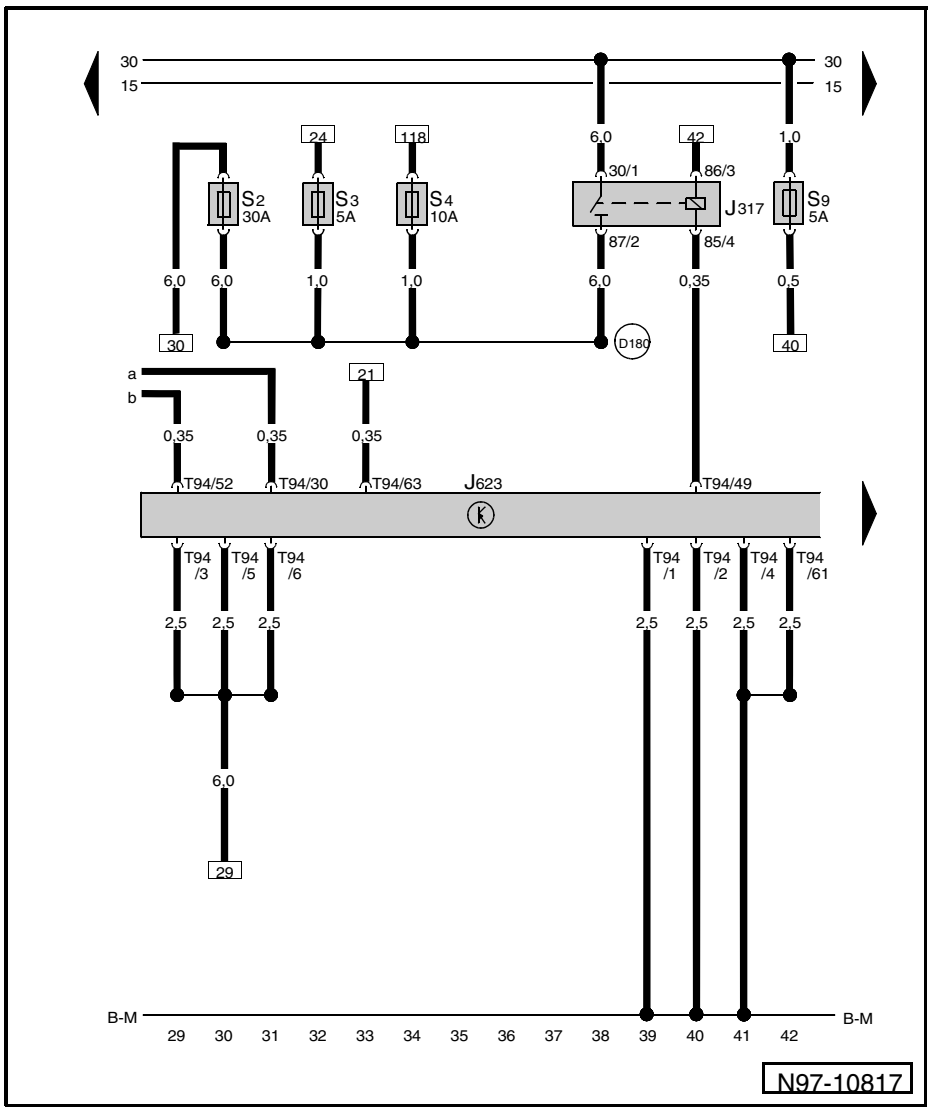
S4 - Circlip
- ❑ 10 A
- ❑ In fuse carrier

S9 - Circlip
- ❑ 5 A
- ❑ In fuse carrier

T94-Connection, 94-pin

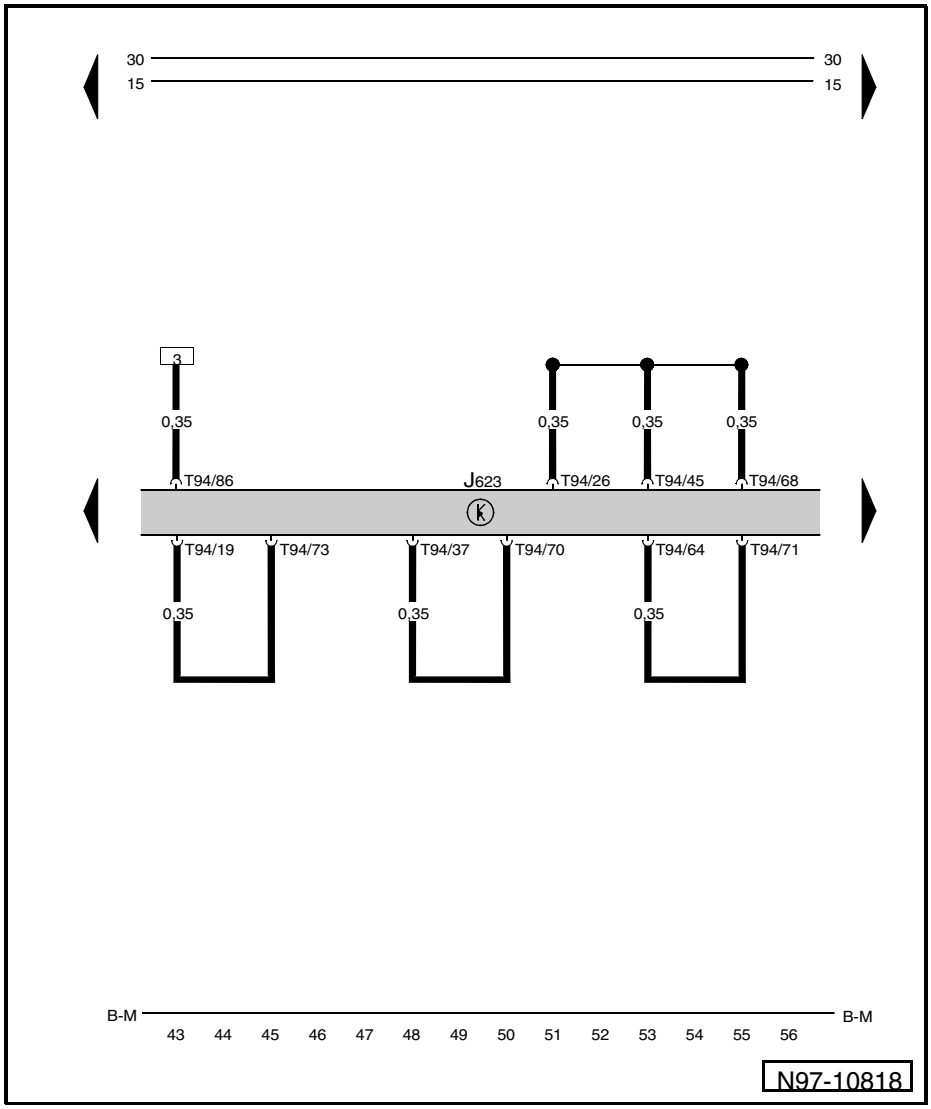
D180-Connection (87a) in engine bay wiring harness

B-M-Battery earth/engine earth



3.1.4 Coding bridges, engine control unit

J623-Engine control unit
T94-Connection, 94-pin
B-M-Battery earth/engine earth



3.1.5 Charge pressure sender, intake air temperature sender, coolant temperature sender, fuel temperature sender, engine control unit

G31-Charge pressure sender

G42-Intake air temperature sender

G62-Coolant temperature sender

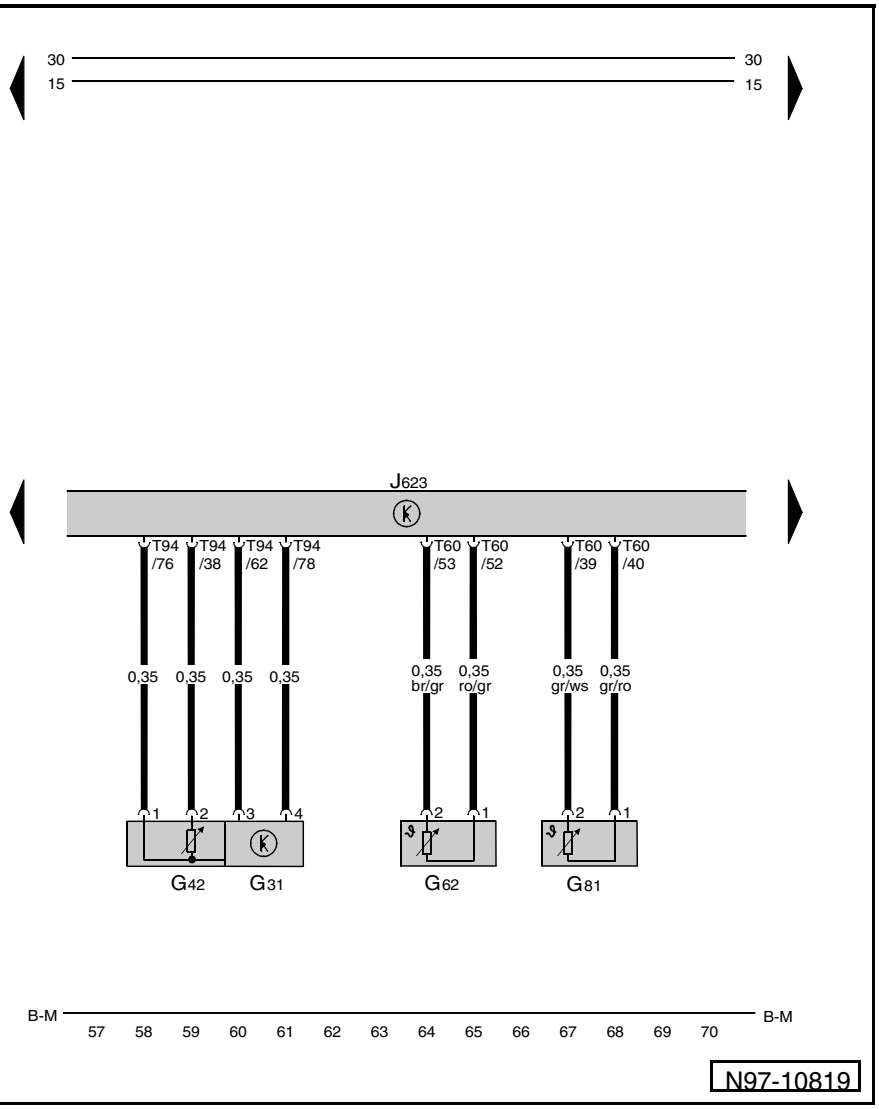
G81-Fuel temperature sender

J623-Engine control unit

T60-Connection, 60-pin

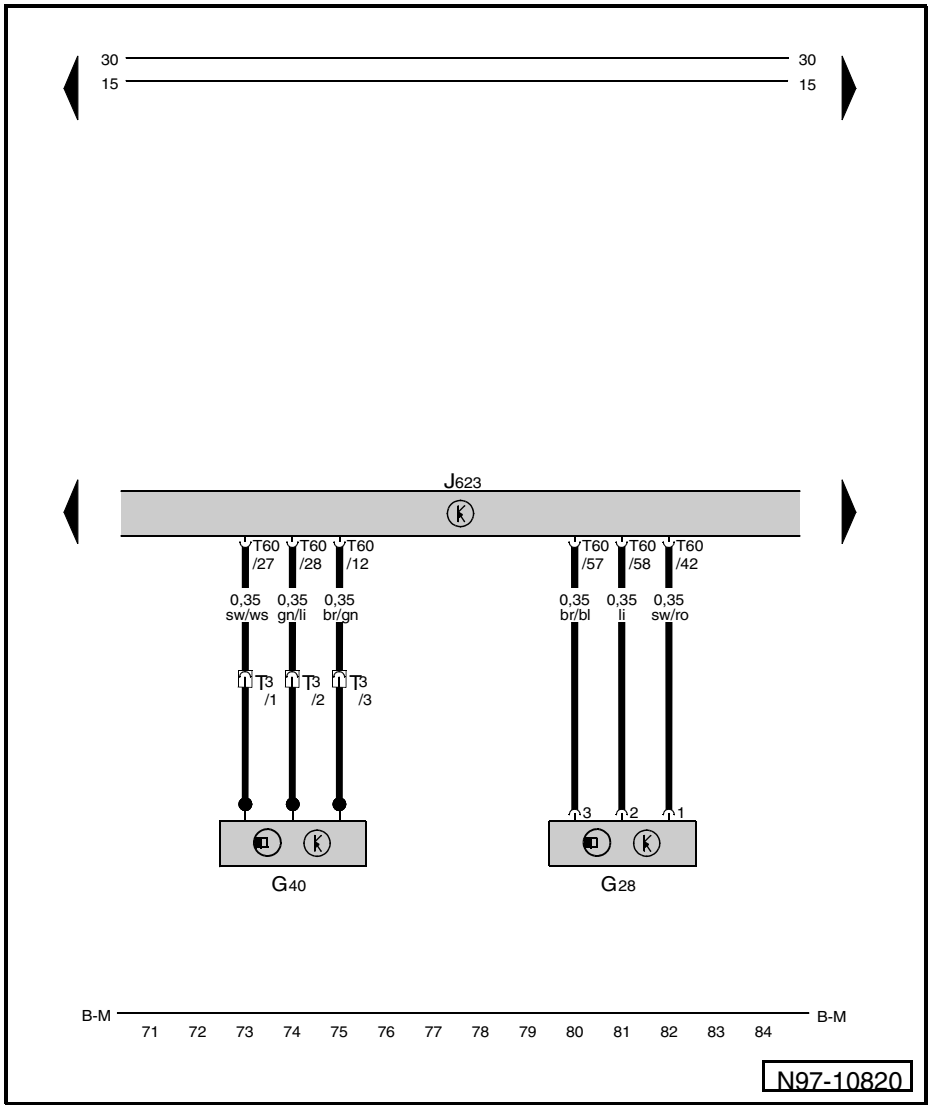
T94-Connection, 94-pin

B-M-Battery earth/engine earth



3.1.6 Engine speed sender, Hall sender, engine control unit

G28-Engine speed sender
G40-Hall sender -G40-
J623-Engine control unit
T3- Connection, 3-pin
T60-Connection, 60-pin
B-M-Battery earth/engine earth



