Service.

Engine codes	ARD	AVM	BEQ		

Workshop Manual Volkswagen Industrial Engine

4-cyl. diesel engine (without intermediate shaft)

Edition December 2001

Service Department. Technical Information

Service.

List of Workshop Manual Repair Groups

Volkswagen Industrial Engine

Engine code	ARD	AVM	BEQ							

Booklet 4-cyl. diesel engine (without intermediate shaft)
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When filing a Technical Bulletin enter the Bulletin No. in the adjacent column.When using the Workshop Manual you can then see at a glance whether Technical Bulletins have been published in respect of the particular Repair Group in which you are looking.

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21 Charging						
23 Mixture preparation, Injection						
26 Exhaust system						
27 Starter, Voltage supply						
28 Glow plug system						

Technical Information should always be available to all foremen and mechanics, because their compliance with the instructions given is essential to ensure vehicle roadworthiness and safety. In addition, the normal safety precautions to be observed when working on motor vehicles are also applicable.

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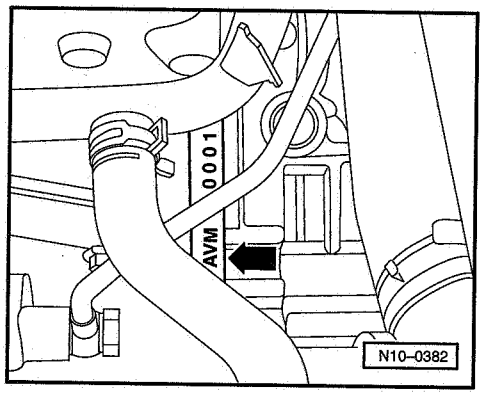
Technical data

Engine number



◄ The engine number ("Code letters" and "Serial number") can be found on the joint between engine/gearbox -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 (alphanumeric). The first part (maximal 3 characters) makes up the "engine code", and the second part (6 characters), the "serial number". If more than 999,999 engines with the same engine code are produced, the first of the six characters is replaced with a letter.

Engine data

Codes		ARD	AVM	BEQ
Manufactured		04.02 ➤	10.00 ➤	04.02 ➤
Displacement	ltr.	1.9	1.9	1.9
Output	kW at rpm	44/3600	63/3100	32/2600
Torque	Nm at rpm	130/2000...2400	215/1900	133/2600...2600
Bore	Ø mm	79.5	79.5	79.5
Stroke	mm	95.5	95.5	95.5
Compression ratio		19.5	19.5	19.5
CN	at least	49	49	49
Firing order		1-3-4-2	1-3-4-2	1-3-4-2
Exhaust gas recirculation		no	yes	yes
Charged		no	yes	no
Charge air cooled		no	yes	no
Electronic engine performance control		yes	yes	yes

Self-diagnosis

Engine output data varies according to the coding for the Diesel direct injection system control unit.

When the engine is placed into service for the first time, the engine control unit is to be coded as per the required data set ⇒ page 23-117.

Features of self-diagnosis

The control unit for the Diesel direct injection system 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 among different faults ⇒ Fault table from page 01-18 and stores these until the contents of the fault memory are erased.

Faults which only occur sporadically will have the addendum "sporadic fault" on the print out. These faults will be indicated on the display by the addendum "/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 erased from the fault memory.

If faults are recognized that affect the running of the engine, the glow period warning lamp flashes.

The faults stored can be read-out with the fault reader V.A.G 1551, the vehicle system tester V.A.G 1552 or the new tester VAS 5051 ⇒ Page 01-11.

The fault memory must be erased after the faults have been eliminated ⇒ Page 01-13.

Note:

General information for self-diagnosis can be found in the instruction manuals for the fault reader V.A.G 1551, vehicle system tester V.A.G 1552 or the new tester VAS 5051.

Technical data of self-diagnosis

Equipment

- The data transfer between control unit and fault reader V.A.G 1551 or vehicle system tester V.A.G 1552 is carried out in the operating mode "Rapid data transfer".

- Fault memory: Non-volatile memory and volatile memory[1)]

[1)] Will be cancelled after 50th engine start if fault has not occurred again.

Interrogating control unit versions

The control unit version is displayed when the fault reader V.A.G 1551, the vehicle system tester V.A.G 1552 or the new tester VAS 5051 is connected and engine electronics control unit selected ⇒ Page 01-5.

Functions which can be selected when using address word 01, engine electronics, of the fault readers V.A.G 1551/1552 or VAS 5051

Note:

The prerequisites to select the desired functions can be found in the following table.

Function		Prerequisite		
Functions on V.A.G 1551/1552 or on VAS 5051		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
04	Basic setting	no	yes	no
05	Erase fault memory	yes	yes	yes
06	End output	yes	yes	yes
07	Code control unit	yes	no	no
08	Read measured value block	yes	yes	yes

[1)] Only carry out with ignition switched on, when engine does not start.

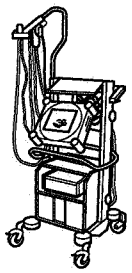
Connecting fault reader

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051 in the operating mode vehicle self-diagnosis.
⇒ Operating instructions for vehicle diagnosis, testing and information system VAS 5051.

Check conditions

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

VAS 5051



W00-1236

Connecting VAS 5051

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

♦ VAS 5051 Vehicle diagnosis, testing and information system

♦ Diagnosis cable VAS 5051/1 or VAS 5051/3

Work sequence

- Fit connector from diagnosis cable VAS 5051/1 or VAS 5051/3 to diagnosis connection.

- Depending upon desired function:
  Switch ignition on
  or
  Start engine ⇒ Page 01-4, Table "Selectable functions".

Notes:

♦ *If nothing appears on the display, check voltage supply for diagnosis connection using current flow diagram ⇒ page 27-20.*

♦ *If the display does not indicate as described in the work sequence:*
⇒ Operating instructions for vehicle diagnosis, testing and information system VAS 5051

Selecting operating mode:

- Press button on display for "Vehicle self-diagnosis".

Selecting vehicle system:

- Press button "01 - Engine electronics" on display.

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

If the coding differs from the data set, then:

- Check control unit coding ⇒ page 23-117, Coding engine control unit.

Selecting diagnosis function:

All diagnostic functions available are indicated on the display.

- Select desired function on touch screen.

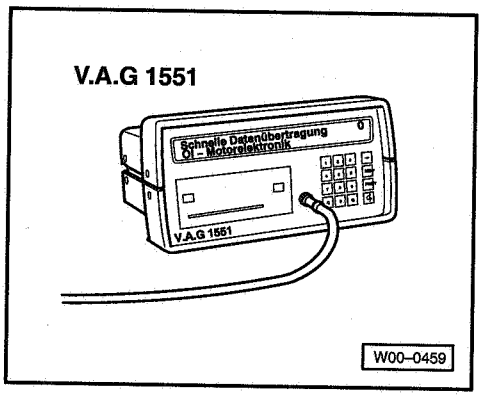
Notes:

The display zones in functions 04 - Basic setting or 08 - Read measured value block are shown from top to bottom.

The following test sequences are for fault reader V.A.G 1551.

Connecting V.A.G 1551

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



♦ V.A.G 1551 Fault reader

♦ V.A.G 1551/3 Cable

Note:

The vehicle system tester V.A.G 1552 can be used instead of the fault reader V.A.G 1551, however a print-out is not possible.

Work sequence

- Connect fault reader V.A.G 1551 using cable V.A.G 1551/3.

- Depending upon desired function:
  Switch ignition on
  or
  Start engine ⇒ Page 01-4, Table "Selectable functions".

Notes:

♦ *If nothing appears on the display, check voltage supply for diagnosis connection using current flow diagram ⇒ page 27-20.*

♦ *If the display does not indicate as described in the work sequence:*
⇒ Fault reader operating instructions

♦ *If due to an input fault "Fault in the data transfer!" is displayed, pull wire off fault reader, reconnect and repeat work step.*

V.A.G - Self-diagnosis HELP
1 - Rapid data transfer*
2 - Flash code output*

◄ Indicated on display:

* Appears alternately

- Operate fault reader taking into account the information on the display:

- Press key 1 for "Rapid data transfer".

- Press keys 0 and 1 for address word "Engine electronics" and confirm entry with Q key.

038906012EE 1.9 l R4 IMO A000SG 3303 →
Coding 00002 WSC xxxxx

◄ The control unit identification and coding are indicated on the display, e.g.:

♦ 038906012EE = Part No. of the control unit (for latest control unit versions see parts catalogue)

♦ 1.9 ltr. = Engine capacity

♦ R4 = Type of engine (4 Cyl. in-line engine)

♦ IMO = Identification for industrial engine

♦ A = Engines with working speed governor
(0 = no working speed governor)

♦ SG = Gearbox type: manual gearbox
(AG = automatic gearbox, not relevant)

♦ 3303 = Programme level number

♦ Coding 00002 = Control unit coding, coding variants of engine control unit ⇒ page 23-120.

♦ WSC xxxxx = Workshop code from V.A.G 1551, of the workshop who carried out the last coding. (If the factory coding has not been changed, WSC 00000 appears)

If the coding differs from the data set, then:

- Check control unit coding ⇒ page 23-117, Coding engine control unit.

- Press the → key.

Rapid data transfer HELP
Select function XXX

◄ Indicated on display:

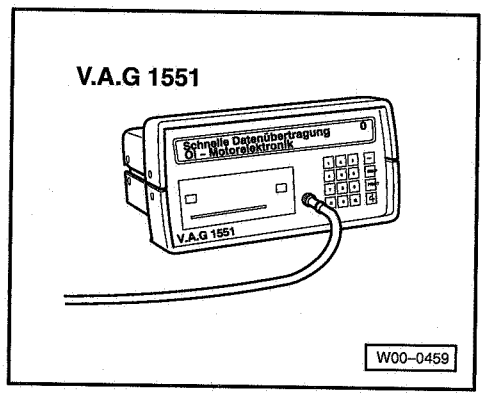
- Further measures see repair procedures.

Fault memory

Interrogate fault memory of all control units
⇒ page 01-15, Automatic test sequence

Interrogating fault memory

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3

Note:

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051.

Work sequence

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Only when engine does not start:

- *Switch ignition on.*

- Switch on fault reader printer with the print key. The warning lamp in key must light up.

Rapid data transfer HELP
Select function XX

◄ Indicated on display:

- Operate fault reader taking into account the information on the display:

- Press keys 0 and 2 for function "Interrogate fault memory" and confirm entry with Q key.

X Faults recognised!

◄ The number of faults stored or "No fault recognised!" will be shown on the display.

If one or more faults are stored:

The stored faults will be displayed and printed out one after the other.

Rapid data transfer HELP
Select function XX

◄ After the stored faults have been printed out, the display will show:

- Rectify the printed faults using the fault table
  ⇒ page 01-18.

- Afterwards erase fault memory ⇒ Page 01-13.

If no fault is stored:

- Press the → key.

Rapid data transfer	HELP
Select function XX	

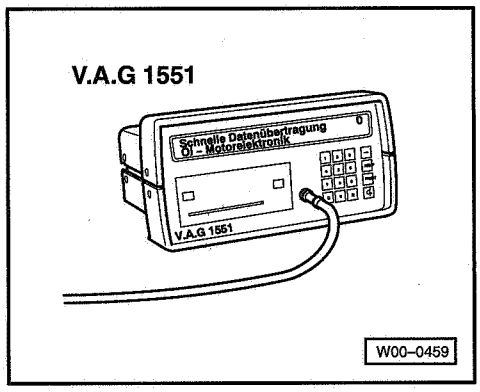
◄ Indicated on display:

- Press keys 0 and 6 for the "End output" function and confirm input with the Q key.

- Switch off ignition.

Erasing fault memory

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3

Note:

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051.

Test conditions

- Fault eliminated

Work sequence

Note:

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

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Rapid data transfer	HELP
Select function XXX	

◄ Indicated on display:

- Press keys 0 and 2 for function "Interrogate fault memory" and confirm entry with Q key.

Rapid data transfer	HELP
Select function XX	

◄ - Press → key until all faults still stored have appeared and the display reads:

- Press keys 0 and 5 for the function "Erase fault memory" and confirm entry with Q key.

Rapid data transfer →
Fault memory is erased!

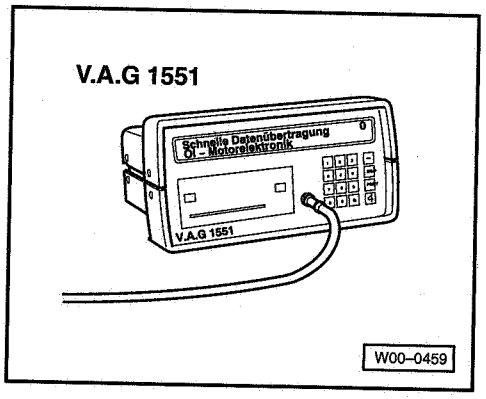
◀ Indicated on display:

- If the fault memory will not erase there is a fault still in the system and this must be rectified.
- Press the → key.

Rapid data transfer HELP
Select function XXX

◀ Indicated on display:

- Press keys 0 and 6 for the "End output" function and confirm input with the Q key.
- Switch off ignition.



Automatic test sequence

The various control units/components are connected together via a data bus. This is why it is always sensible to interrogate the fault memory of all control units first with the "automatic test sequence".

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3

Note:

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051.

Work sequence

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

During test and assembly work faults can be recognised from other control units like e.g. plug disconnected. Therefore on completion the fault memories of all control units must be interrogated and erased. To do this:

- Press key 0 twice for address word "Automatic test sequence" and confirm entry with Q key. The V.A.G 1551 transmits all known address words one after the other.

When a control unit answers with its identification the number of stored faults appears on the display or "No fault recognised".

Any system faults that are stored will be displayed one after the other and printed out. The V.A.G 1551 will then transmit the next address word.

V.A.G - SELF-DIAGNOSIS HELP
1 - Rapid data transfer*
2 - Flash code output*

◄ The automatic test sequence has ended when the following appears on the display:

- Erase all fault memories and run engine under load.

  During this test the following operating conditions must be fulfilled:

  ♦ The coolant temperature must exceed 80 °C .

  ♦ When the temperature is reached, the operating conditions

  Idling
  Part throttle
  Full throttle
  Overrun
  must be attained several times.

- Interrogate the fault memories of all control units again using the "automatic test sequence". No faults must be stored in fault memory.

If no fault is stored:

- Press the → key.

Rapid data transfer HELP
Select function XX

◄ Indicated on display:

- Press keys 0 and 6 for the "End output" function and confirm input with the Q key.

- Switch off ignition.

Fault table

Notes:

♦ *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, for example, P0118, will also be issued. Currently, you do not need to heed the P codes, which will be used only in future self-diagnosis systems.*

♦ *Explanation of the fault types (e.g. "open circuit/short circuit to earth"):*
⇒ Fault reader operating instructions

♦ *If components are indicated as faulty:*
First check the wiring and connectors to these components as well as the system earth connections according to current flow diagram. This is particularly relevant if faults are output as "occurring sporadically" (SP).

♦ *Erase fault memory after rectifying faults ⇒ Page 01-13.*

V.A.G 1551 print out, e.g.:

16502 P0118 035
Coolant temperature sender -G62
Signal too high
Sporadic fault

Explanation:

♦ *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*

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00668 Vehicle voltage terminal 30 Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ Current supply relay terminal 30 (J317) defective ♦ Relay sticks (sporadically)	♦ Engine will not start ♦ Various running problems including engine will not start	- Check diesel direct injection system voltage supply ⇒ page 23-48
00741 Brake pedal monitoring 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) flashes ♦ Brake light defective	- Check F and F47 ⇒ page 23-109

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01044 Control unit incorrectly coded	♦ Invalid control unit coding	♦ Glow period warning lamp (K29) flashes	- Coding control unit ⇒ page 23-117
01117 Load signal for alternator terminal DF Implausible signal	♦ Open circuit or wiring short to earth ♦ Alternator defective ♦ Voltage regulator defective	♦ Engine pre-heating not operating	- Check alternator and voltage regulator ⇒ page 27-9

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01282 Intake manifold flap change-over valve - N239			
Short to positive	♦ Wiring short to positive ♦ N239 defective/stuck in open position	♦ Cold start problems ♦ Cold idling problems ♦ Hard load change ♦ Idling problems	- Check N239 ⇒ page 23-95
Open circuit/short to earth	♦ Wiring open circuit or short to earth ♦ N239 defective		

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01283 Intake manifold flap motor -V157			
Short to positive	♦ Wiring short to positive ♦ V157 defective	♦ No exhaust gas recirculation, throttle valve opened fully	- Check V157 ⇒ page 01-53, Final control diagnosis
Open circuit/short to earth	♦ Wiring open circuit or short to earth ♦ V157 defective		
Defective	♦ Control flap defective ♦ V157 defective		

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16485 P0101 Air mass meter -G70 Implausible signal	♦ Wiring open circuit or short to earth ♦ G70 defective	♦ Reduced output ♦ Black smoke	- Check G70 ⇒ Page 23-87
16500 P0116 Coolant temperature sender -G62 Implausible signal	♦ Wiring open circuit or short to positive ♦ G62 defective	♦ Black smoke when starting ♦ Glow period is always approx. 20 seconds	- Check G62 ⇒ page 23-53 - Check thermostat ⇒ page 19-6, item 20

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16705 P0321 Engine speed sender - G28 Implausible signal	♦ Wiring open circuit or short to earth ♦ G28 defective ♦ Metal swarf on G28 ♦ G28 loose ♦ Gap speed sender/sender wheel too large	♦ Engine stalls ♦ Engine runs rough ♦ Glow period warning lamp (K29) flashes ♦ Increased emission figures ♦ Rev. counter no display	- Check G28 ⇒ page 23-50
16706 P0322 Engine speed sender - G28 No signal	♦ Wiring open circuit or short circuit ♦ G28 defective	♦ Engine will not start ♦ Engine stalls ♦ Glow period warning lamp (K29) flashes ♦ Rev. counter no display	- Check G28 ⇒ page 23-50

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16885 P0501 Road speed signal Implausible signal	♦ Wiring open circuit or short to earth ♦ Switch or button for working speed governor defective	♦ Working speed governor not OK.	- Check working speed signal ⇒ page 23-102

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16944 P0560 Voltage supply Implausible signal	♦ Wiring open circuit or wiring short to earth ♦ Current supply relay terminal 30 (J317) defective ♦ Relay sticks (sporadically)	♦ Engine will not start ♦ Various running problems including engine will not start	- Check diesel direct injection system voltage supply ⇒ page 23-48
16946 P0562 Voltage supply Voltage too low	♦ Voltage supply less than 4 V	♦ Engine will not start ♦ Various running problems including engine will not start	- Check diesel direct injection system voltage supply ⇒ page 23-48

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16947 P0563 Voltage supply Voltage too high	♦ Voltage supply more than 20 V	♦ Engine will not start ♦ Various running problems including engine will not start	- Check diesel direct injection system voltage supply ⇒ page 23-48
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) flashes ♦ Brake light defective	- Check F and F47 ⇒ page 23-109

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
16989 P0605 Control unit -J248- defective	♦ Control unit (J248) internally defective	♦ Various running problems ♦ Engine stops	- Replace J248 ⇒ page 23-115
17552 P1144 Air mass meter -G70 Open circuit/short to earth	♦ Wiring open circuit or short to earth ♦ G70 defective	♦ Reduced output ♦ Black smoke	- Check G70 ⇒ Page 23-87
17553 P1145 Air mass meter -G70 Short to positive	♦ Wiring open circuit or short to positive ♦ G70 defective	♦ Reduced output ♦ Black smoke	- Check G70 ⇒ Page 23-87

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17554 P1146 Air mass meter -G70 Voltage supply	♦ Operating voltage to high or too low ♦ Wiring open circuit	♦ Reduced output ♦ Black smoke	- Check G70 ⇒ Page 23-87
17563 P1155 Intake manifold pressure sender -G71 Short to positive	♦ Wiring short to positive ♦ G71 defective	♦ Reduced output ♦ Increased emission figures	- Check G71 ⇒ Page 23-82, Checking intake manifold pressure and elevation senders

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17564 P1156 Intake manifold pressure sender -G71 Open circuit/short to earth	♦ Wiring open circuit or short to earth ♦ G71 defective	♦ Reduced output ♦ Increased emission figures	- Check G71 ⇒ Page 23-82, Checking intake manifold pressure and elevation senders
17565 P1157 Intake manifold pressure sender -G71 Voltage supply	♦ Operating voltage too high or too low ♦ Wiring open circuit ♦ G71 defective	♦ Reduced output ♦ Increased emission figures	- Check G71 ⇒ Page 23-82, Checking intake manifold pressure and elevation senders

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17568 P1160 Intake manifold temperature sender -G72 Short to earth	♦ Wiring short to earth ♦ G72 defective	♦ Goes to predetermined value 136.8 °C	- Check G72 ⇒ Page 23-58
17569 P1161 Intake manifold temperature sender -G72 Open circuit/short to positive	♦ Wiring open circuit or short to positive ♦ G72 defective	♦ Goes to predetermined value 136.8 °C	- Check G72 ⇒ Page 23-58

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17570 P1162 Fuel temperature sender -G81 Short to earth	♦ Wiring short to earth ♦ G81 defective	♦ Attains predetermined value -5.4 °C ♦ Increased emission figures	- Check G81 ⇒ page 23-64
17571 P1163 Fuel temperature sender -G81 Open circuit/short to positive	♦ Wiring open circuit or short to positive ♦ G81 defective	♦ Attains predetermined value -5.4 °C ♦ Increased emission figures	- Check G81 ⇒ page 23-64

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17653 P1245 Needle lift sender -G80 Short to earth	♦ Wiring short to earth ♦ G80 defective	♦ Glow period warning lamp (K29) flashes ♦ Engine runs rough ♦ Reduced output ♦ Increased emission figures	- Check G80 ⇒ page 23-75
17654 P1246 Needle lift sender -G80 Implausible signal	♦ Wiring open circuit or short to earth ♦ Insufficient fuel ♦ Air in fuel system ♦ Injector pipe to injector with needle lift sender not OK ♦ G80 defective	♦ Glow period warning lamp (K29) flashes ♦ Engine runs rough ♦ Reduced output ♦ Increased emission figures	- Check G80 ⇒ page 23-75

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17655 P1247 Needle lift sender -G80 Open circuit/short to positive	♦ Wiring open circuit or short to positive ♦ G80 defective	♦ Glow period warning lamp (K29) flashes ♦ Engine runs rough ♦ Reduced output ♦ Increased emission figures	- Check G80 ⇒ page 23-75
17656 P1248 Injection commencement regulation Control difference	♦ Fuel tank empty ♦ Fuel supply not OK, insufficient fuel ♦ Start of delivery not OK ♦ Commencement of injection valve (N108) defective ♦ Needle lift sender (G80) defective	♦ Engine runs rough ♦ Reduced output ♦ Increased emission figures ♦ Poor cold start characteristics	- Fuel filter or fuel supply pipes blocked - Check dynamically and adjust commencement of injection ⇒ Page 23-35 - Check N108 ⇒ Page 01-53, Final control diagnosis - Check G80 ⇒ Page 23-75

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17659 P1251 Commencement of injection valve -N108 Short to positive	♦ Wiring short to positive ♦ N108 defective	♦ Engine knocks at idling because commencement of injection is constantly "advanced"	- Check N108 ⇒ page 01-53, Final control diagnosis
17660 P1252 Commencement of injection valve -N108 Open circuit/short to earth	♦ Wiring open circuit ♦ N108 defective	♦ Engine knocks at idling because commencement of injection is constantly "advanced"	- Check N108 ⇒ Page 01-53, Final control diagnosis
	♦ Wiring short to earth ♦ N108 defective	♦ Poor performance because commencement of injection is constantly "retarded"	

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17663 P1255 Coolant temperature sender -G62 Short to earth	♦ Wiring short to earth ♦ G62 defective	♦ Black smoke during start ♦ Glow period is always about 20 seconds	- Check G62 ⇒ Page 23-53
17664 P1256 Coolant temperature sender -G62 Open circuit/short to positive	♦ Wiring open circuit or short to positive ♦ G62 defective	♦ Black smoke during start ♦ Glow period is always about 20 seconds	- Check G62 ⇒ Page 23-53

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17762 P1354 Modulating piston movement sender - G149 Electrical fault in current circuit	♦ Wiring open circuit or short circuit ♦ Injection pump defective	♦ Glow period warning lamp (K29) flashes ♦ Various running problems ♦ Engine stops	- Check G149 ⇒ page 23-68, Checking modul. piston movement sender+quantity adjuster
17795 P1387 Control unit defective	♦ Control unit (J248) internally defective	♦ Various running problems ♦ Engine stops	- Replace J248 ⇒ Page 23-115
17810 P1402 Exhaust gas recirculation valve -N18 Short to positive	♦ Wiring short to positive ♦ N18 defective	♦ No exhaust gas recirculation	- Check N18 ⇒ page 01-53, Final control diagnosis

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17849 P1441 Exhaust gas recirculation valve -N18 Open circuit/short to earth	♦ Wiring open circuit ♦ N18 defective	♦ No exhaust gas recirculation	- Check N18 ⇒ Page 01-53, Final control diagnosis
	♦ Wiring short to earth	♦ Too much exhaust gas recirculation ♦ Reduced output, black smoke	
17911 P1503 Load signal from alternator DF terminal Implausible signal	♦ Open circuit or wiring short to earth ♦ Alternator defective ♦ Voltage regulator defective	♦ Engine pre-heating not operating	- Check alternator and voltage regulator ⇒ page 27-9

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17945 P1537 Fuel cut-off valve -N109 Faulty function	♦ N109 leaking or sticking ♦ N109 defective	♦ Reduced output ♦ Engine stops	- Check N109 ⇒ page 01-53, Final control diagnosis
17946 P1538 Fuel cut-off valve -N109 Open circuit/short to earth	♦ Wiring open circuit or short to earth ♦ N109 defective	♦ Reduced output ♦ Engine stops	- Check N109 ⇒ Page 01-53, Final control diagnosis

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17948 P1540 Road speed signal Signal too high	♦ Wiring open circuit or short to earth ♦ Switch or button for working speed governor defective	♦ Working speed governor not OK.	- Check working speed signal ⇒ page 23-102
17954 P1546 Charge pressure control solenoid valve -N75 Short to positive	♦ Wiring short to positive ♦ N75 defective	♦ Reduced output ♦ Charge pressure too low	- Check N75 ⇒ page 01-53, Final control diagnosis

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17957 P1549 Charge pressure control solenoid valve -N75 Open circuit/short to earth	♦ Wiring open circuit ♦ N75 defective	♦ Reduced output ♦ Charge pressure too low	- Check N75 ⇒ Page 01-53, Final control diagnosis
	♦ Short to earth ♦ N75 defective	♦ Reduced output ♦ Charge pressure too high	
17958 P1550 Charge pressure Control difference	♦ Charge pressure control solenoid valve (N75) defective ♦ Hose connections interchanged, not connected ♦ Leaks between turbocharger and engine (charge air path) ♦ Turbocharger defective	♦ Reduced output	- Check N75 ⇒ page 01-53, Final control diagnosis - Check charge pressure control ⇒ page 21-6

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17964 P1556 Charge pressure control Control limit not reached	♦ Charge pressure control solenoid valve (N75) defective ♦ Turbocharger defective ♦ Leaks between turbocharger and engine (charge air path)	♦ Charge pressure too low ♦ Reduced output	- Check N75 ⇒ page 01-53, Final control diagnosis - Check charge pressure control ⇒ page 21-6
17965 P1557 Charge pressure control Regulation limit surpassed	♦ Hose connections interchanged, not attached	♦ Reduced output ♦ Charge pressure too high	- Check N75 ⇒ page 01-53, Final control diagnosis - Check charge pressure control ⇒ page 21-6

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17969 P1561 Metering adjuster - N146 Control difference	♦ Wiring open circuit or short circuit ♦ Injection pump defective	♦ Glow period warning lamp (K29) flashes ♦ Various running problems ♦ Engine stops	- Check N146 ⇒ page 23-68, Checking modulating piston movement sender and quantity adjuster
17970 P1562 Metering adjuster - N146 Upper stop value	- Upper stop value attained - N146 defective/blocked	- Reduced output - Jerking	- Check N146 ⇒ Page 23-68, Checking modulating piston movement sender and quantity adjuster
17971 P1563 Metering adjuster - N146 Lower stop value	- Lower stop value attained - N146 defective/blocked	- Black smoke - Rough idling	- Check N146 ⇒ Page 23-68, Checking mod.piston move.sender and quantity adjuster

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17978 P1570 Engine control unit electronically locked	♦ Open circuit or short circuit in communication wire	♦ Engine starts briefly and then stalls ♦ Glow period warning lamp (K29) flashes	- Check wiring between engine control unit (J248) and immobiliser control unit (J334) using current flow diagram ⇒ page 27-20, Current flow diagram
	♦ Engine control unit (J248) not renewed in conjunction with immobiliser control unit (J334) ♦ J248 defective ♦ J334 defective		- Renew J248 ⇒ page 23-115
	♦ Start attempt without authorised key ♦ Manipulation attempt		- Start engine using authorised key

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
18008 P1600 Voltage supply terminal 15 Voltage too low	♦ No voltage when ignition is on (terminal 15)	♦ Engine does not start ♦ Various running problems including engine will not run	- Check voltage supply for diesel direct injection system ⇒ page 23-48
18009 P1601 Terminal 30 voltage supply relay -J317 Implausible signal	♦ Terminal 30 voltage supply relay (J317) defective ♦ Relay sticks (sporadically)	♦ Engine does not start ♦ Various running problems including engine will not run	- Check voltage supply for diesel direct injection system ⇒ page 23-48

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
18020 P1612 Engine control unit Incorrectly coded	♦ Invalid control unit coding	♦ Glow period warning lamp (K29) flashes	- Code control unit ⇒ page 23-117
18024 P1616 Glow period warning lamp -K29 Short to positive	♦ Short to positive	♦ Glow period warning lamp not functioning	- Check K29 ⇒ page 01-53, Final control diagnosis
18025 P1617 Glow period warning lamp -K29 Open circuit/short to earth	♦ Wiring open circuit ♦ Bulb defective	♦ Glow period warning lamp not functioning	- Check K29 ⇒ Page 01-53, Final control diagnosis
	♦ Short to earth	♦ Glow period warning lamp permanently on	

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
18026 P1618 Glow plug relay -J52 Short to positive	♦ Wiring short to positive ♦ J52 defective	♦ No glow period ♦ Poor cold starting ♦ Glow period warning lamp (K29) flashes	- Check J52 ⇒ page 01-53, Final control diagnosis
18027 P1619 Glow plug relay -J52 Open circuit/short to earth	♦ Wiring open circuit or short to earth ♦ J52 defective	♦ No glow period ♦ Poor cold starting ♦ Glow period warning lamp (K29) flashes	- Check J52 ⇒ Page 01-53, Final control diagnosis

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
18039 P1631 Accelerator position sender -G79 Signal too high	♦ G79 defective	♦ Glow period warning lamp (K29) flashes ♦ Increased idling speed	- Check G79 ⇒ page 20-7
18040 P1632 Accelerator position sender -G79 Voltage supply	♦ Wiring open circuit ♦ Operating voltage too high or too low	♦ Glow period warning lamp (K29) flashes ♦ Increased idling speed	- Check G79 ⇒ page 20-7

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
18047 P1639 Accelerator position sender 1/2 -G79+G185[1)] Implausible signal	♦ Wiring open circuit or short to earth ♦ G79 defective	♦ Glow period warning lamp (K29) flashes ♦ Increased idling speed	- Check G79 ⇒ page 20-7
18048 P1640 Control unit -J248- defective	♦ Control unit (J248) internally defective	♦ Various running problems ♦ Engine stops	- Replace J248 ⇒ page 23-115
18058 P1650 Drive train data bus No message from combi-instrument	♦ Fault in data bus wire to combi-instrument		- Check matching resistor of data bus ⇒ Page 23-120

[1)] Incorrect fault text display. Display must indicate:
Accelerator pedal position sender -G79
implausible signal

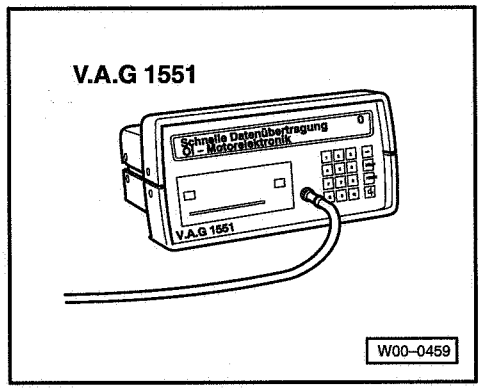
V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
19456 P3000 Glow period warning lamp -K29 Fault message from combi-instrument	♦ Fault in data bus wire to combi-instrument		- Check matching resistor of data bus ⇒ Page 23-120
19459 P3003 Low heat output relay -J359 Short to positive	♦ Wiring open circuit or short to positive ♦ J359 defective	♦ Engine preheating not functioning	- Check J359 ⇒ Page 01-53, Final control diagnosis

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
19461 P3005 High heat output relay -J360 Short to positive	♦ Wiring open circuit or short to positive ♦ J360 defective	♦ Engine preheating not functioning	- Check J360 ⇒ Page 01-53, Final control diagnosis
19560 P3104 Intake manifold flap change-over valve - N239 Short to positive	♦ Wiring short to positive ♦ N239 defective/stuck in open position	♦ Cold start problems ♦ Cold idling problems ♦ Hard load change ♦ Idling problems	- Check N239 ⇒ page 23-95

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
19561 P3105 Intake manifold flap change-over valve - N239 Open circuit/short to earth	♦ Wiring open circuit or short to earth ♦ N239 defective	♦ Cold start problems ♦ Cold idling problems ♦ Hard load changes ♦ Idling problems	- Check N239 ⇒ page 23-95

Final control diagnosis

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3

Note:

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051.

Check conditions

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

Performing final control diagnosis (engine code AVM)

The final control diagnosis activates the following components in the stated sequence:

1. Commencement of injection valve (N108)
2. Exhaust gas recirculation valve (N18)
3. Conditioner compressor interruption (take no notice of display)
4. Fuel shut-off valve (N109)
5. Charge pressure control solenoid valve (N75)
6. Glow plug relay (J52)
7. Glow period warning lamp (K29)
8. Low heat output relay (J359) (take no notice of display)
9. High heat output relay (J360) (take no notice of display)

Notes:

♦ *Activation of individual control elements is limited to 30 seconds but can be stopped at any time by pressing the → button.*

♦ *The ignition must be switched off before repeating the final control diagnosis.*

Work sequence

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Rapid data transfer HELP Select function XXX

◄ Indicated on display:

- Operate fault reader taking into account the information on the display:

- Press keys 0 and 3 for the function "Final control diagnosis".

Rapid data transfer Q 03 Final control diagnosis

◄ Indicated on display:

Activating commencement of injection valve (N108)

- Confirm input with Q key.

Final control diagnosis → Commencement of injection valve -N108

◄ Indicated on display:

Activating the valve, influences the noise of combustion considerably (pre-ignition).

If no changes in the combustion noises are heard:

- Proceed with final control diagnosis until completed.

- Check injection timing regulation range ⇒ page 23-77.

Activating EGR valve (N18)

- Press the → key.

Final control diagnosis → Exhaust gas recirculation valve -N18

◄ Indicated on display:

The valve must click.

Note:

Because the clicking of the valve is not audible over the engine noise, it can only be checked by feel.

Valve does not click:

- Proceed with final control diagnosis until completed.

- Check exhaust gas recirculation ⇒ page 26-8.

Activating air conditioner compressor interruption

- Press the → key.

Final control diagnosis → Conditioner compressor interruption

◄ Indicated on display:
(take no notice of display)

Activating fuel shut-off valve (N109)

- Press the → key.

Final control diagnosis → Fuel shut-off valve -N109

◄ Indicated on display:

The engine must stop.

If the engine does not stop:

- Switch off ignition.
- Unscrew fuel shut-off valve and remove any metal particles or dirt.
- Repeat final control diagnosis. If the engine will not stop, replace fuel shut-off valve ⇒ Page 23-23, item 7.

If the engine stalls:

- Continue final control diagnosis with engine stopped and ignition switched on.

Actuating charge pressure control solenoid valve (N75)

- Press the → key.

Final control diagnosis →
Charge pressure control solenoid valve -N75

◄ Indicated on display:

The solenoid valve must click.

Note:

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

If the solenoid valve does not click:

- Proceed with final control diagnosis until completed.
- Check charge pressure control ⇒ page 21-6.

Activating glow plug relay (J52)

- Press the → key.

Final control diagnosis →
Glow plug relay -J52

◄ Indicated on display:

The relay must click.

Switching on and off the relay can also be observed as the interior light becomes brighter and darker as a result of the glow plug high power consumption.

If the relay does not click:

- Check glow plug relay (J52) ⇒ page 27-20, Current flow diagrams.

Activating glow period warning lamp (K29)

- Press the → key.

Final control diagnosis →
Glow period warning lamp -K29

◄ Indicated on display:

The control lamp must flash.

Control lamp does not flash:

- Check glow period warning lamp (K29) ⇒ page 27-20, Current flow diagrams.

Activating low heat output relay (J359)

- Press the → key.

Final control diagnosis →
Low heater output relay -J359

◄ Indicated on display:
(take no notice of display)

Activating high heat output relay (J360)

- Press the → key.

Final control diagnosis →
High heater output relay -J360

◄ Indicated on display:

- Press the → key.

Rapid data transfer HELP
Select function XXX

◄ Indicated on display:

- Press keys 0 and 6 for the "End output" function and confirm input with the Q key.

- Switch off ignition.

This concludes the final control diagnosis.

Performing final control diagnosis (engine codes ARD and BEQ)

The final control diagnosis activates the following components in the stated sequence:

1. Commencement of injection valve (N108)
2. Exhaust gas recirculation valve (N18)
   (engine code BEQ only)
3. Conditioner compressor interruption
   (take no notice of display)
4. Intake manifold flap motor (V157)
   (engine code BEQ only)
5. Fuel shut-off valve (N109)
6. Glow plug relay (J52)
7. Glow period warning lamp (K29)
8. Low heat output relay (J359)
   (take no notice of display)
9. High heat output relay (J360)
   (take no notice of display)

Notes:

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

Work sequence

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Rapid data transfer HELP
Select function XXX

◄ Indicated on display:

- Operate fault reader taking into account the information on the display:
- Press keys 0 and 3 for the function "Final control diagnosis".

Rapid data transfer Q
03 Final control diagnosis

◄ Indicated on display:

Activating commencement of injection valve (N108)

- Confirm input with Q key.

Final control diagnosis →
Commencement of injection valve -N108

◄ Indicated on display:

Activating the valve, influences the noise of combustion considerably (pre-ignition).

If no changes in the combustion noises are heard:

- Proceed with final control diagnosis until completed.
- Check injection timing regulation range ⇒ page 23-77.

Activating EGR valve (N18)
(engine code BEQ only)

- Press the → key.

Final control diagnosis →
Exhaust gas recirculation valve -N18

◄ Indicated on display:

The valve must click.

Note:

Because the clicking of the valve is not audible over the engine noise, it can only be checked by feel.

Valve does not click:

- Proceed with final control diagnosis until completed.
- Check exhaust gas recirculation ⇒ page 26-19.

Activating air conditioner compressor interruption

- Press the → key.

Final control diagnosis →
Conditioner compressor interruption

◄ Indicated on display:
(take no notice of display)

Activating intake manifold flap motor (V157) (engine code BEQ only)

- Press the → key.

Final control diagnosis →
Intake manifold flap motor -V157

◄ Indicated on display:

Activating the intake manifold flap motor changes the combustion noise (the positioning motor opens and closes the intake manifold flap).

If no changes to combustion noises can be heard:

- Proceed with final control diagnosis until completed.
- Press keys 0 and 6 for the "End output" function and confirm input with the Q key.
- Switch off ignition.
- Check intake manifold flap motor (V157) ⇒ Page 23-98.

Activating fuel shut-off valve (N109)

- Press the → key.

Final control diagnosis →
Fuel shut-off valve -N109

◄ Indicated on display:

The engine must stop.

If the engine does not stop:

- Switch off ignition.
- Unscrew fuel shut-off valve and remove any metal particles or dirt.
- Repeat final control diagnosis. If the engine will not stop, replace fuel shut-off valve ⇒ Page 23-23, item 7.

If the engine stalls:

- Continue final control diagnosis with engine stopped and ignition switched on.

Activating glow plug relay (J52)

- Press the → key.

Final control diagnosis →
Glow plug relay -J52

◄ Indicated on display:

The relay must click.

Switching on and off the relay can also be observed as the interior light becomes brighter and darker as a result of the glow plug high power consumption.

If the relay does not click:

- Check glow plug relay (J52)
  ⇒ page 27-20, Current flow diagrams.

Activating glow period warning lamp (K29)

- Press the → key.

Final control diagnosis →
Glow period warning lamp -K29

◄ Indicated on display:

The control lamp must flash.

Control lamp does not flash:

- Check glow period warning lamp (K29)
  ⇒ page 27-20, Current flow diagrams.

Activating low heat output relay (J359)

- Press the → key.

Final control diagnosis →
Low heater output relay -J359

◄ Indicated on display:
(take no notice of display)

Activating high heat output relay (J360)

- Press the → key.

Final control diagnosis →
High heater output relay -J360

◄ Indicated on display:

- Press the → key.

Rapid data transfer HELP
Select function XXX

◄ Indicated on display:

- Press keys 0 and 6 for the "End output" function and confirm input with the Q key.

- Switch off ignition.

This concludes the final control diagnosis.

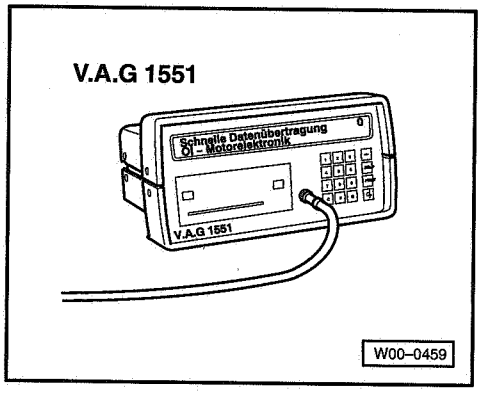
Measured value blocks

Observe safety precautions ⇒ Page 23-2.

Reading measured value block

The measured values in the functions read measured value block and basic setting are described during the individual component test. This table serves only as an overview.

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3

Note:

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051.

Check conditions

- The 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
  ⇒ Page 01-11, interrogating fault memory
- Coolant temperature must be at least 80 °C, ⇒ Display group 001, display zone 4.

Work sequence

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Rapid data transfer HELP
Select function XXX

◄ Indicated on display:

- Press keys 0 and 8 for the function "Read measured value block" and confirm entry with Q key.

Read measured value block
Input display group number XXX

◄ Indicated on display:

Note:

The display group number 001 is an example, to illustrate the sequence.

- Press keys 0, 0 and 1 for "Display group number 1" and confirm entry with Q key.

Read measured value block 1 →			
1	2	3	4

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

Note:

To change to another display group proceed as follows:

Display group	V.A.G 1551	V.A.G 1552
Higher	Press key 3	Press ↑ key
Lower	Press key 1	Press ↓ key
Skip	Press key C	Press key C

- If the specifications in all display zones are obtained, press → key.

Rapid data transfer HELP Select function XXX	◀

Indicated on display:

- Press keys 0 and 6 for the "End output" function and confirm input with the Q key.

- Switch off ignition.

Evaluating measured value blocks at idling speed and ignition on

Display group 000 at idling speed (engine warm, coolant temperature not below 80 °C)

Display group 000 (decimal value displayed) for engine code AVM			
• Engine running at idling speed			
Read measured value block 0 x x x x x x x x x x	◀ Indicated on display		
1 2 3 4 5 6 7 8 9 10	◀ Display zones	**Specification**	**Corresponds to**
10	Air mass[1]	108...144	360...480 mg/H
9	Fuel temperature	91...201	20...80 °C
8	Intake manifold temperature	182...50	10...100 °C
7	Coolant temperature	80...35	80...110 °C
6	Atmospheric pressure (air pressure)	181...222	900...1100 mbar
5	Intake manifold pressure (charge pressure)	82...102	900...1100 mbar
4	Injected quantity	15...45	3.0...9.0 mg/H
3	Accelerator pedal position	0	0 %
2	Commencement of injection	38...100	0°...5° BTDC
1	Engine speed	41...45	860...950 rpm

[1] The measured values are only valid when the exhaust gas recirculation (EGR) is switched on. When the engine is idling the EGR is switched off after running for a predetermined period, therefore give burst on throttle or restart engine.

Display group 000 (decimal value displayed) for engine codes ARD and BEQ

- Engine running at idling speed

Read measured value block 0 ◀ Indicated on display

x x x x x x x x x x

1 2 3 4 5 6 7 8 9 10 ◀ Display zones

Display zones	Specification	Corresponds to
Displayed value not relevant	disregard	—
Fuel temperature	91...201	20...80 °C
Intake manifold temperature	182...50	10...100 °C
Coolant temperature	80...35	80...110 °C
Atmospheric pressure (air pressure)	181...222	900...1100 mbar
Displayed value not relevant	disregard	—
Injected quantity	15...45	3.0...9.0 mg/H
Accelerator pedal position	0	0 %
Commencement of injection	38...88	0°...4° BTDC
Engine speed	41...45	860...950 rpm

Display group 001 at idling speed (engine warm, coolant temperature not below 80 °C)

Display group 001 -Injected quantity-

- Engine running at idling speed

Read measured value block 1 → ◀ Indicated on display

xxxx rpm | xx.x mg/H | x.xxx V | xxx.x °C

1 2 3 4 ◀ Display zones

Display zones	Specification	Evaluation
Coolant temperature	80.0...110.0 °C	—
Voltage from modulating piston movement sender Engine code AVM Engine codes ARD and BEQ	 1.450...1.950 V 1.600...2.100 V	 ⇒ page 01-73
Injected quantity	3.0...9.0 mg/H	⇒ Page 01-73
Engine speed	860...950 rpm	—

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

V.A.G 1551 display	Possible fault cause	Fault elimination
Below specification	♦ Injection pump too rich	- Renew injection pump ⇒ page 23-28
Above specification	♦ Engine too cold	- Run engine at increased speed to warm up and repeat check
	♦ Injection pump too lean	- Renew injection pump ⇒ Page 23-28

Evaluation: Display group 1, display zone 3 - Modulating piston movement sender voltage

V.A.G 1551 display	Possible fault cause	Fault elimination
Below specification	♦ Injection pump too rich	- Renew injection pump ⇒ page 23-28
Above specification	♦ Engine too cold	- Run engine at increased speed to warm up and repeat check
	♦ Injection pump too lean	- Renew injection pump ⇒ Page 23-28

Display group 002 at idling speed (engine warm, coolant temperature not below 80 °C)

Display group 002 -idling speed-						
Read measured value block 2 →				◀ Indicated on display		
xxxx rpm	xxx.x %	xxx	xxx.x °C			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Coolant temperature	80.0...110.0 °C	—
				Operating condition	01x	⇒ page 01-75
				Accelerator pedal position	0.0 %	⇒ Page 01-75
				Engine speed	860...950 rpm	—

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

V.A.G 1551 display	Possible fault cause	Fault elimination
1.0...100.0 %	♦ Accelerator pedal position sender (G79) defective ♦ Wiring open circuit to G79	- Check -G79 ⇒ page 20-7

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

Note:

Significance of figures in 3-digit number block for engine operating condition:

Significance when display = 1			
x	x	x	Engine operating condition
		x	Display value irrelevant
	1		Idling switch closed
1			Increased idling speed because electrical consumer/s switched on

Display group 003 at idling speed (engine warm, coolant temperature not below 80 °C)

Display group 003 -Exhaust gas recirculation[1]-						
Read measured value block 3 →				◀ Indicated on display		
xxxx rpm	xxx mg/H	xxx mg/H	xxx %			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Duty cycle from EGR valve: ♦ Engine code AVM ♦ Engine code ARD ♦ Engine code BEQ	15...80 % ignore 94...96 %	—
				Air mass drawn in (actual): ♦ Engine code AVM ♦ Engine codes ARD and BEQ	360...480 mg/H ignore	⇒ page 01-77
				Air mass drawn in (specified): ♦ Engine code AVM ♦ Engine codes ARD and BEQ	360...480 mg/H ignore	⇒ page 01-77
				Engine speed	860...950 rpm	—

[1] The measured values are only valid when the exhaust gas recirculation (EGR) is switched on. When the engine is idling the EGR is switched off after running for a predetermined period, therefore give burst on throttle or restart engine.

Evaluation: Display group 3, display zone 2 - Air mass drawn in (specified)

V.A.G 1551 display	Possible fault cause	Fault elimination
Above specification	♦ Engine too cold	- Run engine at increased speed to warm up and repeat check

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

V.A.G 1551 display	Possible fault cause	Fault elimination
Below specification	♦ Excessive exhaust gas recirculation	- Check exhaust gas recirculation ⇒ page 26-8
	♦ Unmetered air	- Check intake air system for leaks.
Above specification	♦ Engine too cold	- Run engine at increased speed to warm up and repeat check
	♦ Insufficient exhaust gas recirculation	- Engine running for a long time at idling speed, give burst on throttle.
	♦ Air mass meter (G70) defective	- Check air mass meter ⇒ page 23-87 - If a fault is present the measured value block indicates a constant air mass value of approx. 550 mg/H over the complete rpm and load range.

Display group 004 at idling speed (engine warm, coolant temperature not below 80 °C)

Display group 004 -Commencement of injection-						
• Engine running at idling speed						
Read measured value block 4 →				◀ Indicated on display		
xxxx rpm	xx.x ° B/ATDC	xx.x ° B/ATDC	xxx %			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Commencement of injection valve duty cycle ♦ Engine code AVM ♦ Engine codes ARD and BEQ	 3...97 % 2...80 %	---
				Commencement of injection (actual)	about commencement of injection (specified)	⇒ Page 01-79
				Commencement of injection (specified) ♦ Engine code AVM ♦ Engine codes ARD and BEQ	 0.0°...5.0° BTDC 0.0°...4.0° BTDC	⇒ page 01-79
				Engine speed	860...950 rpm	---

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

V.A.G 1551 display	Possible fault cause	Fault elimination
Above specification	♦ Engine too cold	- Run engine at increased speed to warm up and repeat check

Evaluation: Display group 4, display zone 3 - Commencement of injection (actual)

V.A.G 1551 display	Possible fault cause	Fault elimination
Above specification	♦ Engine too cold	- Run engine at increased speed to warm up and repeat check
	♦ Injection pump set too "advanced"	- Check and adjust commencement of injection dynamically ⇒ Page 23-35
	♦ Commencement of injection valve -N108 defective	- Check -N108 ⇒ Page 01-53, Final control diagnosis
Below specification	♦ Injection pump set extremely "retarded"	- Check and adjust commencement of injection dynamically ⇒ page 23-35
	♦ Commencement of injection valve -N108 defective ♦ Injection adjustment blocked	- Check -N108 ⇒ Page 01-53, Final control diagnosis

Display group 005

Note:

The values displayed are not relevant for fault finding within the service department.

Display group 005 -Starting conditions-						
Read measured value block 5 →				◀ Indicated on display		
xxxx rpm	xx.x mg/H	xx.x ° B/ATDC	xxx.x °C			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Coolant temperature	---	---
				Commencement of injection (actual)	---	---
				Starting quantity	---	---
				Engine speed	---	---

Display group 006 with ignition switched on

Display group 006 -Switch positions-						
• Ignition on, engine not running						
Read measured value block 6 →				◀ Indicated on display		
xxx km/h	xxx	xxxxxx	xxx			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Working speed governor: ♦ activated ♦ not activated	 0 255	
			Display value irrelevant		ignore	—
		Clutch and brake pedal monitoring			x00	⇒ page 01-82
	Speed				xxx km/h[2)]	—

[2)] The cruise control system (CCS) function in the Diesel direct injection system control unit and the CCS operating switch (E45) is used for the working speed governor (WSG). The engine speed signal from the engine speed sender (G28) is used as a replacement signal for the speed signal ⇒ Page 23-102, Checking speed signal for working speed governor.

Evaluation: Display group 6, display zone 2 -Brake pedal monitoring

Note:

Significance of figures in 3-digit number block for brake pedal monitoring:

Significance when display = 1			
x	x	x	Brake pedal monitoring
		1	Brake light switch -F closed
	1		Brake pedal switch -F-47 open
x			Display irrelevant

Display group 007 with ignition switched on (engine cold and not running)

Display group 007 -Temperatures-						
• Ignition on, engine not running						
Read measured value block 7 →				◀ Indicated on display		
xxx.x °C	---	xxx.x °C	xxx.x °C			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Coolant temperature	Approx. ambient temperature[1)]	⇒ Page 01-84
				Intake manifold temperature	Approx. ambient temperature[1)]	⇒ Page 01-84
					---	---
				Fuel temperature	Approx. ambient temperature[1)]	⇒ Page 01-84

[1)] Details of temperature specifications are not possible. When the engine is cold the fuel, intake air and coolant temperatures must equate approximately to ambient temperature. If a temperature deviates noticeably then the relevant sender must be checked.

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

V.A.G 1551 display	Possible fault cause	Fault elimination
- 5.4 °C	♦ Short circuit or fuel temperature sender (G81) defective	- Check G81 ⇒ page 23-64 - If a fault is present, the measured value block indicates a fuel temperature of -5.4 °C

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

V.A.G 1551 display	Possible fault cause	Fault elimination
Approx.136.8 °C	♦ Intake manifold temperature sender -G72 defective	- Check -G72 ⇒ Page 23-58 - If a fault is present, the measured value block indicates a constant intake manifold or intake air temperature of approx.136.8 °C

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

V.A.G 1551 display	Possible fault cause	Fault elimination
Large deviation from ambient temperature	♦ Short circuit or coolant temperature sender -G62 defective	- Check -G62 ⇒ Page 23-53 - If a fault is present, the fuel temperature is displayed instead

Display group 009

Note:

The values displayed are not relevant for fault finding within the service department.

Display group 009 -Injected quantity limitation-						
Read measured value block 9 →				◀ Indicated on display		
xxxx rpm	xx.x mg/H	xx.x mg/H	x.xxx V			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Modulating piston movement sender voltage	—	—
			Injected quantity limitation		—	—
		Injected quantity			—	—
	Engine speed				—	—

Display group 012

Note:

The values displayed are not relevant for fault finding within the service department.

Display group 012 -Glow plug system-						
Read measured value block 12 →				◀ Indicated on display		
xxxxxxxx	xx.xx	xx.x V	xxx.x °C			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Coolant temperature	—	—
			Supply voltage from control unit		—	—
		Pre-glow period (in seconds)			—	—
	Pre-glow period system status				—	—

Display group 013 at idling speed (engine warm, coolant temperature not below 80 °C)

Display group 013 -Smooth idling speed control-						
• Engine running at idling speed						
Read measured value block 13 →				◀ Indicated on display		
x.xx mg/H	x.xx mg/H	x.xx mg/H	x.xx mg/H			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Smooth running control injected quantity cyl. 4 ♦ Engine code AVM ♦ Engine codes ARD and BEQ	- 2.00...+2.00 mg/H - 1.90...+1.90 mg/H	⇒ page 01-88
				Smooth running control injected quantity cyl. 3 ♦ Engine code AVM ♦ Engine codes ARD and BEQ	- 2.00...+2.00 mg/H - 1.90...+1.90 mg/H	⇒ page 01-88
				Smooth running control injected quantity cyl. 2 ♦ Engine code AVM ♦ Engine codes ARD and BEQ	- 2.00...+2.00 mg/H - 1.90...+1.90 mg/H	⇒ page 01-88
				Smooth running control injected quantity cyl. 1 ♦ Engine code AVM ♦ Engine codes ARD and BEQ	- 2.00...+2.00 mg/H - 1.90...+1.90 mg/H	⇒ page 01-88

Evaluation: Display group 13, display zones 1...4 - Idling speed smooth running control

♦ The injection system is equipped with an idling speed smooth running control. There may be power differences between the individual cylinders (component tolerances, injector delivery, compressions etc.) which are recognised and equalized via selective injected quantities.

♦ Recognition at idling speed is via the signal from the engine speed sender which delivers four signals per crankshaft revolution to the control unit. If the signals are delivered at the same rhythm then all cylinders work the same. If one cylinder is weaker then the crankshaft takes longer for the next half revolution. Conversely a more powerful cylinder accelerates the crankshaft so less time is taken.

♦ If the control unit recognises a difference, then the relevant cylinder is 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.

Display group 015

Note:

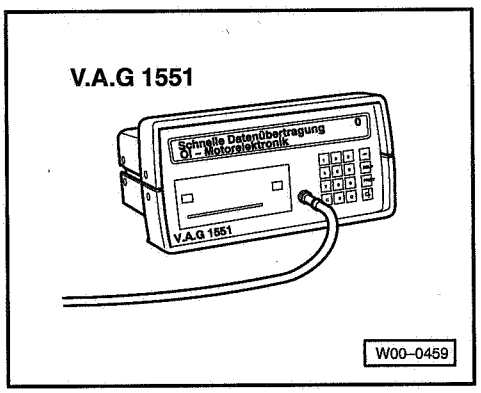
The values displayed are not relevant for fault finding within the service department.

Display group 015 -Fuel consumption-						
Read measured value block 15 →				◀ Indicated on display		
xxxx rpm	xx.x mg/H	xx.xx l/h	xx.x mg/H			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Injection quantity requirement	—	—
				Fuel consumption	—	—
				Injection quantity (actual)	—	—
				Engine speed	—	—

Conditions for measurements at full load

Due to the various installation possibilities of an industrial engine the full load measurements must first ensure that the engine, under operating conditions, achieves full load.

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3

Note:

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051.

Check conditions

- The 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
  ⇒ Page 01-11, interrogating fault memory

- Coolant temperature must be at least 80 °C, ⇒ Display group 001, display zone 4.

Work sequence

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Rapid data transfer HELP
Select function XXX

◄ Indicated on display:

- Press keys 0 and 8 for the function "Read measured value block" and confirm entry with Q key.

Read measured value block
Input display group number XXX

◄ Indicated on display:

- Press keys 0, 0 and 1 for "Display group number 1" and confirm entry with Q key.

Read measured value block 1 →
xxxx rpm xxx.x mg/H x.xxx V 87.3 °C

◄ Indicated on display:

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

Continue with check only when coolant temperature is attained.

- Increase engine speed, under full load, from approx. 1500 rpm using full throttle (accelerator position sender on full throttle stop).

Note:

The brake pedal must not be operated whilst taking measurements. The control unit thus reduces the fuel quantity which leads to incorrect measurements.

- Press PRINT key on V.A.G 1551 at approx. 2500 rpm.

Read measured value block 1 →
2520 rpm 35.0 mg/H x.xxx V 87.3 °C

◄ Indicated on display:

- Check specification for charge pressure in display zone 2:
  Specification for engine code AVM:
  33.0...40.0 mg/h
  Specification for engine codes ARD and BEQ:
  41.0...45.0 mg/h

If the quantity injected is not attained:

- Increase engine load and repeat the test sequence.

If the quantity injected is attained:

- Press → key.
- Further measures see repair procedures.

Reading measured value blocks at full load/throttle

Display group 000 at full load (engine warm, coolant temperature not below 80 °C)

Notes:

- *When testing, increase engine speed, under full load, from 1500 rpm at full throttle. See conditions when measuring at full load ⇒ Page 01-90.*
- *The measured values must be printed out or read (2nd person required) when the revolutions reach 2,500 rpm.*

Display group 000 (decimal value displayed) for engine code AVM		
• Engine running at full load		
• Engine speed 2500...3100 rpm		
Read measured value block 0 ◀ Indicated on display		
x x x x x x x x x x		
1 2 3 4 5 6 7 8 9 10 ◀ Display zones	**Specification**	**Corresponds to**
Air mass	210...255	700...850 mg/H
Fuel temperature	91...201	20...80 °C
Intake manifold temperature	182...50	10...100 °C
Coolant temperature	80...35	80...110 °C
Atmospheric pressure (air pressure)	181...222	900...1100 mbar
Intake manifold pressure (charge pressure)	174...204	1800...2150 mbar
Injected quantity	165...200	33.0...40.0 mg/H
Accelerator pedal position	255	100 %
Commencement of injection	86...163	1.5°...10.0° BTDC
Engine speed	118...148	2500...3100 rpm

Display group 000 (decimal value displayed) for engine codes ARD and BEQ		
• Engine running at full load		
• Engine speed 2500...3100 rpm		
Read measured value block 0 ◀ Indicated on display x x x x x x x x x x 1 2 3 4 5 6 7 8 9 10 ◀ Display zones	**Specification**	**Corresponds to**
Displayed value not relevant	disregard	---
Fuel temperature	91...201	20...80 °C
Intake manifold temperature	182...50	10...100 °C
Coolant temperature	80...35	80...110 °C
Atmospheric pressure (air pressure)	181...222	900...1100 mbar
Displayed value not relevant	disregard	---
Quantity injected	120...140	24.0...28.0 mg/H
Accelerator pedal position	255	100 %
Commencement of injection	100...163	5...10° BTDC
Engine speed	118...148	2500...3100 rpm

Display group 004 at full load (engine warm, coolant temperature not below 80 °C)

Notes:

- *When testing, increase engine speed, under full load, from 1500 rpm at full throttle. See conditions when measuring at full load ⇒ Page 01-90.*
- *The measured values must be printed out or read (2nd person required) when the revolutions reach 2,500 rpm.*

Display group 004 -Commencement of injection- for engine code AVM		
• Engine at full load • Engine speed 2500...3100 rpm		
Read measured value block 4 → ◀ Indicated on display xxxx rpm xx.x ° B/ATDC xx.x ° B/ATDC xxx % 1 2 3 4 ◀ Display zones	**Specification**	**Evaluation**
Commencement of injection valve duty cycle	3...85 %	⇒ page 01-98
Commencement of injection (actual)	Approx. com. of inj. (specified)	⇒ Page 01-98
Commencement of injection (specified)	1.5°...10.0° BTDC	—
Engine speed	2500...3100 rpm	—

Display group 004 -Commencement of injection- for engine codes ARD and BEQ						
• Engine at full load • Engine speed 2500...3100 rpm						
Read measured value block 4 →				◀ Indicated on display		
xxxx rpm	xx.x ° B/ATDC	xx.x ° B/ATDC	xxx %			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Commencement of injection valve duty cycle	70...95 %	⇒ Page 01-98
				Commencement of injection (actual)	Approx. com. of inj. (specified)	⇒ Page 01-98
				Commencement of injection (specified)	5.0°...10.0° BTDC	—
				Engine speed	2500...3100 rpm	—

Evaluation: Display group 4, display zone 3 - Commencement of injection (actual)

V.A.G 1551 display	Possible fault cause	Fault elimination
If large deviation from specified value (approx. 5°)	♦ Commencement of injection valve -N108 defective	- Check -N108 ⇒ Page 01-53, Final control diagnosis
	♦ Injection pump timing way off	- Check commencement of injection dynamically and adjust ⇒ Page 23-35
	♦ Air in fuel system	- Check fuel supply system

Evaluation: Display group 4, display zone 4 - Duty cycle of commencement of injection valve

V.A.G 1551 display	Possible fault cause	Fault elimination
Specification outside tolerance	♦ Commencement of injection valve -N108 defective	- Check -N108 ⇒ Page 01-53, Final control diagnosis
		- Check commencement of injection dynamically and adjust ⇒ Page 23-35
		- Check fuel supply system

Display group 010 at full load (engine warm, coolant temperature not below 80 °C)

Notes:

- *When testing, increase engine speed, under full load, from 1500 rpm at full throttle. See conditions when measuring at full load ⇒ Page 01-90.*
- *The measured values must be printed out or read (2nd person required) when the revolutions reach 2,500 rpm.*

Display group 010 -Air quantities- for engine code AVM						
• Engine at full load • Engine speed 2500...3100 rpm						
Read measured value block 10 →				◀ Indicated on display		
xxx mg/H	xxxx mbar	xxxx mbar	xxx.x %			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Accelerator pedal position	100 %	⇒ Page 01-102
				Intake manifold pressure (charge pressure)	1800...2150 mbar	⇒ page 01-101
				Atmospheric pressure (ambient pressure)	No specification	—
				Air mass drawn in	750...850 mg/H	⇒ page 01-101

Display group 010 -Air quantities- for engine codes ARD and BEQ						
• Engine at full load • Engine speed 2500...3100 rpm						
Read measured value block 10 →				◀ Indicated on display		
—	xxxx mbar	—	xxx.x %			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Accelerator pedal position	100 %	⇒ Page 01-102
					—	—
				Atmospheric pressure (ambient pressure)	No specification	—
					—	—

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

V.A.G 1551 display	Possible fault cause	Fault elimination
Below specification	♦ Revs too high or too low	- Read off specified value at 3100 rpm.
	♦ Charge pressure too low	- Check charge pressure control ⇒ page 21-6
	♦ Air mass meter (G70) defective	- Check -G70 ⇒ Page 23-87 - If a fault is present, the measured value block indicates a constant air mass value of about 550 mg/H over total engine speed and load range

Evaluation: Display group 10, display zone 3 - Intake manifold pressure (charge pressure)

V.A.G 1551 display	Possible fault cause	Fault elimination
Below specification	♦ Charge pressure control defective ♦ Turbocharger defective	- Check charge pressure control ⇒ page 21-6
Above specification	♦ Turbocharger defective	

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

V.A.G 1551 display	Possible fault cause	Fault elimination
Below specification	♦ No full throttle	- Repeat check at full throttle
	♦ Accelerator pedal position sender (G79) defective ♦ Wiring open circuit to G79	- Check G79 ⇒ page 20-7

Display group 011 at full load (engine warm, coolant temperature not below 80 °C)

Notes:

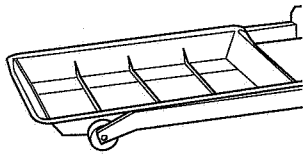
- *When testing, increase engine speed, under full load, from 1500 rpm at full throttle. See conditions when measuring at full load ⇒ Page 01-90.*
- *The measured values must be printed out or read (2nd person required) when the revolutions reach 2,500 rpm.*

Display group 011 -Charge pressure control- for engine code AVM						
• Engine at full load • Engine speed 2500...3100 rpm						
Read measured value block 11 →				◀ Indicated on display		
xxxx rpm	xxxx mbar	xxxx mbar	xxx %			
1	2	3	4	◀ Display zones	**Specification**	**Evaluation**
				Duty cycle from charge pressure control valve	20...85 %	—
				Charge pressure (actual)	approx. charge pressure (specification)	⇒ page 01-104
				Charge pressure (specified)	1800...2150 mbar	—
				Engine speed	2500...3100 rpm	—

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

V.A.G 1551 display	Possible fault cause	Fault elimination
Below specification	♦ Charge pressure control defective ♦ Turbocharger defective	- Check charge pressure control ⇒ page 21-6
	♦ Measured at high altitude	No fault: - If possible repeat measurement at 0 m elevation (sea level)
Above specification	♦ Turbocharger defective	- Check charge pressure control ⇒ page 21-6

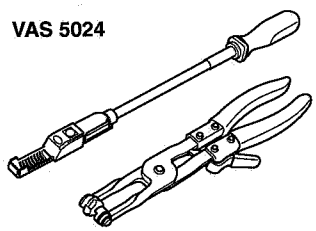
V.A.G 1306



V.A.G 1331

V.A.G 1332

VAS 5024



W10–0074

Removing and installing engine

Special tools, workshop equipment, test and measuring appliances and auxiliary items required

- V.A.G 1306 Drip tray
- V.A.G 1331 Torque wrench (5...50 Nm)
- V.A.G 1332 Torque wrench (40...200 Nm)
- VAS 5024 Assembly tool for spring-type clamps

Notes on removing

Note:

The following work procedure covers just the basic instructions for removing and installing industrial engines as no set routine can be established for all engines due to the variations in installation.

Work sequence

Warning!

When carrying out repair work, especially due to the cramped conditions, note the following:

- ***Route all lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant, refrigerant, brake fluid and vacuum pipes and hoses) and electrical wiring so that the original positions are restored.***
- ***Ensure sufficient clearance to all moving or hot components.***

- All cable ties which are opened or cut open when removing engine, must be replaced in the same position when installing engine.

- With ignition switched off disconnect battery earth strap.

- Disconnect fuel supply and return pipes at fuel filter.

Warning!

- ***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!***

- Seal the pipes so that the fuel system is not contaminated by dirt etc.

- Observe rules for cleanliness ⇒ page 23-4.
- Drain coolant ⇒ Page 19-8.
- Pull coolant hoses off radiator.
- Pull off all coolant hoses to engine with assembly tool for spring-type clamps VAS 5024.
- Disconnect all electric wires from gearbox, alternator and starter and move clear.
- Pull off/disconnect all other electrical connections as necessary from engine and lay to one side.

- Pull vacuum and breather hoses off engine as necessary.
- Remove front exhaust pipe.

Assemblies with air conditioner:

- *Observe additional information and removal instructions ⇒ Page 10-7.*

When working on the engine, it should be secured to the assembly stand support clamp VW 313 using the engine and gearbox box support VW 540.

Notes on installing

Installation is carried out in the reverse order, when doing this note the following:

Work sequence

- Check clutch release bearing for wear, renew if necessary.

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

- Check whether the dowel sleeves for centralising engine/gearbox are in the cylinder block, install if necessary.

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

- Align assembly mountings stress-free by rocking.

- Install front exhaust pipe.

- Filling with coolant ⇒ Page 19-8

- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

Tightening torques

Bolted connections		Tightening torque
On cylinder head	M 6	10 Nm
	M 7	15 Nm
	M 8	20 Nm
	M10	40 Nm
	M 12	60 Nm

Additional information and removal instructions for installations with air conditioner

Warning!

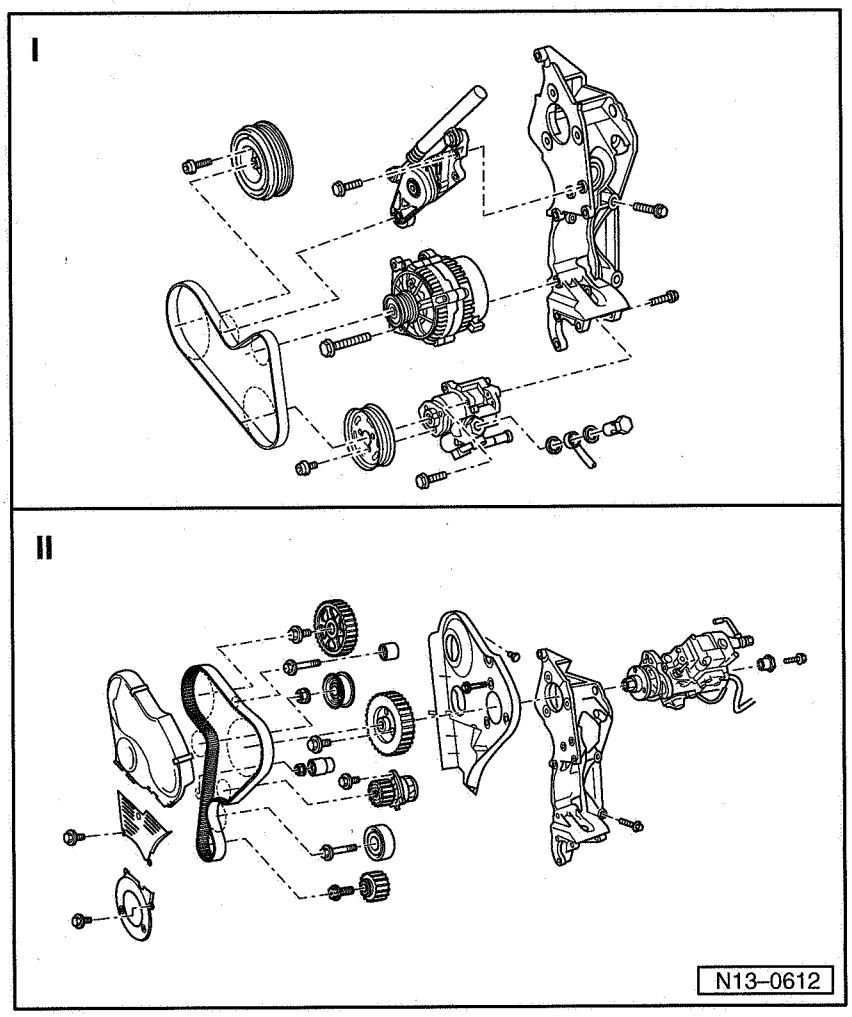
The air conditioning system refrigerant circuit must not be opened.

Notes:

- *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 and the refrigerant pipes/hoses, ensure that the pipes and hoses are not stretched, kinked or bent.*

To facilitate removing and installing the engine without opening the refrigerant circuit:

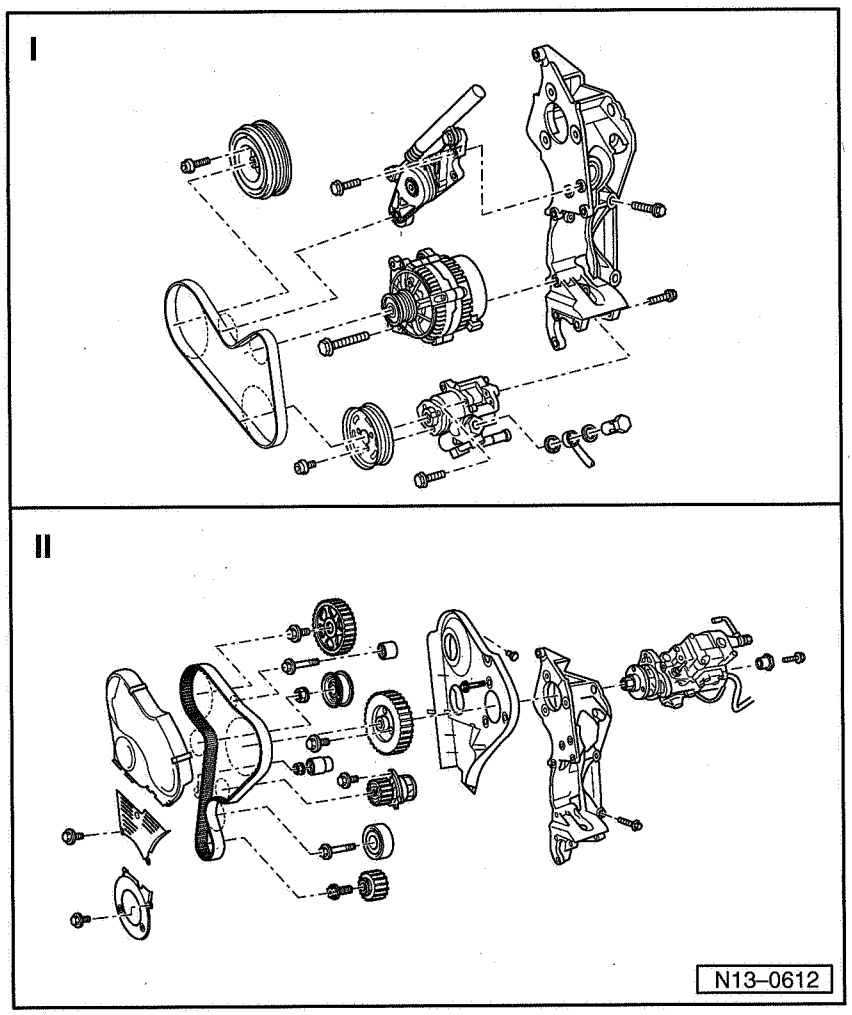
- Remove retaining clamp(s) from refrigerant pipes.
- Remove ribbed belt ⇒ Page 13-14.
- Remove air conditioning compressor and place to side so that refrigerant lines are free of stress.