3.1.7 Accelerator pedal position sender, unit injector valves, engine control unit

G79-Accelerator position sender

G185-Accelerator pedal position sender 2

J623-Engine control unit

N240-Unit injector valve, cylinder 1

N241-Unit injector valve, cylinder 2

N242-Unit injector valve, cylinder 3

N243-Unit injector valve, cylinder 4

T6a-Connection, 6-pin

T8 - Connection, 8-pin

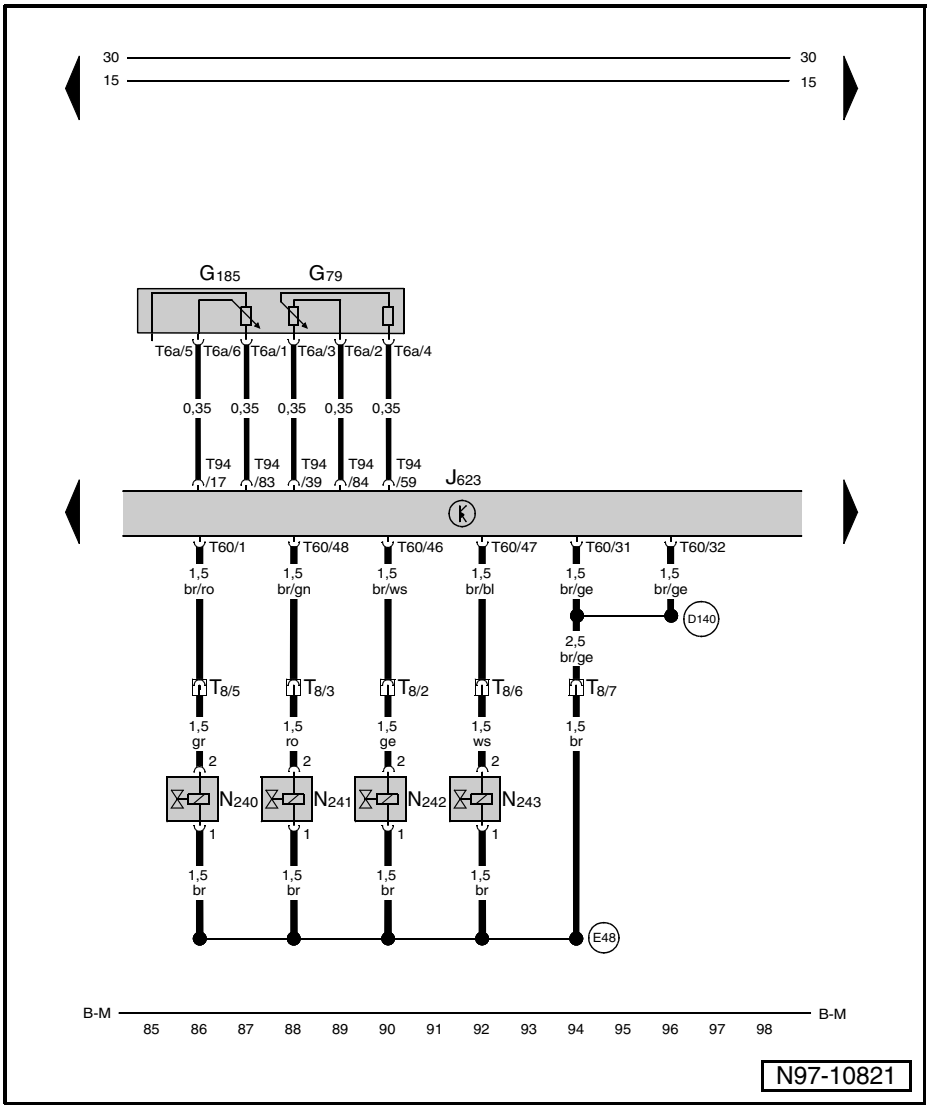
T60-Connection, 60-pin

T94-Connection, 94-pin

D140-Connection unit injector valves in engine supply wiring harness

E48-Connection unit injector valves in unit injector valve wiring harness

B-M-Battery earth/engine earth



3.1.8 Air mass meter, heater resistor for crankcase breather, engine control unit

G70-Air mass meter

J623-Engine control unit

N79-With heater element for crankcase breather

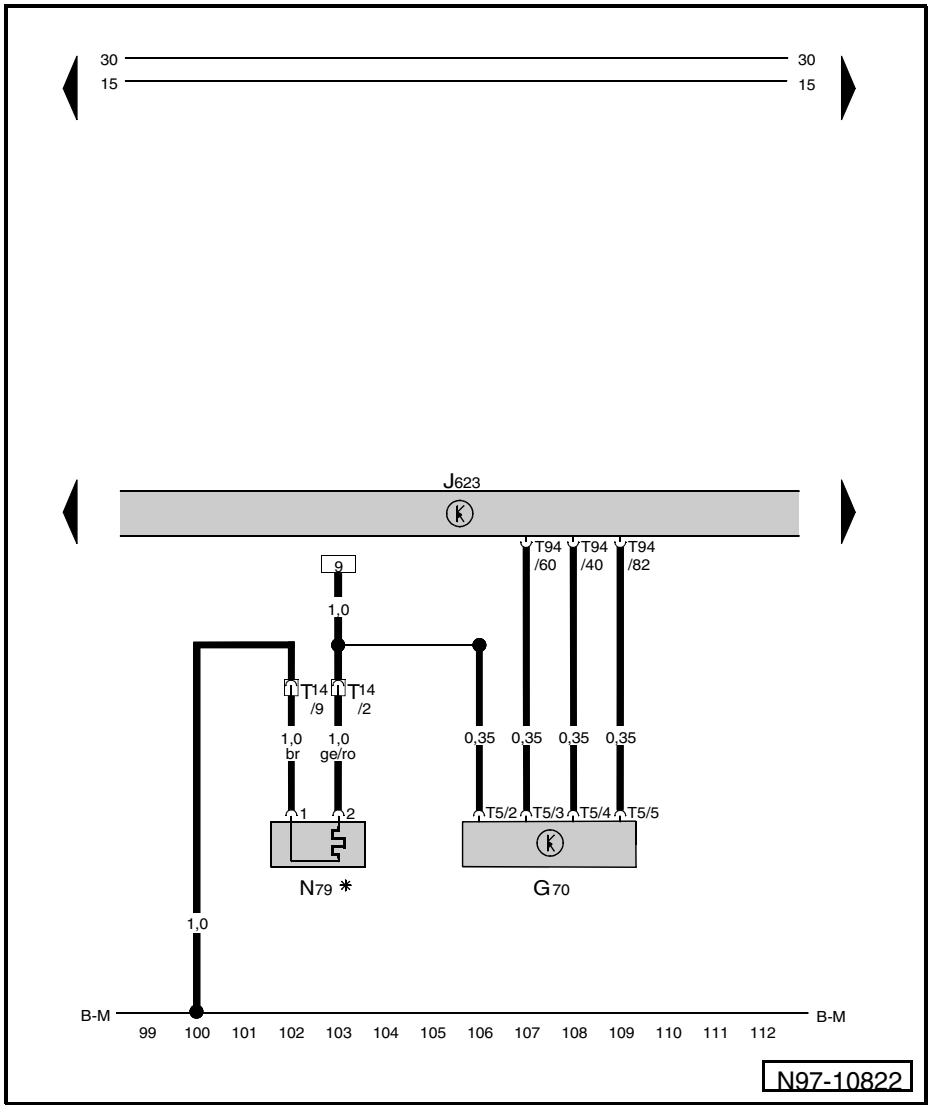
❑ * If installed

T5 - Connector, 5-pin

T14-Connection, 14-pin

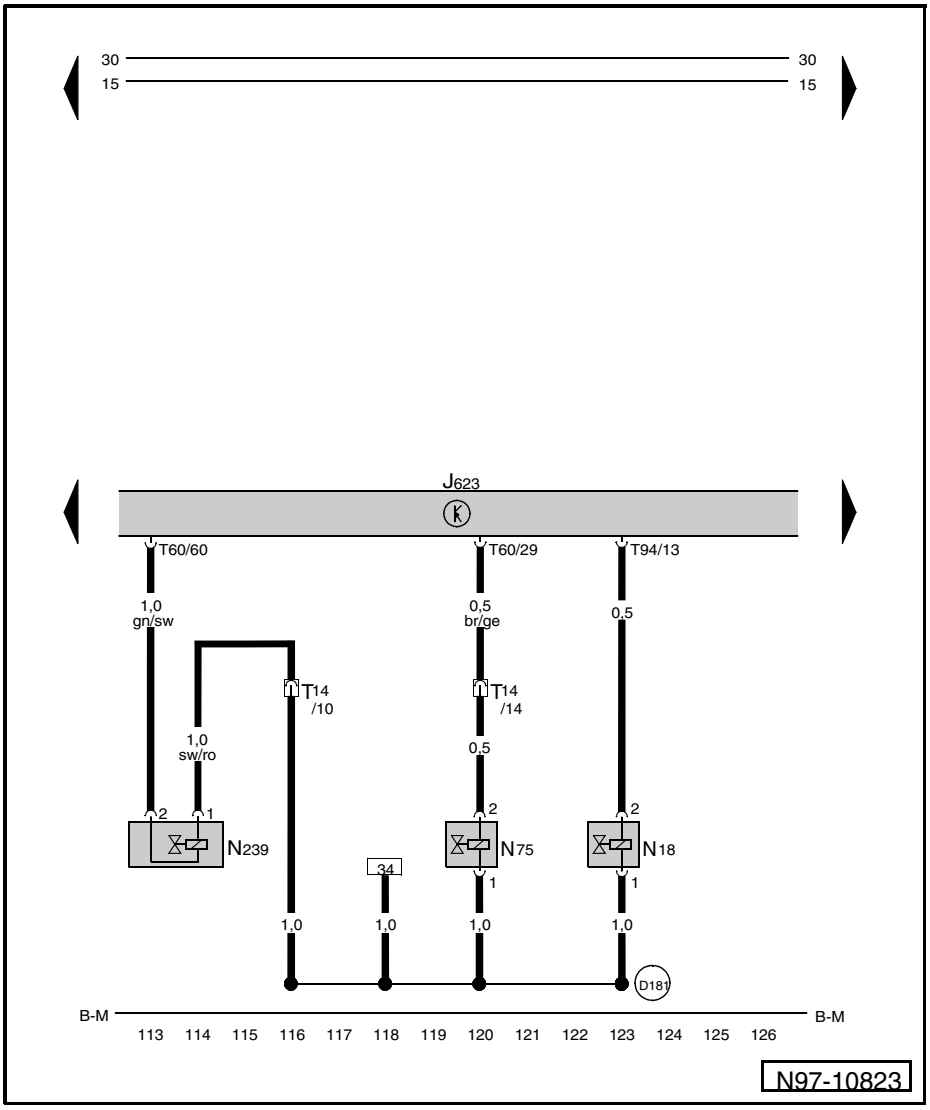
T94-Connection, 94-pin

B-M-Battery earth/engine earth



3.1.9 Exhaust gas recirculation valve, charge pressure control solenoid, intake manifold flap changeover valve

J623-Engine control unit
N18-Exhaust gas recirculation valve
N75-Charge pressure control solenoid valve
N239-Intake manifold flap changeover valve
T14-Connection, 14-pin
T60-Connection, 60-pin
T94-Connection, 94-pin
D181-Connection 2 (87a) in engine bay wiring harness
B-M-Battery earth/engine earth



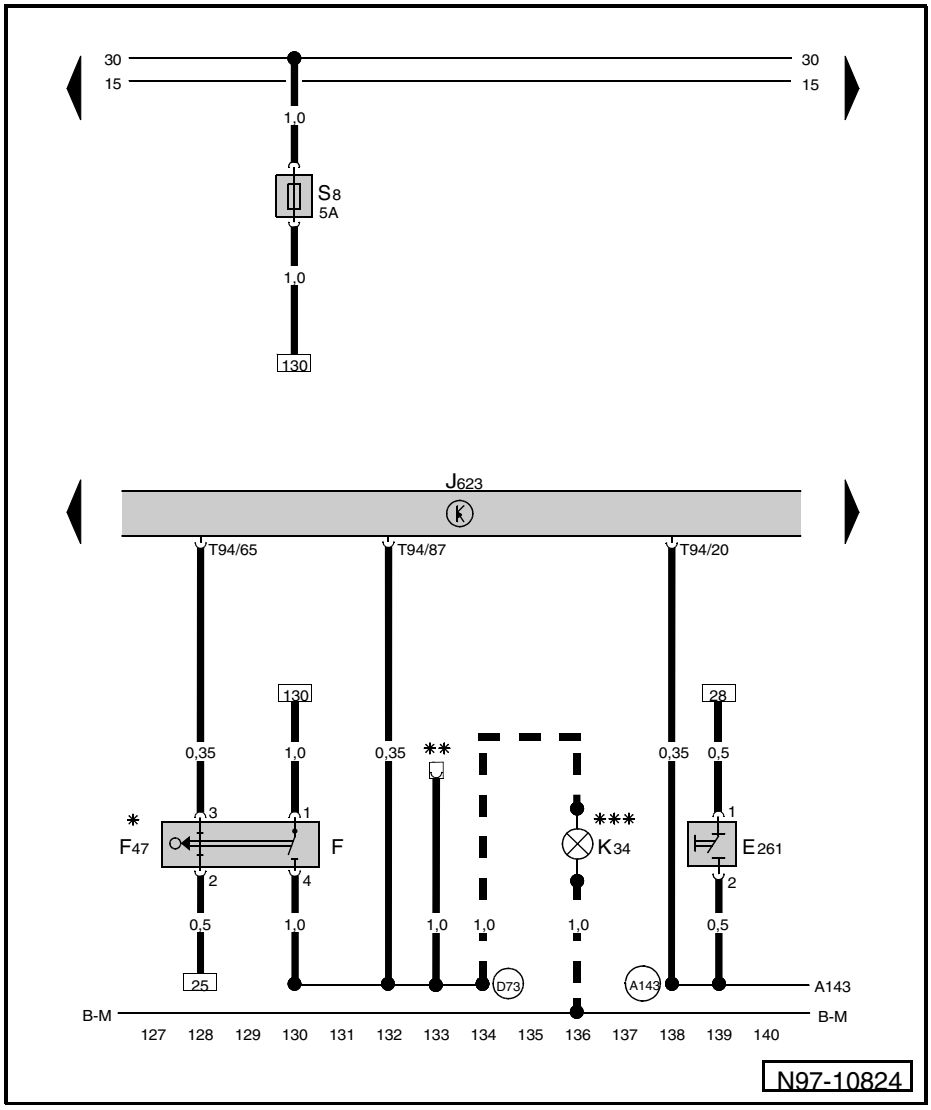
3.1.10 Brake light switch, brake pedal switch, working speed governor switch, brake light warning lamp, engine control unit