Dismantling and assembling engine

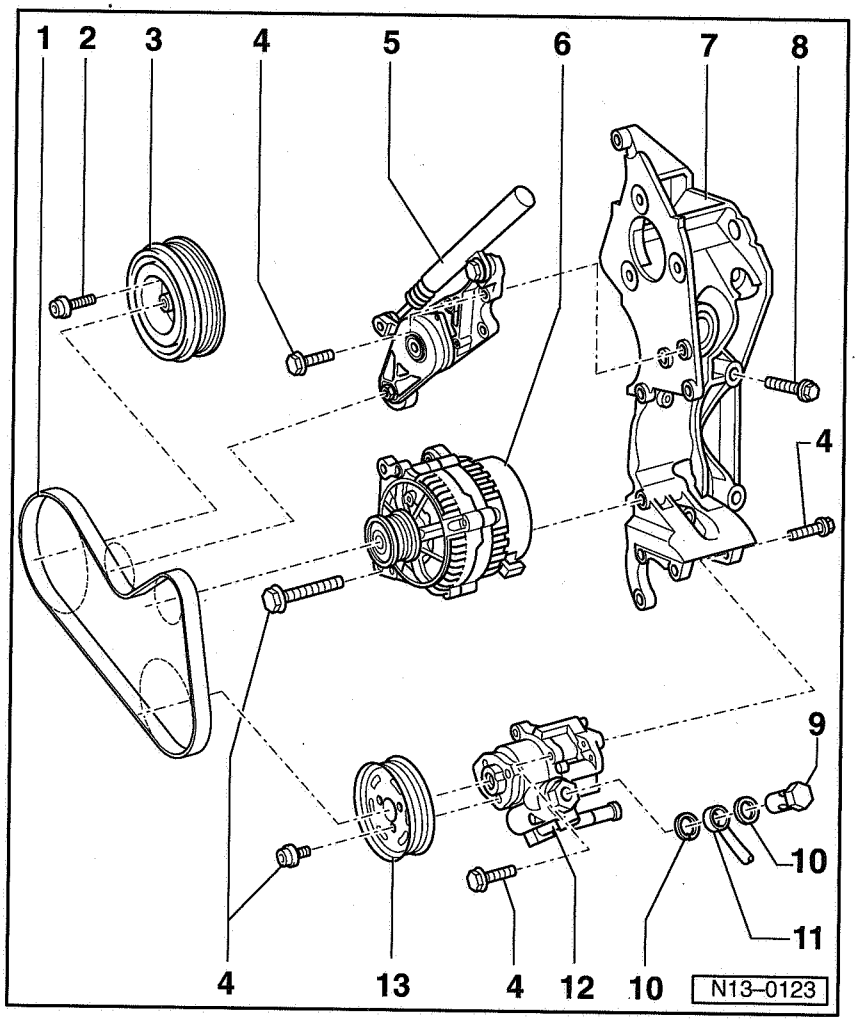
Notes:

- *If during repair work, metal shavings or larger quantities of small metal particles are found in the engine oil - caused, for example, by partial seizure of the crankshaft and conrod bearings - then, apart from thoroughly cleaning out the oil passages, it is necessary to renew the oil cooler.*
- *Defective injectors can cause violent knocking noises in the engine which sound like defective bearings. When this occurs, run engine at idling speed and slacken off injector pipe unions one after the other. If knocking stops when a union is loosened, this indicates that the injector concerned is defective.*
- *All bearing and running surfaces must be oiled before assembling.*



I ⇒ Page 13-3

II ⇒ Page 13-7



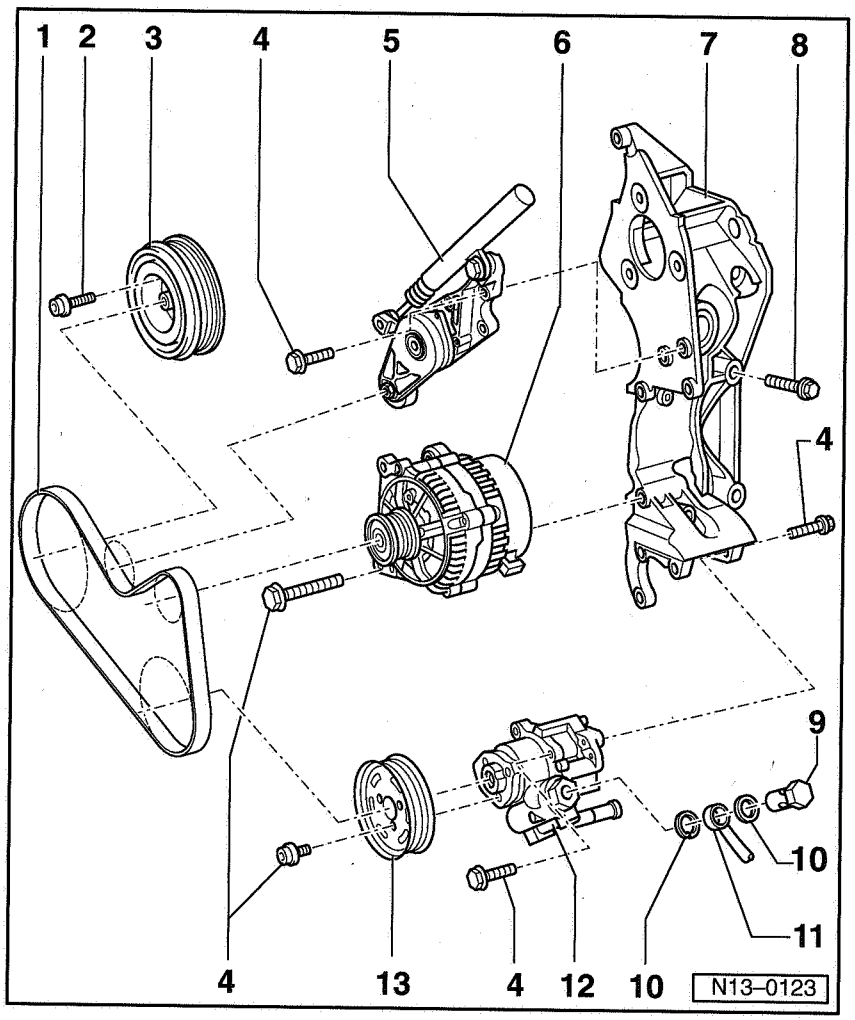
Part I

1 - Ribbed belt
- ♦ Mark direction of rotation before removing
- ♦ Check for wear
- ♦ Do not kink
- ♦ Removing and installing ⇒ Page 13-14
- ♦ Checking ⇒ page 13-17
- ♦ Removing and installing on units with air conditioner and additional idler wheel ⇒ fig. 1

2 - 10 Nm + 1/4 turn (90 °) further
- ♦ Renew

3 - Belt pulley/vibration damper
- ♦ Can only be installed in one position. Holes are off-set

4 - 25 Nm



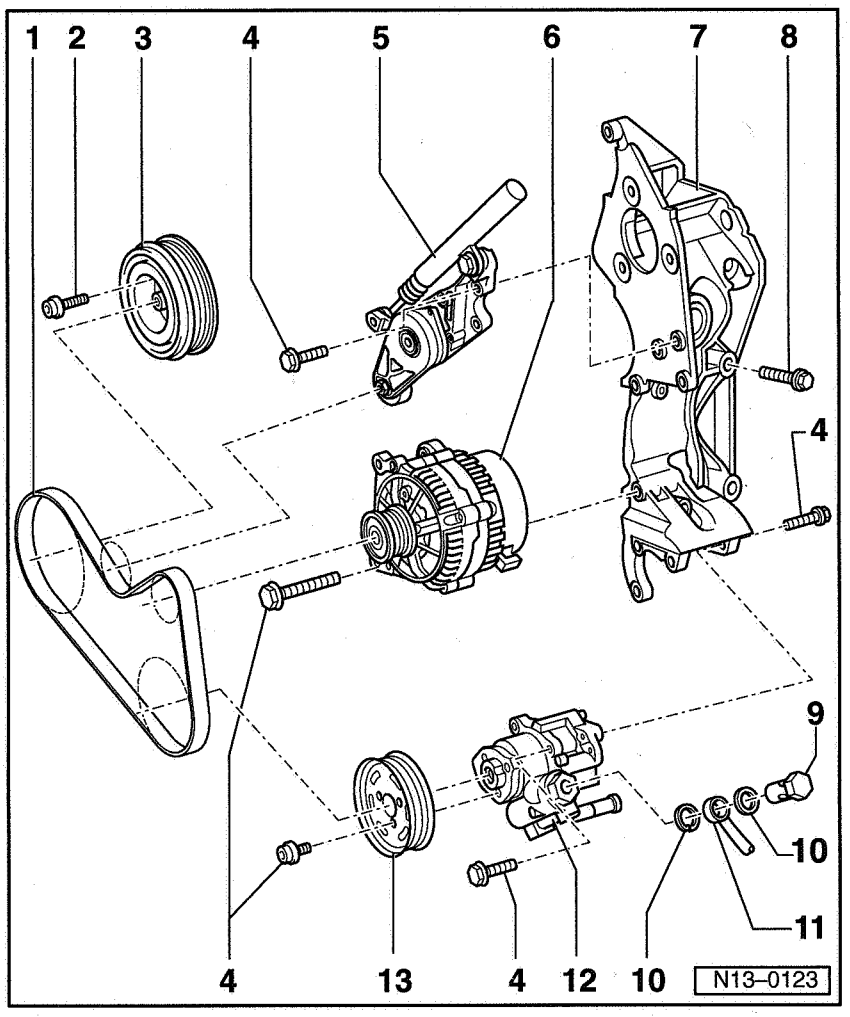
5 - Tensioning device for ribbed belt
- ♦ Only engine code AVM with suspension
- ♦ Turn with open-end spanner to slacken ribbed belt ⇒ Page 13-14

6 - Alternator

7 - Compact bracket
- ♦ For injection pump, alternator and vane pump for power assisted steering
- ♦ For units without air conditioner
- ♦ Removing and installing compact bracket on units with air conditioner:

⇒ Golf 1998 ➤, Bora 1999 ➤; Heater, air conditioner; Repair group 87; Removing and installing compressor bracket

8 - 45 Nm



9 - Banjo bolt, 30 Nm

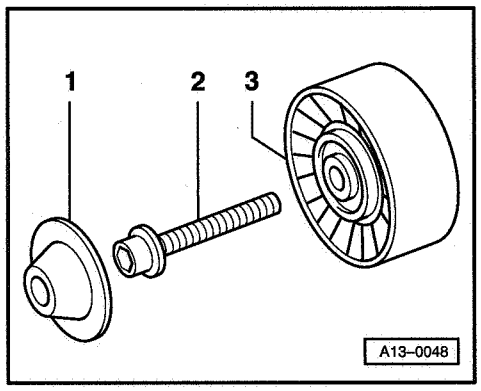
10 - Seal
- ♦ Renew

11 - Pressure pipe

12 - Vane pump
- ♦ For power assisted steering
- ♦ Removing and installing

⇒ Golf 1998 ➤, Bora 1999 ➤; Running gear, axles, steering front and four-wheel drive; Repair group 48; Assembly overview: Vane pump, reservoir, hydraulic pipes

13 - Pulley
- ♦ For vane pump



◄ **Fig. 1 Removing and installing idler wheel**

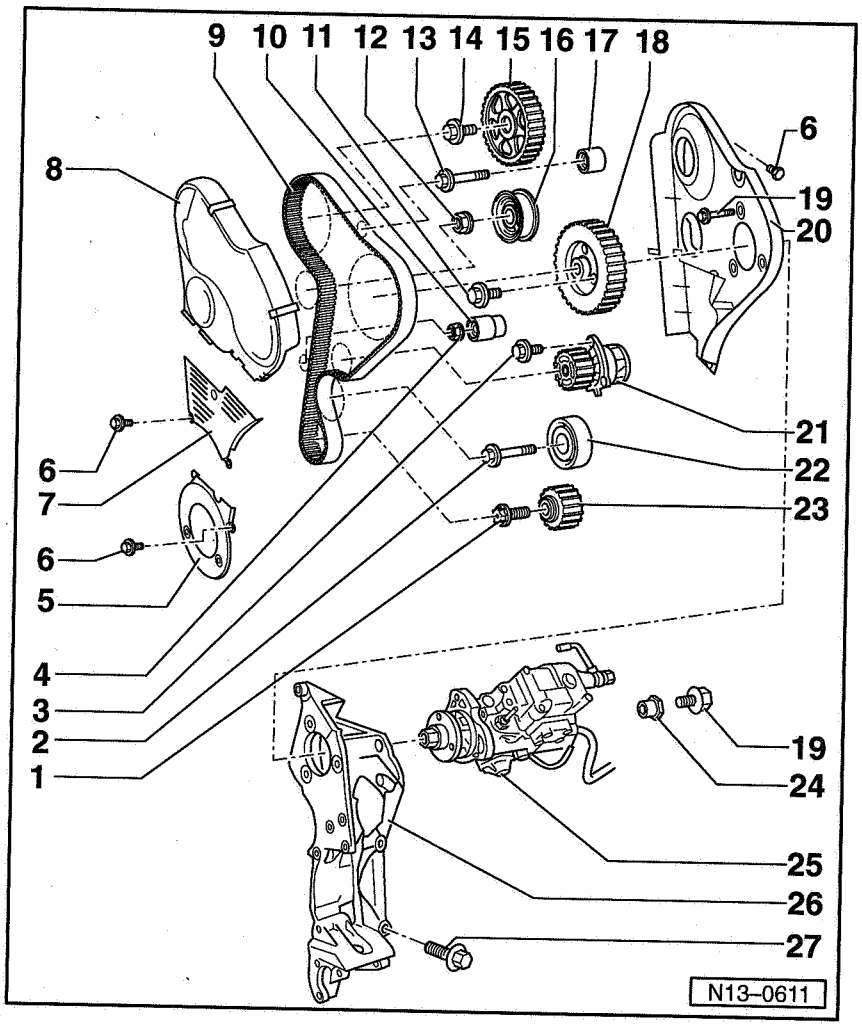
For units with air conditioner only

Removing

- Remove ribbed belt ⇒ Page 13-14.
- Lever off cover -1- using a screwdriver.
- Unscrew securing bolt -2- and remove idler wheel -3-.

Installing

- Attach idler wheel -3- and tighten securing bolt -2-. Tightening torque 25 Nm.
- Install ribbed belt ⇒ Page 13-14.



Part II

1 - 120 Nm + 1/4 turn (90 °) further
- ♦ Renew
- ♦ Counter-hold with 3415 to loosen and tighten
- ♦ Do not additionally oil or grease the threads and shoulder
- ♦ The quarter turn further can be done in several stages.

2 - 40 Nm + 1/4 turn (90 °) further
- ♦ Renew

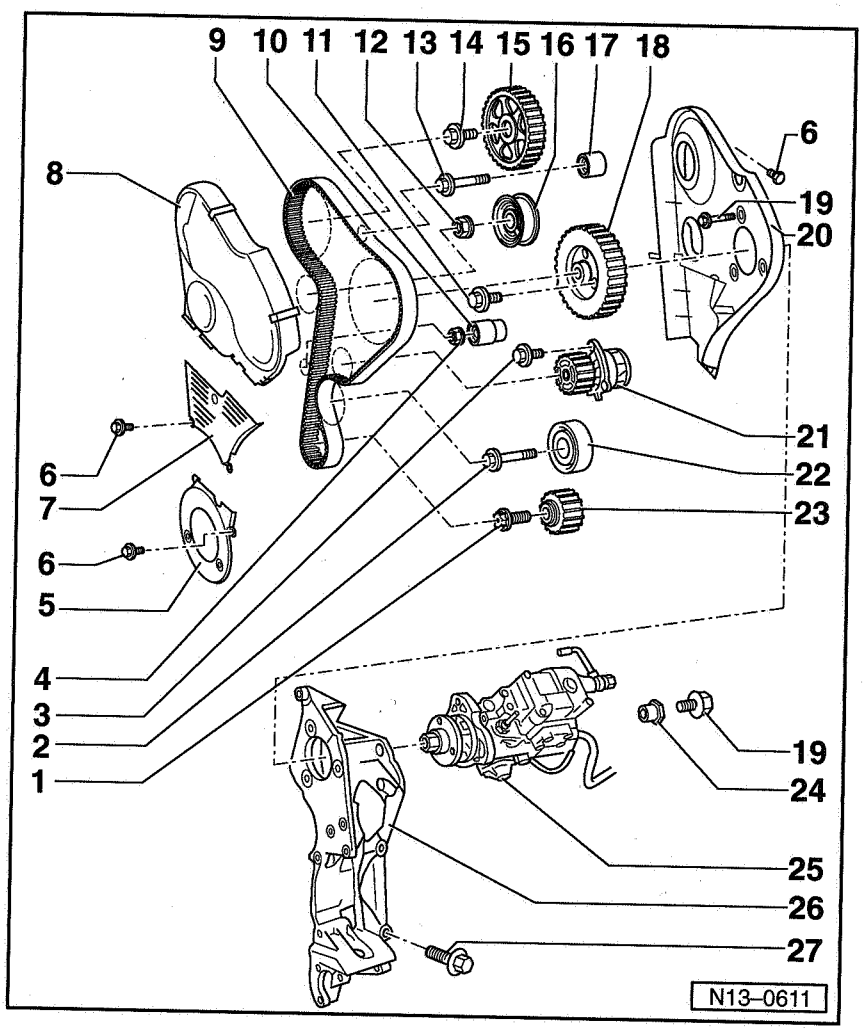
3 - 15 Nm

4 - 23 Nm

5 - Toothed belt guard - lower part

6 - 10 Nm

7 - Toothed belt guard - centre part



8 - Toothed belt guard - upper part

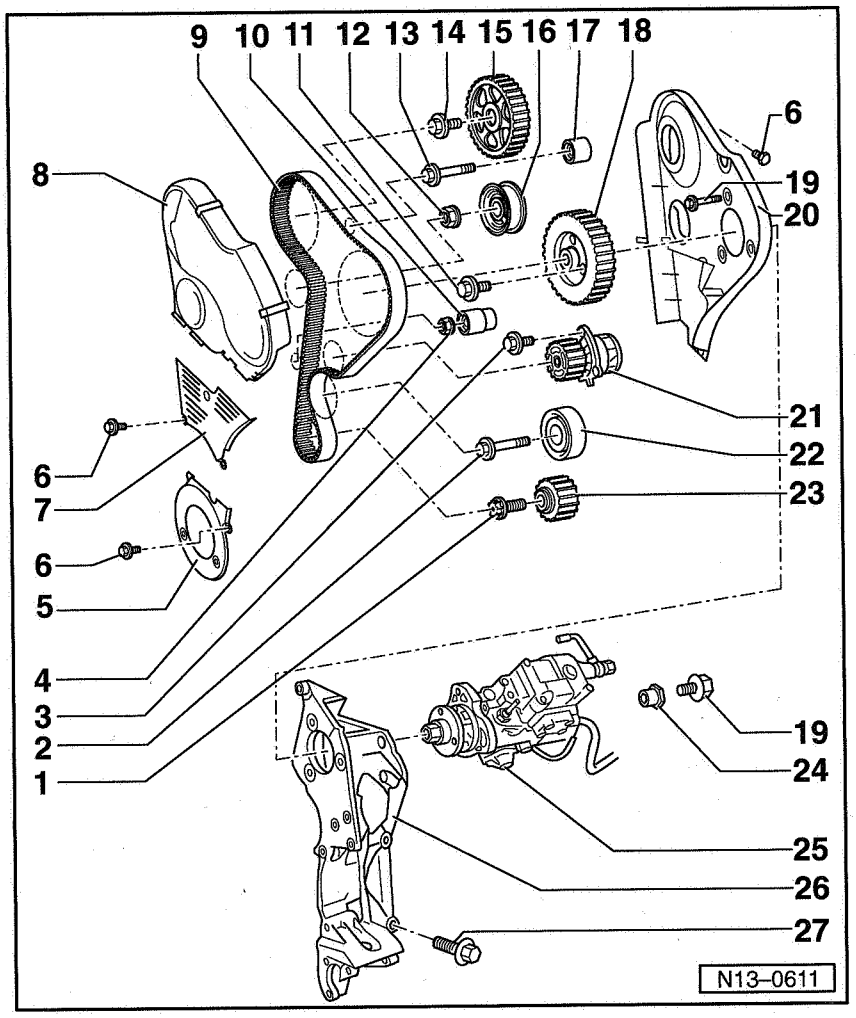
9 - Toothed belt
- ♦ Mark D.O.R. before removing
- ♦ Check for wear
- ♦ Do not kink
- ♦ Removing, installing and tensioning ⇒ Page 15-8

10 - Idler wheel
- ♦ Engine code AVM only

11 - Injection pump sprocket securing bolts
- ♦ Take note of different types and torque settings ⇒ Fig. 1

12 - 20 Nm

13 - 23 Nm



14 - 45 Nm
- ♦ Counter-hold with 3036 to loosen and tighten

15 - Camshaft sprocket
- ♦ Pull off with puller T40001

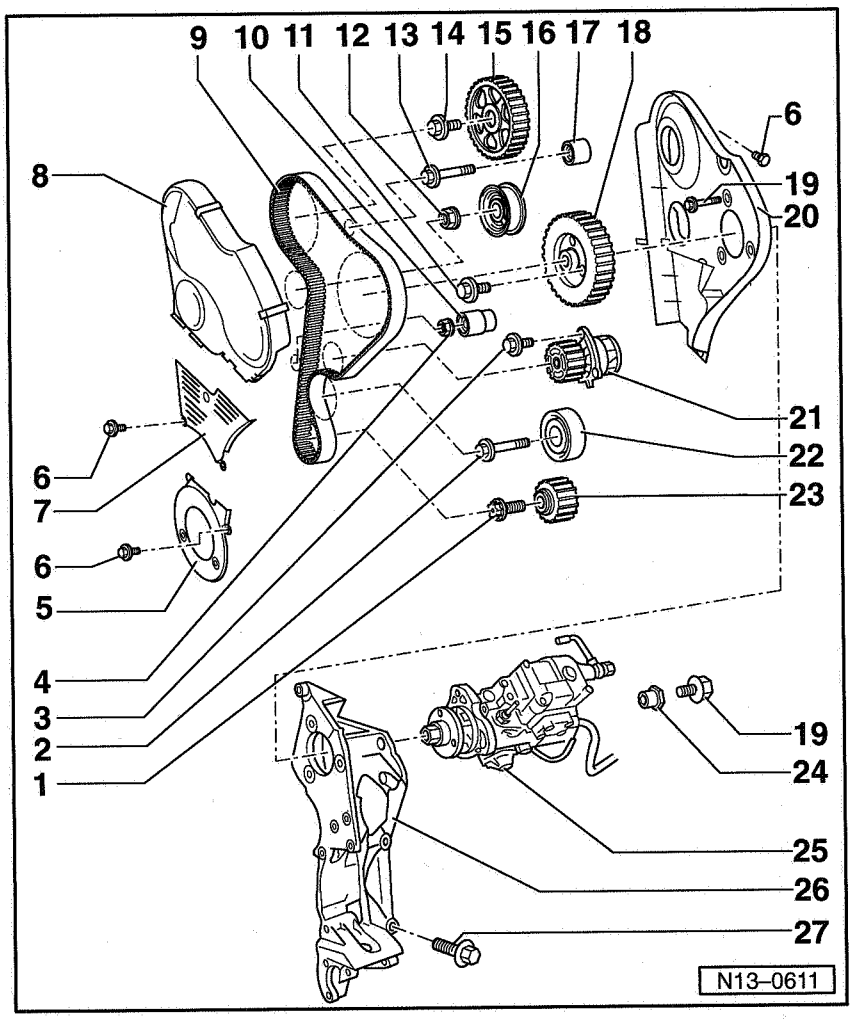
16 - Tensioning roller
- ♦ Checking semi-automatic toothed belt tensioning roller
  ⇒ Page 15-18

17 - Idler wheel

18 - Injection pump sprocket
- ♦ Two part
- ♦ Take note of different types (Part No.) ⇒ Fig. 1
- ♦ Removing and installing ⇒ Page23-28, Removing and installing injection pump

19 - 25 Nm

20 - Rear toothed belt guard

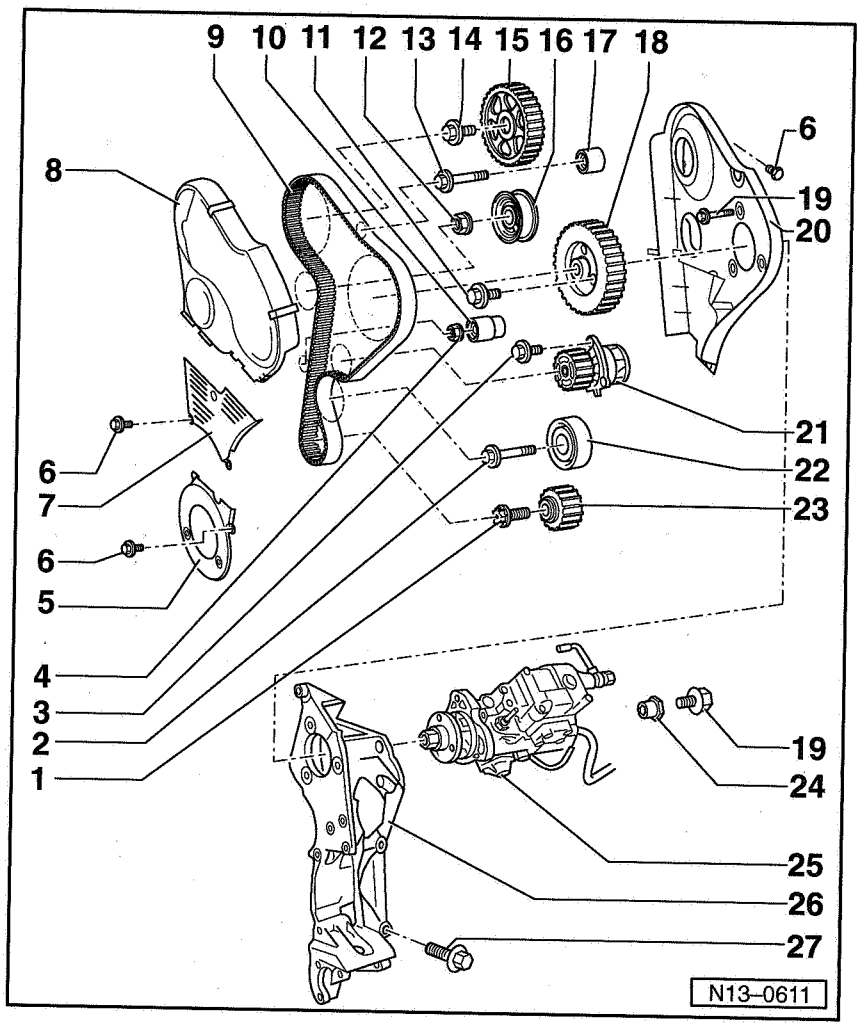


21 - Coolant pump
- ♦ Check for ease of movement
- ♦ Note installation position
- ♦ Removing and installing
  ⇒ Page 19-13

22 - Idler wheel
- ♦ Remove to remove coolant pump
- ♦ Removing and installing:
  ⇒ page 19-13, Removing and installing coolant pump

23 - Crankshaft toothed belt sprocket

24 - Sleeve
- ♦ With securing nut



25 - Injection pump

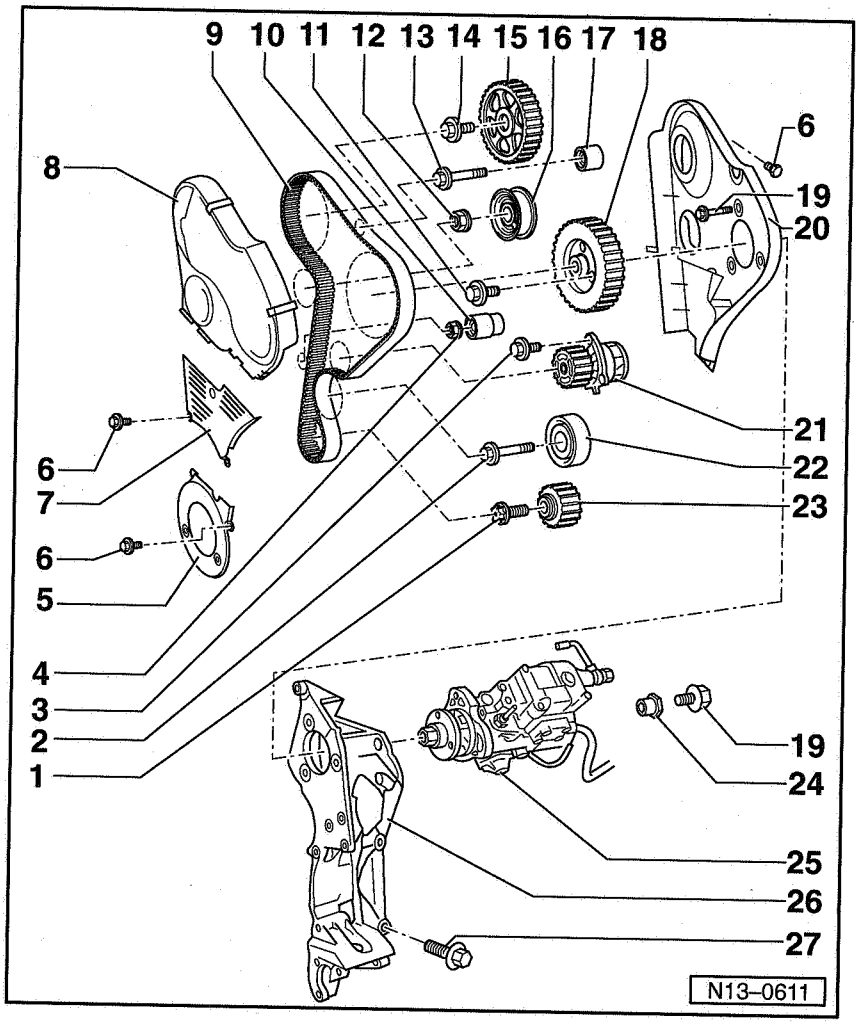
- ♦ With quantity adjuster (metering)
- ♦ With quantity adjuster (N146)
- ♦ With modulating piston movement sender (G149)
- ♦ With fuel temperature sender (G81)

- ♦ Removing and installing
  ⇒ Page 23-28
- ♦ Dynamically checking and adjusting commencement of injection
  ⇒ Page 23-35

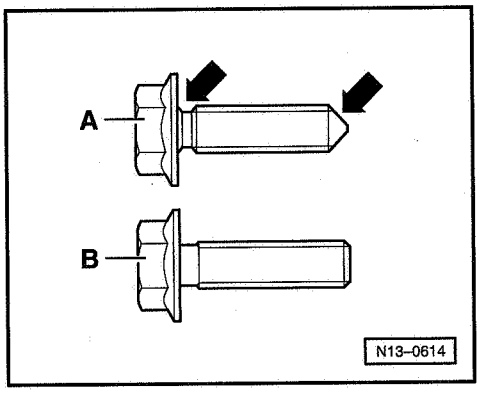
26 - Compact bracket

- ♦ For injection pump, alternator and vane pump for power assisted steering
- ♦ For units without air conditioner
- ♦ Removing and installing compact bracket on units with air conditioner:

⇒ Golf 1998 ➤, Bora 1999 ➤; Heater, air conditioner; Repair group 87; Removing and installing compressor bracket



27 - 45 Nm



◄ **Fig. 1 Types of injection pump sprocket securing bolts**

Version -A-:
Securing bolts with chamfer on shaft and pointed end -arrows-

- ♦ Part number of injection pump sprocket:
  038 130 111 A
- ♦ Torque setting of securing bolts:
  20 Nm + $^1/_4$ turn (90°)
- ♦ Renew securing bolts

Note:

The securing bolt -A- is a stretch bolt and must always be replaced.

Version -B-: Securing bolts without chamfer on shaft and without pointed end

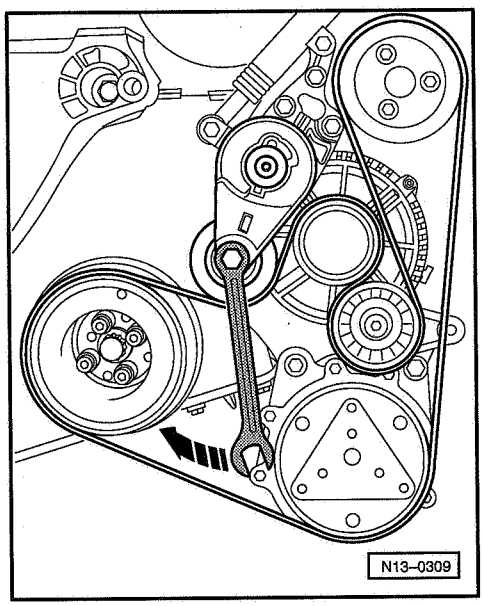
- ♦ Part No. of injection pump sprocket:
  038 130 111 B
- ♦ Torque setting of securing bolts:
  25 Nm
- ♦ Securing bolts need not be renewed

Removing and installing ribbed belt

Removing ribbed belt

Note:

Before removing the ribbed belt mark the direction of rotation. When installing the belt ensure it is correctly seated in the pulley.



◄
- Swing tensioning roller in direction of arrow using open jaw spanner 16 mm A/F on tensioning lever.
- Remove ribbed belt.

Installing ribbed belt

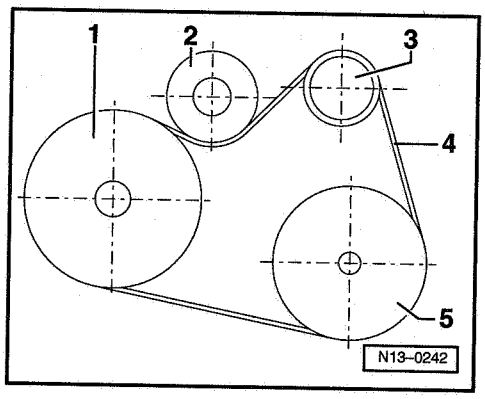
- Install in reverse order.

Notes:

- *On units without air conditioner remove ribbed belt from alternator first and fit on alternator last when installing.*
- *On units with air conditioner remove ribbed belt from idler roller first and fit on idler roller last when installing.*
- *Ensure, before installing ribbed belt, that all ancillaries (alternator, air conditioner compressor, power assisted steering vane pump) are secured tightly.*
- *When fitting the ribbed belt observe belt direction of rotation and that the belt is seated correctly in the belt pulleys.*

After completing repairs always:

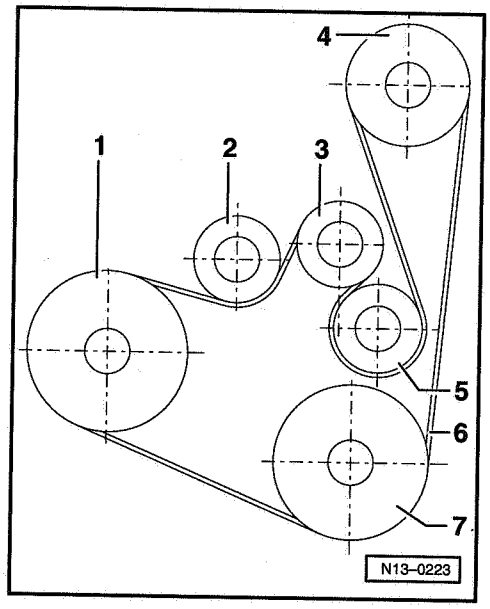
- Start engine and check belt running.



Ribbed belt routing

◄ Belt drive without air conditioner compressor

1 - Vibration damper/belt pulley
2 - Tensioning roller
3 - Pulley - Alternator
4 - Ribbed belt
5 - Pulley - P.A.S. vane pump



◄ Belt drive with air conditioner compressor

1 - Vibration damper/belt pulley
2 - Tensioning roller
3 - Pulley - alternator
4 - Pulley - P.A.S. vane pump
5 - Idler wheel
6 - Ribbed belt
7 - Pulley - air conditioner compressor

Checking ribbed belt

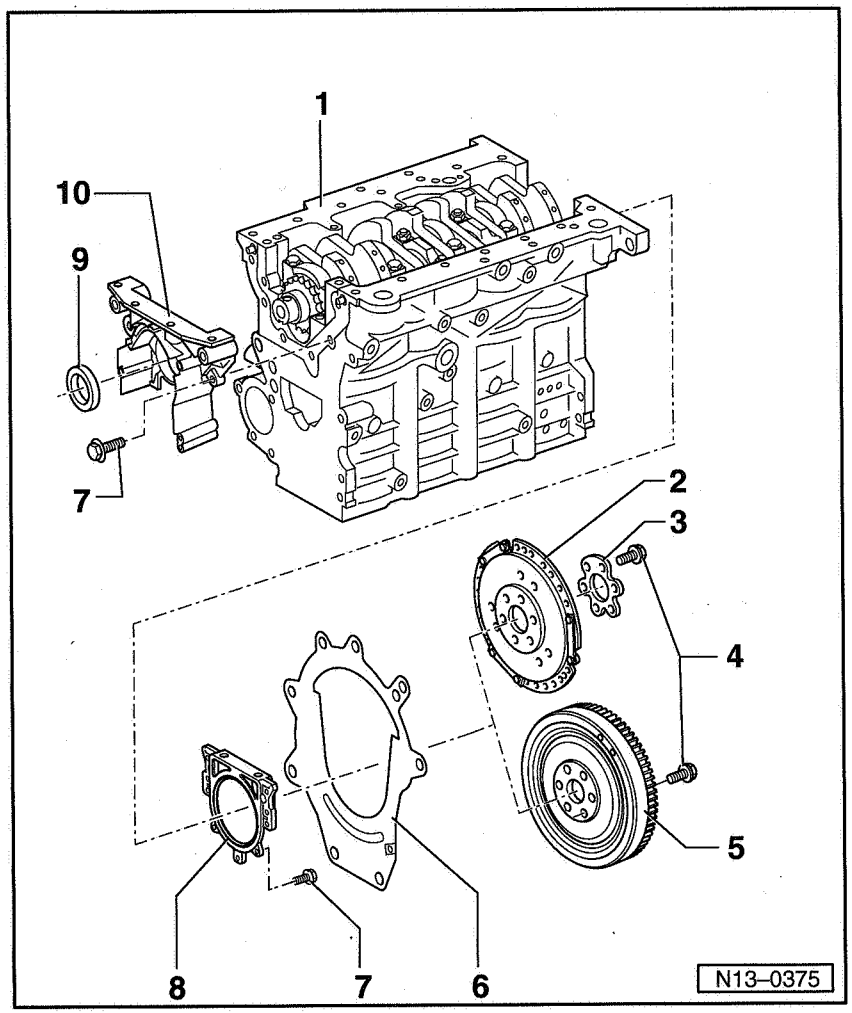
Note:

It is essential to renew the ribbed belt if a fault is found. This will avoid possible break-downs or operating problems.

Test sequence

- Crank engine by hand and check ribbed ribbed belt for:

  - ♦ Sub-surface cracks (cracks, core ruptures, cross sectional breaks)
  - ♦ Layer separation (top layer, cord strands)
  - ♦ Base break-up
  - ♦ Fraying of cord strands
  - ♦ Flank wear (material wear, frayed flanks, flank brittleness -glassy flanks-, surface cracks)



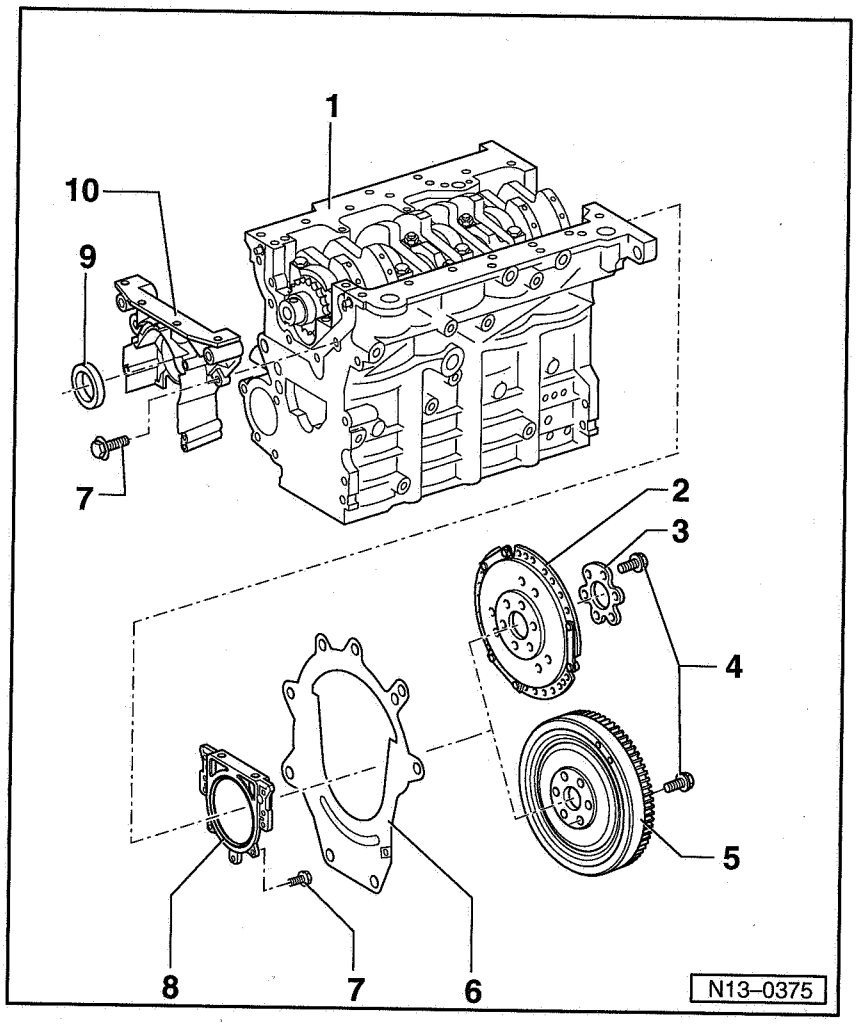
Removing and installing sealing flange and pressure plate/flywheel/drive plate

1 - Cylinder block
- ♦ Removing and installing crankshaft ⇒ Page 13-31
- ♦ Dismantling and assembling pistons and conrods ⇒ Page 13-36

2 - Pressure plate/drive plate
- ♦ To remove and install flywheel counter-hold with VW 558

3 - Plate
- ♦ Observe fitting position

4 - 60 Nm + $^1/_4$ turn (90 °) further
- ♦ Renew



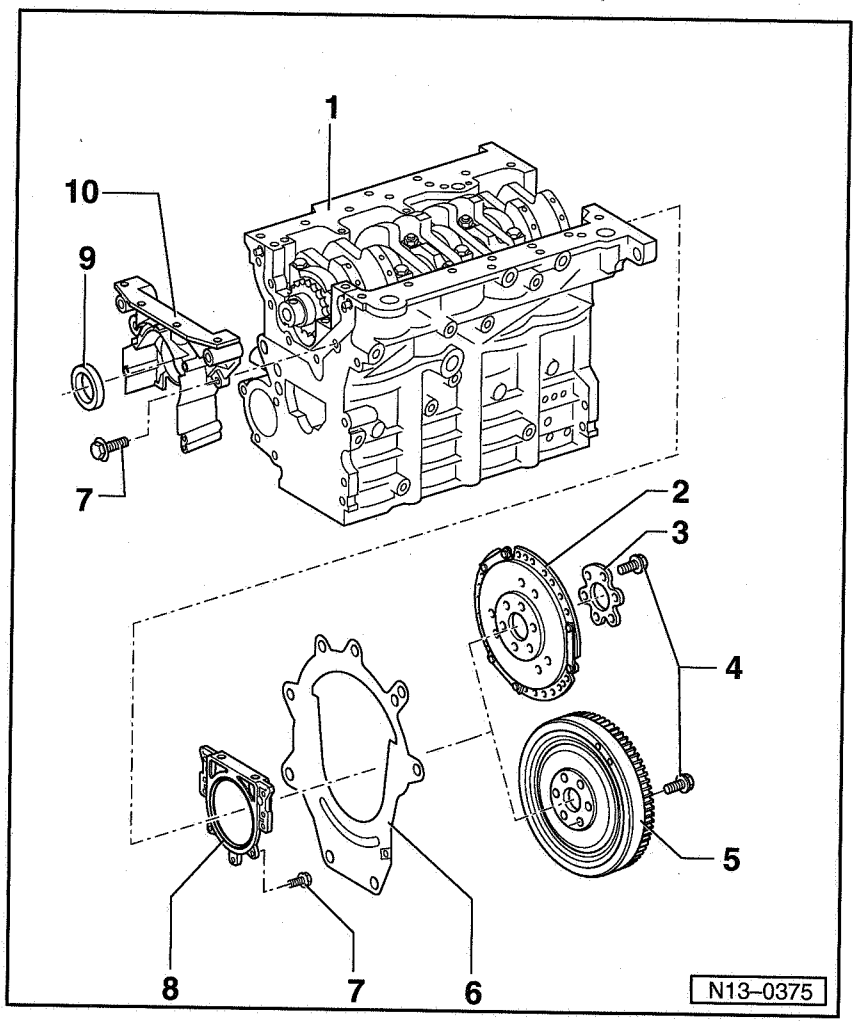
5 - Flywheel/drive plate

- To remove and install flywheel counter-hold with 3067

6 - Intermediate plate

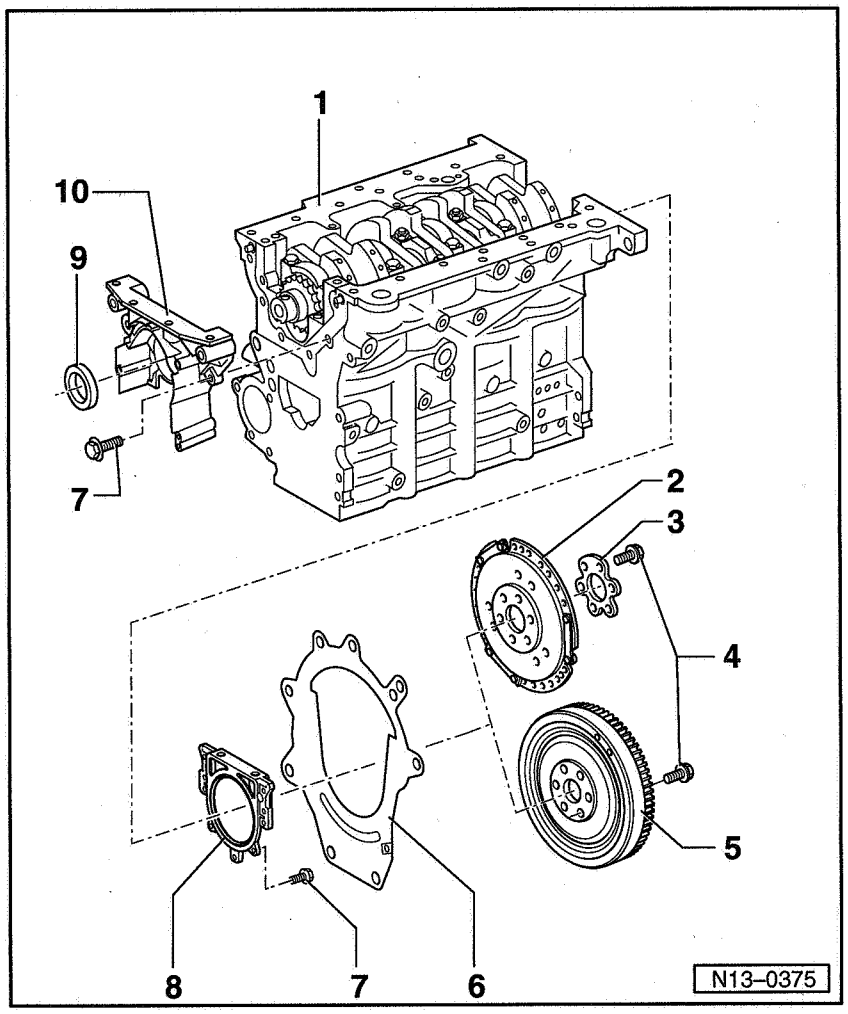
- Must be located on dowel sleeves
- Do not damage/bend when assembling

7 - 15 Nm



8 - Sealing flange with oil seal

- PTFE version of oil seal
- Identification: no inner coil spring
- Only renew complete
- Do not additionally oil or grease the oil seal sealing lip
- Before installing, remove oil remains from crankshaft journal with a clean cloth
- Use protective sleeve supplied when installing
- Remove protective sleeve first after sealing flange has been slid onto crankshaft journal

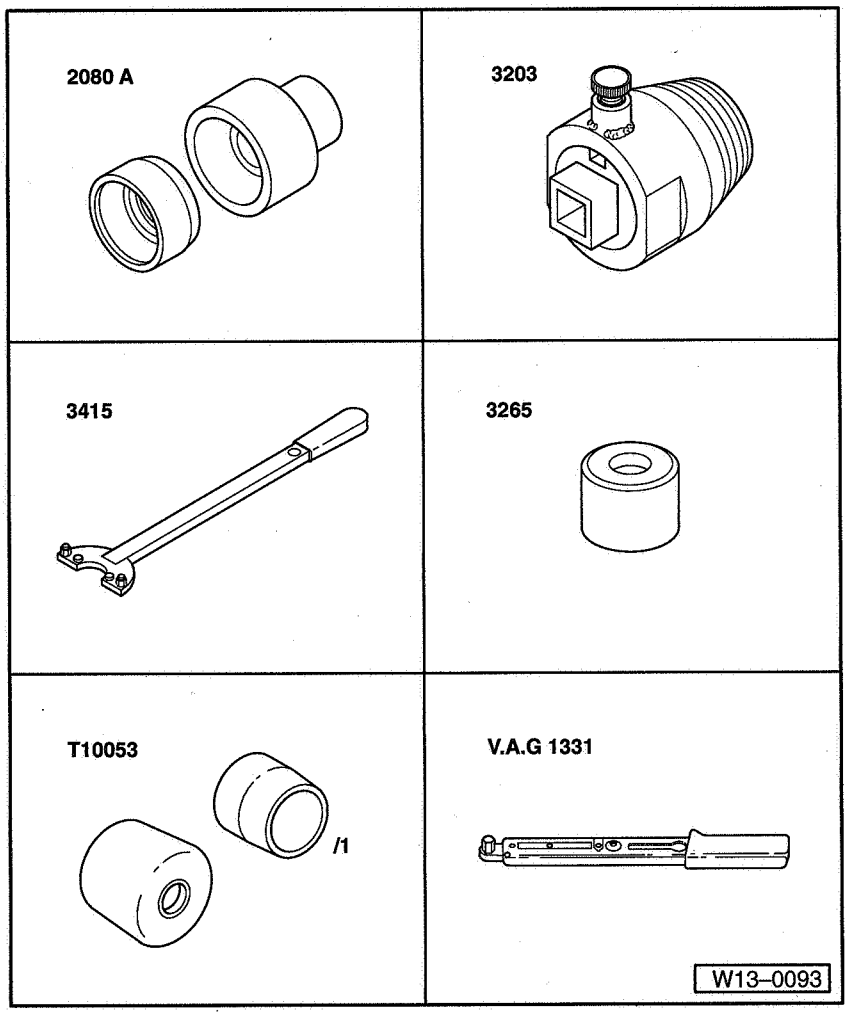


9 - Oil seal

- ♦ Note differing versions
- ♦ Sealing flange with PTFE oil seal without inner coil spring
- ♦ Renewing crankshaft oil seal - pulley end ⇒ Page 13-22

10 - Front sealing flange

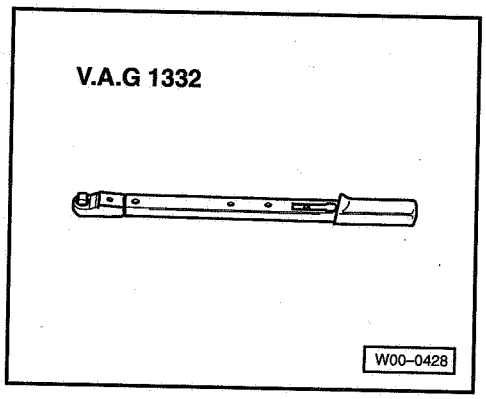
- ♦ Must be located on dowel sleeves
- ♦ Removing and installing ⇒ Page 13-27



Renewing crankshaft oil seal - pulley end

Special tools, workshop equipment, test and measuring appliances and auxiliary items required

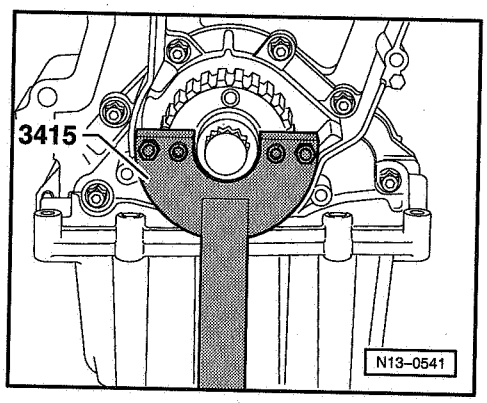
- ♦ 2080 A Fitting sleeve
- ♦ 3203 Oil seal extractor
- ♦ 3415 Counter-hold tool
- ♦ 3265 Fitting sleeve
- ♦ T10053 Assembly tool (for PTFE oil seal)
- ♦ V.A.G 1331 Torque wrench (5...50 Nm)



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

Removing

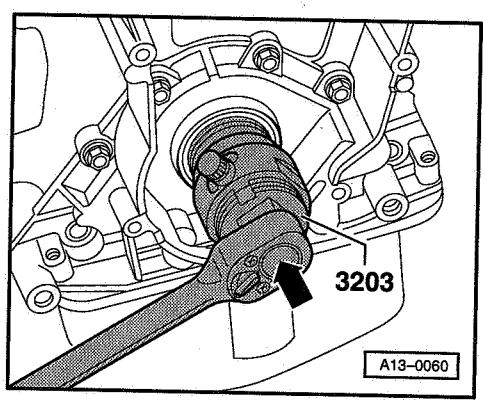
- Remove ribbed belt ⇒ Page 13-14.
- Remove toothed belt ⇒ Page15-8.



◄ - Remove crankshaft toothed belt sprocket. To do this, counter-hold sprocket with 3415.

- To guide seal extractor, screw centre bolt into crankshaft onto stop by hand.

- Unscrew inner part of the oil seal extractor 3203 two turns (approx. 3 mm) out of the outer part and lock with knurled screw.



◄ - Lubricate threaded head of oil seal extractor, 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 crankshaft until the oil seal is pulled out.

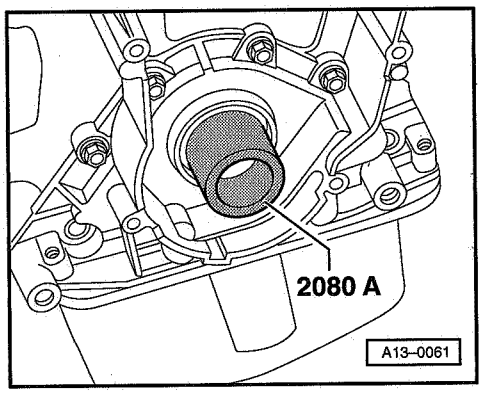
Installing

Note:

Gradual introduction of PTFE oil seals (recognised by the fact that they have no inner circular spring and the lip is wider). The lip of this seal must not be smeared with oil or grease. An old-design radial seal (with inner circular spring) can be replaced by a PTFE seal. However, a PTFE seal cannot be replaced by an old-design radial seal.

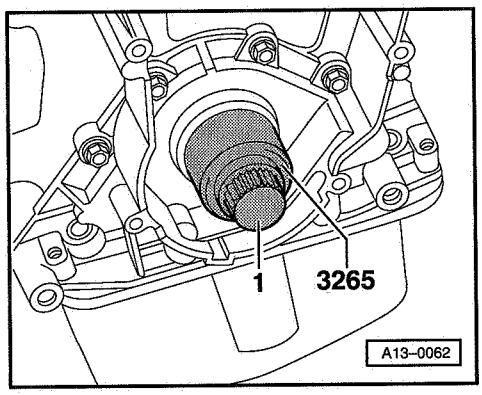
Installing PTFE oil seal
⇒ Page 13-26.

- Lightly oil sealing lip of oil seal.



◄ - Fit guide sleeve from 2080 A onto crankshaft journal.

- Slide oil seal over guide sleeve onto crankshaft journal.



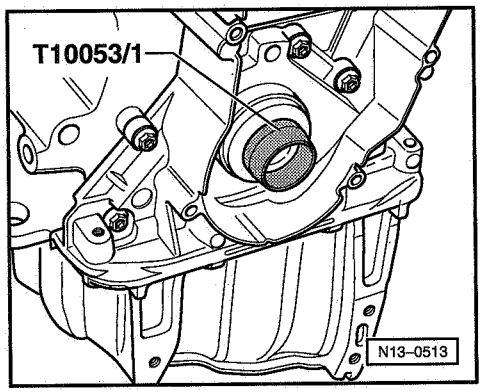
◄ - Press in oil seal using press sleeve from 3265 onto stop with centring bolt -1- approx. 2-3 mm into sealing flange.

- Install and tension toothed belt ⇒ Page 15-8.

Installing PTFE oil seal

Note:

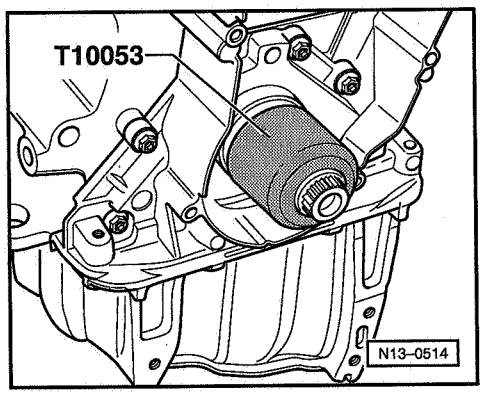
The oil seal sealing lip must not be additionally oiled or greased.



- Before installing, remove oil remains from crankshaft journal with a clean cloth.

◄ - Fit guide sleeve T10053/1 onto crankshaft journal.

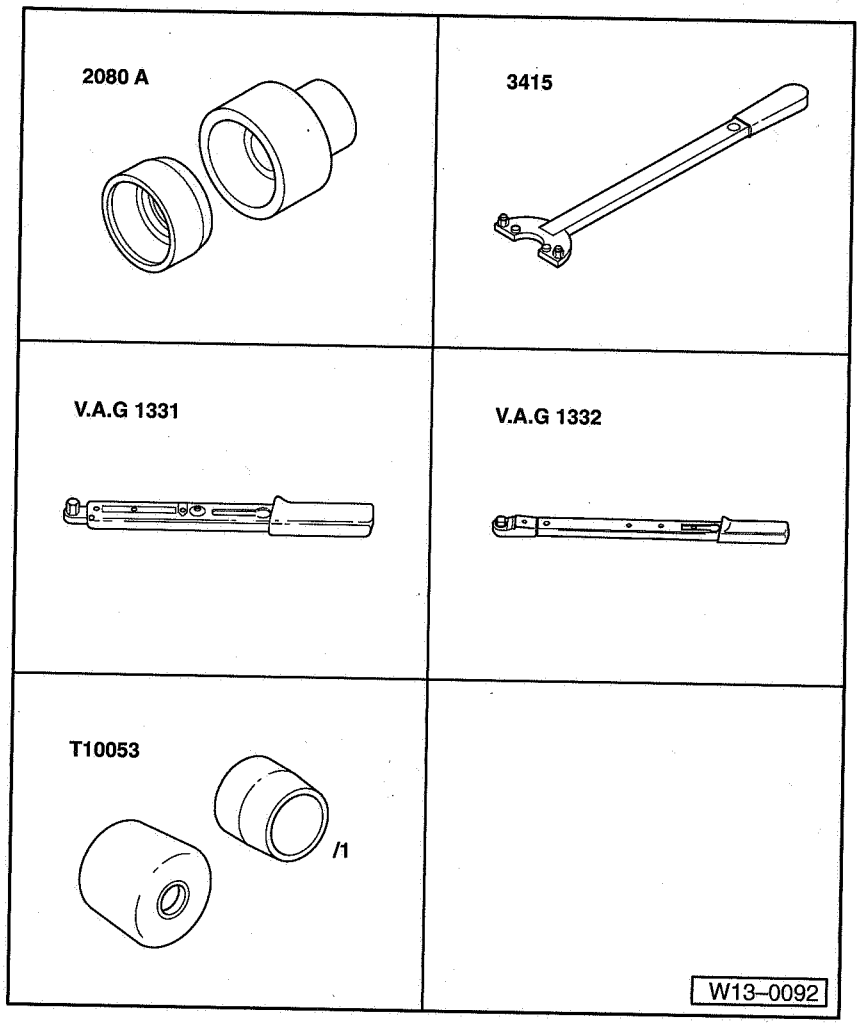
- Slide oil seal over guide sleeve onto crankshaft journal.



◄ - Press in oil seal onto stop using press sleeve T10053 and bolt T10053/2.

- Install and tension toothed belt ⇒ Page 15-8.

- Install ribbed belt ⇒ Page 13-14.



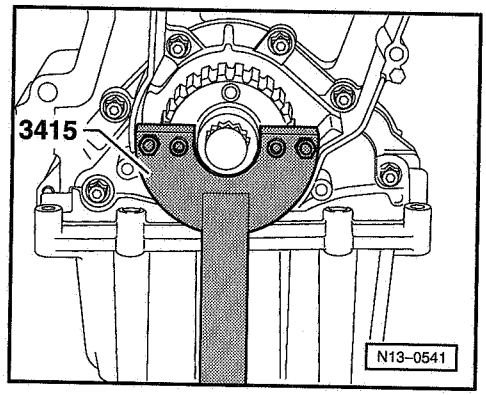
Removing and installing front sealing flange

Special tools, workshop equipment, test and measuring appliances and auxiliary items required

- ♦ 2080 A Fitting sleeve
- ♦ 3415 Counter-hold tool
- ♦ V.A.G 1331 Torque wrench (5...50 Nm)
- ♦ V.A.G 1332 Torque wrench (40...200 Nm)
- ♦ T10053 Assembly tool (for PTFE oil seal)
- ♦ D176404 A2 Silicone sealant
- ♦ Hand drilling machine with plastic brush insert
- ♦ Flat scraper

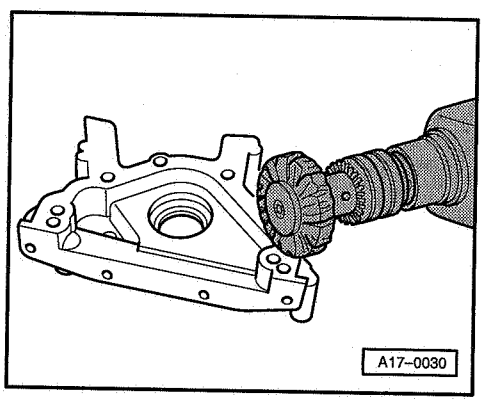
Removing

- Remove ribbed belt ⇒ Page 13-14.
- Remove toothed belt ⇒ Page15-8.



◄ - Remove crankshaft toothed belt sprocket. To do this, counter-hold sprocket with 3415.

- Drain engine oil.
- Remove sump ⇒ Page 17-11.
- Unbolt front sealing flange.
- Take off sealing flange, release using light blows with a rubber headed hammer if necessary.
- Remove sealant residue on cylinder block with a flat scraper.



- Cover seal with a clean rag.

◄ - Remove sealant remains on sealing flange with a rotating plastic brush (wear protective goggles).

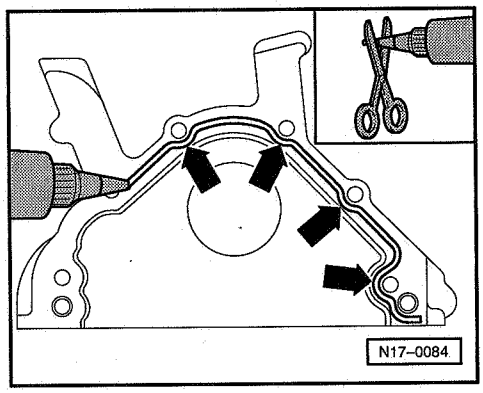
- Clean sealing surface, must be free of oil and grease.

Installing

Notes:

♦ *Note the use by date of the sealant.*

♦ *The sealing flange must be installed within 5 minutes of applying the silicone sealant.*



◄ - Cut off tube nozzle at forward marking (nozzle approx. 3 mm Ø).

- Apply silicone sealing compound, as shown, to clean sealing surface of the sealing flange. Sealing compound bead must be:

  ♦ 2...3 mm thick.

  ♦ and run on inside of bolt holes -arrows-.

Notes:

♦ *The sealant bead must not be thicker, otherwise the excess sealant can get into the sump and block the strainer in the suction pipe to the oil pump and can also drip onto the sealing surface of the crankshaft radial seal.*

♦ *Cover the sealing surface of the oil seal with a clean cloth before applying the sealant.*

- Fit sealing flange immediately and lightly tighten all bolts.

Note:

Use guide sleeve from 2080A to fit sealing flange with the oil seal already installed.

PTFE oil seal

Note:

Use guide sleeve T10053/1 to fit sealing flange with the oil seal already installed.

Continuation for all versions

- Tighten sealing flange securing bolts using alternate sequence.
  Tightening torque:15 Nm

- Remove excess sealant

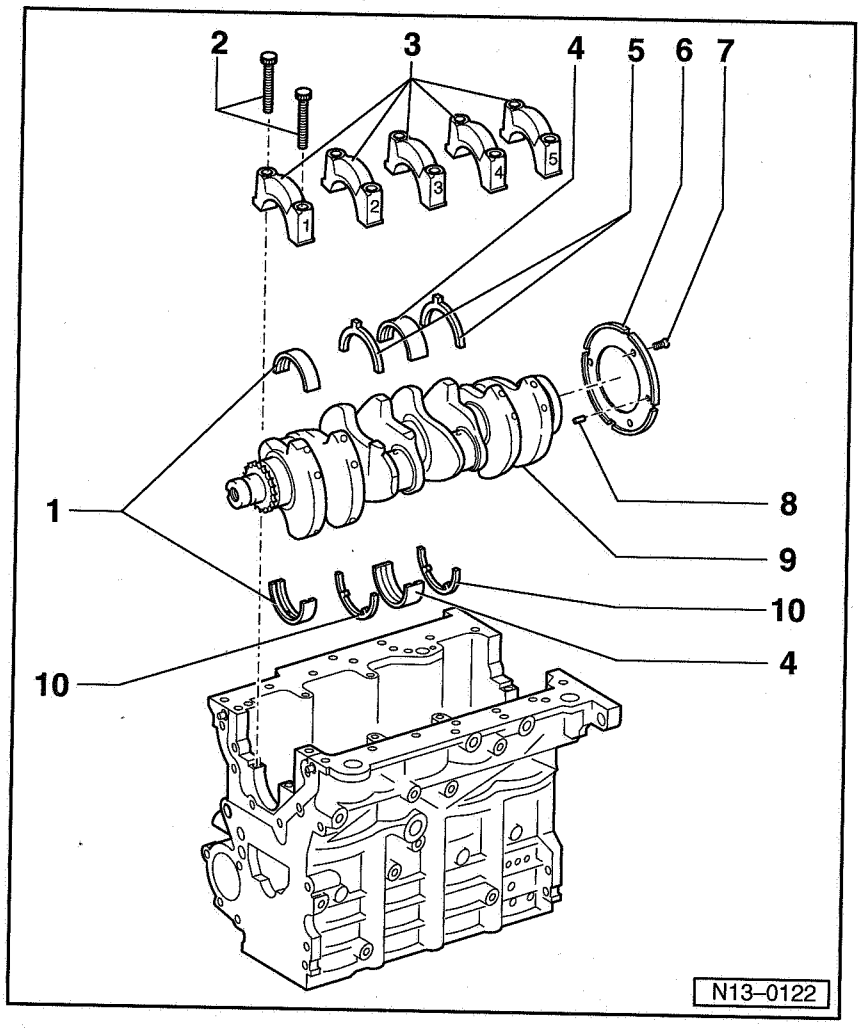
- Install sump ⇒ Page 17-11.

Note:

After installing, the sealant must be allowed to dry for approx. 30 minutes before engine oil is replenished.

- Install and tension toothed belt ⇒ Page 15-8.

- Install ribbed belt ⇒ Page 13-14.



Removing and installing crankshaft

Notes:

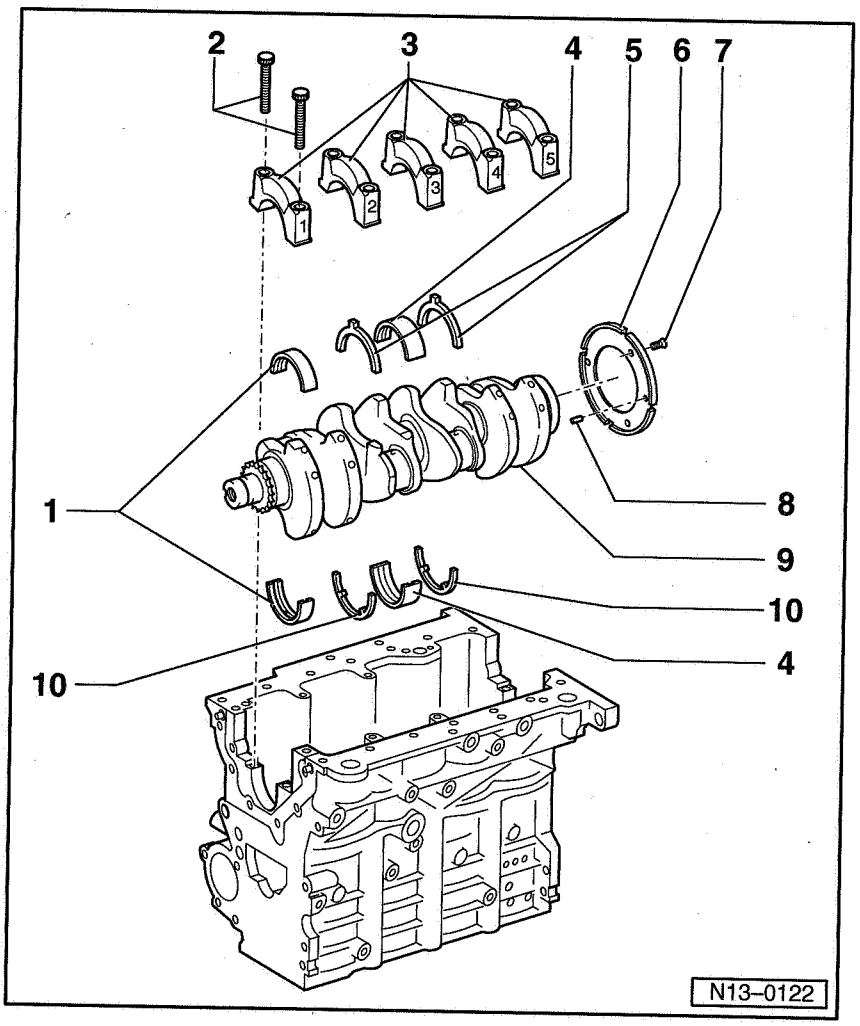
- *Before removing the crankshaft, ensure that a suitable surface is prepared to ensure that the sender wheel (item 6) is not damaged or lies against any other item.*
- *When changing bearing shells ensure that bearing shells of same colour code are used.*

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 (cylinder block/bearing cap) must be on the same side

4 - Bearing shell 3

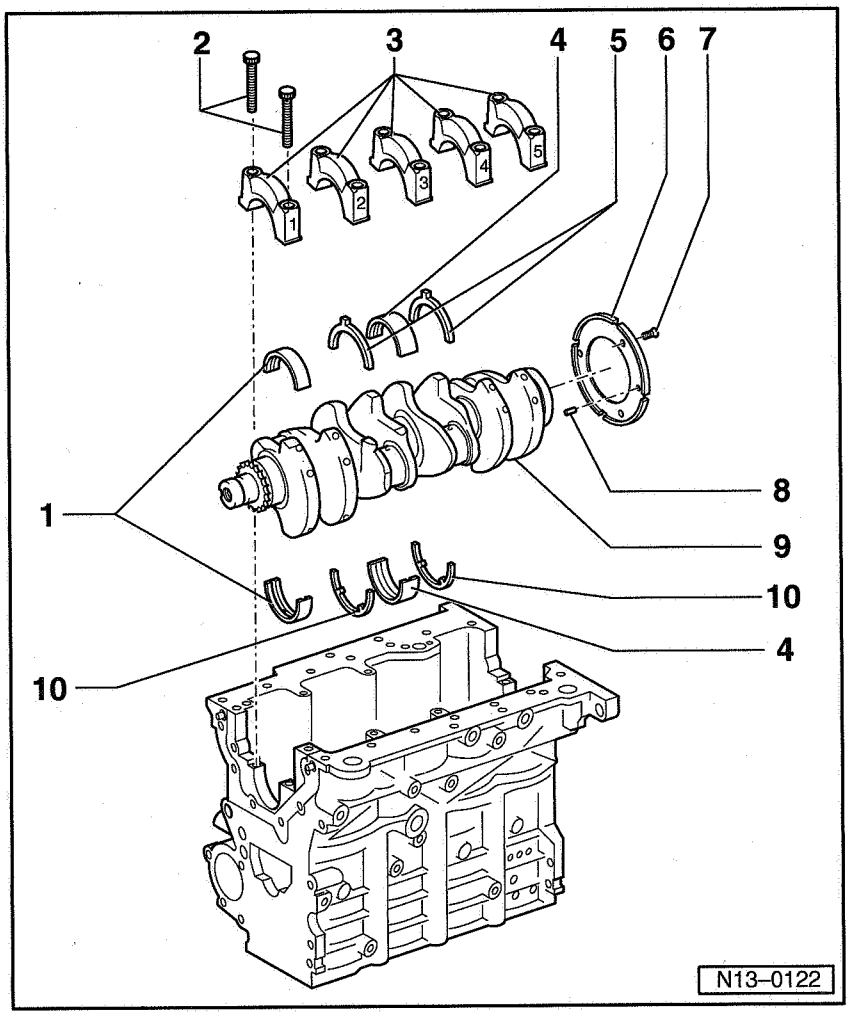
- For bearing cap without oil groove
- For cylinder block with oil groove
- Do not interchange used bearing shells (mark)

5 - Thrust washer

- For bearing cap 3
- Note fixing arrangement

6 - Sender wheel

- For engine speed sender (G28)
- Renew if damaged

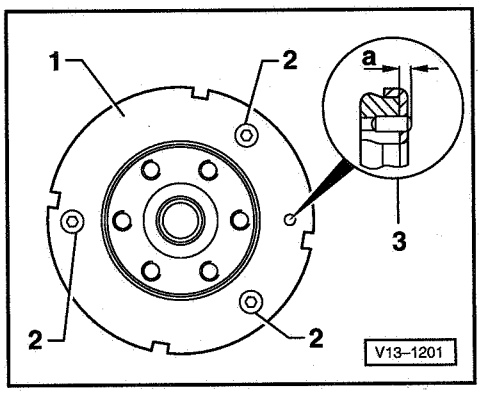


7 - 10 Nm + 1/4 turn (90 °) further
- ♦ Renew

8 - Fitted pin
- ♦ Check projection from crankshaft ⇒ fig. 1

9 - Crankshaft
- ♦ Axial clearance new: 0.07...0.17 mm
  Wear limit: 0.37 mm
- ♦ Check radial clearance with Plastigage
  New: 0.03...0.08 mm
  Wear limit: 0.17 mm
- ♦ Do not rotate the crankshaft when checking the radial clearance
- ♦ Crankshaft dimensions
  ⇒ Page 13-35

10 - Thrust washer
- ♦ For cylinder block, bearing 3



◄ **Fig. 1 Checking fitted pin projection out of crankshaft**

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

- ♦ Depth gauge

Test sequence

- Use depth gauge to check projection -a- of fitted pin with sender wheel -1- removed.