E261-Switch for working speed governor
F - Brake light switch
F47-Brake pedal switch
- ❑ * Safety switch

J623-Engine control unit
K34-Brake light warning lamp
- ❑ *** If installed

S8 - Circlip
- ❑ 5 A
- ❑ In fuse carrier

T94-Connection, 94-pin
A143-Connection (working speed governor) in dash panel wiring harness
D73-Positive connection (54) in engine bay wiring harness
**** - Brake light output, terminal 54**
B-M-Battery earth/engine earth



3.1.11 Button to resume governed working speed, switch for working speed governor, button for working speed governor, alternator warning lamp, engine control unit

E426-Button to resume governed working speed

E427-Switch for working speed governor

- ❑ Safety contact

E428-Button for working speed governor

- ❑ Tip down function

E429-Button for working speed governor

- ❑ Tip up function

J623-Engine control unit

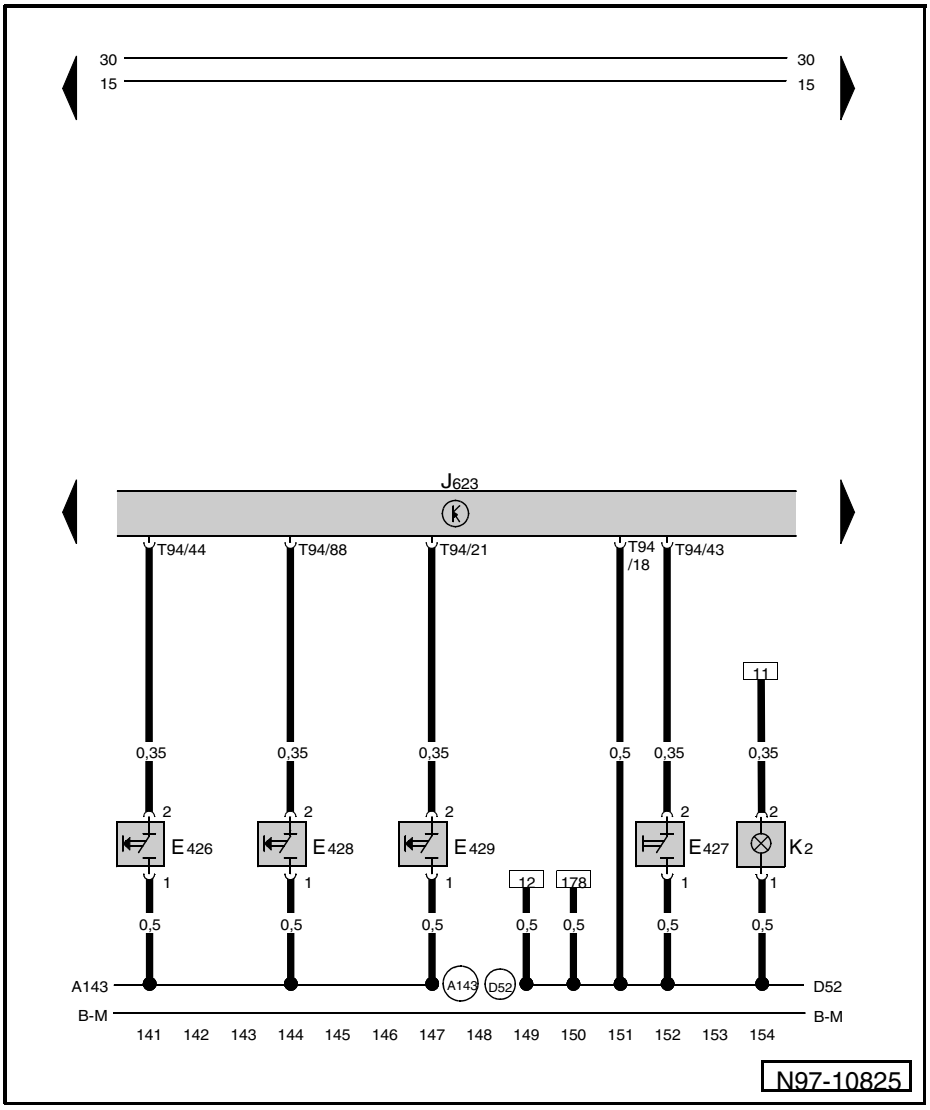
K2- Alternator warning lamp

T94-Connection, 94-pin

A143-Connection (working speed governor) in dash panel wiring harness

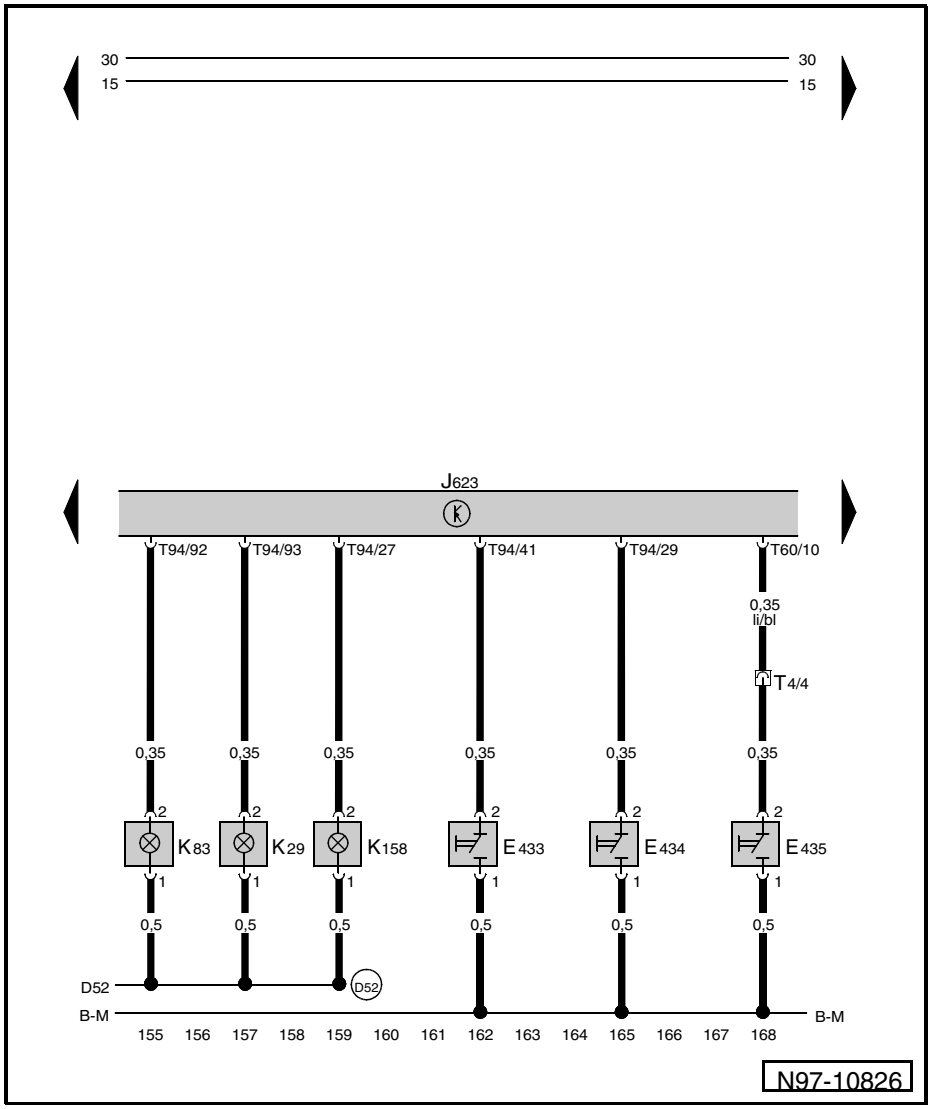
D52-Positive connection (15a) in engine bay wiring harness

B-M-Battery earth/engine earth



3.1.12 Switch for fixed speed 1...3, warning lamps, engine control unit

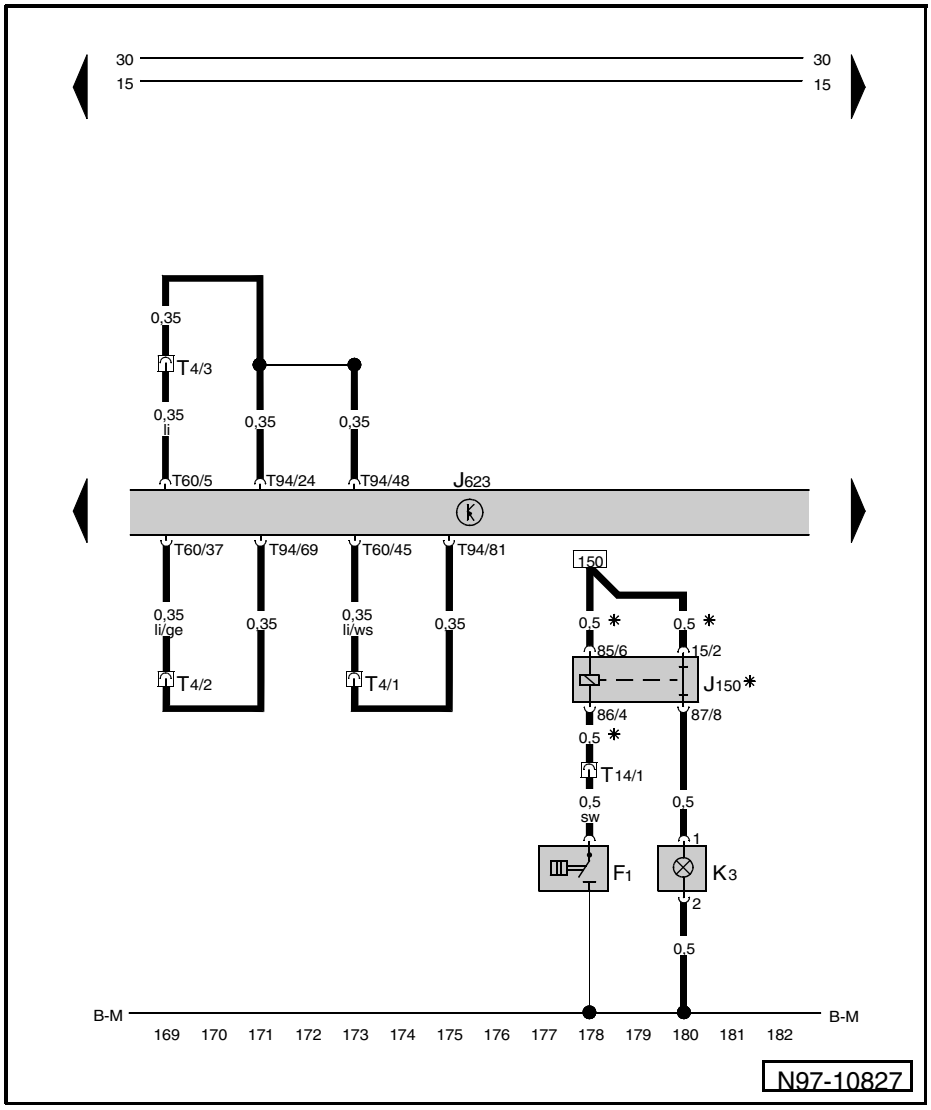
E433-Switch for fixed speed 1
E434-Switch for fixed speed 2
E435-Switch for fixed speed 3
J623-Engine control unit
K29-Glow period warning lamp
K83-Exhaust gas warning lamp
K158-Working speed governor warning lamp
T4 - Connector, 4-pin
T60-Connection, 60-pin
T94-Connection, 94-pin
D52-Positive connection (15a) in engine bay wiring harness
B-M-Battery earth/engine earth



3.1.13 Coding bridges, oil pressure switch, oil pressure control delay relay, oil pressure warning lamp, engine control unit

F1 - Oil pressure switch
J150-Oil pressure control delay relay
- ❑ * Customer specific

J623-Engine control unit
K3 - Oil pressure warning lamp
T4 - Connector, 4-pin
T14-Connection, 14-pin
T60-Connection, 60-pin
T94-Connection, 94-pin
*** - Customer specific**
B-M-Battery earth/engine earth