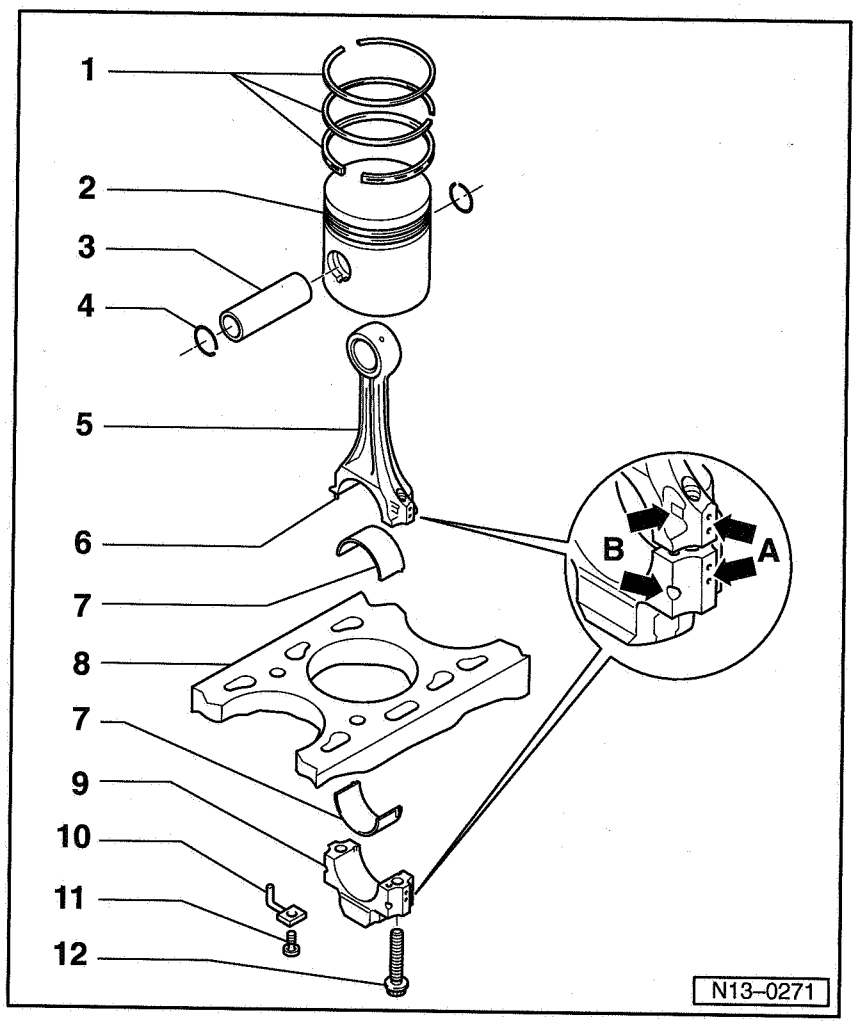
1 - Sender wheel

2 - Securing bolt

3 - Projection of fitted pin -3- out of crankshaft
a = 2.5...3.0 mm

Crankshaft dimensions

Honing dim. in mm	Crankshaft main journal ∅	Conrod journal ∅
Basic dimension	-0.022 54.00 -0.042	-0.022 47.80 -0.042
1st undersize	-0.022 53.75 -0.042	-0.022 47.55 -0.042
2nd undersize	-0.022 53.50 -0.042	-0.022 47.30 -0.042
3rd undersize	-0.022 53.25 -0.042	-0.022 47.05 -0.042



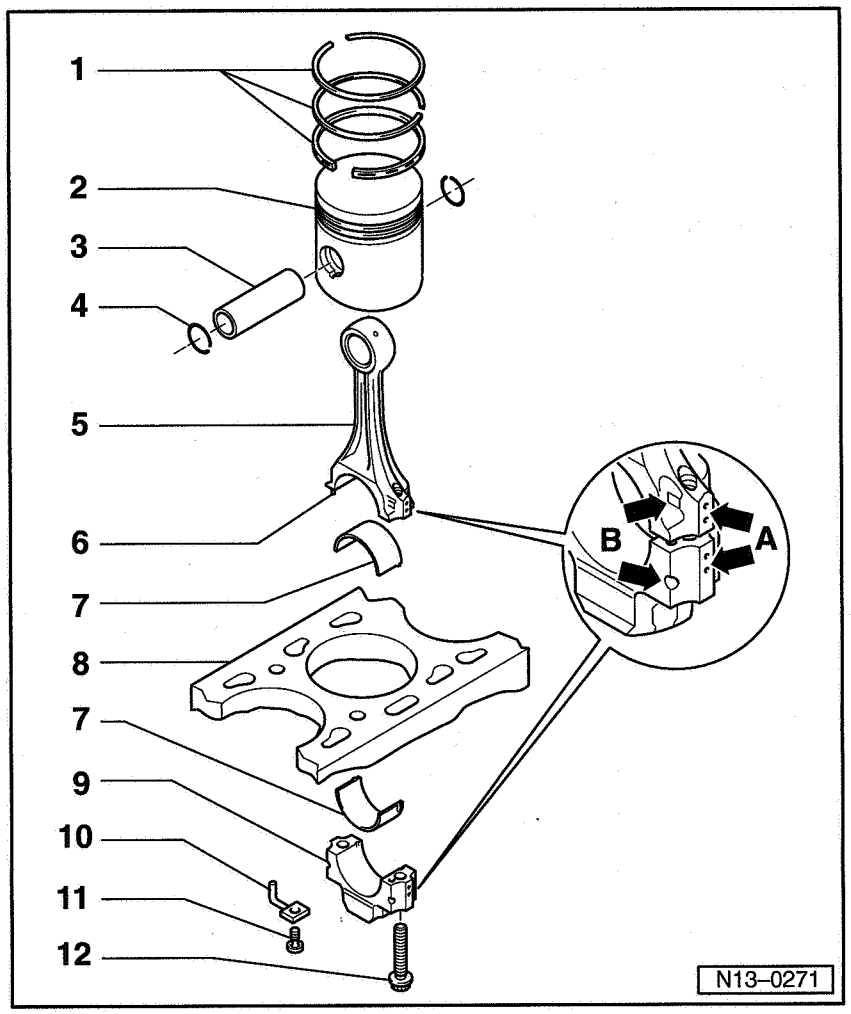
Dismantling and assembling pistons and conrods

1 - Piston ring

- ♦ Offset gaps by 120 °
- ♦ Remove and install with piston ring pliers
- ♦ "TOP" faces towards piston crown
- ♦ Checking ring gap ⇒ Fig. 1
- ♦ Checking ring to groove clearance ⇒ Fig. 2

2 - Piston

- ♦ With combustion chamber
- ♦ Mark installation position and cylinder number
- ♦ Mark installation position and allocation piston/cylinder ⇒ Fig. 4
- ♦ Arrow on piston crown points to pulley end
- ♦ Install using piston ring clamp
- ♦ Cracks on piston skirt, renew piston
- ♦ Checking piston projection at TDC ⇒ Page 13-44

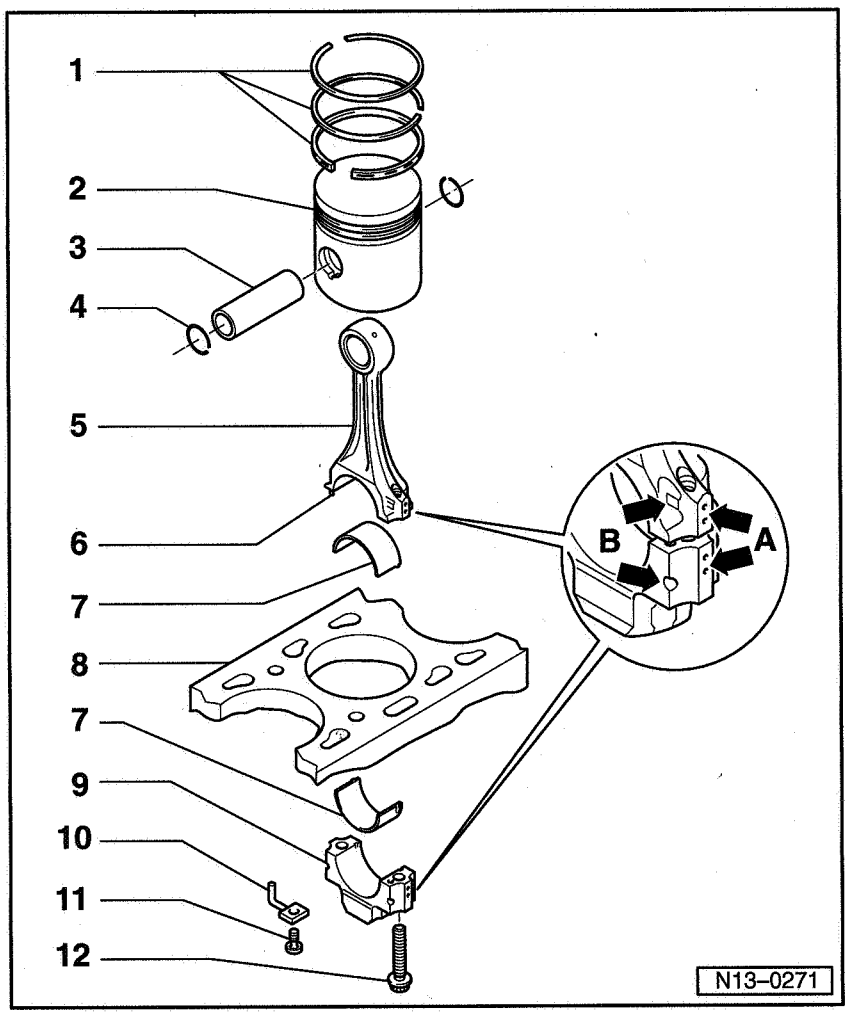


3 - Piston pin
- ♦ If difficult to remove, heat piston to 60 °C
- ♦ Remove and install with drift VW 222a

4 - Circlip

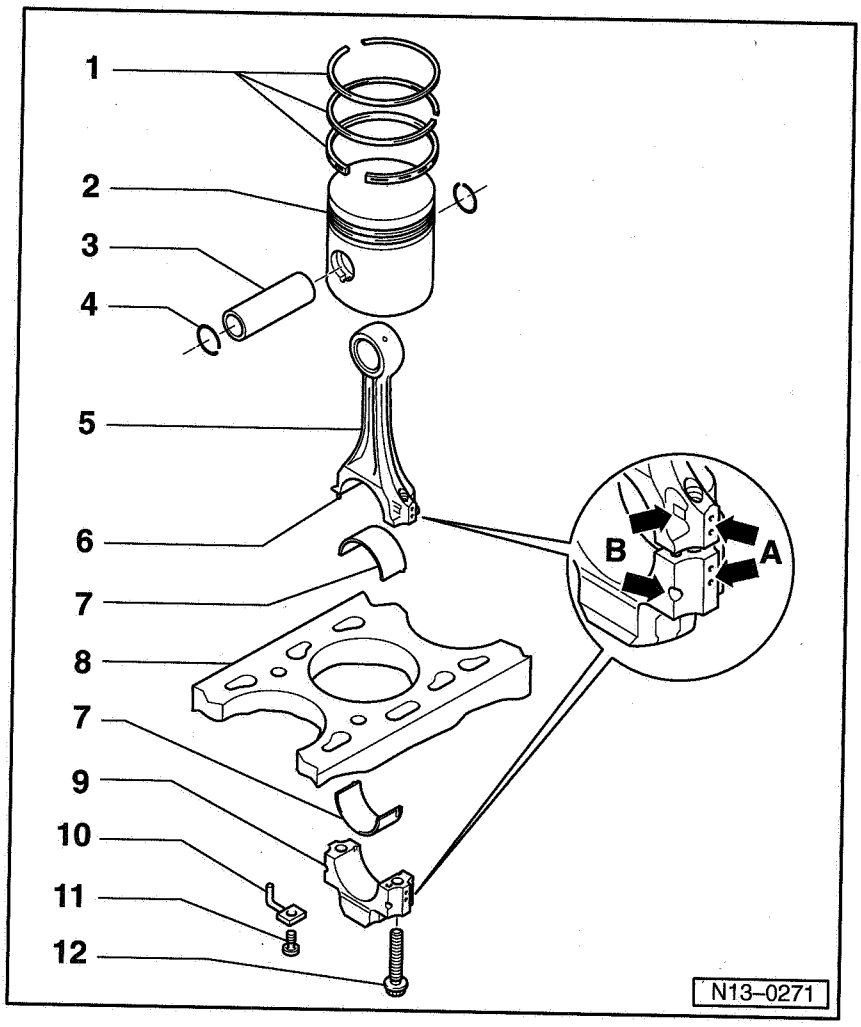
5 - Conrod
- ♦ Only renew as a set
- ♦ Mark cylinder number -A-
- ♦ Installation position:
  Marking -B- faces towards pulley end

6 - Fitted pin
- ♦ The fitted pin must seat securely in the conrod, not in the bearing cap



7 - Bearing shell
- ♦ Note installation position
- ♦ Do not interchange used bearing shells
- ♦ Ensure retaining lugs fit tightly in recesses
- ♦ Axial clearance
  Wear limit: 0.37 mm
- ♦ Check radial clearance with Plastigage:
  Wear limit: 0.08 mm
  Do not rotate crankshaft when checking radial clearance

8 - Cylinder block
- ♦ Checking cylinder bores
  ⇒ Fig. 3
- ♦ Piston and cylinder dimensions
  ⇒ Page 13-46

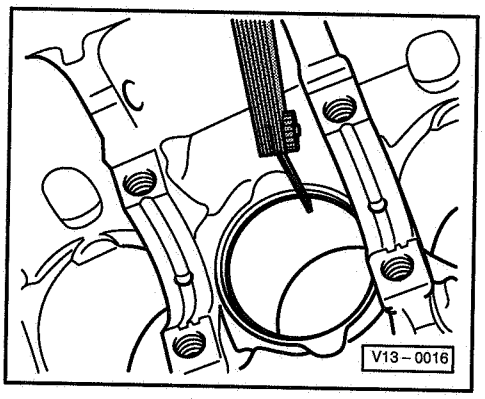


9 - Conrod bearing cap
- ♦ Note installation position

10 - Oil spray jet
- ♦ For piston cooling

11 - 25 Nm
- ♦ Insert without sealant

12 - Conrod bolt, 30 Nm + 1/4 turn (90 °) further
- ♦ Renew
- ♦ Oil threads and contact surface
- ♦ To measure radial clearance use old bolts



◄ **Fig. 1 Checking piston ring gap**

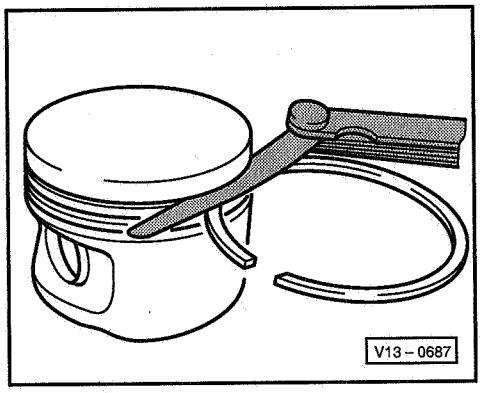
Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

♦ Feeler gauges

Test sequence

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

Piston ring Dimensions in mm	New	Wear limit
1st compression ring	0.20...0.40	1.0
2nd compression ring	0.20...0.40	1.0
Oil scraper ring	0.25...0.50	1.0



◄ **Fig. 2 Checking ring to groove clearance**

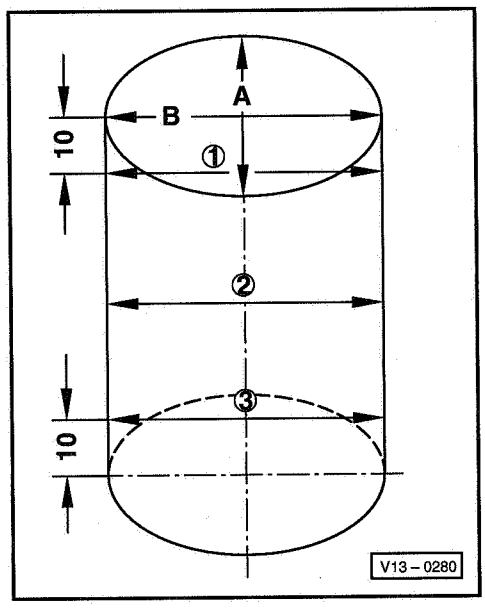
Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

♦ Feeler gauges

Test sequence

- Clean ring groove before checking.

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



◄ **Fig. 3 Checking cylinder bores**

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

♦ Internal dial gauge 50...100 mm

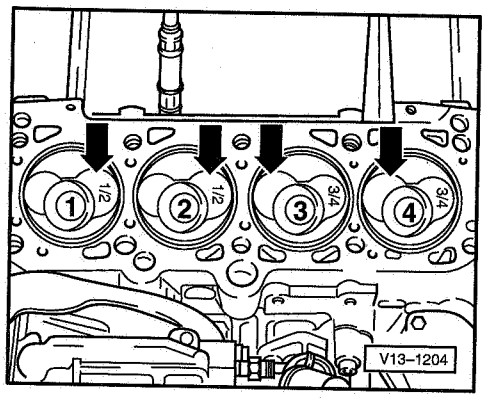
Test sequence

- Take measurements at right angles -A- and -B- at 3 positions.

Deviation from specification
max. 0.10 mm.

Note:

Measuring the cylinder bores must not be done when the cylinder block is mounted on a repair stand with adapter bracket VW 540, as incorrect measurements would then be possible.



◄ **Fig. 4 Piston installation position and piston/cylinder allocation**

Piston in cylinders 1 and 2:

Larger inlet valve chamber towards flywheel -arrows-

Piston in cylinders 3 and 4:

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

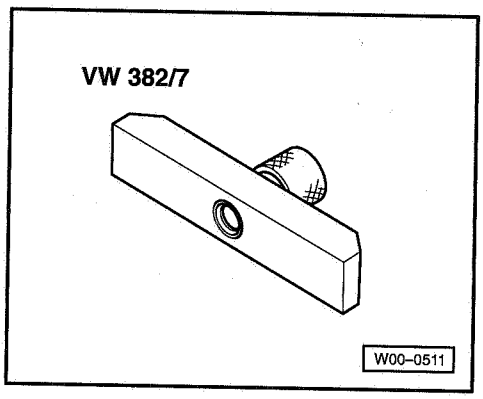
Note:

New piston allocation to cylinders is shown by a coloured marking on piston crown.

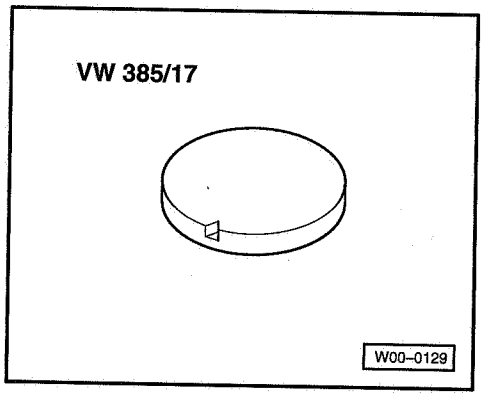
- *Piston for cylinder 1 and 2: marked 1/2*
- *Piston for cylinder 3 and 4: marked 3/4*

Checking piston projection at TDC

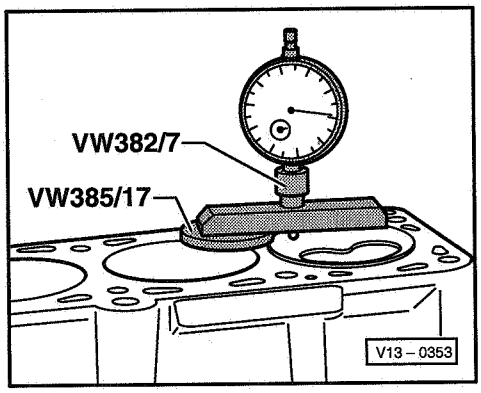
Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



- VW 382/7 Measuring device



- VW 385/17 End plate



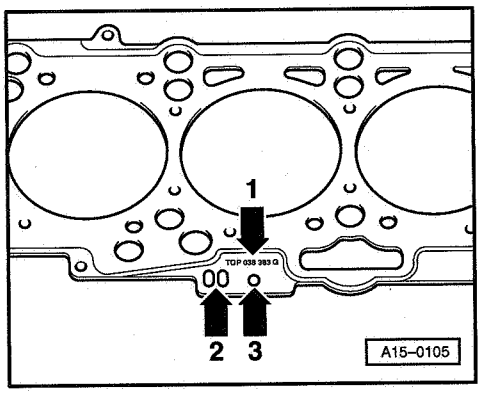
Test sequence

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

Note:

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
- ♦ Production control code = arrow 2 (can be disregarded)
- ♦ Holes = arrow 3

Note:

If differing figures are obtained when measuring piston projection, the highest figure should be taken when selecting the gasket.

Piston and cylinder dimensions

Honing dimension		Piston - ∅	Cylinder bore - ∅
Basic dimen.	mm	79.47	79.51
1st oversize	mm	79.72	79.76
2nd oversize	mm	79.97	80.01

Removing and installing cylinder head

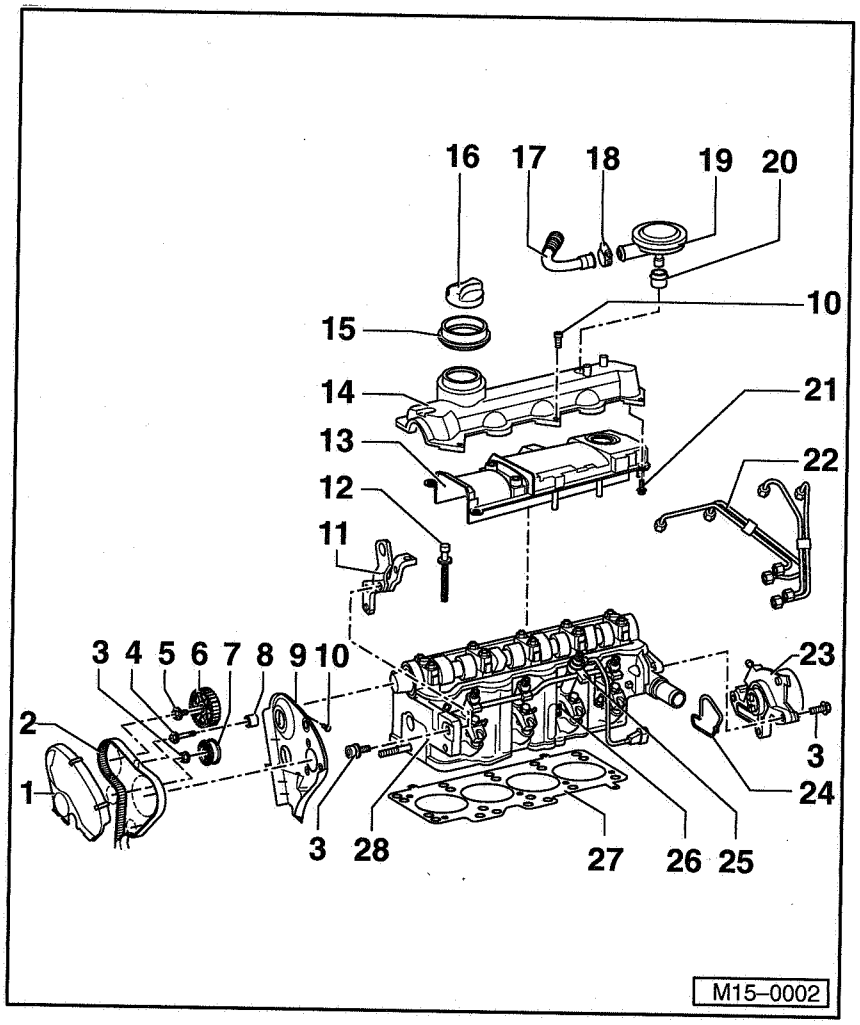
Notes:

- *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 replaced, all the coolant in the system must also be renewed.*

Checking compression pressures ⇒ Page 15-26

Observe safety precautions ⇒ Page 23-2.

Observe rules for cleanliness ⇒ Page 23-4.



1 - Toothed belt guard - upper part

2 - Toothed belt
- ♦ Mark D.O.R. before removing
- ♦ Check for wear
- ♦ Do not kink
- ♦ Removing, installing and tensioning ⇒ Page 15-8

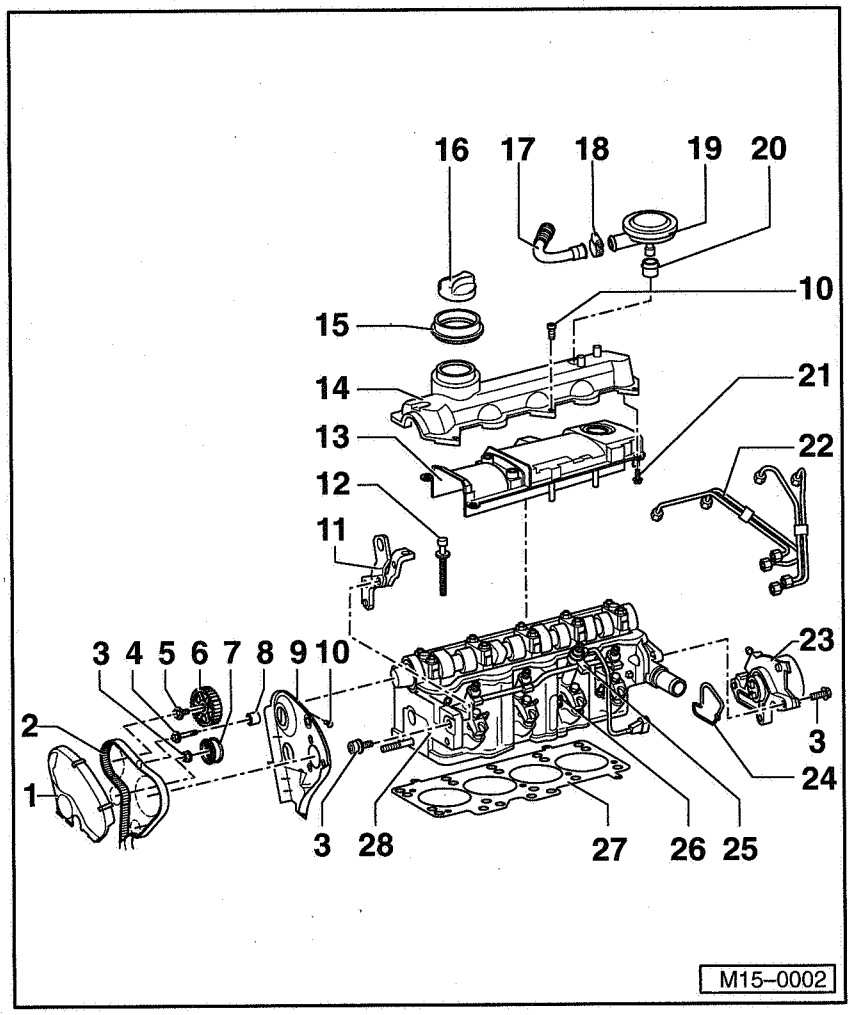
3 - 20 Nm

4 - 23 Nm

5 - 45 Nm
- ♦ Counter-hold with 3036 to loosen and tighten

6 - Camshaft sprocket
- ♦ Pull off with puller T40001

7 - Tensioning roller
- ♦ Checking semi-automatic toothed belt tensioning roller ⇒ Page 15-18



8 - Idler roller

9 - Rear toothed belt guard

10 - 10 Nm

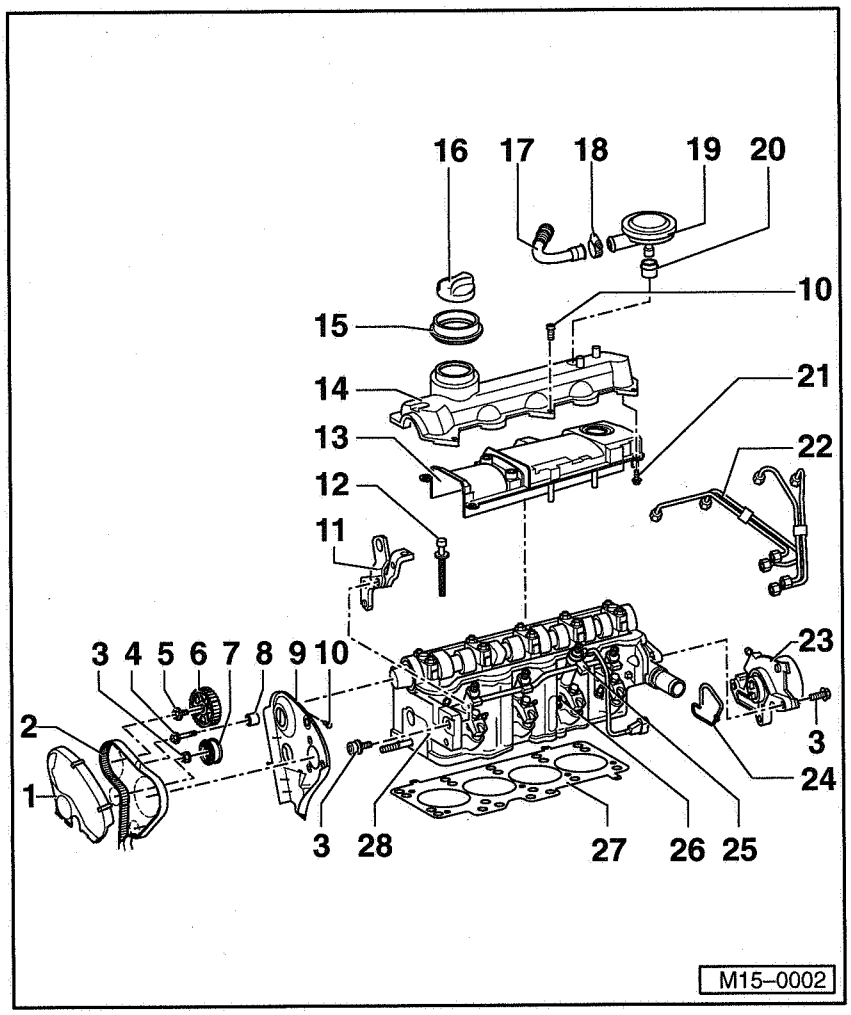
11 - Lifting eye

12 - Cylinder head bolt
- ♦ Renew
- ♦ Note sequence when loosening and tightening
  ⇒ Page 15-20, removing and installing cylinder head

13 - Oil deflector

14 - Cylinder head cover
- ♦ With vulcanised seal
- ♦ Before fitting, thoroughly clean sealing surface of cylinder head with clean rag

15 - Seal
- ♦ Renew if damaged



16 - Cap
- ♦ Renew seal if damaged

17 - Breather pipe

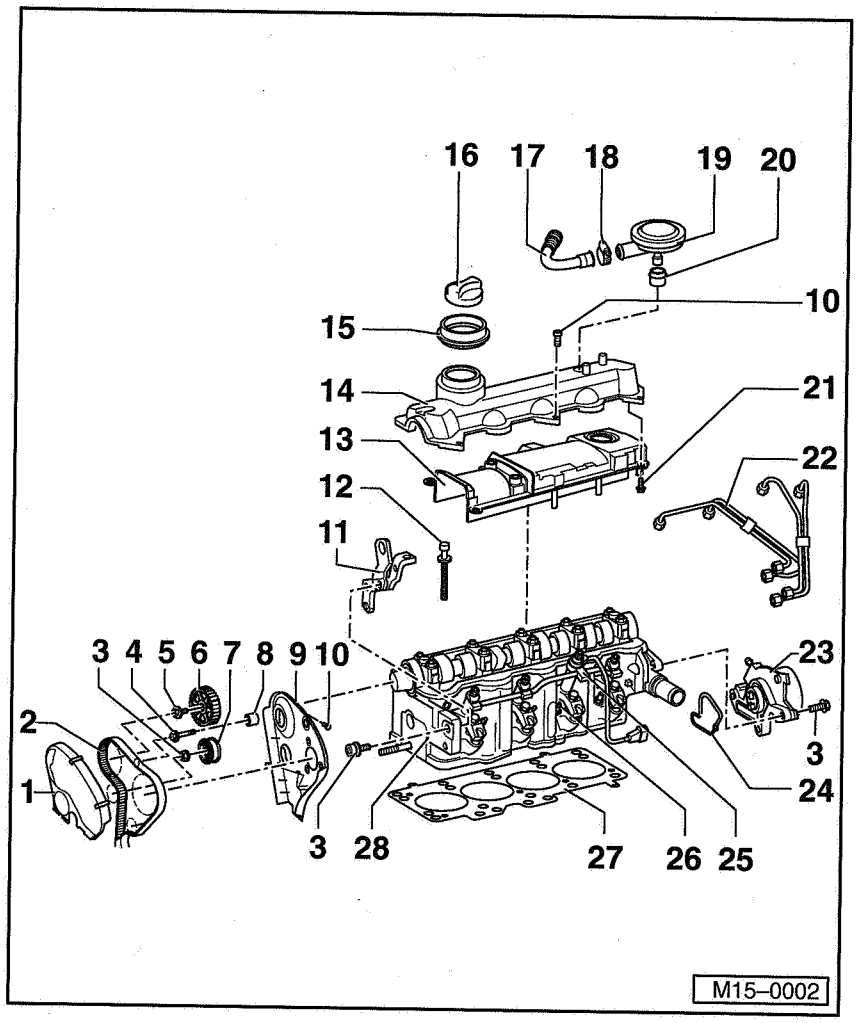
18 - Retaining clip

19 - Pressure regulating valve
- ♦ For crankcase breather

20 - Seal
- ♦ Renew if damaged

21 - 5 Nm
- ♦ Engine code AVM only

22 - Injector pipes
- ♦ Tighten to 25 Nm
- ♦ Remove with ring spanner 3035
- ♦ Always remove pipework complete
- ♦ Do not alter shape



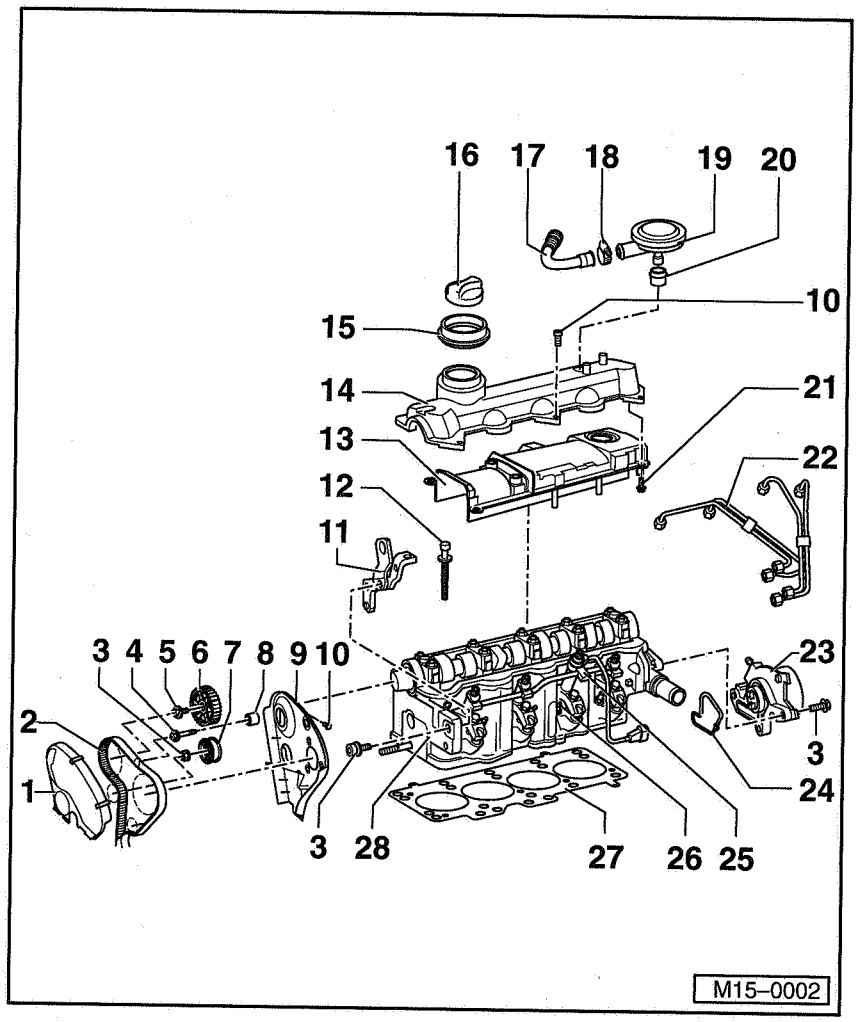
23 - Vacuum pump

24 - Gasket
- ♦ Renew

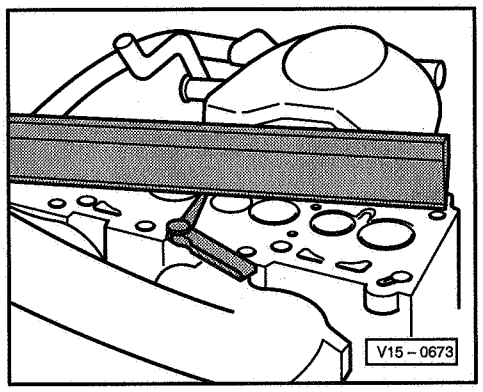
25 - Injector
- ♦ Removing and installing ⇒ Page 23-42
- ♦ Checking ⇒ Page 23-45
- ♦ For 3rd cylinder with needle lift sender (G80)
- ♦ Checking needle lift sender ⇒ Page 23-75

26 - Glow plug
- ♦ 15 Nm
- ♦ Remove and install using U/J extension and socket 3220
- ♦ Checking ⇒ Page 28-3

27 - Cylinder head gasket
- ♦ Renew
- ♦ Note marking ⇒ Fig. 2
- ♦ If replaced renew the complete coolant



28 - Cylinder head
- ♦ Check for distortion ⇒ Fig. 1
- ♦ Removing and installing ⇒ Page 15-20
- ♦ If replaced renew the complete coolant



◄ **Fig. 1 Checking cylinder head for distortion**

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

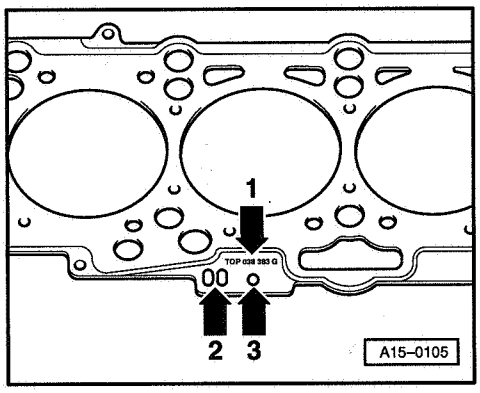
♦ Straight edge

♦ Feeler gauges

Max. permissible distortion: 0.1 mm

Note:

Reworking diesel cylinder heads is not permissible.