3.1.14 Diagnosis connection, engine control unit

J623-Engine control unit

S...- Circlip

- ❑ 5 A
- ❑ In fuse carrier

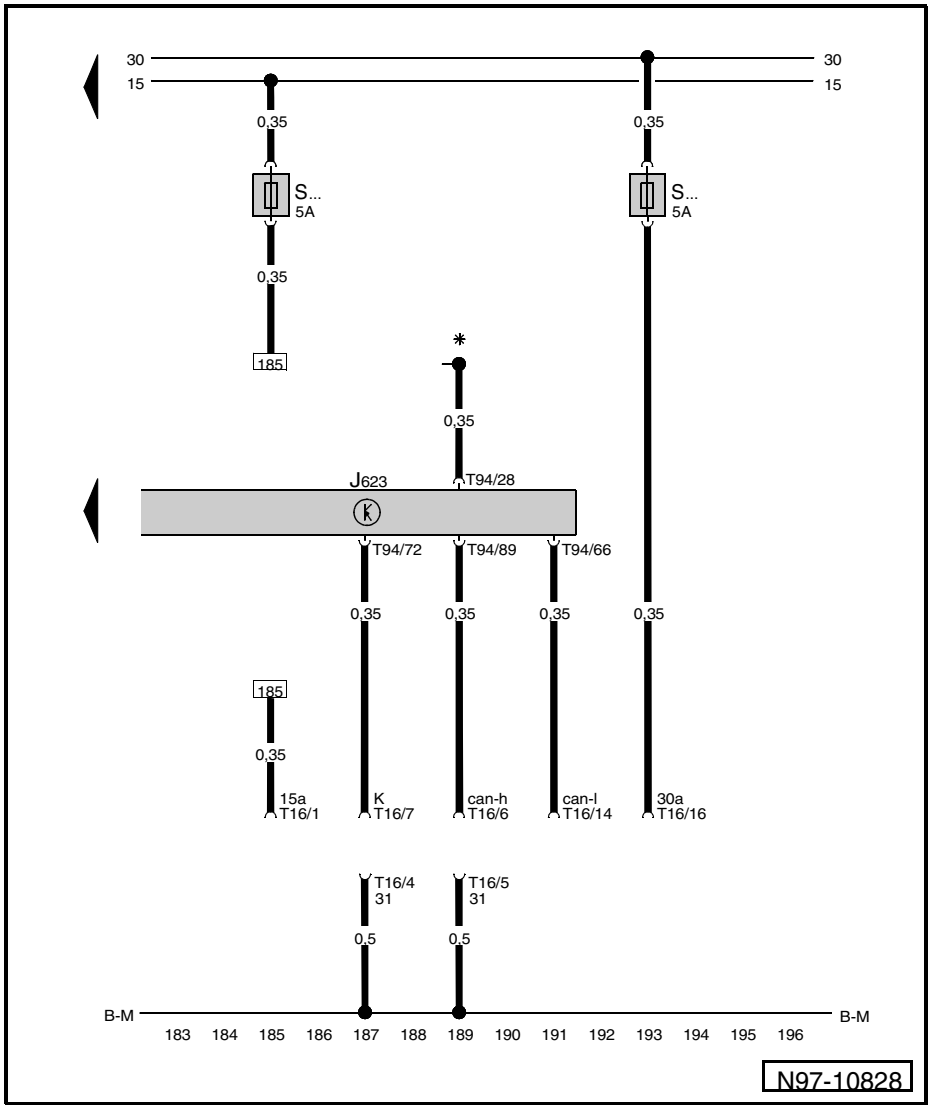
T16-Connection, 16-pin

- ❑ For diagnosis connection

T94-Connection, 94-pin

*** - Speed signal output**

B-M-Battery earth/engine earth



3.2 Current flow diagrams: engine code CBKA

Battery, starter, alternator, voltage regulator, ignition/starter switch ⇒ Seite 305.

Fuel presupply pump, fuel pump relay, automatic glow period control unit, glow plugs ⇒ Seite 306.

term. 30 voltage supply relay, engine control unit ⇒ Seite 307.

Coding bridges, engine control unit ⇒ Seite 308.

Charge pressure sender, intake air temperature sender, coolant temperature sender, fuel temperature sender, engine control unit ⇒ Seite 309.

Engine speed sender, Hall sender, engine control unit ⇒ Seite 310.

Accelerator pedal position sender, unit injector valves, engine control unit ⇒ Seite 311.

Air mass meter, intake manifold flap motor, intake manifold flap potentiometer, temperature sender after particulate filter, engine control unit ⇒ Seite 312.

Exhaust gas temperature sender 1, exhaust gas temperature sender 2, exhaust gas recirculation potentiometer, exhaust gas recirculation valve, engine control unit ⇒ Seite 313.

Lambda probe, lambda probe heater, exhaust gas pressure sensor 1, engine control unit ⇒ Seite 314.

Heater resistor for crankcase breather, exhaust gas recirculation cooler changeover valve, charge pressure control solenoid, metering pump, engine control unit ⇒ Seite 315.

Brake light switch, brake pedal switch, working speed governor switch, brake light warning lamp, engine control unit ⇒ Seite 316.

Button to resume governed working speed, switch for working speed governor, button for working speed governor, alternator warning lamp, engine control unit ⇒ Seite 317.

Switch for fixed speed 1...3, warning lamps, engine control unit ⇒ Seite 318.

Coding bridges, oil pressure switch, oil pressure control delay relay, oil pressure warning lamp, engine control unit ⇒ Seite 319.

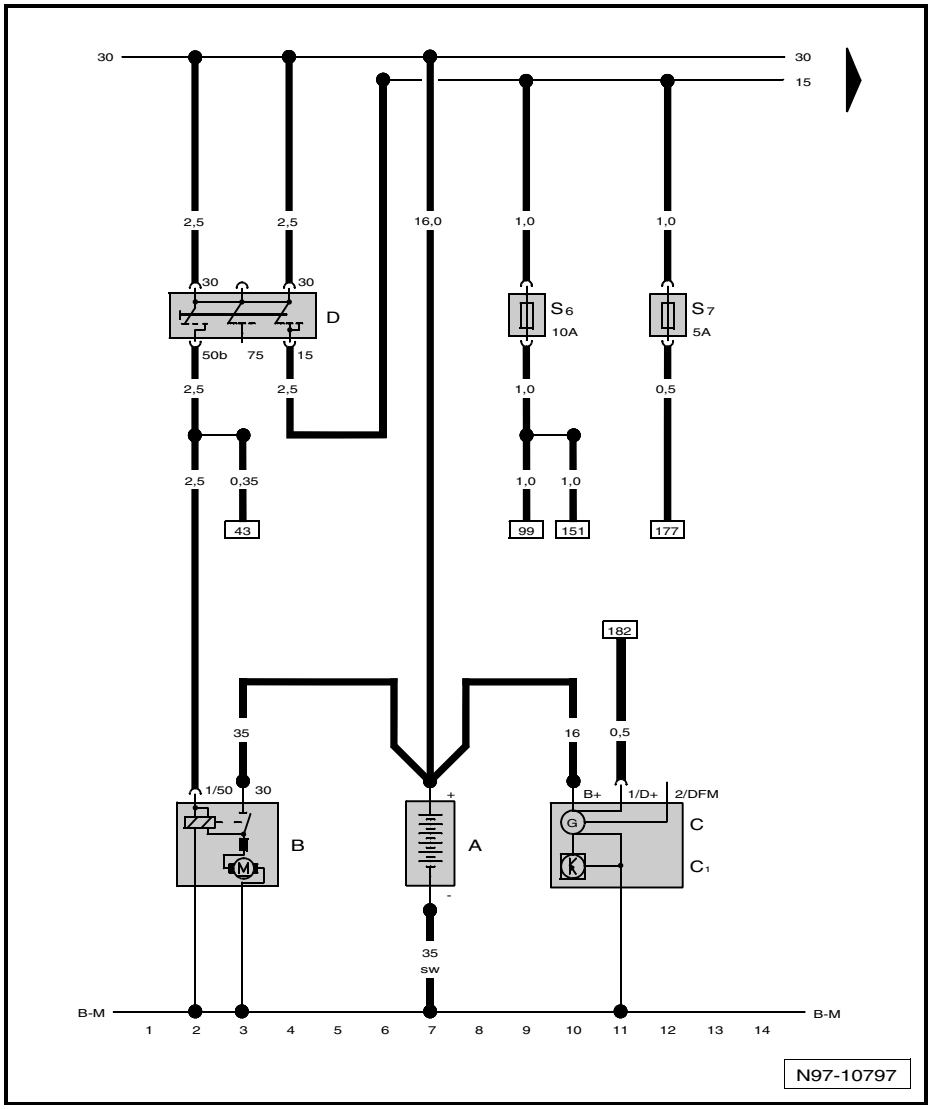
Diagnosis connection, engine control unit ⇒ Seite 320.

3.2.1 Battery, starter, alternator, voltage regulator, ignition/starter switch

A - Battery
B - Starter
C - Alternator
C1 - Voltage regulator
D - Ignition/starter switch
S6 - Circlip
- ❑ 10 A
- ❑ In fuse carrier

S7 - Circlip
- ❑ 5 A
- ❑ In fuse carrier

B-M - Battery earth/engine earth



3.2.2 Fuel presupply pump, fuel pump relay, automatic glow period control unit, glow plugs

G6 - Fuel presupply pump
- ❑ * If installed

J17 - Fuel pump relay

J179 - Automatic glow period control unit

Q10 - Glow plug 1

Q11 - Glow plug 2

Q12 - Glow plug 3

Q13 - Glow plug 4

S1 - Circlip
- ❑ 50 A
- ❑ In fuse carrier

S10 - Circlip
- ❑ 15 A
- ❑ In fuse carrier
- ❑ * If installed

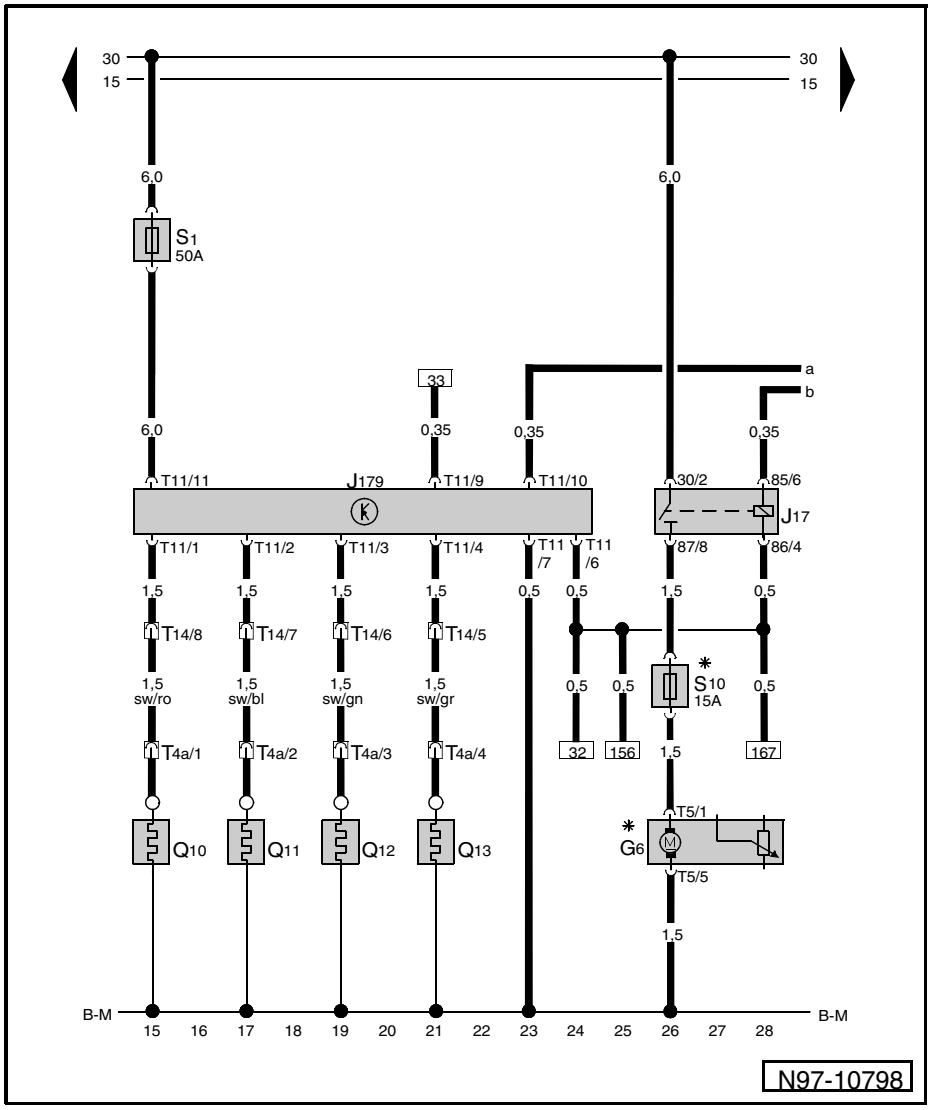
T4a - Connector, 4-pin

T5 - Connector, 5-pin

T11 - Connection, 11-pin

T14 - Connection, 14-pin

B-M - Battery earth/engine earth



3.2.3 Term. 30 voltage supply relay, engine control unit

J317-Terminal 30 voltage supply relay

J623-Engine control unit

S2 - Circlip
- ❑ 30 A
- ❑ In fuse carrier

S3 - Circlip
- ❑ 5 A
- ❑ In fuse carrier

S4 - Circlip
- ❑ 10 A
- ❑ In fuse carrier

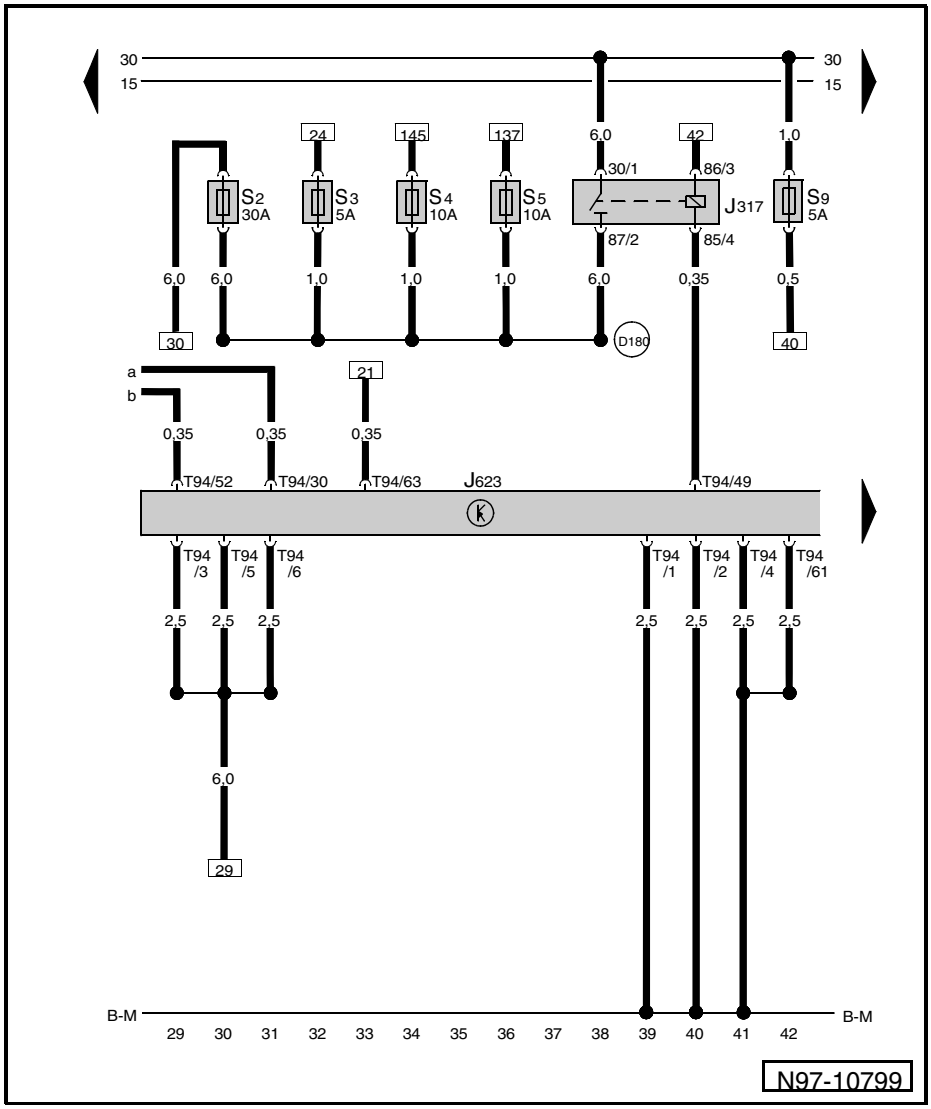
S5 - Circlip
- ❑ 10 A
- ❑ In fuse carrier

S9 - Circlip
- ❑ 5 A
- ❑ In fuse carrier

T94-Connection, 94-pin

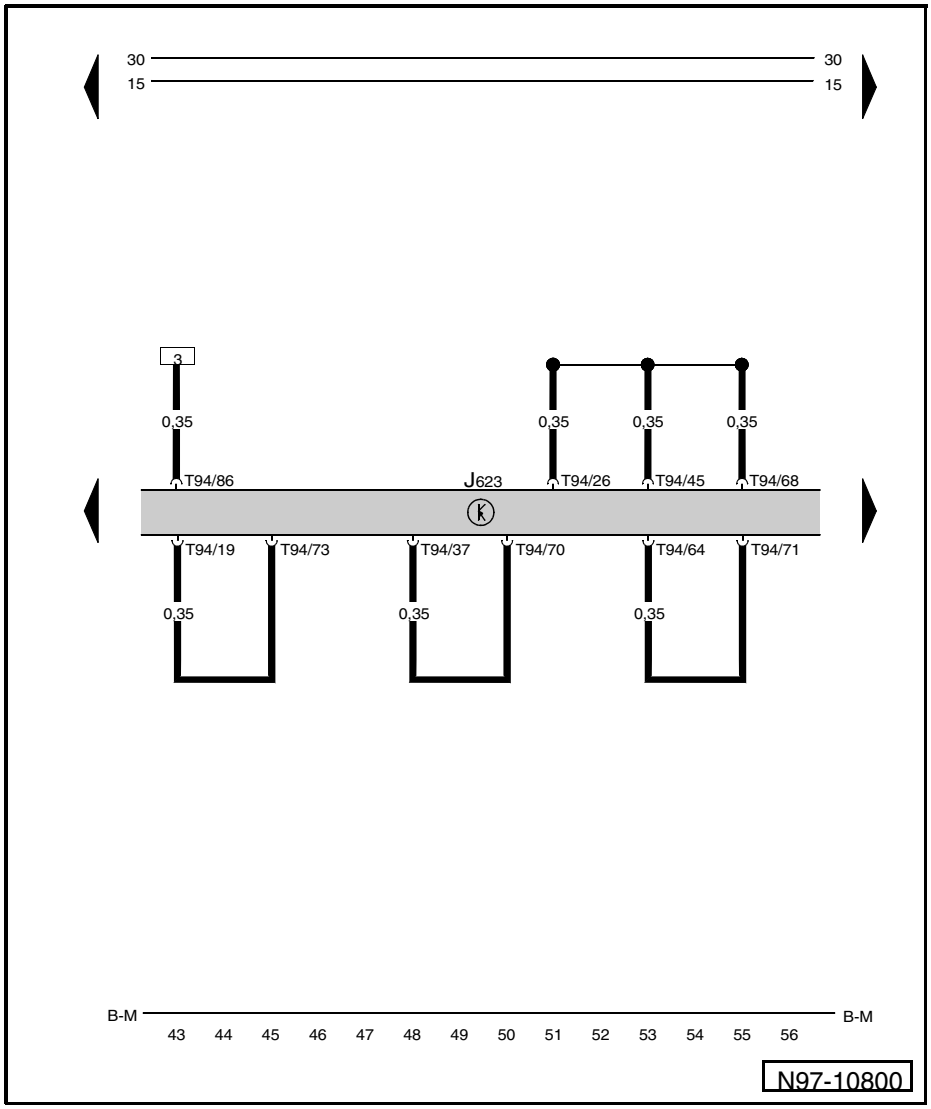
D180-Connection (87a) in engine bay wiring harness

B-M-Battery earth/engine earth



3.2.4 Coding bridges, engine control unit

J623-Engine control unit
T94-Connection, 94-pin
B-M-Battery earth/engine earth



3.2.5 Charge pressure sender, intake air temperature sender, coolant temperature sender, fuel temperature sender, engine control unit

G31-Charge pressure sender

G42-Intake air temperature sender

G62-Coolant temperature sender

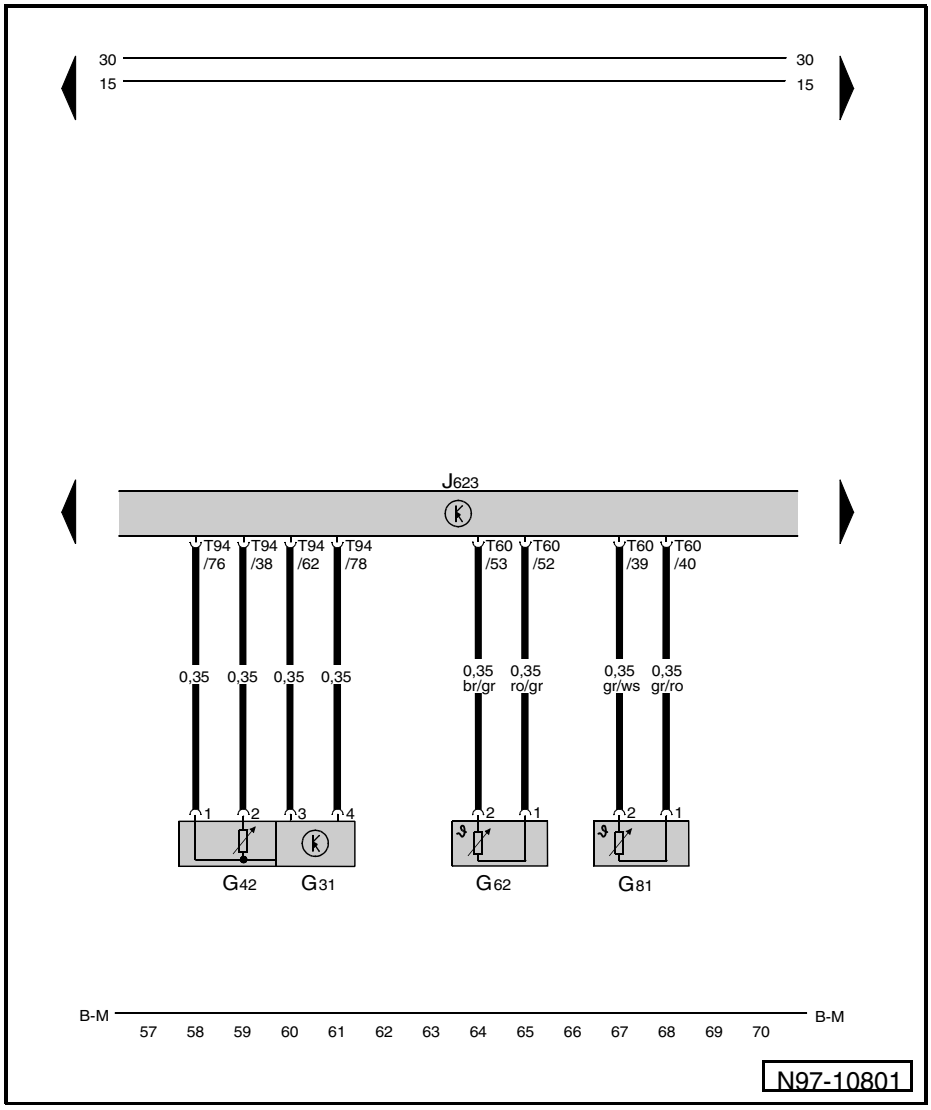
G81-Fuel temperature sender

J623-Engine control unit

T60-Connection, 60-pin

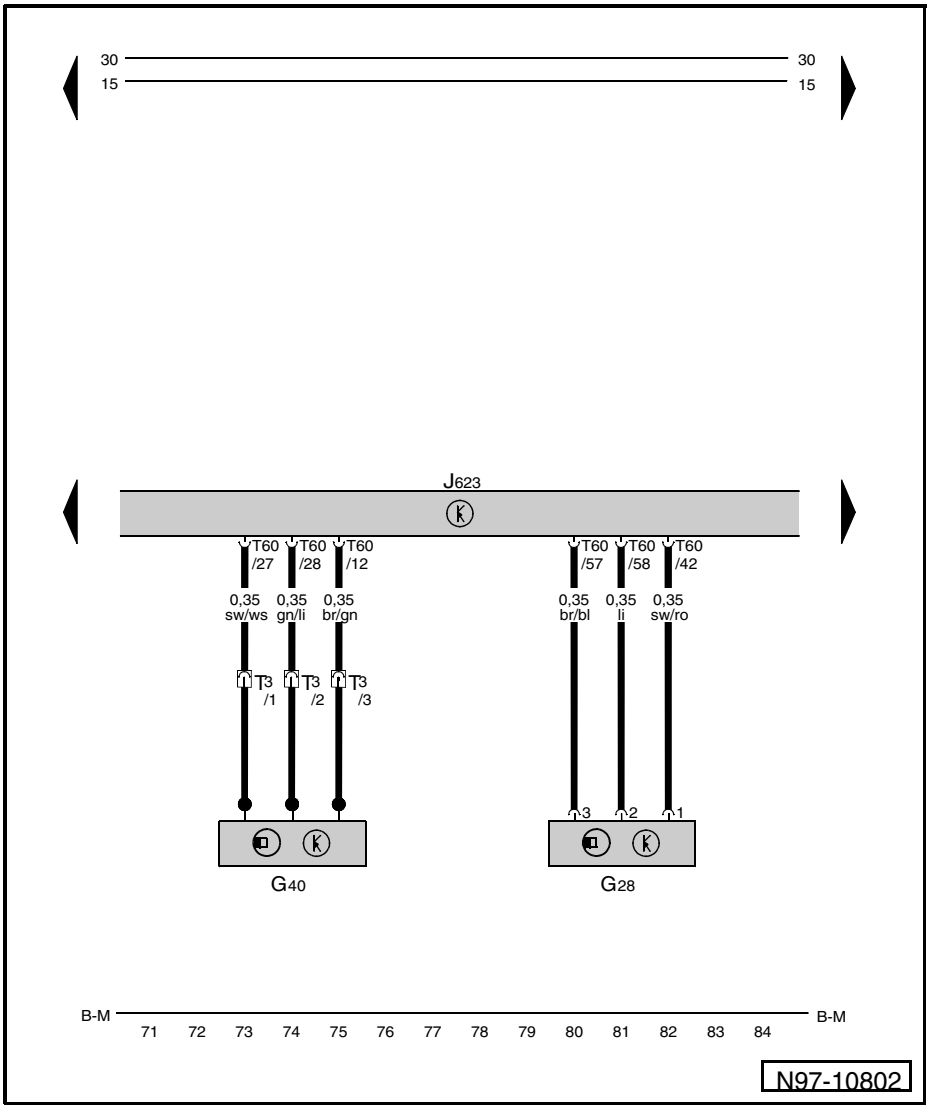
T94-Connection, 94-pin

B-M-Battery earth/engine earth



3.2.6 Engine speed sender, Hall sender, engine control unit

G28-Engine speed sender
G40-Hall sender -G40-
J623-Engine control unit
T3- Connection, 3-pin
T60-Connection, 60-pin
B-M-Battery earth/engine earth