◄ **Fig. 2 Cylinder head gasket identification**

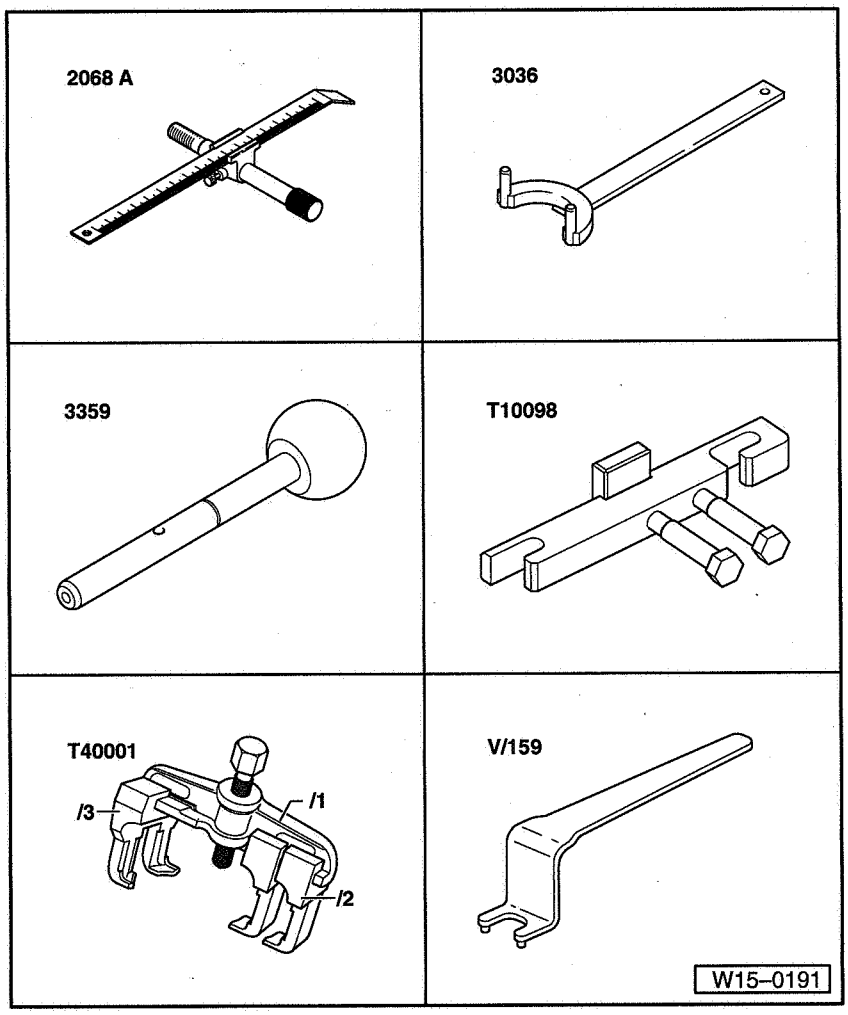
♦ Part No. = arrow 1

♦ Production control code = arrow 2 (can be disregarded)

♦ Holes = arrow 3

Note:

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



Removing, installing and tensioning toothed belt

Special tools, workshop equipment, test and measuring appliances and auxiliary items required

♦ 2068 A TDC setting device

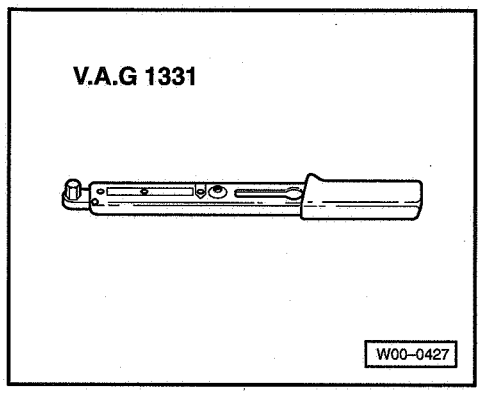
♦ 3036 Counter hold tool

♦ 3359 Locking pin

♦ T10098 Camshaft bar

♦ T40001 Puller

♦ V/159 Pin wrench, Matra
(for engines with engine code AVM)



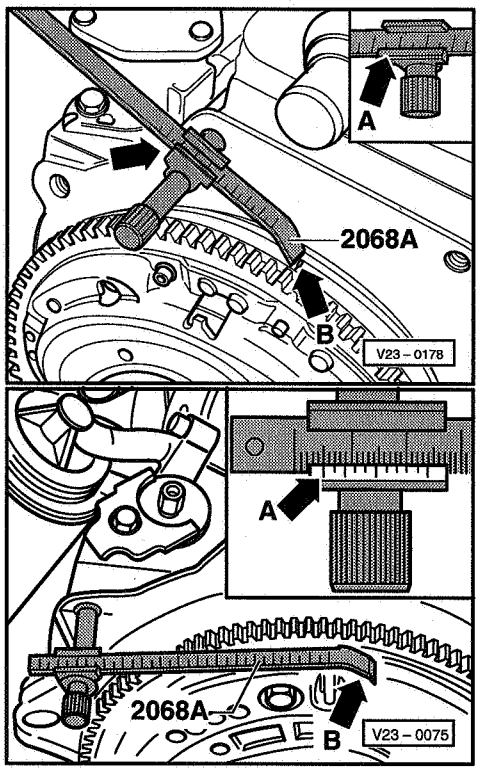
♦ V.A.G 1331 Torque wrench (5...50 Nm)

Removing

Note:

Adjustment work on toothed belts must be performed on cold engines only.

- Remove toothed belt guard upper part.
- Remove vacuum pump.
- Remove ribbed belt ⇒ Page 13-14.



Engines with flywheel (engine code AVM)

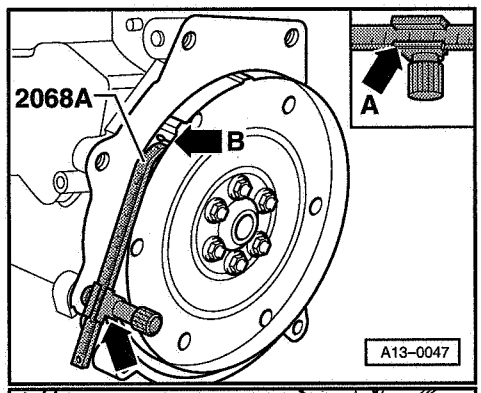
◄ - Install adjustment device 2068 A as shown.

- Adjust setting device to 96 mm -arrow A-. Take the reading from the left-hand edge of the marker.
- Turn crankshaft until TDC mark on the flywheel is aligned with the tip of the adjusting tool -arrow B-.

Engines with flywheel (engines ARD and BEQ)

◄ - Install adjustment device 2068 A as shown.

- Adjust setting device to 5 mm -arrow A-. Take the reading from the left-hand edge of the marker.
- Turn crankshaft until TDC mark on the flywheel is aligned with the tip of the adjusting tool -arrow B-.



Engines with drive plate

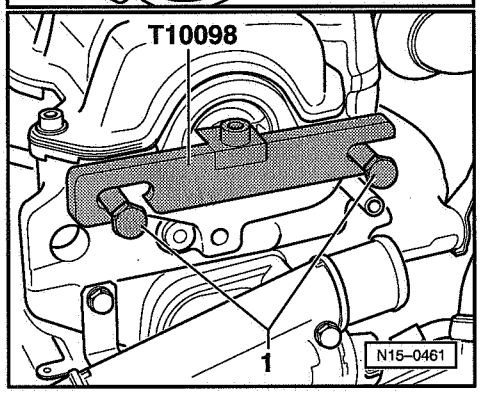
◄ - Install adjustment device 2068 A as shown.

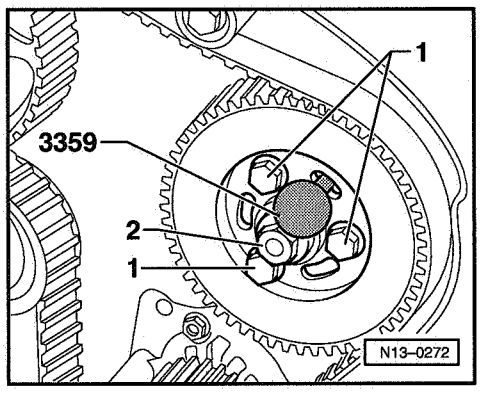
- Adjust setting device to 30 mm -arrow A-. Take the reading from the left-hand edge of the marker.
- Turn crankshaft until TDC mark on the flywheel is aligned with the tip of the adjusting tool -arrow B-.

Continuation for all vehicles

◄ - Screw in fitted bolts -1- onto stop in cylinder head by hand.

- Lock camshaft with camshaft bar T10098 as shown.





◄ - Lock injection pump sprocket with pin 3359.

- Loosen injection pump sprocket securing bolts -1-.

Notes:

- ♦ *Unscrew securing bolts with chamfer on shaft and pointed end, one after the other, and renew. (Part No. of injection pump sprocket 038 130 111 A).*
- ♦ *Securing bolts without chamfer on shaft and pointed end need not be renewed. (Part No. of injection pump sprocket 038 130 111 B).*
- ♦ *The nut -2- on the pump shaft should never be loosened. Otherwise the basic pump setting will be altered and will not be able to be corrected with normal workshop tools.*

- Loosen tensioner.
- Remove vibration damper/belt pulley.
- Remove lower and centre toothed belt guard.
- Mark D.O.R. of toothed belt.
- Take off toothed belt.

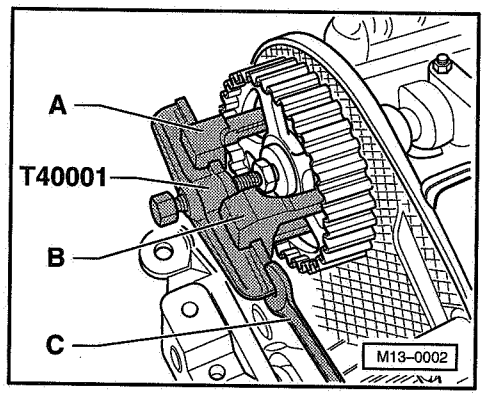
Installing

- Check whether TDC mark on flywheel or drive plate and reference mark are aligned.

- Loosen the camshaft securing bolts a full turn. To loosen the camshaft sprocket securing bolts, use counter-hold tool 3036 to hold the camshaft sprocket.

Note:

Never use camshaft bar T10098 as a counter-hold when loosening and tightening the camshaft sprocket. Use counter-hold tool 3036.



◄ - Place puller T40001 with single leg T40001/2 -A- and double leg T40001/3 -B- centrally on the camshaft sprocket and pull it off.

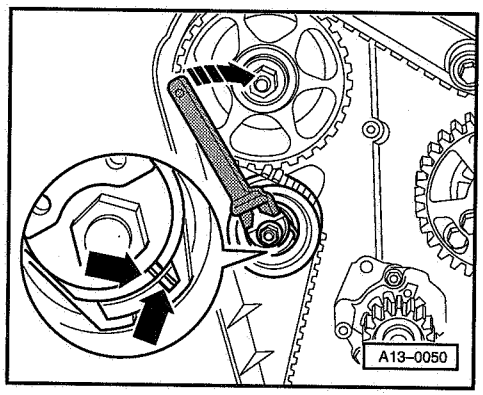
Use an open ended spanner -C- to counter-hold when doing this.

- Fit toothed belts on crankshaft toothed belt sprocket, idler wheel, injection pump sprocket, coolant pump sprocket and tensioning roller (note direction of rotation).

- Align injection pump sprocket to centre position in elongated holes.

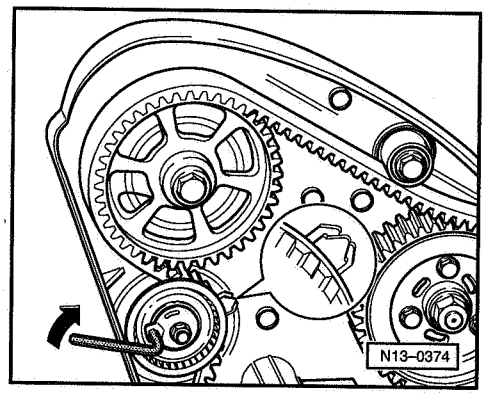
- Fit camshaft sprocket together with toothed belt and locate with securing bolt (camshaft sprocket can still turn).

Engine code AVM



◄ - Tension toothed belt. Using pin wrench (e.g. Matra V159) on eccentric turn clockwise until the notch and the raised mark -arrows- align.

Engine codes ARD and BEQ



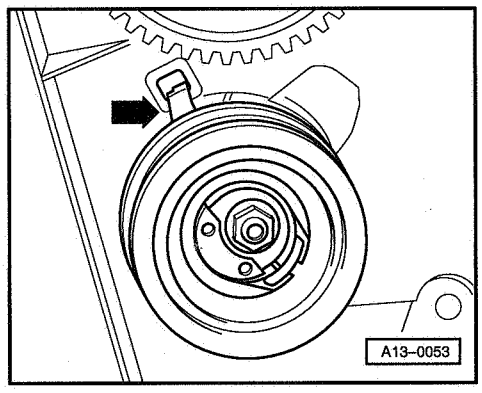
◄ - Tension toothed belt. Do this by turning eccentric clockwise using a commercially available hexagon key, until notch and indicator align.

Continued for all engine codes

Note:

If the eccentric has been turned too far the tensioning roller must be relieved completely and retensioned. The eccentric must never be turned back when it has been turned too far.

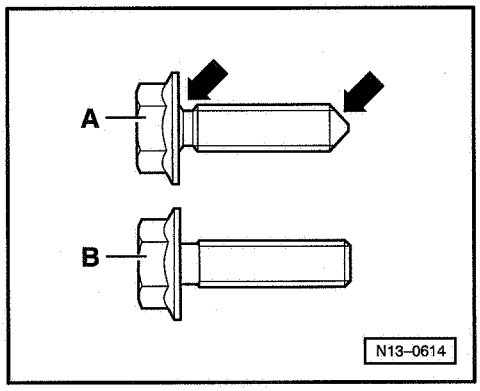
- Tighten lock nut on tensioning roller.
  Torque setting: 20 Nm



Note:

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

- Check TDC mark on flywheel or drive plate again.
- Tighten camshaft sprocket securing bolt to 45 Nm.



Version -A-: Securing bolts with chamfer on shaft and point -arrows-

- Tighten new injection pump sprocket securing bolts.
  Tightening torque: 20 Nm

Notes:

- *Following the dynamic test of the commencement of injection, the securing bolts should be tightened by 90° (1/4 turn).*
- *Because they are stretch bolts they must only be used once.*

Version -B-: Securing bolts without chamfer on shaft and without pointed end

- Tighten the old injection pump sprocket securing bolts.
  Tightening torque: 25 Nm

Note:

Securing bolts need not be renewed.

Continuation for all versions

- Remove camshaft bar T10098 from camshaft.

- Remove pin.

- Turn crankshaft two rotations in engine D.O.R. and set again to TDC No. 1 cylinder.

- Check that
  TDC marking on flywheel or drive plate
  location of camshaft bar in camshaft
  location of locking pin in injection pump sprocket
  tensioning roller adjustment (notch/raised portion or notch/arrow)
  is correct.

- If the notch and raised portion or notch and arrow are not aligned, tension tensioning roller and tighten securing nut to 20 Nm.

- Turn crankshaft two rotations in engine D.O.R. until crankshaft is set to TDC No. 1 cylinder again.

- Repeat check.

- Install vacuum pump.
  Torque setting: 20 Nm

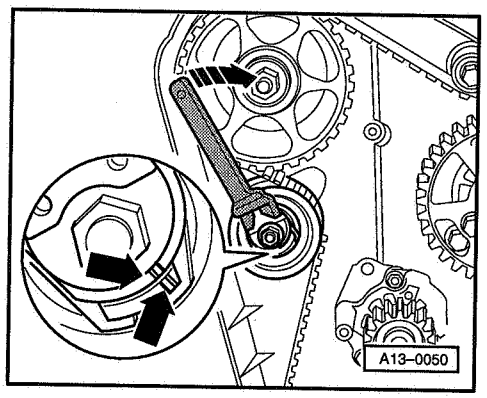
- Install toothed belt guard and vibration damper/ belt pulley.

- Install ribbed belt ⇒ Page 13-14.

- Dynamically check commencement of injection and adjust if necessary ⇒ Page 23-35.

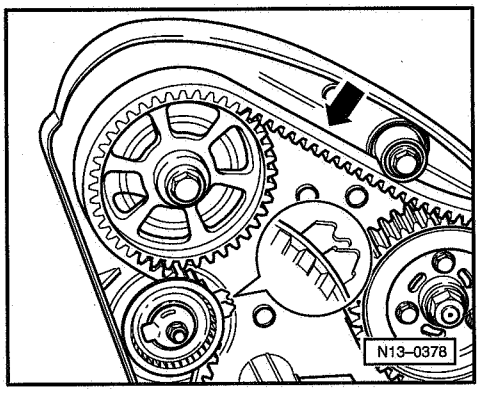
Checking semi-automatic toothed belt tensioning roller

Engine code AVM



◄ - Tension toothed belt with firm thumb pressure.
Notch and raised portion -arrows- must move apart.

- Release thumb pressure on toothed belt. The tensioning roller must move back to its initial position. (Notch and raised portion align again).



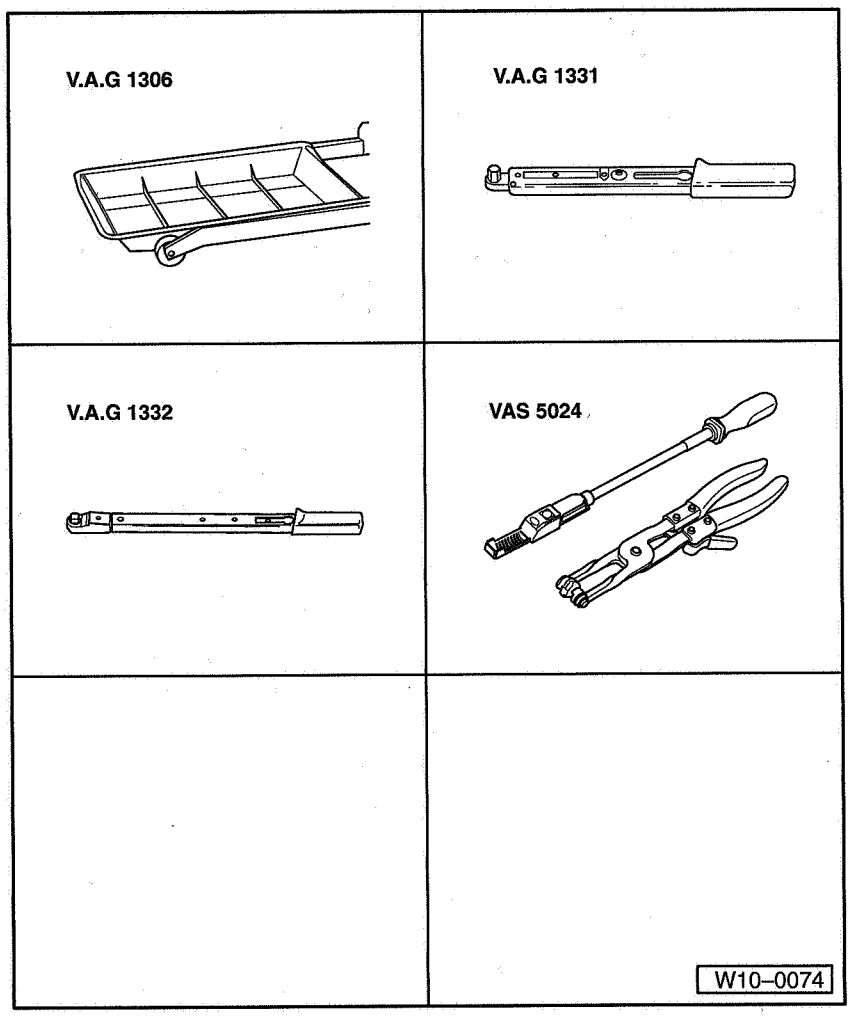
Engine codes ARD and BEQ

◄ - Tension toothed belt with firm thumb pressure -arrow-. arrow and notch must move apart.

- Release thumb pressure on toothed belt. The tensioning roller must follow the movement of the toothed belt.

Note:

The tensioning roller does not return to original position after releasing tension on toothed belt.



Removing and installing cylinder head

Special tools, workshop equipment, test and measuring appliances and auxiliary items required

- ♦ V.A.G 1306 Drip tray
- ♦ V.A.G 1331 Torque wrench (5...50 Nm)
- ♦ V.A.G 1332 Torque wrench (40...200 Nm)
- ♦ VAS 5024 Assembly tool for spring-type clamps

Removing

> ***Warning!***
>
> ***When carrying out repair work, especially due to the cramped conditions, note the following:***
>
> - ***Route all lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant, refrigerant, brake fluid and vacuum pipes and hoses) and electrical wiring so that the original positions are restored.***
> - ***Ensure sufficient clearance to all moving or hot components.***

- All cable ties which are opened or cut open when removing engine, must be replaced in the same position when installing engine.

- With ignition switched off disconnect battery earth strap.

- Drain coolant ⇒ Page 19-8.

- Pull off all coolant hoses to cylinder head using assembly tool for spring-type clamps VAS 5024.

- Pull off/disconnect all other electrical connections as necessary from cylinder head and place to one side.

- Pull vacuum and breather hoses off cylinder head as necessary.

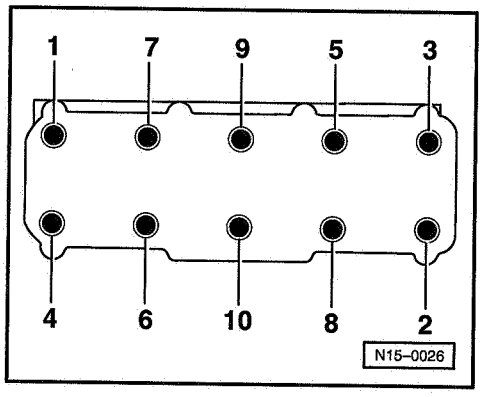
Engine codes ARD and BEQ

- Remove intake manifold upper part ⇒ page 23-19, Dismantling and assembling parts of intake manifold.

Continued for all engine codes

- Remove upper toothed belt guard, cylinder head cover and vacuum pump.

- Remove camshaft sprocket ⇒ page 15-46, Removing and installing camshaft.



◄ - Maintain sequence when loosening and tightening cylinder head bolts.

Installing

Notes:

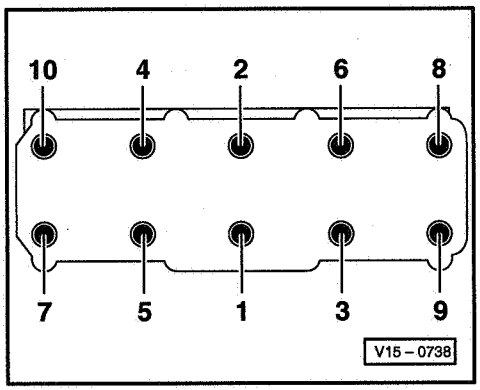
- *Always renew cylinder head bolts.*
- *In cases of repair carefully remove gasket remains from cylinder head and cylinder block. Ensure that no long grooves or scratches are created. When using abrasive paper do not use a grade less than 100.*
- *Carefully remove emery and abrasive remains.*
- *Remove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

- Turn crankshaft to TDC marking before fitting cylinder head.

- Turn crankshaft against engine direction of rotation until all pistons are approximately equally placed below TDC.

- Place cylinder head gasket on.

- Fit cylinder head, screw in cylinder head bolts and tighten by hand.



◄ - Tighten cylinder head in four stages in sequence shown as follows:

- 1. Tighten initially with torque wrench:
  Stage I = 40 Nm
  Stage II = 60 Nm

- 2. Turn further with normal spanner:
  Stage III = $^1/_4$ turn (90 °)
  Stage IV = $^1/_4$ turn (90 °)

Note:

- *Pulling-down cylinder head after repairs is not necessary.*

- After tightening the cylinder head turn camshaft so that the cams for No. 1 cylinder point evenly upwards. Turn crankshaft, in engine D.O.R., To TDC before fitting toothed belt.

- Install camshaft sprocket.

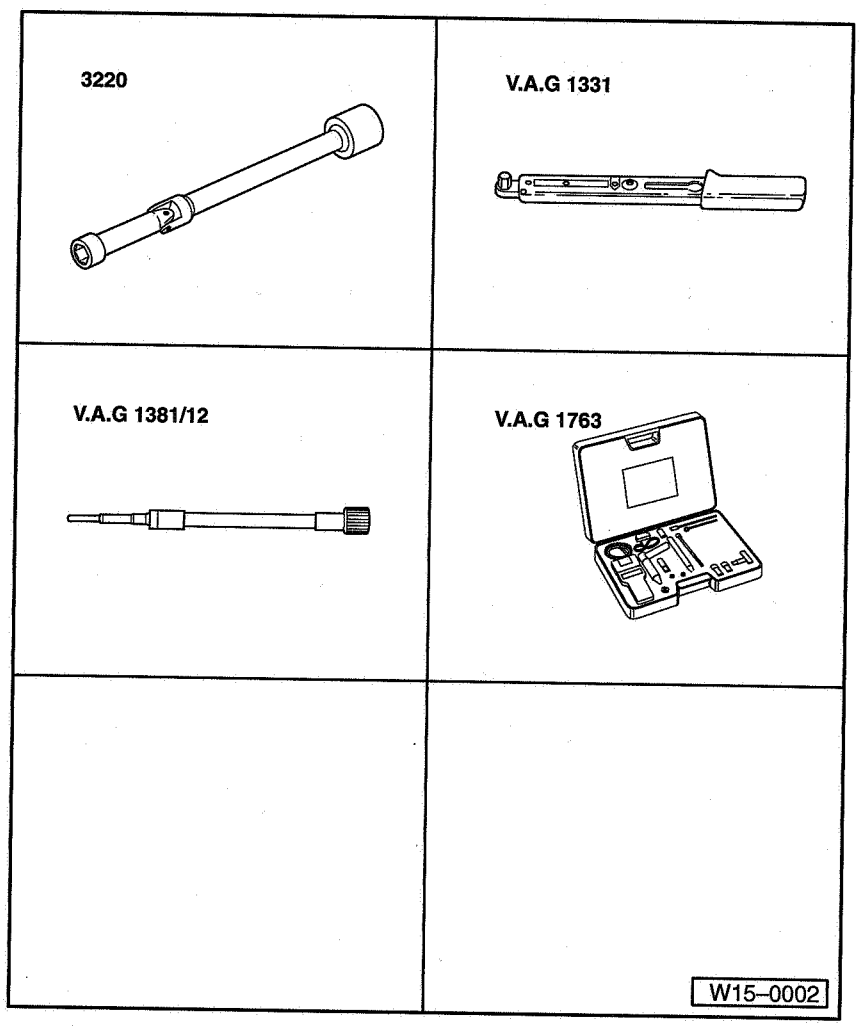
- Install and tension toothed belt ⇒ Page 15-8.

Engine codes ARD and BEQ

- Install intake manifold upper part ⇒ page 23-19, Dismantling and assembling parts of intake manifold.

Continued for all engine codes

- Filling with coolant ⇒ Page 19-8
- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.



Checking compression pressures

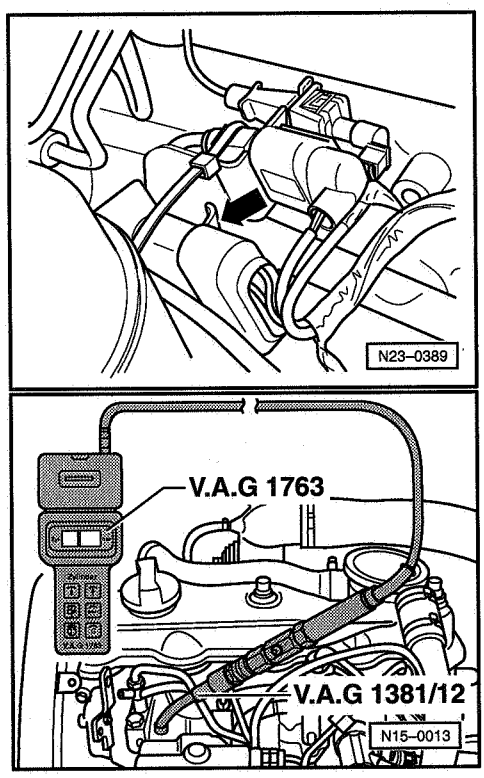
Special tools, workshop equipment, test and measuring appliances and auxiliary items required

- ♦ 3220 Joint spanner
- ♦ V.A.G 1331 Torque wrench (5...50 Nm)
- ♦ V.A.G 1381/12 Adapter
- ♦ V.A.G 1763 Compression tester

Test conditions

- Engine oil temperature min. 30 °C.

Test sequence



◄ - Separate connection to metering unit of injection pump -arrow-.

Engine codes ARD and BEQ

- Remove intake manifold upper part ⇒ page 23-19, Dismantling and assembling parts of intake manifold.

Continued for all engine codes

- Remove all glow plugs using socket spanner 3220.

◄ - Screw in adapter V.A.G 1381/12 in place of the glow plugs.

- Check compression pressure with compression tester V.A.G 1763.

Note:

Using the compression tester ⇒ Operating instructions.

- Operate starter until tester shows no further pressure increase.

Compression pressure:

New: 25...31 bar
Wear limit: 19 bar

Permissible difference between all cylinders: 5 bar

- Install glow plugs with socket and jointed extension 3220
  Tightening torque: 15 Nm.

Engine codes ARD and BEQ

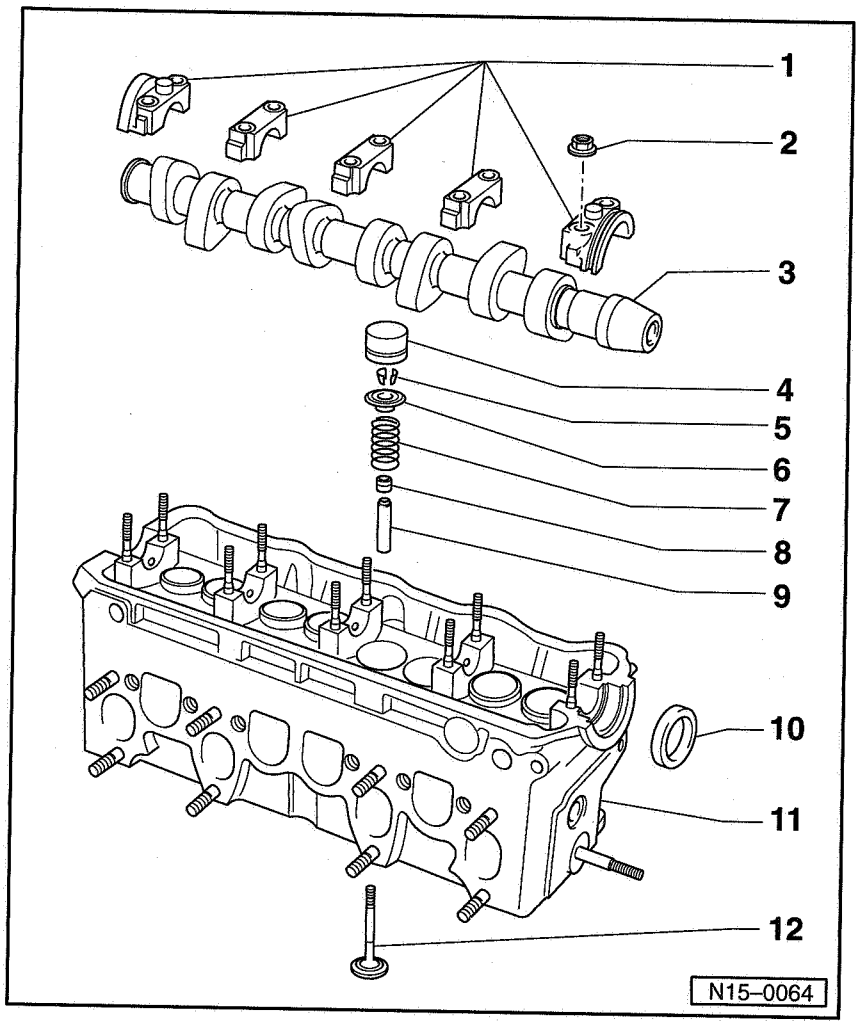
- Install intake manifold upper part ⇒ page 23-19, Dismantling and assembling parts of intake manifold.

Continued for all engine codes

- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

Note:

Faults will have been stored because the connector to injection pump has been separated. Therefore interrogate and, if necessary, erase fault memory.



Servicing valve gear

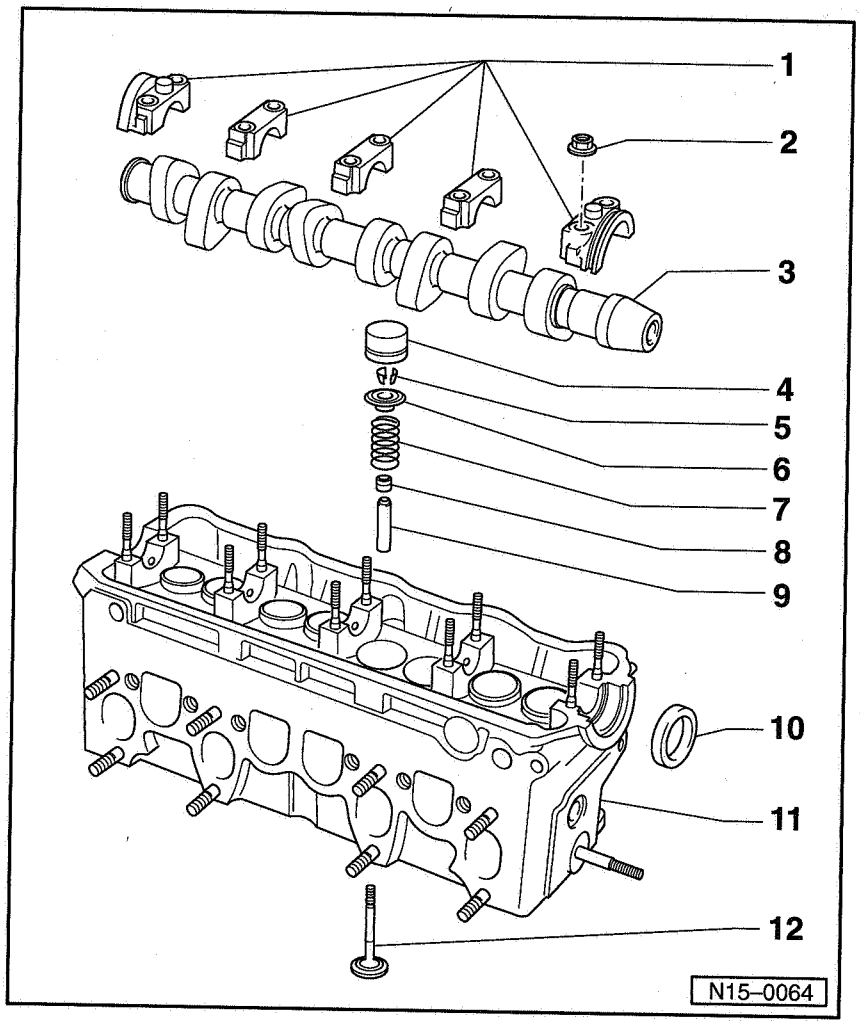
Note:

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.