3.2.7 Accelerator pedal position sender, unit injector valves, engine control unit

G79-Accelerator position sender

G185-Accelerator pedal position sender 2

J623-Engine control unit

N240-Unit injector valve, cylinder 1

N241-Unit injector valve, cylinder 2

N242-Unit injector valve, cylinder 3

N243-Unit injector valve, cylinder 4

T6a-Connection, 6-pin

T8 - Connection, 8-pin

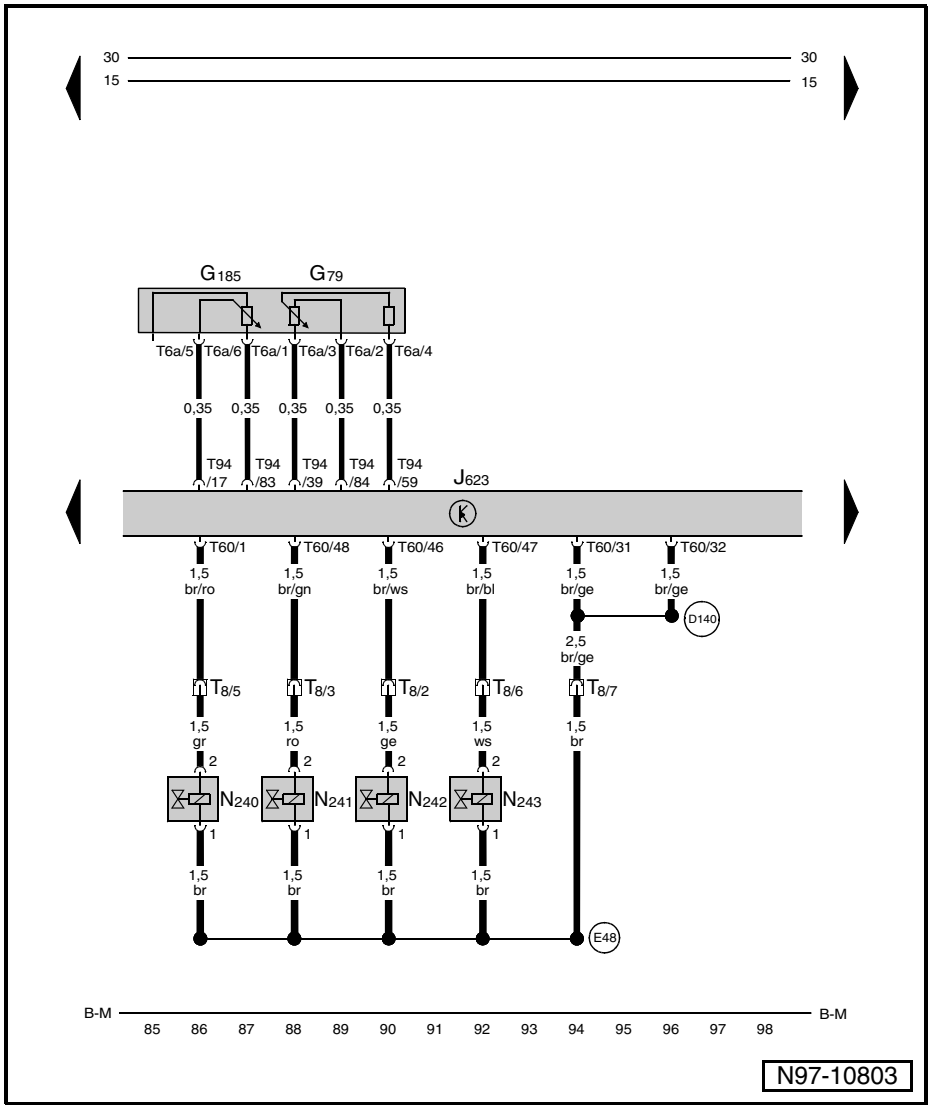
T60-Connection, 60-pin

T94-Connection, 94-pin

D140-Connection unit injector valves in engine supply wiring harness

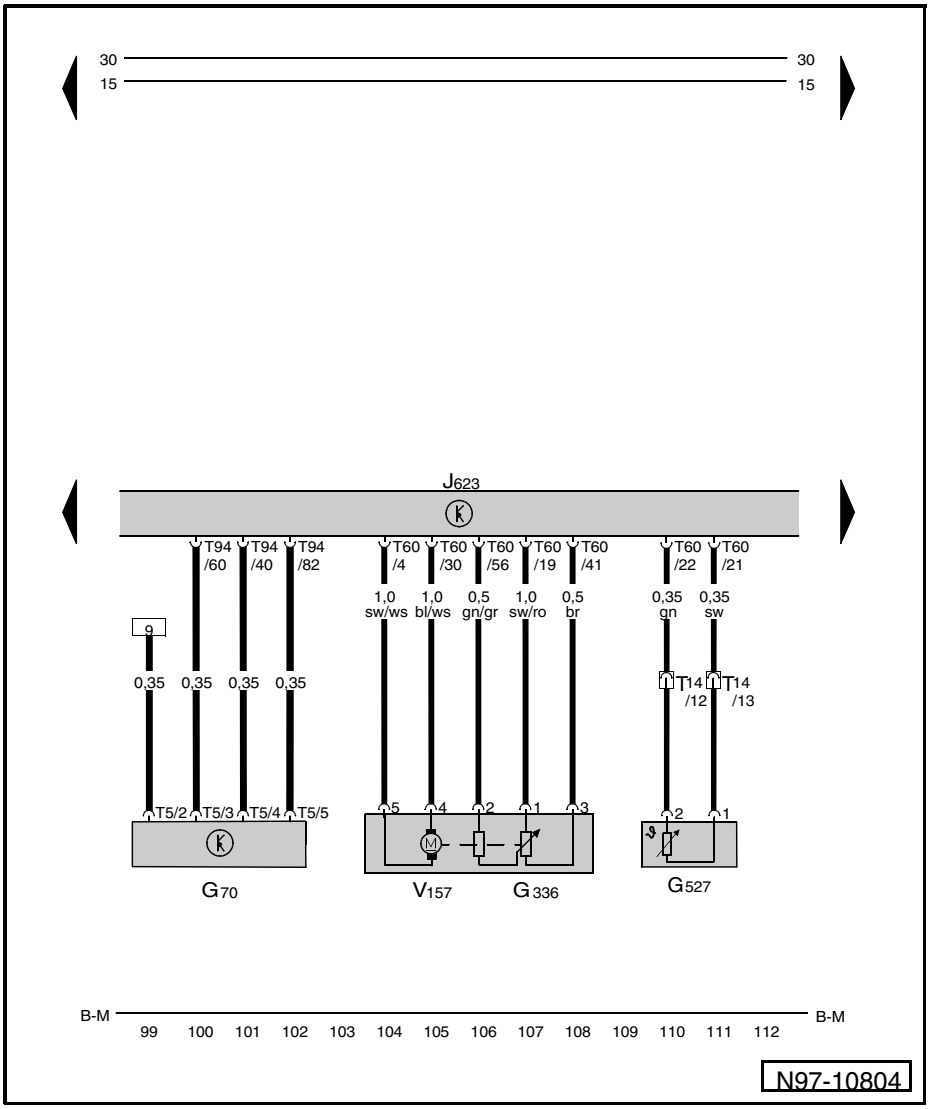
E48-Connection unit injector valves in unit injector valve wiring harness

B-M-Battery earth/engine earth



3.2.8 Air mass meter, intake manifold flap motor, intake manifold flap potentiometer, temperature sender after particulate filter, engine control unit

G70-Air mass meter
G336-Intake manifold flap potentiometer
G527-Temperature sender after particulate filter
J623-Engine control unit
V157-Intake manifold flap motor
T5 - Connector, 5-pin
T14-Connection, 14-pin
T60-Connection, 60-pin
T94-Connection, 94-pin
B-M-Battery earth/engine earth



3.2.9 Exhaust gas temperature sender 1, exhaust gas temperature sender 2, exhaust gas recirculation potentiometer, exhaust gas recirculation valve, engine control unit

G212-Exhaust gas recirculation potentiometer

G235-Exhaust gas temperature sender 1

G448-Exhaust gas temperature sender 2

J623-Engine control unit

N18-Exhaust gas recirculation valve

T2a-Connection, 2-pin

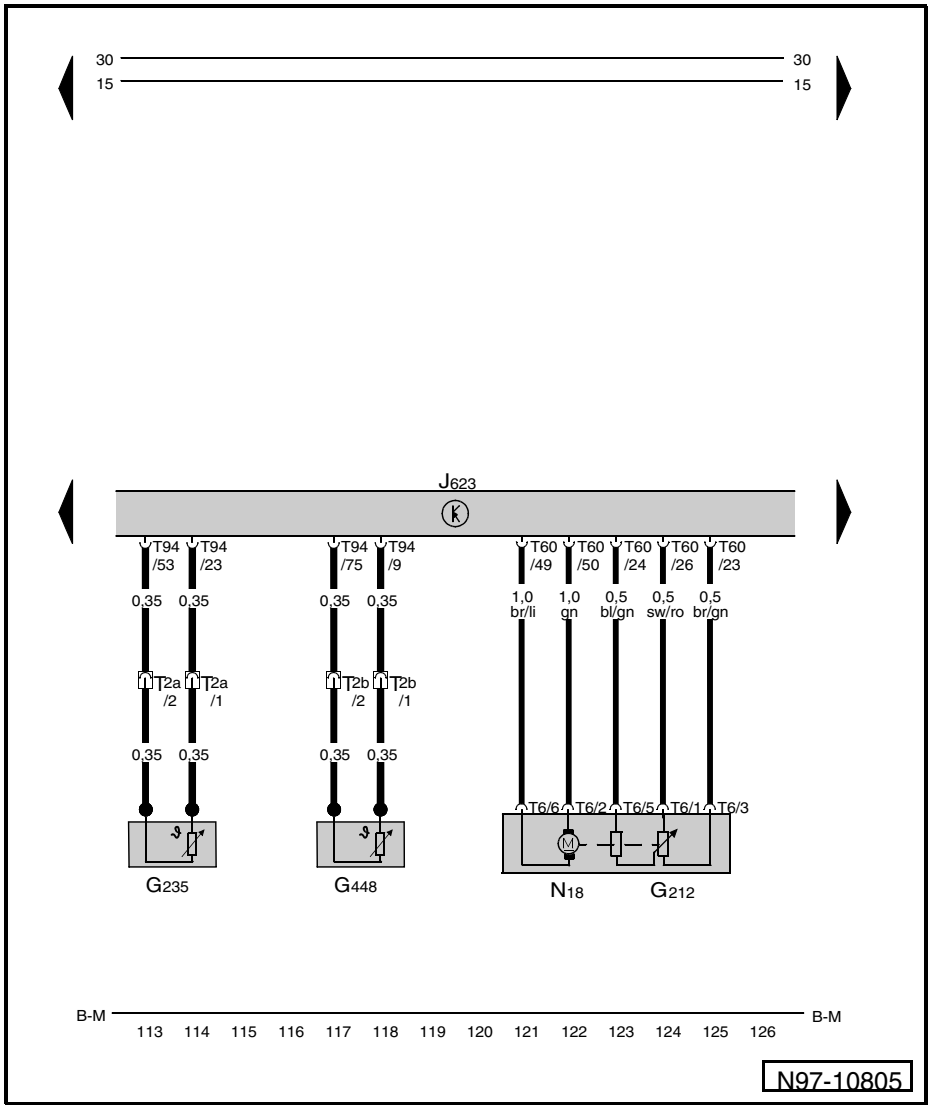
T2b-Connection, 2-pin

T6 - Connection, 6-pin

T60-Connection, 60-pin

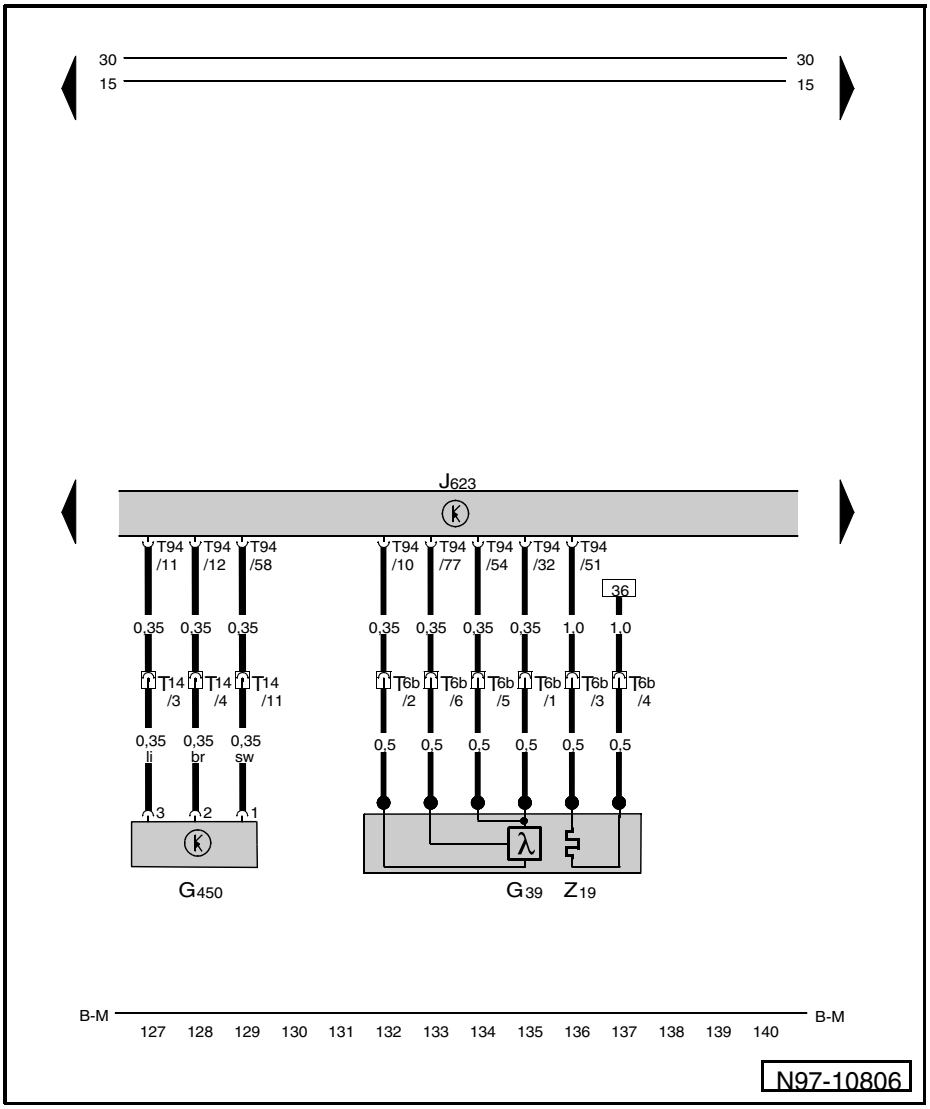
T94-Connection, 94-pin

B-M-Battery earth/engine earth



3.2.10 Lambda probe, lambda probe heater, exhaust gas pressure sensor 1, engine control unit

G39-Lambda probe
G450-Exhaust gas pressure sensor 1
J623-Engine control unit
Z19-Lambda probe heater
T6b-Connection, 6-pin
T14-Connection, 14-pin
T94-Connection, 94-pin
B-M-Battery earth/engine earth



3.2.11 Heater resistor for crankcase breather, exhaust gas recirculation cooler changeover valve, charge pressure control solenoid, metering pump, engine control unit

J623-Engine control unit

N75-Charge pressure control solenoid valve

N79-With heater element for crankcase breather

- ❑ * If installed

N345-Exhaust gas recirculation cooler change-over valve

V54-Metering pump

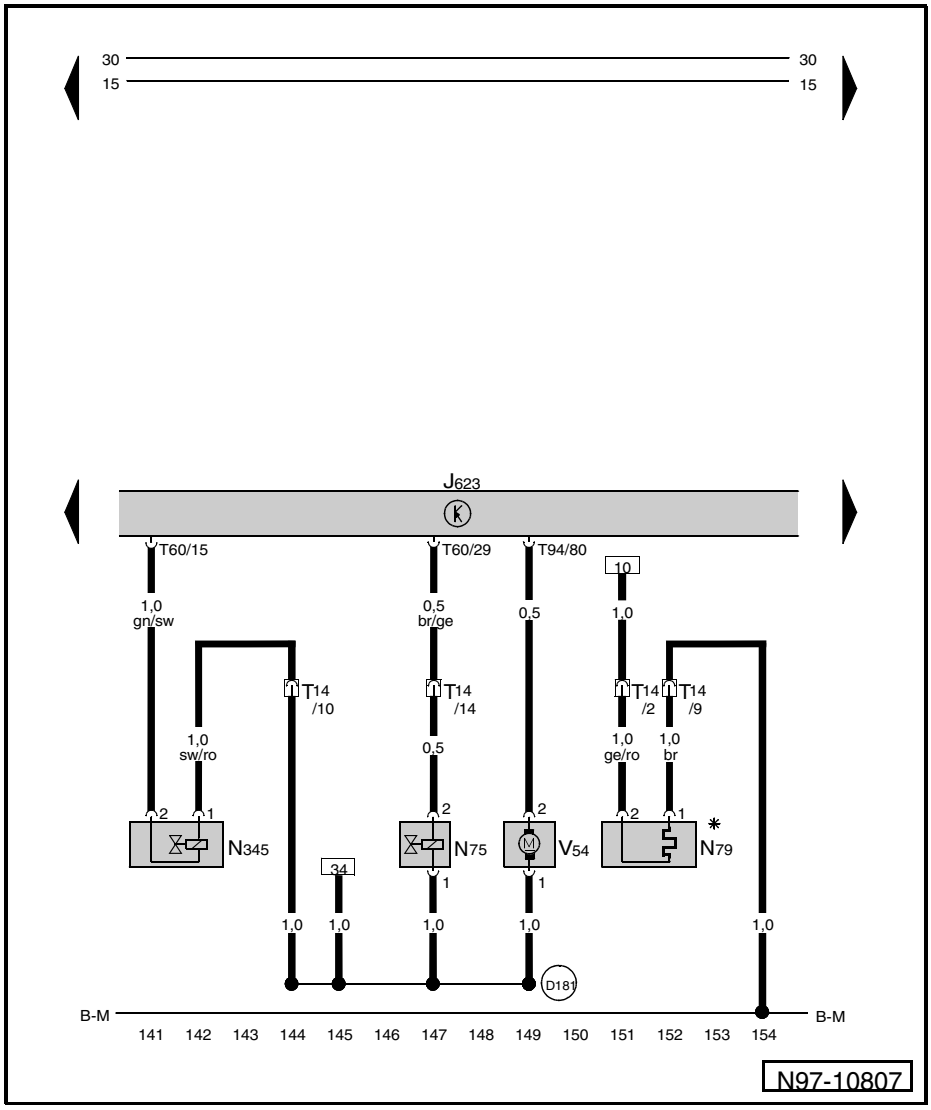
T14-Connection, 14-pin

T60-Connection, 60-pin

T94-Connection, 94-pin

D181-Connection 2 (87a) in engine bay wiring harness

B-M-Battery earth/engine earth



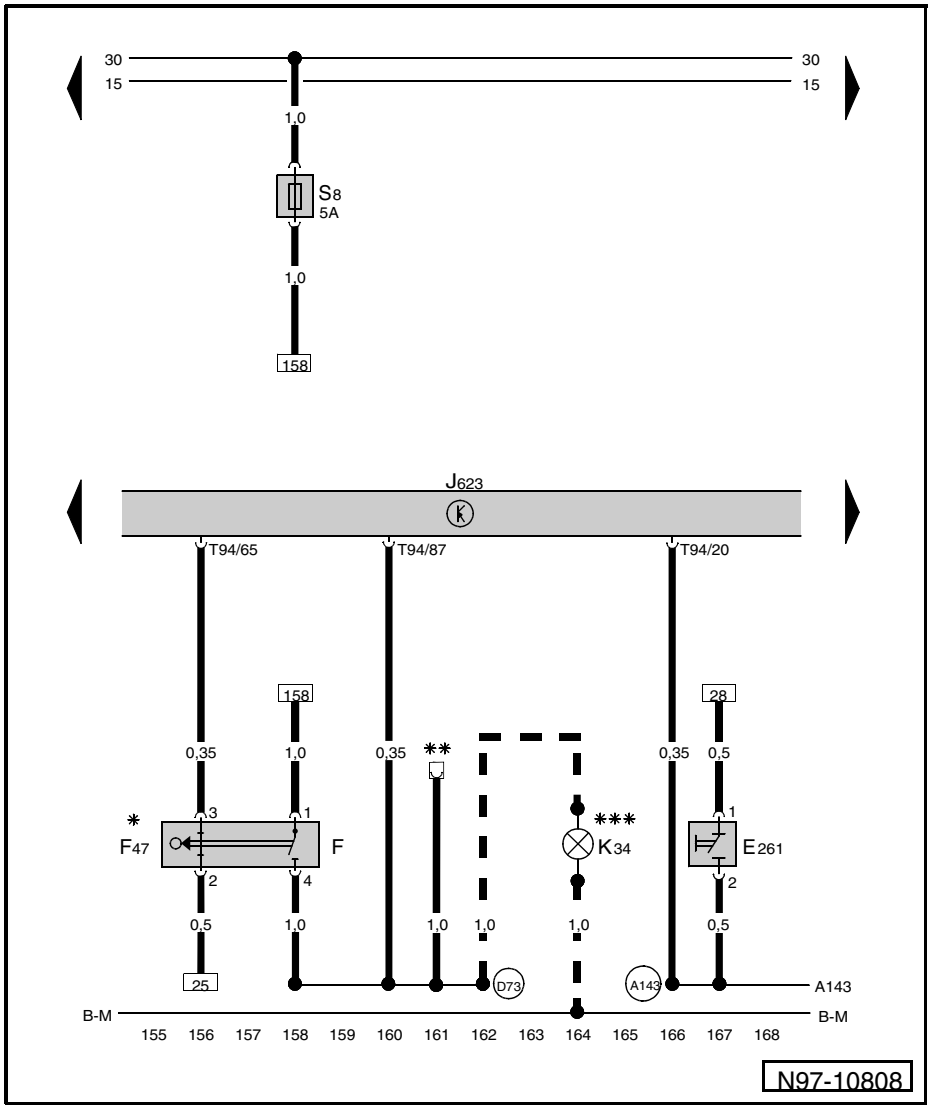
3.2.12 Brake light switch, brake pedal switch, working speed governor switch, brake light warning lamp, engine control unit

E261-Switch for working speed governor
F - Brake light switch
F47-Brake pedal switch
- ❑ * Safety switch

J623-Engine control unit
K34-Brake light warning lamp
- ❑ *** If installed

S8 - Circlip
- ❑ 5 A
- ❑ In fuse carrier

T94-Connection, 94-pin
A143-Connection (working speed governor) in dash panel wiring harness
D73-Positive connection (54) in engine bay wiring harness
** - Brake light output, terminal 54
B-M-Battery earth/engine earth



3.2.13 Button to resume governed working speed, switch for working speed governor, button for working speed governor, alternator warning lamp, engine control unit