1 - Bearing cap

- ♦ Installation position ⇒ Fig. 2
- ♦ Note sequence when loosening and tightening
  ⇒ Page 15-46, Removing and installing camshaft

2 - 20 Nm



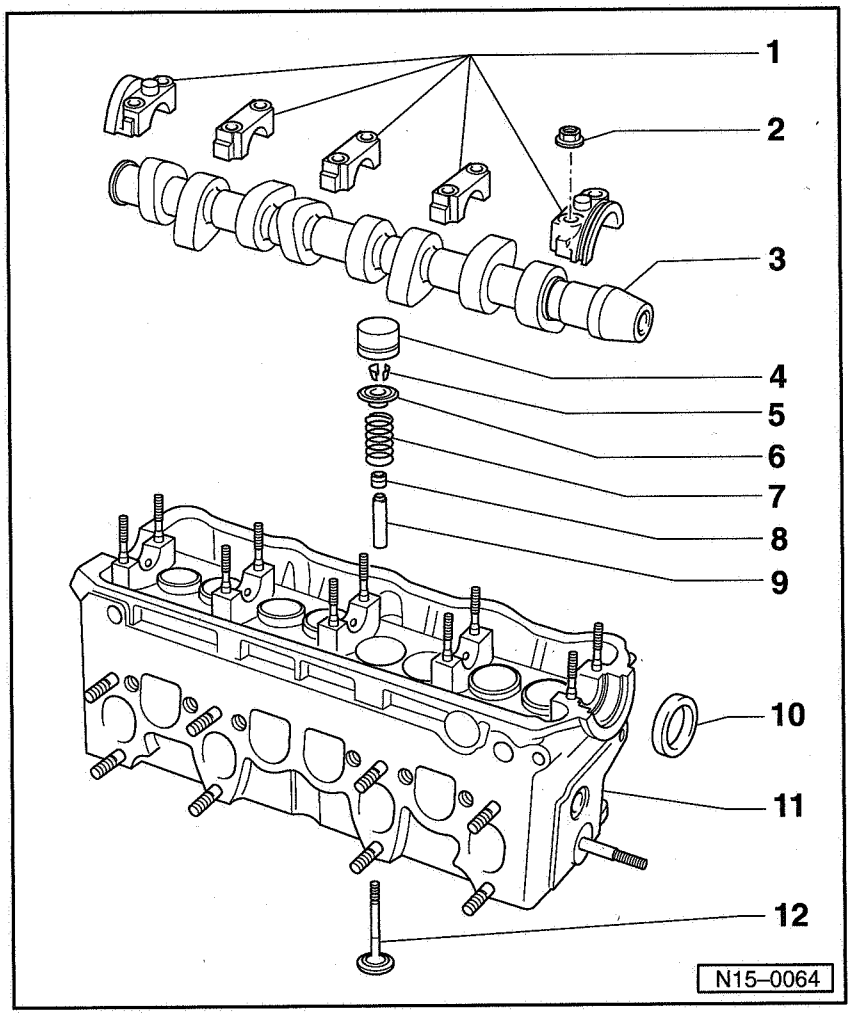
3 - Camshaft

- ♦ Checking axial clearance ⇒ Fig. 1
- ♦ Removing and installing
  ⇒ Page 15-46
- ♦ Checking radial clearance with plastigage
  Wear limit: 0.11 mm
- ♦ Run-out: max. 0.01 mm
- ♦ Identification and valve timing
  ⇒ Fig. 4

4 - Bucket tappet

- ♦ Do not interchange
- ♦ With hydraulic valve clearance compensation
- ♦ Checking ⇒ Page 15-49
- ♦ Store with cam lobe contact surface downwards
- ♦ Before installing check camshaft axial clearance ⇒ Fig. 1
- ♦ Oil contact surface

5 - Cotters

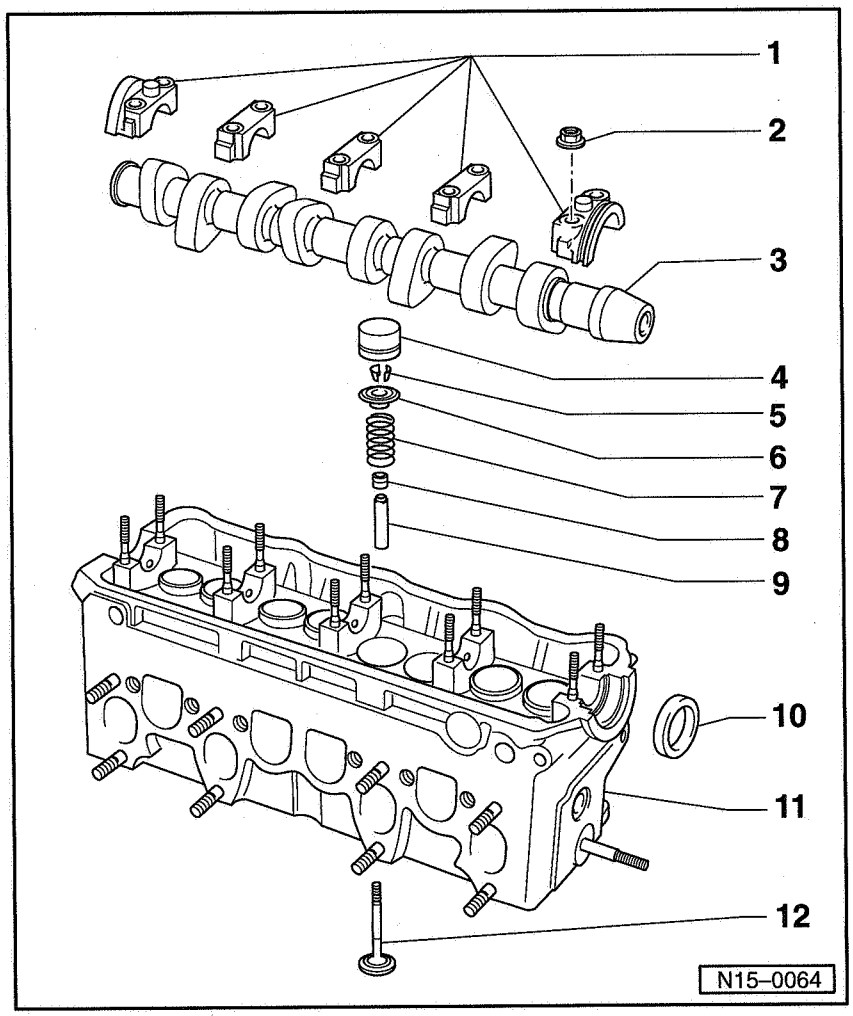


6 - Upper valve spring plate

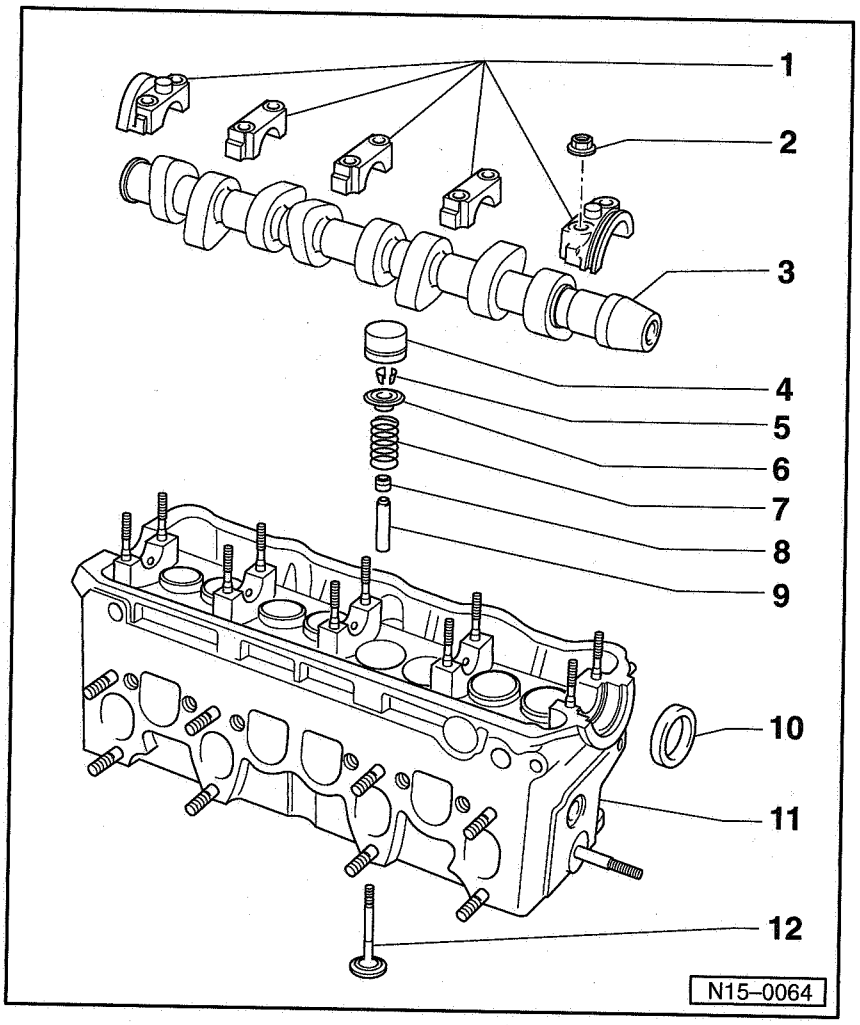
7 - Valve spring
- ♦ Removing and installing: Cylinder head removed: with 2037 installed: ⇒ Page 15-43, renewing valve stem seals

8 - Valve stem seal
- ♦ Renewing ⇒ Page 15-43

9 - Valve guide
- ♦ Checking ⇒ Page 15-40
- ♦ Renewing ⇒ Page 15-41
- ♦ Service version with collar



10 - Oil seal
- ♦ Note differing versions
- ♦ To remove and install, remove bearing cap
- ♦ Removing and installing toothed belt ⇒ Page 15-8
- ♦ Sealing flange with PTFE oil seal without inner coil spring
- ♦ Do not additionally oil or grease the oil seal sealing lip
- ♦ Before installing, remove oil remains from crankshaft journal with a clean cloth
- ♦ To install, tape over (e.g. using Sellotape) groove in taper of camshaft

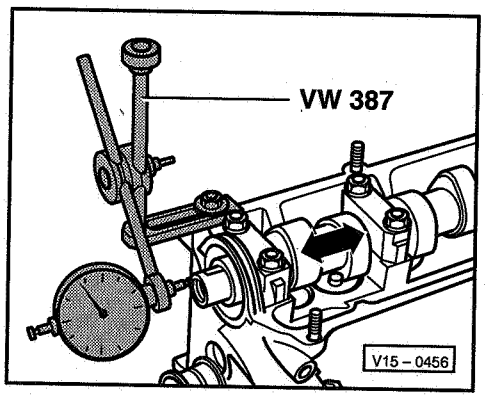


11 - Cylinder head

- ♦ See note
  ⇒ Page 15-29
- ♦ Reworking valve seats
  ⇒ Page 15-37

12 - Valves

- ♦ Valve dimensions ⇒ Fig. 3



◄ **Fig. 1 Checking camshaft axial clearance**

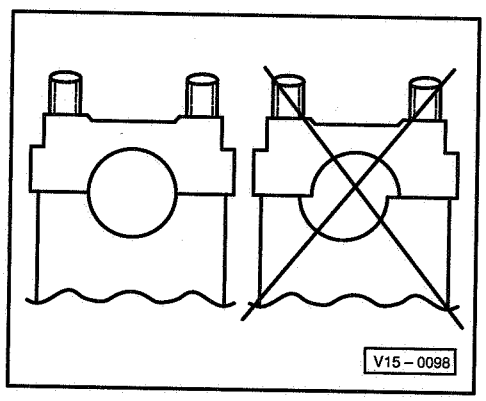
Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

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

Test sequence

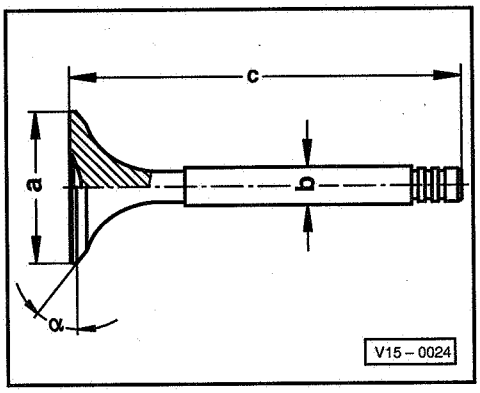
Check with bucket tappets removed and with first and last bearing caps fitted.

Wear limit: max. 0.15 mm



◄ **Fig. 2 Fitting position of camshaft bearing caps**

Note offset. Before installing camshaft fit bearing caps and determine fitting position.



◄ **Fig. 3 Valve dimensions**

Note:

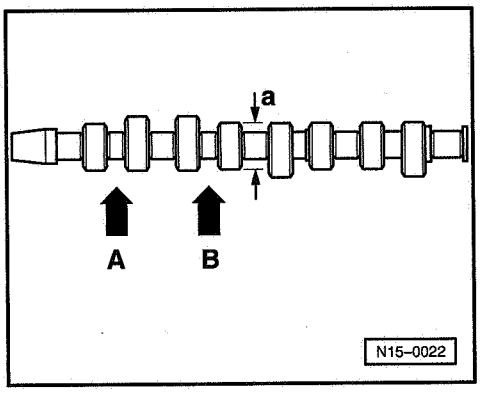
Valves must not be reworked. Only lapping-in is permitted.

Engine code AVM

Dimension		Inlet valve	Exhaust valve
Ø a	mm	35.95	31.45
Ø b	mm	6.963	6.943
c	mm	96.85	96.85
α	∠°	45	45

Engine codes ARD and BEQ

Dimension		Inlet valve	Exhaust valve
Ø a	mm	35.95	31.45
Ø b	mm	6.963	6.943
c	mm	96.55	96.35
α	∠°	45	45



◄ **Fig. 4 Camshaft identification, valve timing**

Identification

- Cam base diameter: a = 38 mm Ø
- Identification by stamped numbers and letters between inlet and exhaust cams:

Engine codes	AVM	ARD, BEQ
No. 1 cylinder -arrow A-	38 A	38 E
No. 2 cylinder -arrow B-	DE	DE

Valve timing at 1 mm valve lift

Engine codes	AVM	ARD, BEQ
Inlet opens after TDC	16 °	11 °
Inlet closes after BDC	25 °	25 °
Outlet opens before BDC	28 °	40 °
Outlet closes before TDC	19 °	10 °

Reworking valve seats

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

- Depth gauge
- Valve seat refacing tool

Notes:

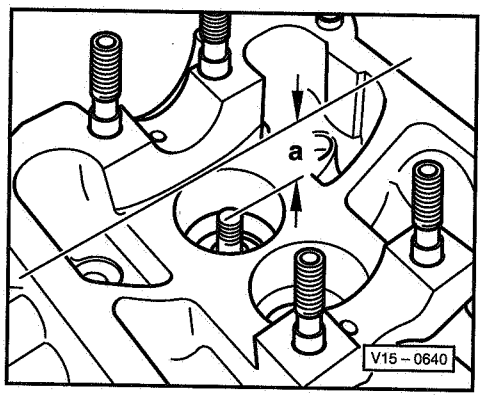
- *When repairing engines with leaking valves, it is not always sufficient to reface or renew valve seats and valves. It is also necessary to check the valve guides for wear. This is particularly important on high mileage engines.*
- *The valve seats should only be reworked just enough to produce a perfect seating pattern. The maximum permissible reworking dimension must be calculated before work is carried out. If the reworking dimension is exceeded, the function of the hydraulic tappets can no longer be guaranteed and therefore the cylinder head should be renewed.*

The maximum permissible reworking dimension is calculated as follows:

- Insert valve and press firmly against seat.

Note:

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



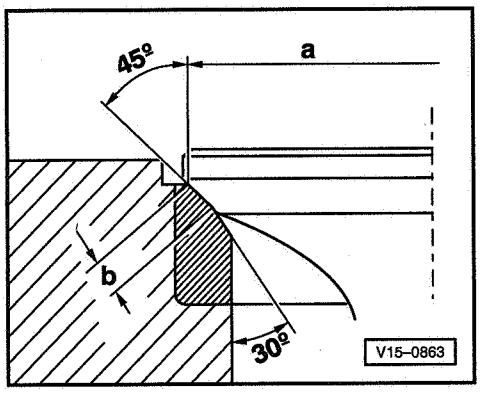
- Measure distance -a- between end of valve stem and upper edge of cylinder head.
- Calculate max. permissible reworking dimension from measured distance -a- and minimum dimension.

Minimum dimension:
Inlet valve 35.8 mm
Exhaust valve 36.1 mm

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

Example:

Measured distance	36.5 mm
- Minimum dimension	35.8 mm
= max. perm. rework dimension	0.7 mm

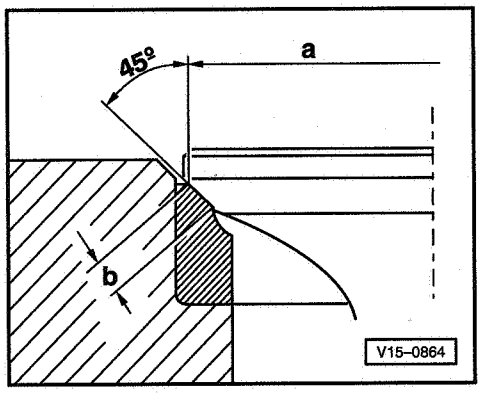


◄ **Reworking inlet valve seat**

a = 35.7 mm Ø
b = 1.6 mm
45 ° = Valve seat angle

Note:

The 30° lower valve seat chamfer is necessary to ensure that the inlet channel flow characteristics are maintained.

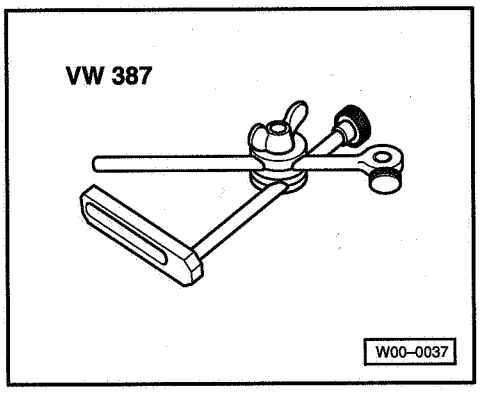


◄ **Reworking exhaust valve seat**

a = 31.4 mm Ø
b = 2.7 mm
45 ° = Valve seat angle

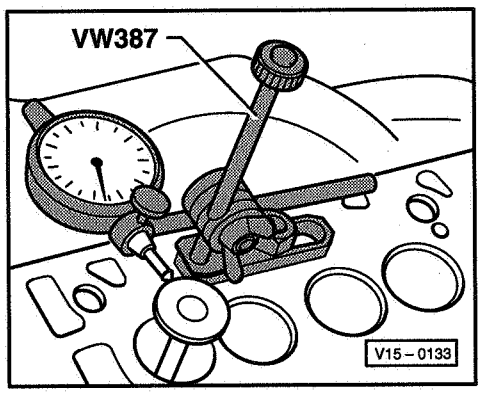
Checking valve guides

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



♦ VW 387 Universal dial gauge bracket

♦ Dial gauge



Test sequence

◄ - Insert new valve into guide until end of valve stem is flush with end of guide. Due to the slight difference in stem dimensions, ensure that only an inlet valve is used in the inlet guide and an exhaust valve in the exhaust guide.

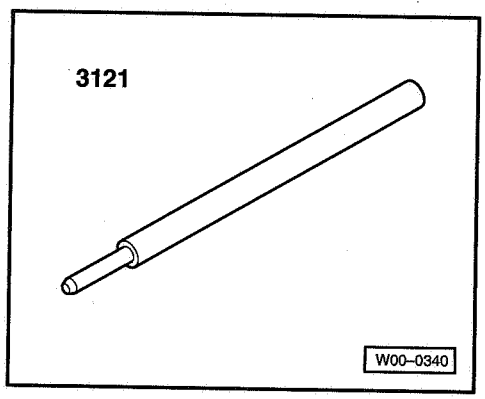
- Determine rock.
  Wear limit: max. 1.3 mm

If rock tolerance is exceeded:

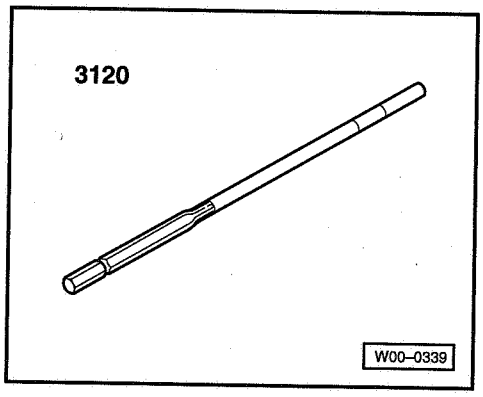
- Renew valve guides ⇒ Page 15-41.

Renewing valve guides

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



♦ 3121 Drift



♦ 3120 Reamer and cutting fluid

Removing

- Clean and check cylinder head. Cylinder heads in which the valve seats can no longer be reworked, or cylinder heads which have already been machined to the minimum dimension, should not have the valve guides replaced.

- Press out worn valve guides with 3121 from the camshaft side (valve guides with shoulder - repair version - from the combustion chamber side).

Installing

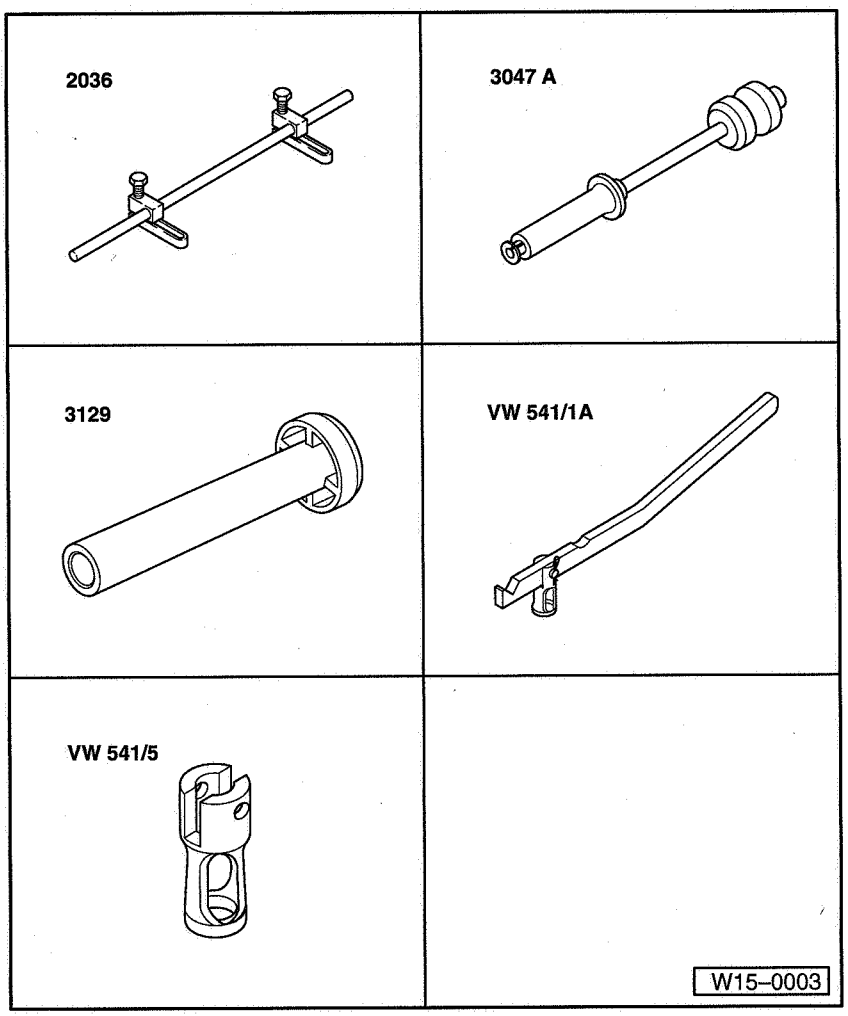
- Press in new guides, moistened with oil, from camshaft side onto shoulder in cold cylinder head using drift 3121.

Note:

When the shoulder on guide makes contact, the pressure must not exceed 1.0 t otherwise shoulder may break off.

- Ream guides out with hand reamer 3120 using plenty of cutting fluid.

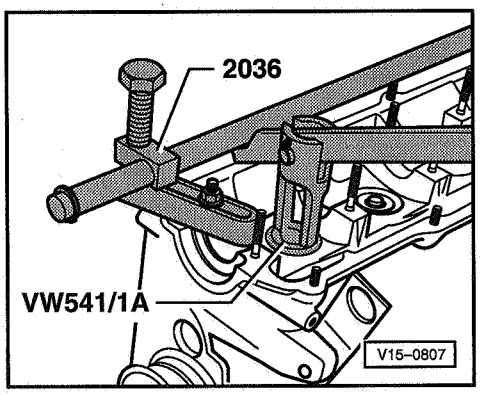
- Rework valve seats ⇒ Page 15-37.

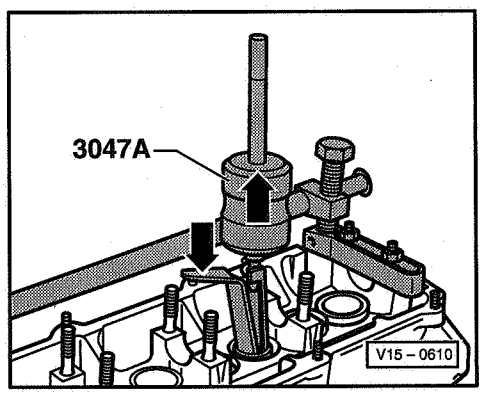


Renewing valve stem seals

Special tools, workshop equipment, test and measuring appliances and auxiliary items required

- ♦ 2036 Assembly appliance
- ♦ 3047A Puller
- ♦ 3129 Fitting tool
- ♦ VW 541/1A Valve lever
- ♦ VW 541/5 Thrust piece





Removing

(with cylinder head fitted)

- Remove camshaft ⇒ Page 15-46.
- Remove the 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).

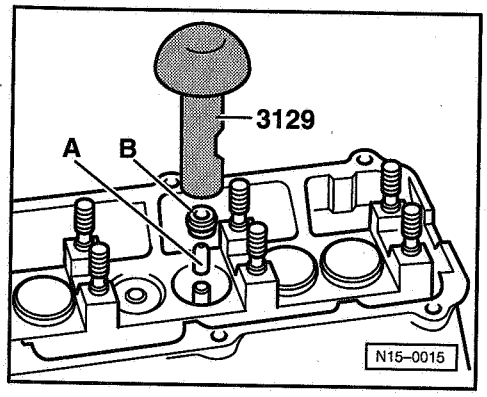
◄ - Fit assembly tool 2036 and adjust mountings to height of studs.

- Remove valve springs with lever VW 541/1A and press piece VW 541/5.

Note:

The valves are supported by the piston crown.

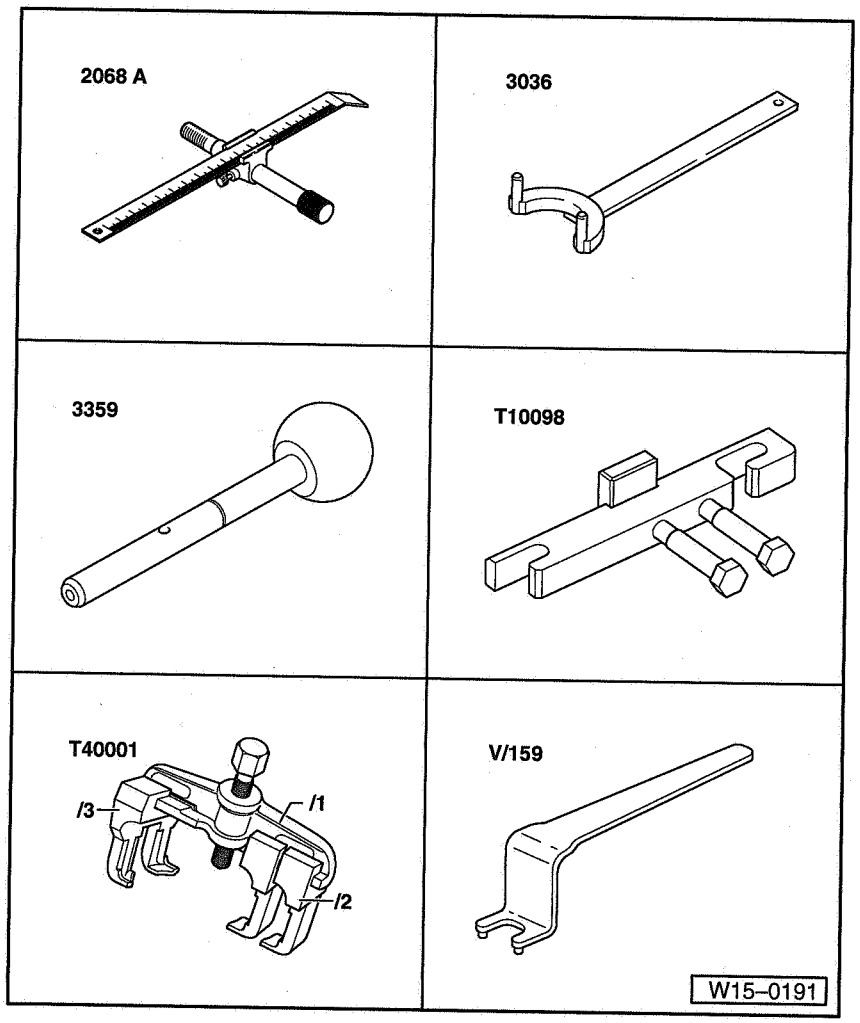
◄ - Pull off valve stem seals with 3047A.



Installing

◄

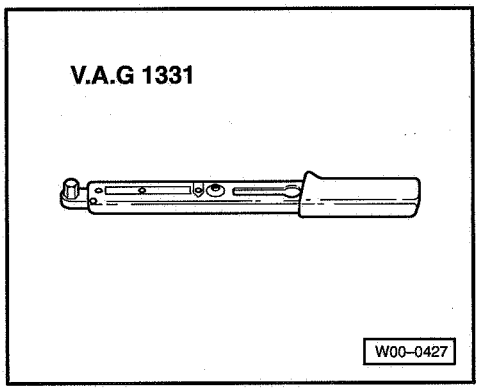
- Place the plastic sleeve supplied on the appropriate valve stem. This will prevent the new valve stem seal being damaged.
- Insert new valve stem seal in fitting tool 3129.
- Oil valve stem seal sealing lip and press carefully onto the valve guide.
- Install camshaft ⇒ page 15-46.



Removing and installing camshaft

Special tools, workshop equipment, test and measuring appliances and auxiliary items required

- ♦ 2068 A TDC setting device
- ♦ 3036 Counter hold tool
- ♦ 3359 Locking pin
- ♦ T10098 Camshaft bar
- ♦ T40001 Puller
- ♦ V/159 Pin wrench, Matra (for engines with engine code AVM)



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

Removing

- Relieve toothed belt tension and take toothed belt off camshaft and injection pump sprockets and injection pump ⇒ page 15-8, Removing, installing, tensioning toothed belt.

Note:

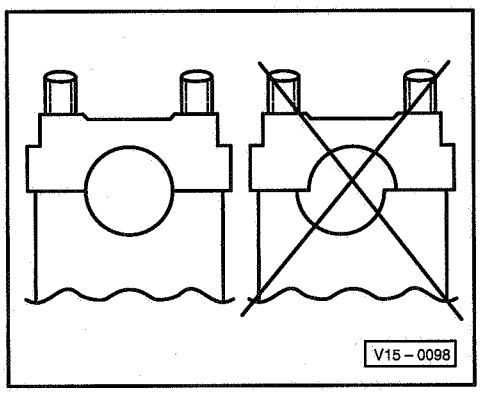
The vibration damper/belt pulley and the centre and lower toothed belt guard need not be removed.

- Take off camshaft sprocket.
- First remove bearing caps 5, 1 and 3. Then loosen bearing caps 2 and 4 alternately and diagonally.

Installing

Notes:

♦ *When installing the camshaft No. 1 cylinder cams must point upwards.*



◄ ♦ *When installing the bearing cap note offset, before installing camshaft fit bearing caps and determine fitting position.*

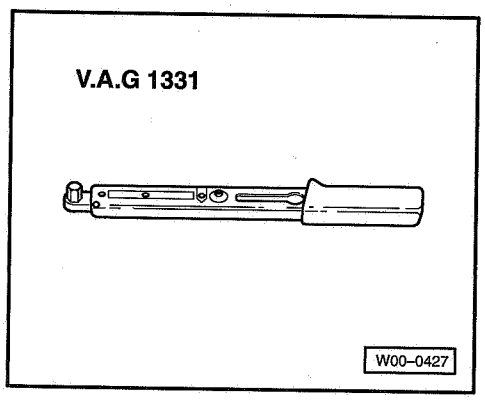
- Oil camshaft running surfaces.
- Tighten bearing caps 2 and 4 alternately and diagonally to
  20 Nm.
- Install bearing caps 5, 1 and 3 and also tighten to
  20 Nm.
- Locate bearing cap 5 by tapping lightly on the end of the camshaft.
- Install camshaft sprocket.
- Install and tension toothed belt ⇒ Page 15-8.

Note:

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

Checking hydraulic bucket tappets

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



- ♦ V.A.G 1331 Torque wrench (5...50 Nm)
- ♦ Feeler gauge
- ♦ Wood or plastic wedge

Test sequence

Notes:

- ♦ *Renew defective tappet complete (cannot be adjusted or repaired).*
- ♦ *Irregular valve noises when starting engine are normal.*

- Start engine and run until engine oil temperature is min. 80 °C.
- Increase engine speed to about 2500 rpm for approx. 2 minutes.

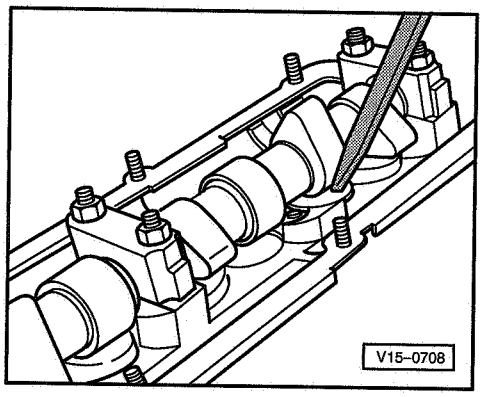
If the hydraulic tappets are still noisy, locate defective tappets as follows:

Engine codes ARD and BEQ

- Remove intake manifold upper part ⇒ page 23-19, Dismantling and assembling parts of intake manifold.

Continued for all engine codes

- Remove cylinder head cover.
- Rotate crankshaft clockwise, until cam of the tappet to be checked is pointing upwards.
- Determine play between cam and bucket tappet.
- If the play is in excess of 0.1 mm, renew bucket tappet. If the play is less than 0.1 mm or no play, proceed with check as follows:



◄ - Press tappet down with a wooden or plastic wedge. If free travel in excess of 1 mm is felt before tappet contacts valve, renew tappet.

Note:

After installing new tappets the engine must not be started for approx. 30 minutes. Hydraulic compensation elements must settle (otherwise valves will strike pistons).

Removing and installing parts of the lubrication system

Notes:

- *If large quantities of metal particles or other deposits (caused, for example, by partial seizure of the crankshaft or conrod bearings) are found in the engine oil when performing repairs, clean the oil passages thoroughly and renew the oil cooler in order to prevent further damage from occurring later.*
- *The oil level must not be above the max. mark - danger of damage to catalyst!*
  Marks ⇒ page 17-7, fig. 1.

Observe safety precautions ⇒ Page 23-2.

Observe rules for cleanliness ⇒ Page 23-4.

Checking oil pressure and oil pressure switch ⇒ Page 17-15.

Oil system capacity:

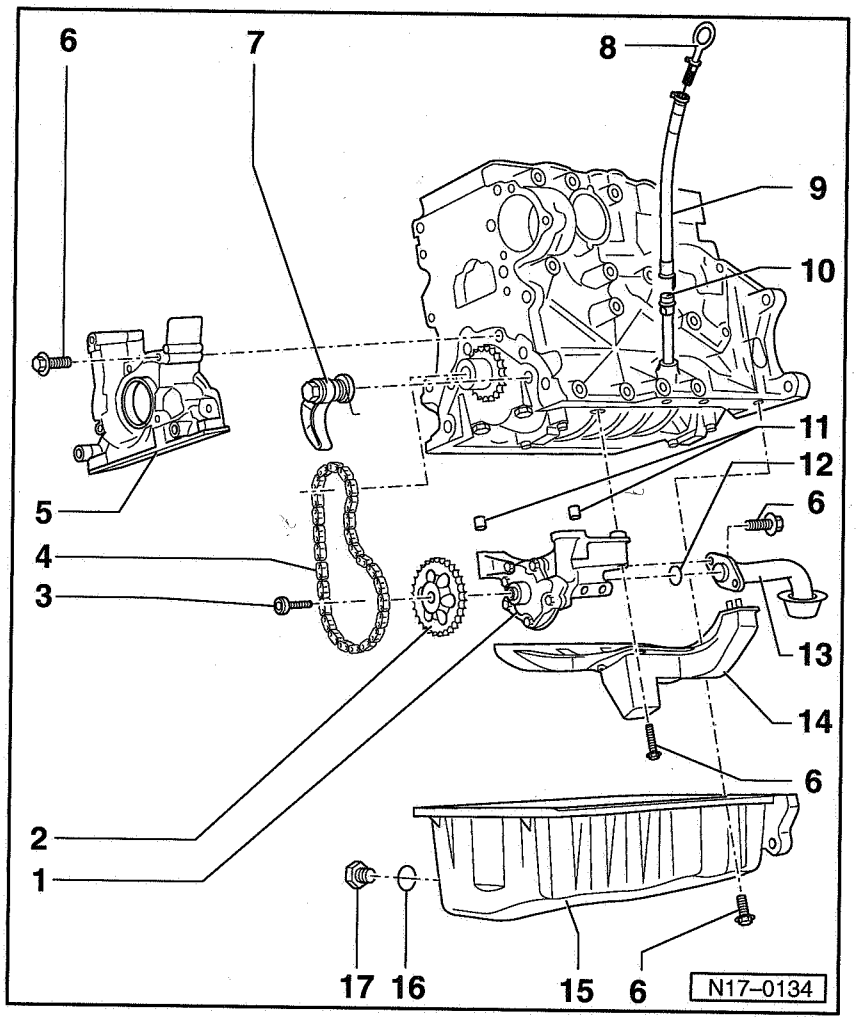
with oil filter 4.5 ltrs.

Engine code AVM (turbo diesel)

Only use engine oil conforming to VW standard 505 00 or 505 01.

Engine codes ARD and BEQ (naturally aspirated diesel)

Only use engine oil conforming to VW standard 500 00, 501 01, 502 00, 505 000 or 505 01 or multi-grade oil conforming to ACEA B3/B4.