E426-Button to resume governed working speed

E427-Switch for working speed governor

- ❑ Safety contact

E428-Button for working speed governor

- ❑ Tip down function

E429-Button for working speed governor

- ❑ Tip up function

J623-Engine control unit

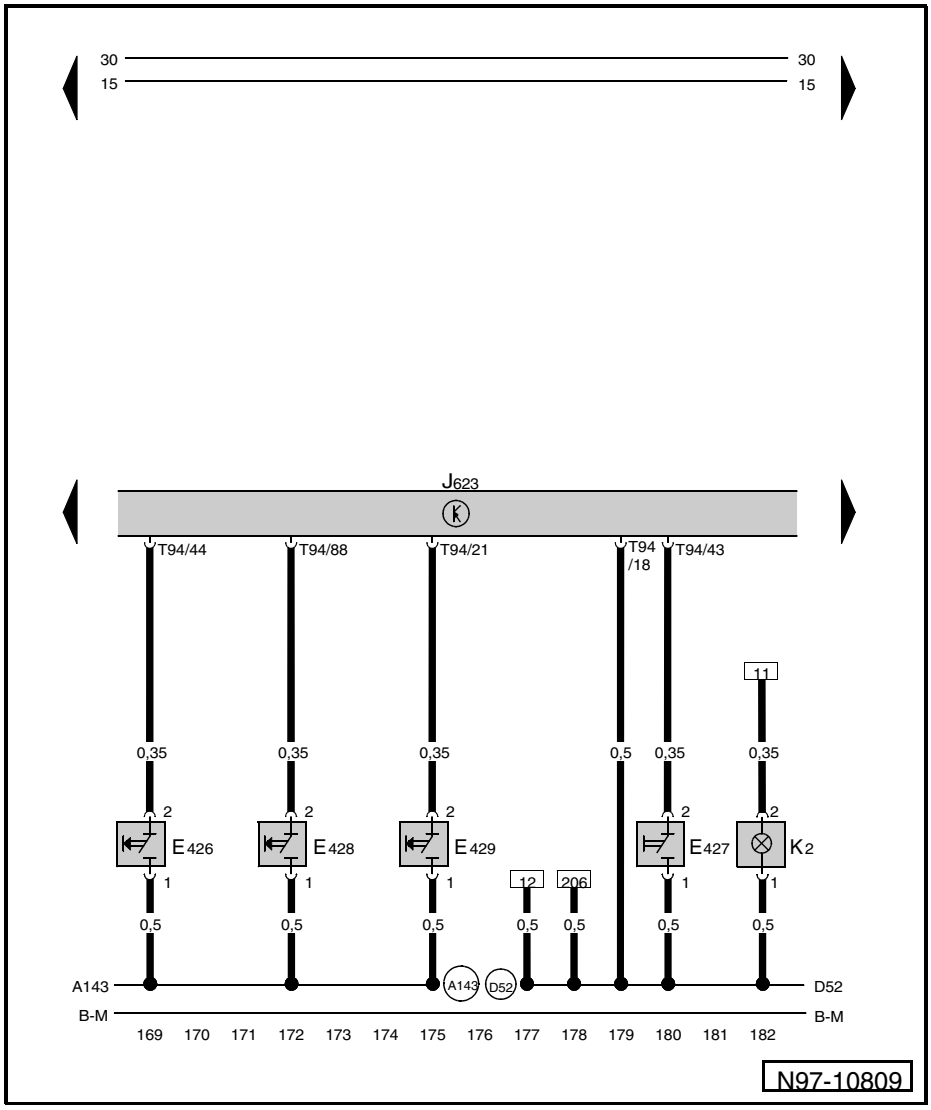
K2- Alternator warning lamp

T94-Connection, 94-pin

A143-Connection (working speed governor) in dash panel wiring harness

D52-Positive connection (15a) in engine bay wiring harness

B-M-Battery earth/engine earth



3.2.14 Switch for fixed speed 1...3, warning lamps, engine control unit

E433-Switch for fixed speed 1

E434-Switch for fixed speed 2

E435-Switch for fixed speed 3

J623-Engine control unit

K29-Glow period warning lamp

K83-Exhaust gas warning lamp

K158-Working speed governor warning lamp

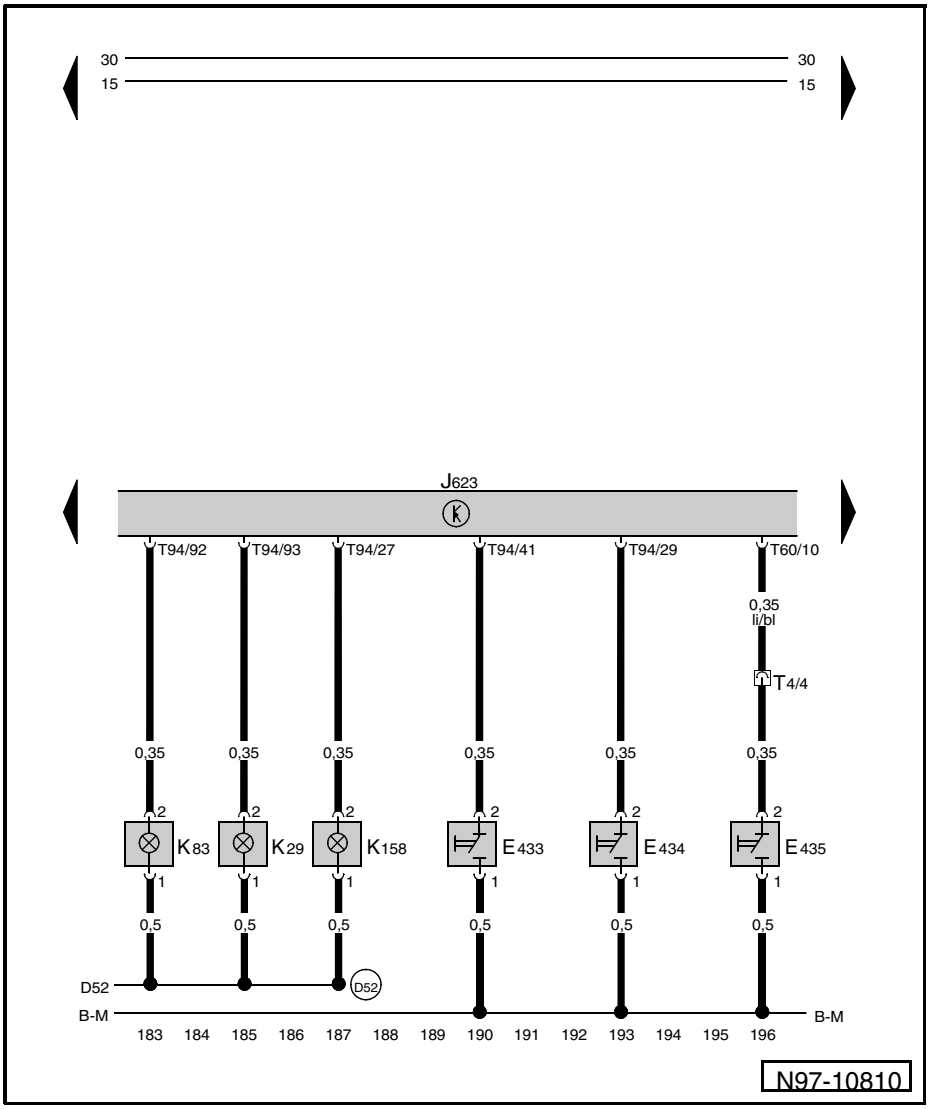
T4- Connector, 4-pin

T60-Connection, 60-pin

T94-Connection, 94-pin

D52-Positive connection (15a) in engine bay wiring harness

B-M-Battery earth/engine earth



3.2.15 Coding bridges, oil pressure switch, oil pressure control delay relay, oil pressure warning lamp, engine control unit

F1 - Oil pressure switch

J150-Oil pressure control delay relay

- ❑ * Customer specific

J623-Engine control unit

K3 - Oil pressure warning lamp

T4 - Connector, 4-pin

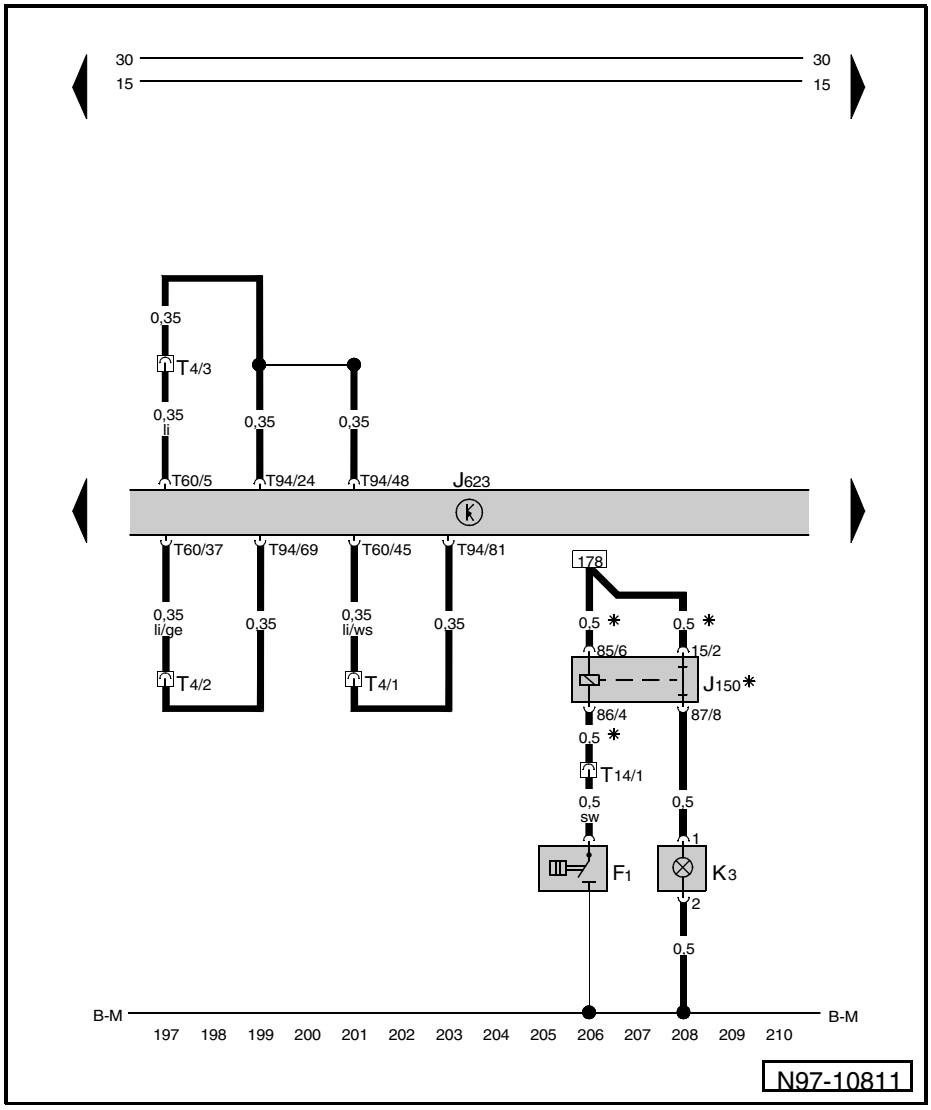
T14-Connection, 14-pin

T60-Connection, 60-pin

T94-Connection, 94-pin

*** - Customer specific**

B-M-Battery earth/engine earth



3.2.16 Diagnosis connection, engine control unit

J623-Engine control unit

S...- Circlip

- ❑ 5 A
- ❑ In fuse carrier

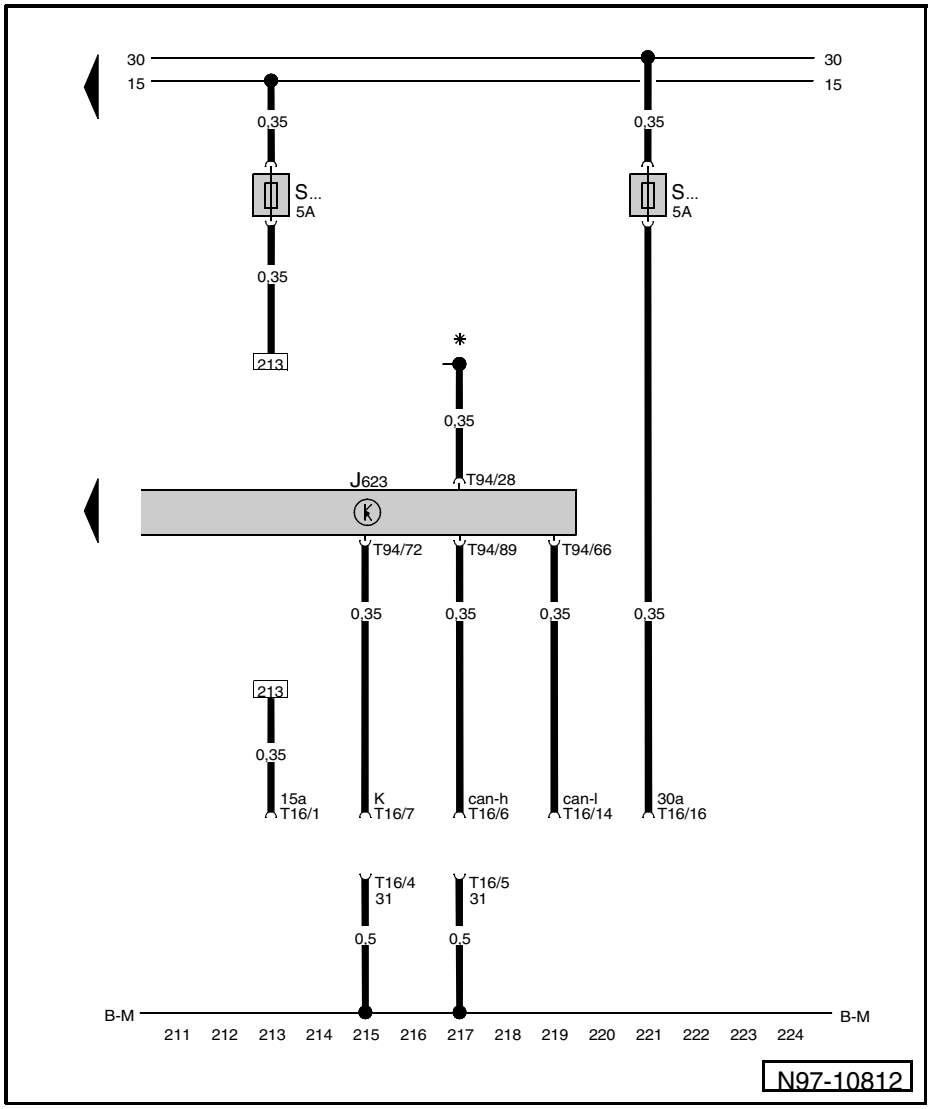
T16-Connection, 16-pin

- ❑ For diagnosis connection

T94-Connection, 94-pin

*** - Speed signal output**

B-M-Battery earth/engine earth



28 – Glow plug system

1 Glow plug system

Characteristics of ceramic glow plugs ⇒ Seite 321.

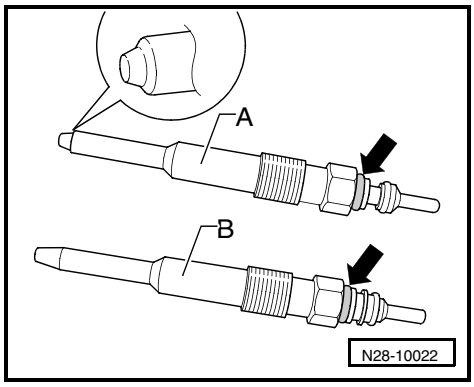
Removing, installing and checking ceramic glow plugs ⇒ Seite 321.

1.1 Characteristics of ceramic glow plugs

ACHTUNG!

The ceramic glow plugs ⇒ Abb. are sensitive to jolts and bending. For this reason, a glow plug which has dropped from a small height (approx. 2 cm) must not be used, even if there is no obvious damage. It is absolutely necessary to follow installation instructions, otherwise the glow plug can break and cause damage to the engine.

Visual characteristics of ceramic glow plugs



Ausführung A-Ceramic glow plugs with phase offset on tip and white colour marking -arrow-.

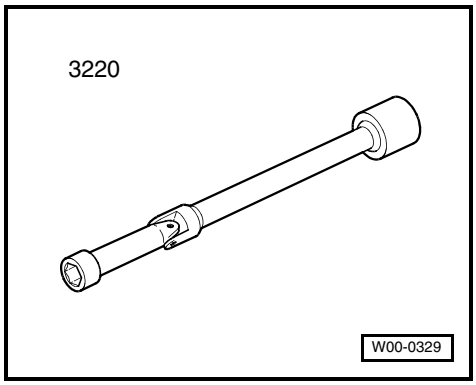
Ausführung B-Metal glow plug with green colour coding -arrow-.

Removing, installing and checking ceramic glow plugs ⇒ Seite 321.

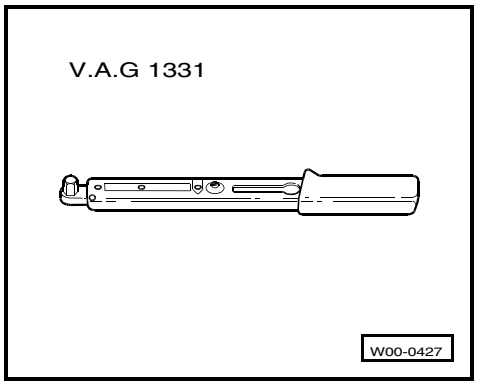
1.2 Removing, installing and checking ceramic glow plugs

Benötigte Spezialwerkzeuge, Prüf- und Messgeräte sowie Hilfsmittel

- Jointed spanner -3220-



- Torque wrench (5...50 Nm) -V.A.G 1331-
- Hand multimeter -V.A.G 1526- or multimeter -V.A.G 1715-
- Adapter set -V.A.G 1594-
- Current flow diagram



Test prerequisites

- Fuses must be OK.
- Engine must be cold.
- Ignition switched off.

Procedure

Hinweis

- *Observe characteristics of ceramic glow plugs ⇒ Seite 321 without fail.*
- *Do not cant ceramic glow plugs when removing and installing. Remove any components hindering assembly.*

– Pull off connectors from ceramic glow plugs.

– Remove ceramic glow plugs using U/J extension and socket -3220-.

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

– Before installing the drilling in cylinder head and the threads must completely cleaned of all deposits.

Hinweis

Never oil or grease thread of cylinder head bore or of ceramic glow plugs.

– Screw in ceramic glow plugs by hand into cylinder head using U/J extension and socket -3220-.

– Then tighten ceramic glow plugs to 15 Nm.

ACHTUNG!

- ***Always check the resistance at all ceramic glow plugs after their installation and before starting the engine for the first time.***
- ***Specification: max. 1,0 Ω***
- ***If the defective ceramic glow plug is broken, remove all fragments from the engine, otherwise damage to the engine may occur.***

– If the specification is exceeded, renew defective ceramic glow plugs.