Part I

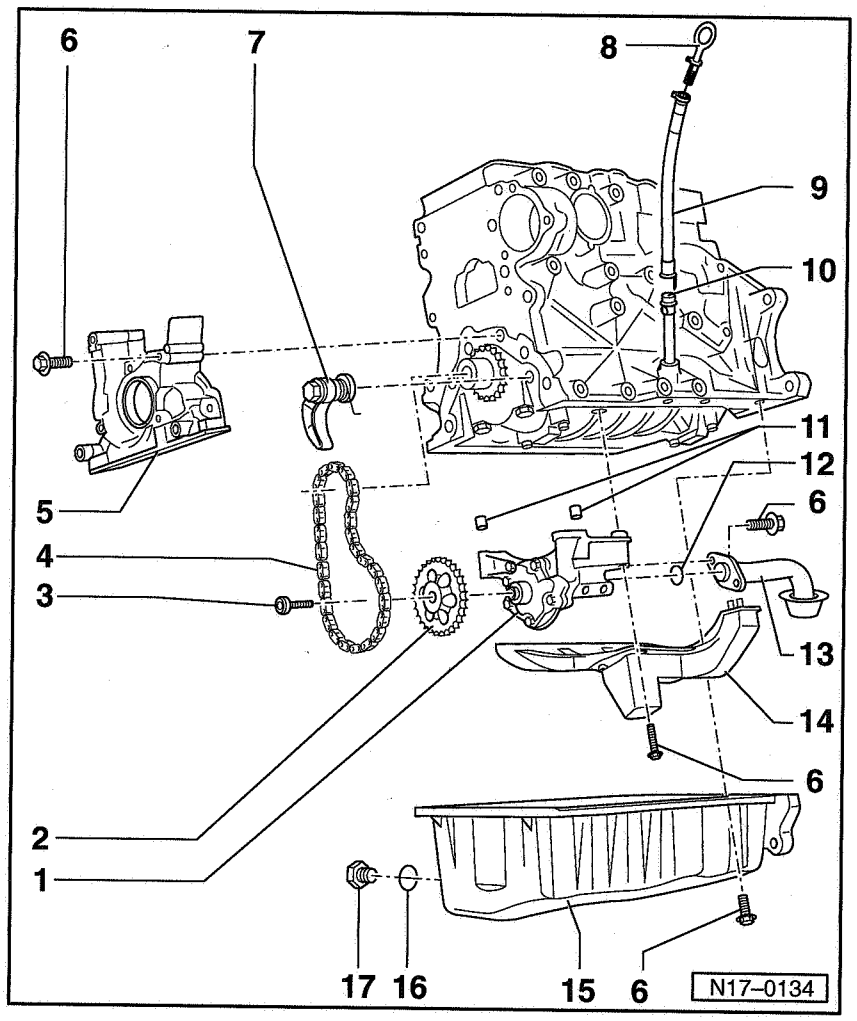
Part II Dismantling oil filter bracket
⇒ Page 17-8

1 - Oil pump
- ♦ With pressure relief valve of 12 bar
- ♦ Before installing, check that both dowel sleeves for centralizing oil pump/cylinder head are fitted
- ♦ Renew if running surfaces and gears are scored

2 - Chain sprocket for oil pump

3 - 25 Nm

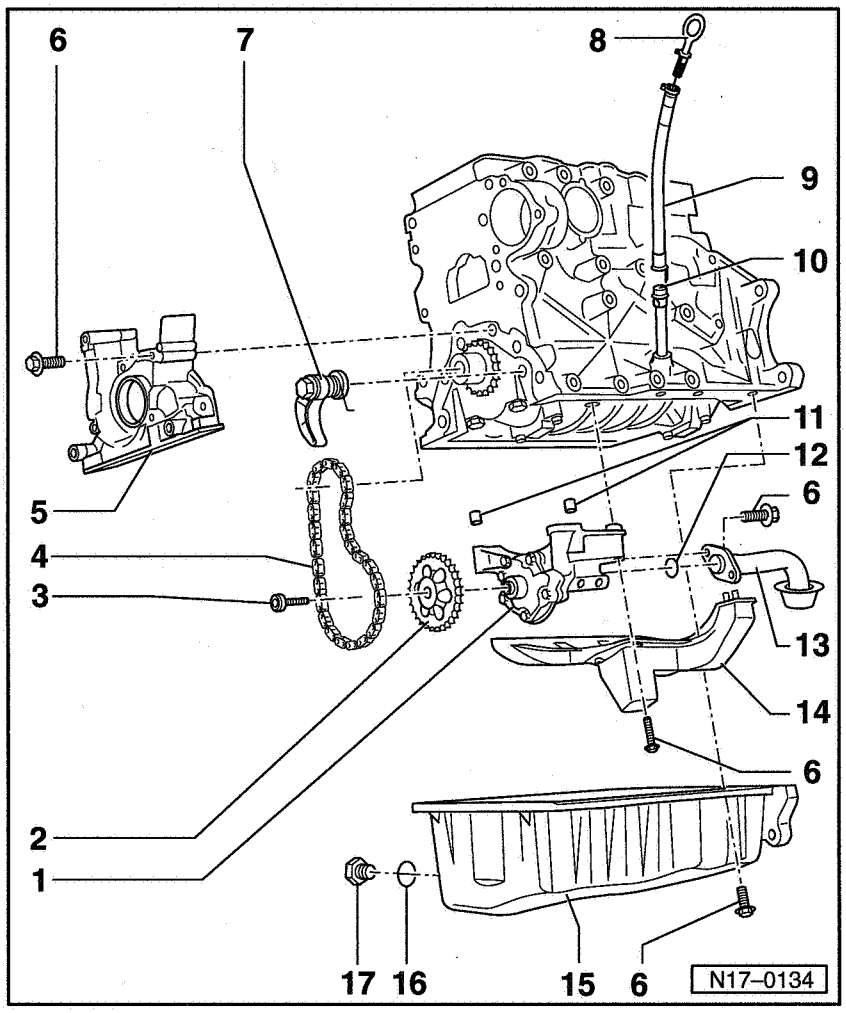
4 - Chain



5 - Front sealing flange
- ♦ Must be located on dowel sleeves
- ♦ Removing and installing
  ⇒ Page 13-27
- ♦ With oil seal
- ♦ Take note of different types of seal
- ♦ PTFE oil seal without inner coil spring
- ♦ Renewing crankshaft oil seal - pulley end ⇒ Page 13-22

6 - 15 Nm

7 - Chain tensioner with tensioning rail, 15 Nm
- ♦ When installing, pretension spring and fit



8 - Dipstick
- ♦ The oil level must not be above the max. mark!
- ♦ Markings ⇒ Page 17-7, Fig. 1
- ♦ Note fitting location: Lug on dipstick must be located opposite to lug on dipstick tube

9 - Guide
- ♦ Pull off to extract oil

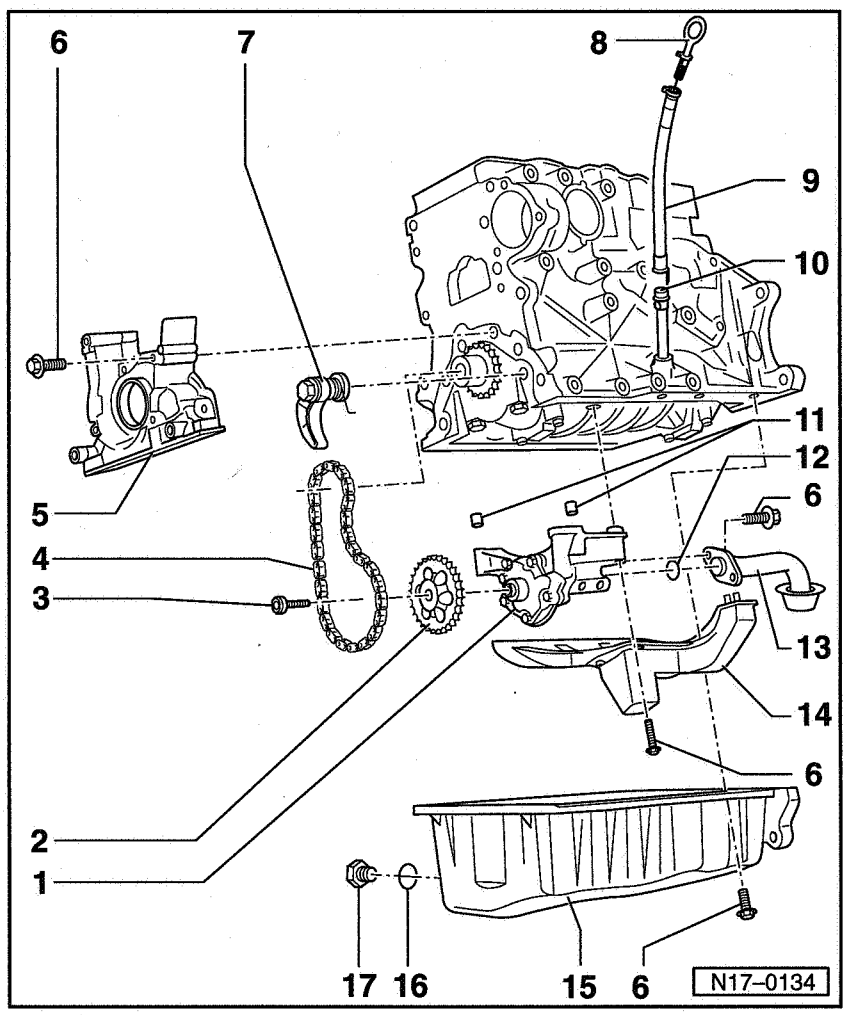
10 - Guide tube

11 - Dowel sleeves

12 - O-ring
- ♦ Renew

13 - Suction pipe
- ♦ Clean strainer if soiled

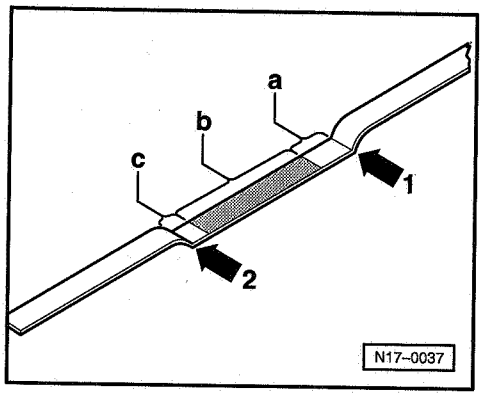
14 - Baffle plate



15 - Sump
- ♦ Clean sealing surface before installing
- ♦ Removing and installing ⇒ page 17-11

16 - Seal
- ♦ Renew

17 - Oil drain plug, 30 Nm



◄ **Fig. 1 Markings on oil dipstick**

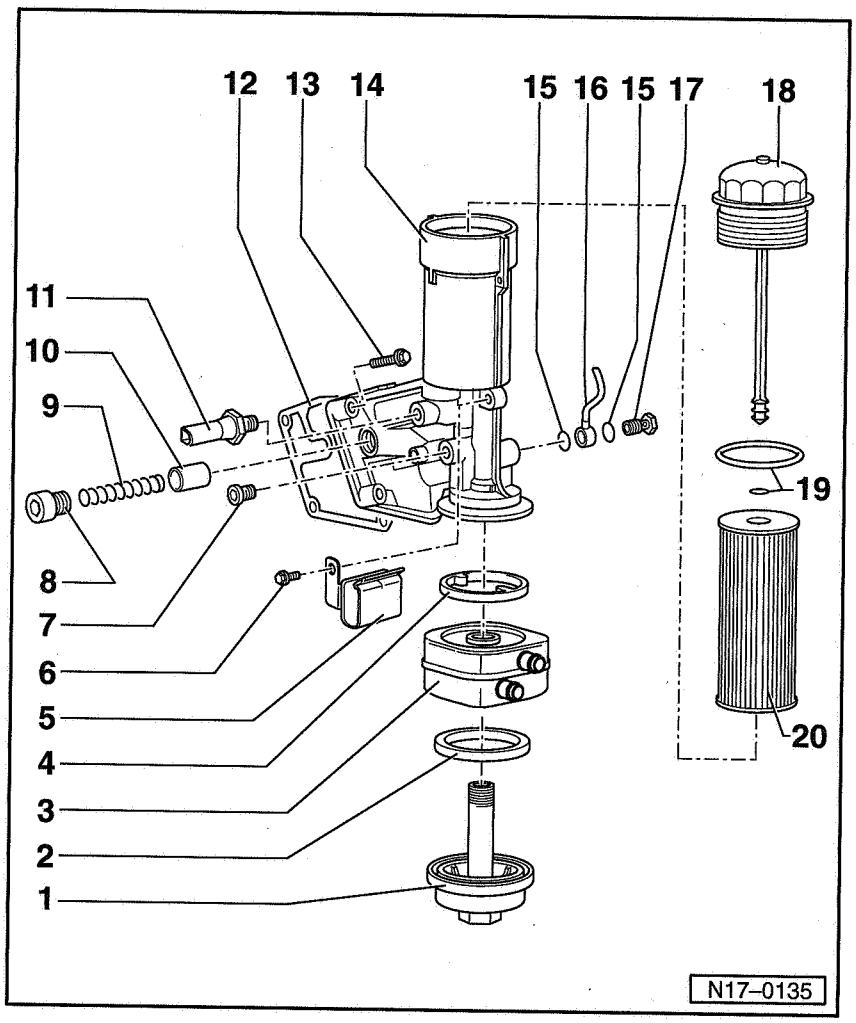
1 - max. mark

2 - min. mark

a - Area above hatched field up to max. mark: Do not replenish with engine oil!

b - Oil level within hatched field: can be replenished with engine oil

c - Area from min. mark up to hatched field: replenish with max. 0.5 ltr. of engine oil!



Part II

1 - Sealing plug, 25 Nm

2 - Gasket
- ♦ Renew

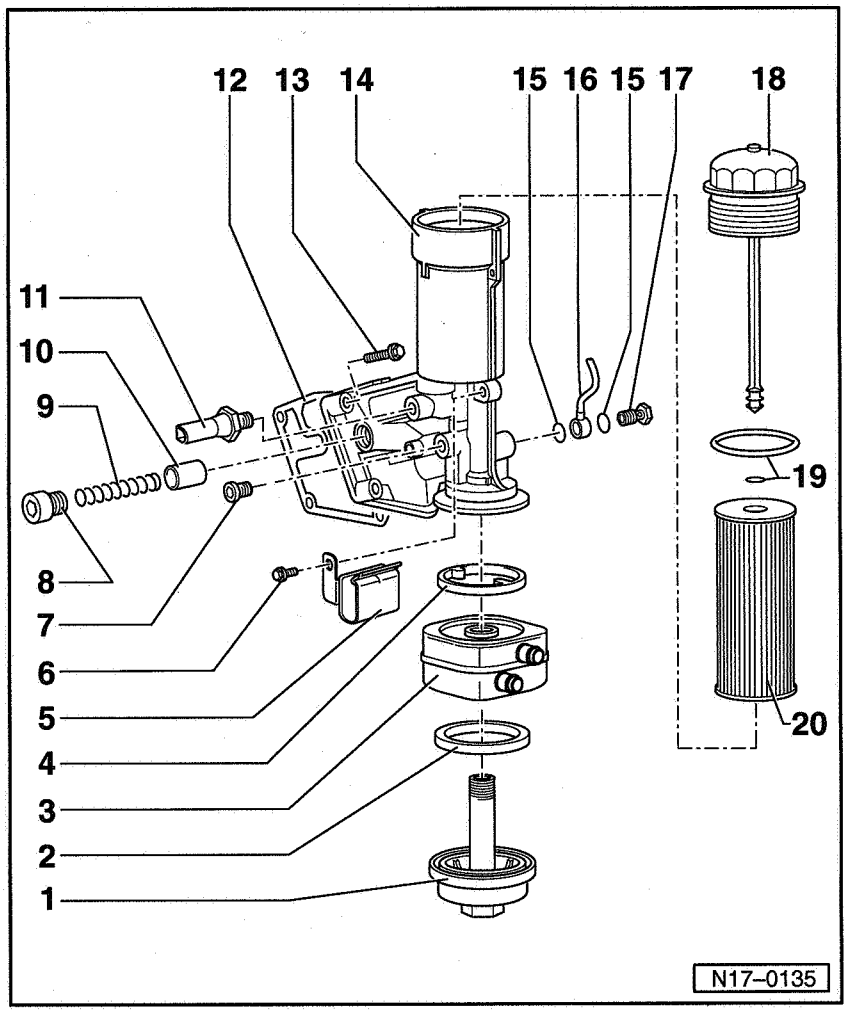
3 - Oil cooler
- ♦ Ensure clearance to adjacent components
- ♦ See note
  ⇒ Page 17-1

4 - Gasket
- ♦ Renew
- ♦ Fit into groove on oil cooler

5 - Bracket

6 - 10 Nm

7 - Sealing plug, 10 Nm
- ♦ If sealing ring is leaking nip open and replace.



8 - Sealing plug, 40 Nm

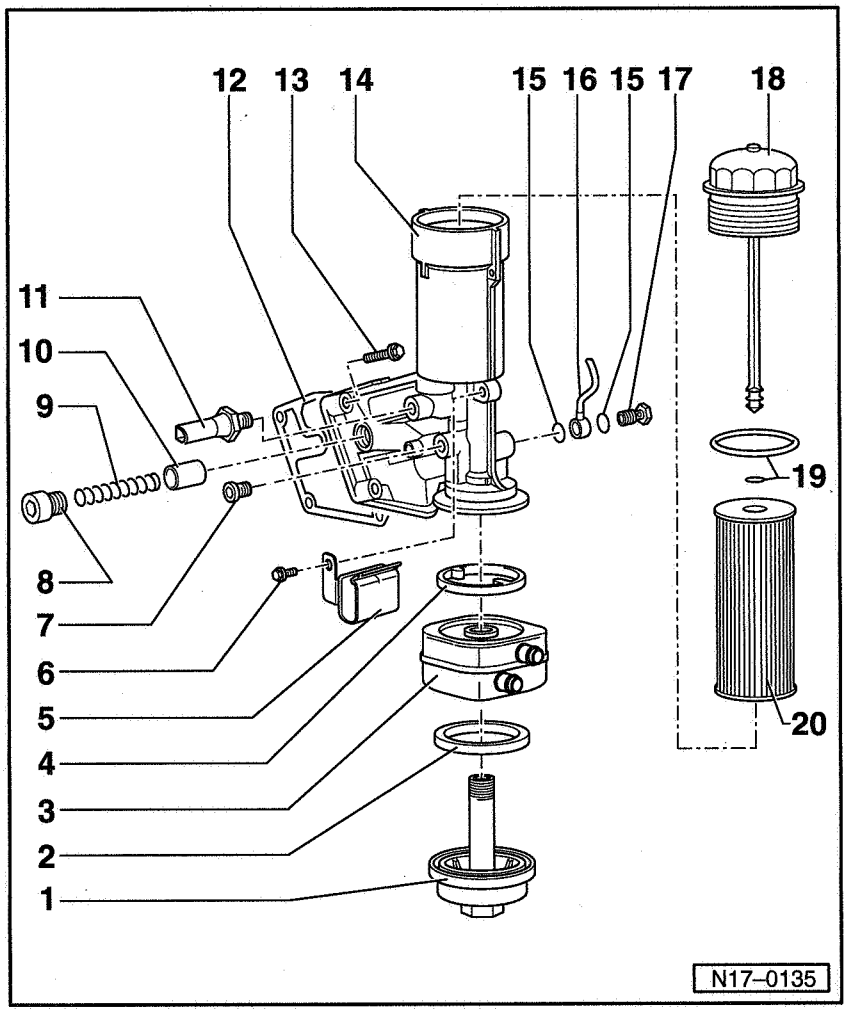
9 - Spring
- For pressure relief valve, approx. 5 bar

10 - Piston
- For pressure relief valve, approx. 5 bar

11 - 0.7 bar oil pressure switch (F1), 25 Nm
- If sealing ring is leaking nip open and replace.
- Checking ⇒ Page 17-15

12 - Gasket
- Renew

13 - 15 Nm + $^1/_4$ turn (90 °) further
- Renew
- First fit upper left and lower right bolt, then tighten the four bolts diagonally



14 - Oil filter bracket

15 - Seal
- Renew
- Engine code AVM only

16 - Oil supply pipe
- To turbocharger
- Engine code AVM only

17 - Banjo bolt, 20 Nm
- Engine code AVM only

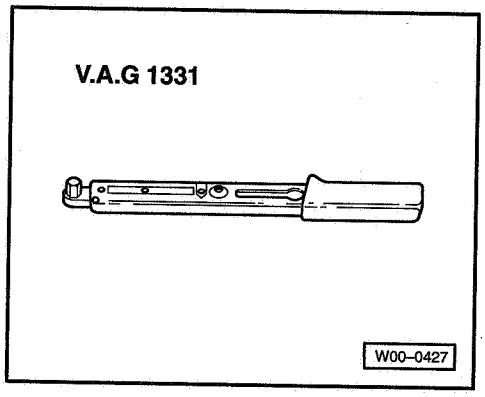
18 - Sealing cap, 25 Nm
- Loosen and tighten with oil filter spanner 3417

19 - O-ring
- Renew

20 - Oil filter element

Removing and installing sump

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



- ♦ V.A.G 1331 Torque wrench (5...50 Nm)
- ♦ Hand drill with plastic brush
- ♦ D176 404 A2 Silicone sealant
- ♦ Protective glasses
- ♦ Flat scraper

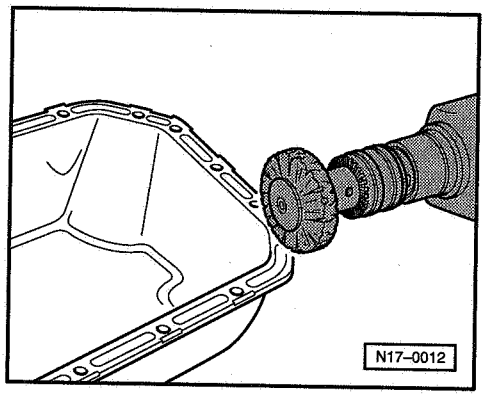
Removing

- Drain engine oil.

Note:

Observe disposal regulations!

- Remove 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 the sump with a rotating brush, e.g. a hand drill with a plastic brush (wear eye protection).

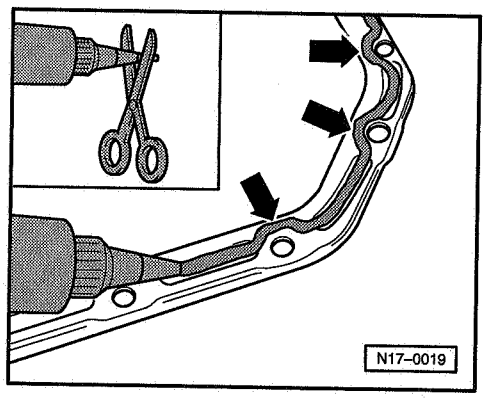
- Clean sealing surface, must be free of oil and grease.

Installing

Notes:

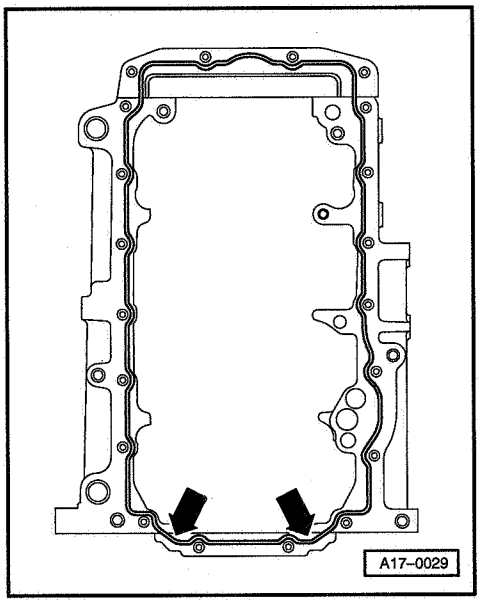
♦ *Note the use by date of the sealant.*

♦ *Sump must be installed within 5 minutes of applying silicone sealing compound.*



◄ - Cut off tube nozzle at forward marking (nozzle approx. 3 mm ∅).

- Apply silicone sealing compound, as shown, to clean sump sealing surface. Sealing compound bead must be.
  - ♦ 2...3 mm thick.
  - ♦ and run on inside of bolt holes -arrows-.



Note:

The sealing compound bead must not be thicker, otherwise excess sealing compound will enter the sump and may block the oil suction pipe strainer.

◄ - Apply silicone sealing bead as shown to the clean sealing surface of the sump. (The illustration shows the position of the sealant bead on the cylinder block).

- Install sump immediately and tighten all sump bolts lightly.

Note:

The sump must be flush with cylinder block.

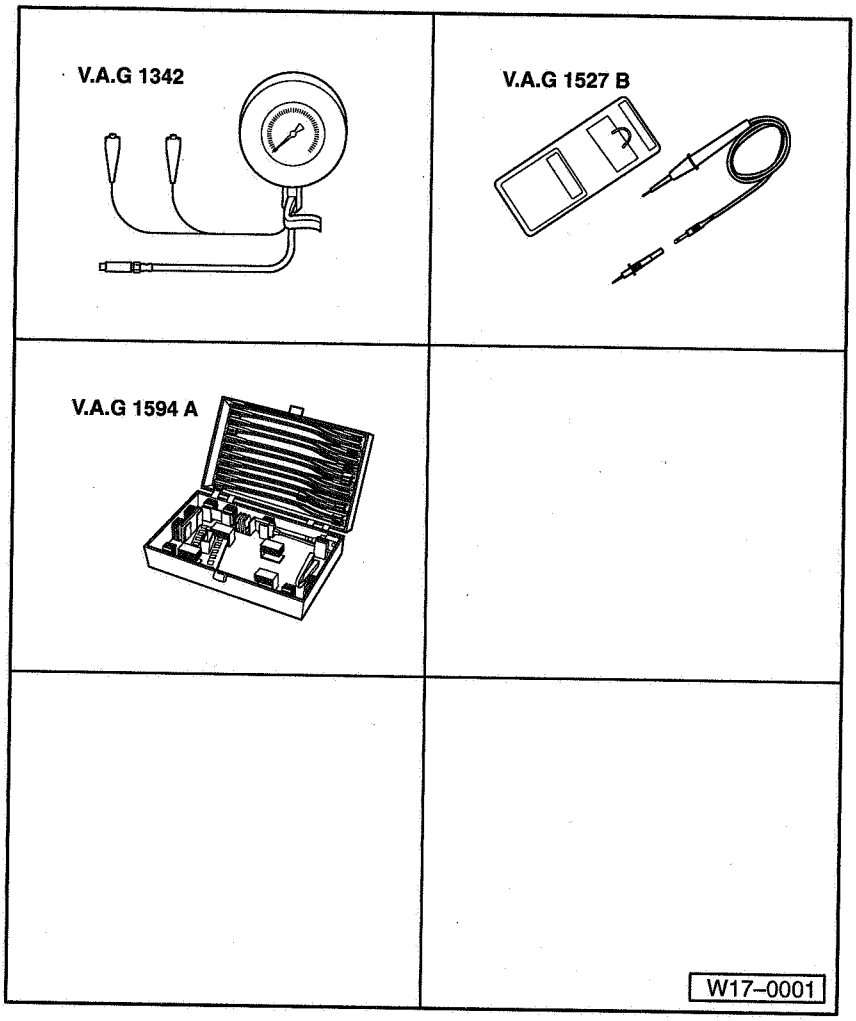
- Tighten sump bolts to
  15 Nm.

- Tighten sump/gearbox bolts to
  45 Nm.

Note:

After installing sump the sealant must be allowed to dry for approx. 30 minutes before engine oil is replenished.

The rest of the assembly is basically a reverse of the dismantling sequence.



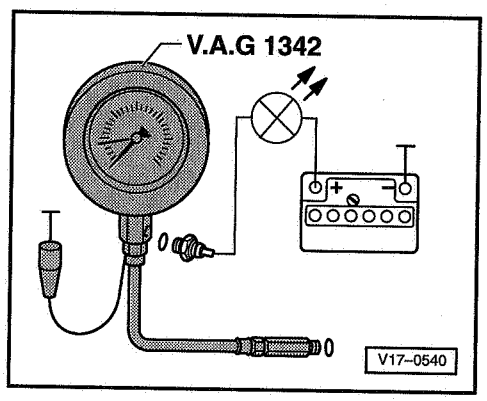
Checking oil pressure and oil pressure switch

Special tools, workshop equipment, test and measuring appliances and auxiliary items required

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

Note:

Functional check and maintenance of the optical oil pressure display/ gauge ⇒ page 27-20, Current flow diagrams.



Test sequence

- Remove oil pressure switch (F1) and screw into tester.
- Screw tester into the oil filter bracket in place of the oil pressure switch.
- Connect brown wire of tester to earth (-).
- Connect diode test lamp V.A.G 1527 B using auxiliary cables from 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)
  ⇒ page 17-9, item 11.

If the LED does not light up:

- Start engine and increase speed slowly.
  At
  0.55...0.85 bar
  the LED must light up, otherwise renew oil pressure switch (F1)
  ⇒ page 17-9, item 11.

Check 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 obtained:

- Rectify mechanical damage, e.g. bearing damage.

- 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 galleries.

- If necessary, replace oil filter bracket with pressure relief valve

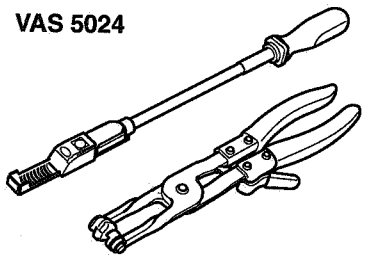
Removing and installing parts of cooling system

Warning!

When carrying out repair work, especially due to the cramped conditions, note the following:

- ***Route all lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant, refrigerant, brake fluid and vacuum pipes and hoses) and electrical wiring so that the original positions are restored.***
- ***Ensure sufficient clearance to all moving or hot components.***

VAS 5024



W00-0495

Notes:

- *Hoses are secured with spring-type clips. In cases of repair only use spring-type clips.*
- *VAS 5024 pliers are recommended when installing spring-type clips.*
- *When the engine is warm the cooling system is under pressure. If necessary release pressure before commencing 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).*

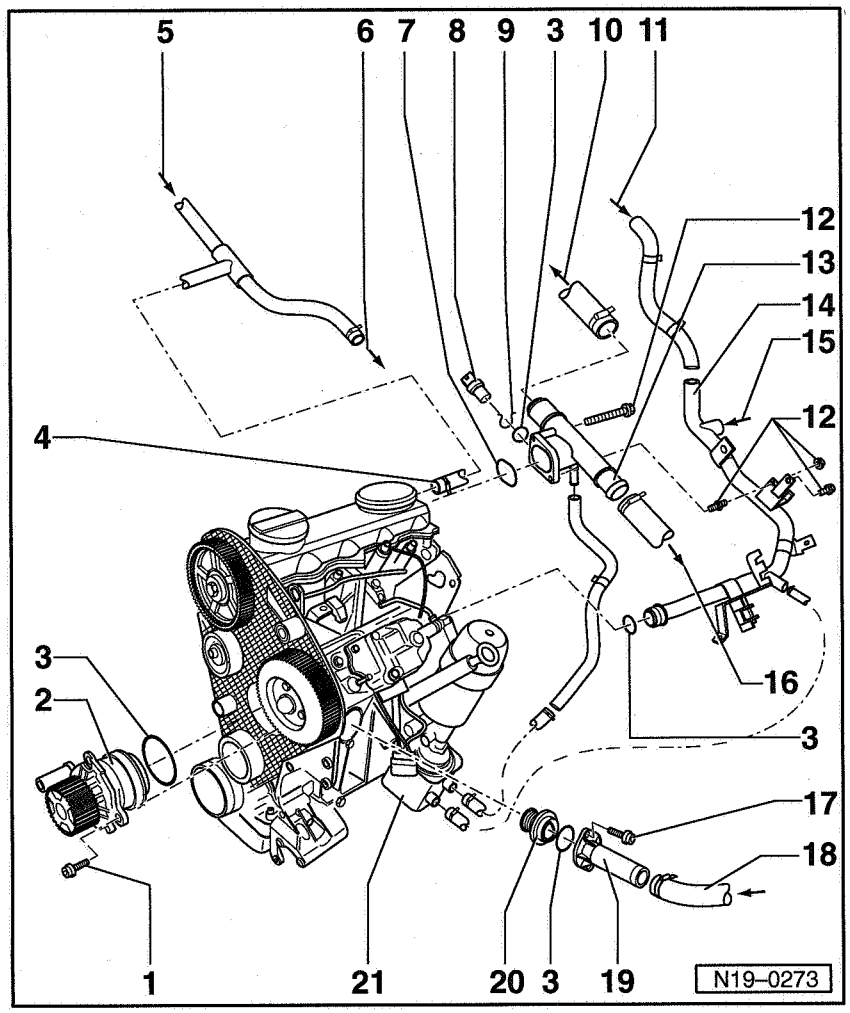
Perform cooling system leakage test with cooling system tester V.A.G 1274 and adapters V.A.G 1274/8 and V.A.G 1274/9.

Parts of cooling system engine side ⇒ 19-3.

Coolant hose connection diagram ⇒ Page 19-7.

Draining and filling with coolant ⇒ Page 19-8.

Coolant mixture ratios ⇒ Page 19-8, draining and filling with coolant



Parts of cooling system engine side

1 - 15 Nm

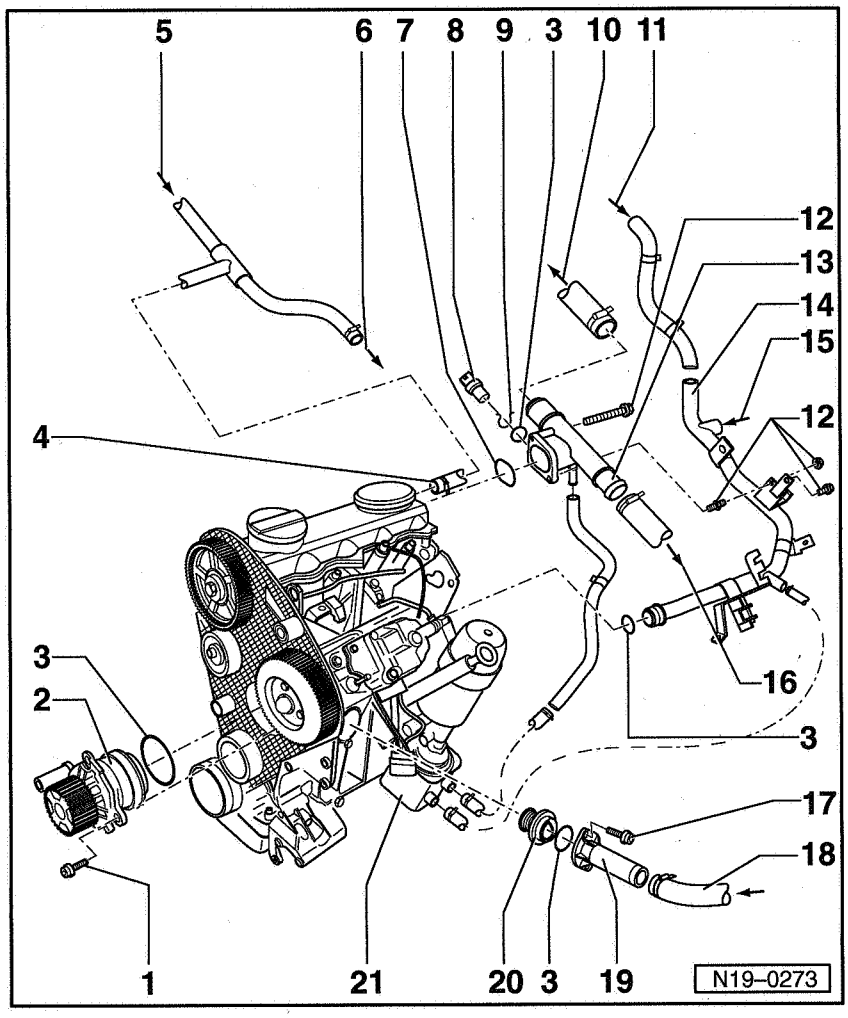
2 - Coolant pump
- ♦ Check for ease of movement
- ♦ Note installation position
- ♦ Removing and installing ⇒ Page 19-13

3 - O-ring
- ♦ Renew

4 - Coolant hose

5 - From top of radiator
- ♦ Coolant hose connection diagram ⇒ Page 19-7

6 - To top of expansion tank
- ♦ Coolant hose connection diagram ⇒ Page 19-7



7 - O-ring
- ♦ Check seated securely
- ♦ Renew

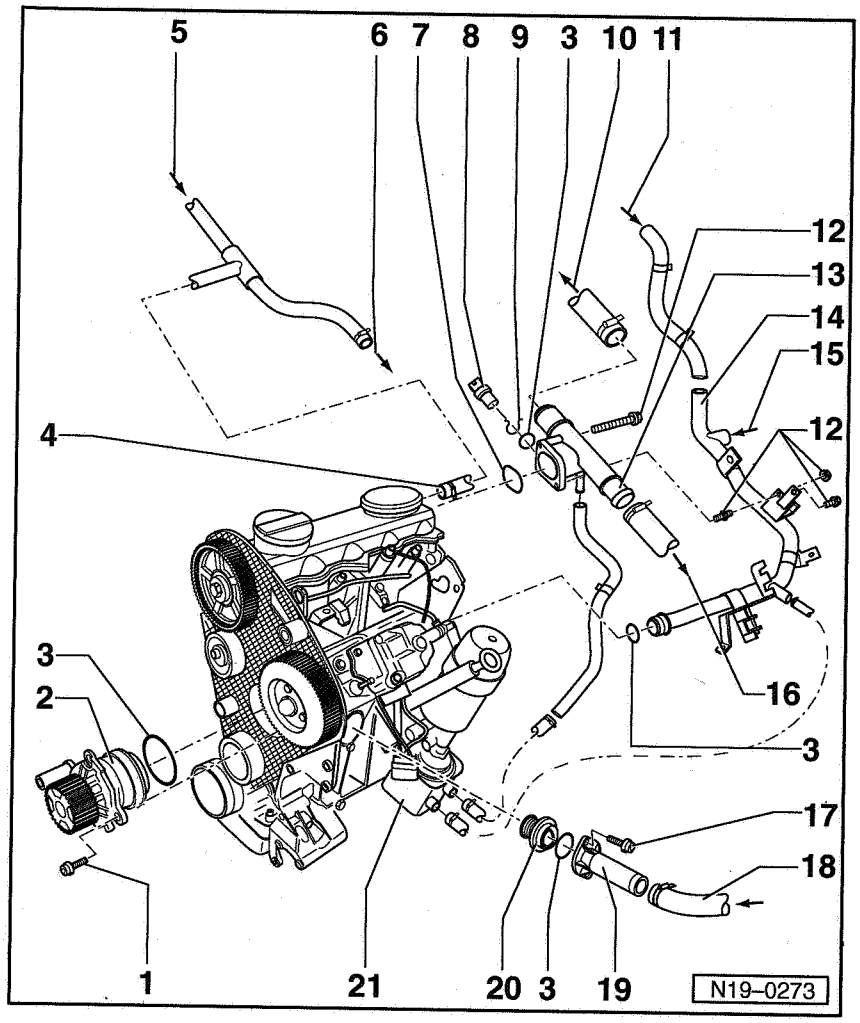
8 - Coolant temperature sender (G62)
- ♦ For engine control unit
- ♦ With coolant temperature gauge sender (G2)
- ♦ If necessary release pressure in cooling system before removing
- ♦ Checking ⇒ Page 23-53

9 - Retaining clip
- ♦ Check seated securely

10 - To heat exchanger
- ♦ Coolant hose connection diagram ⇒ Page 19-7

11 - From heat exchanger
- ♦ Coolant hose connection diagram ⇒ Page 19-7

12 - 10 Nm



13 - Connector piece

14 - Coolant pipe

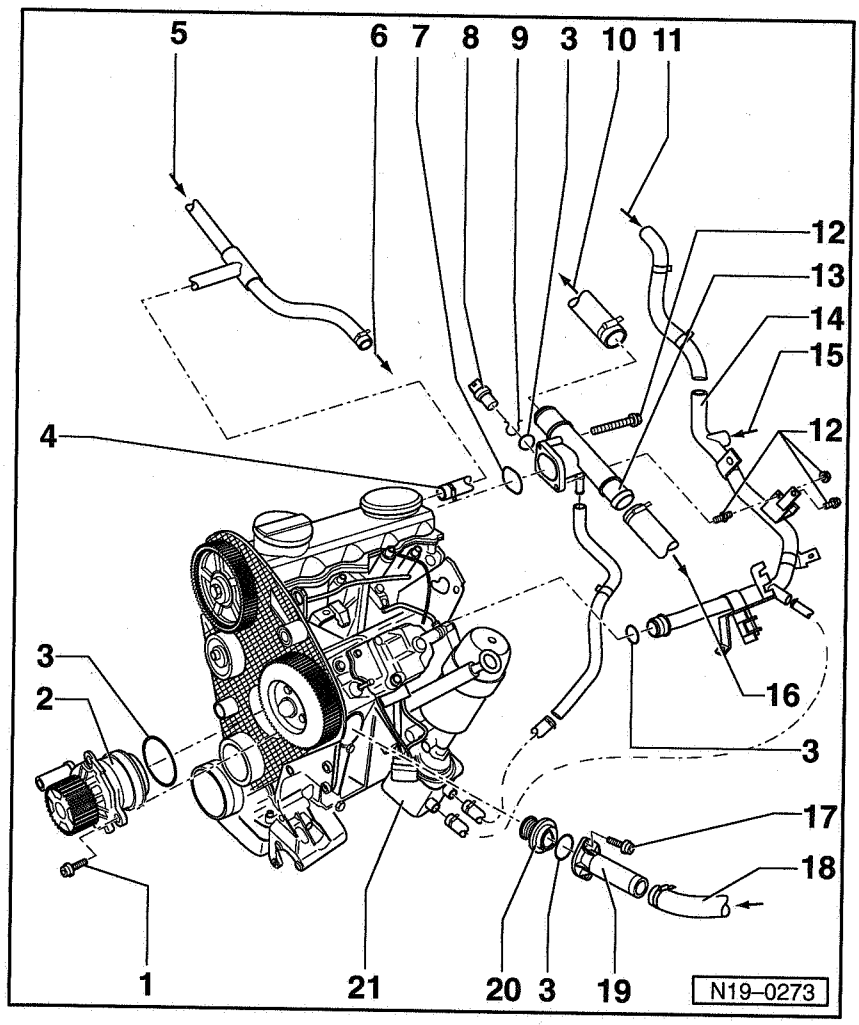
15 - From bottom of expansion tank
- ♦ Coolant hose connection diagram ⇒ Page 19-7

16 - To top of radiator
- ♦ Coolant hose connection diagram ⇒ Page 19-7

17 - 15 Nm

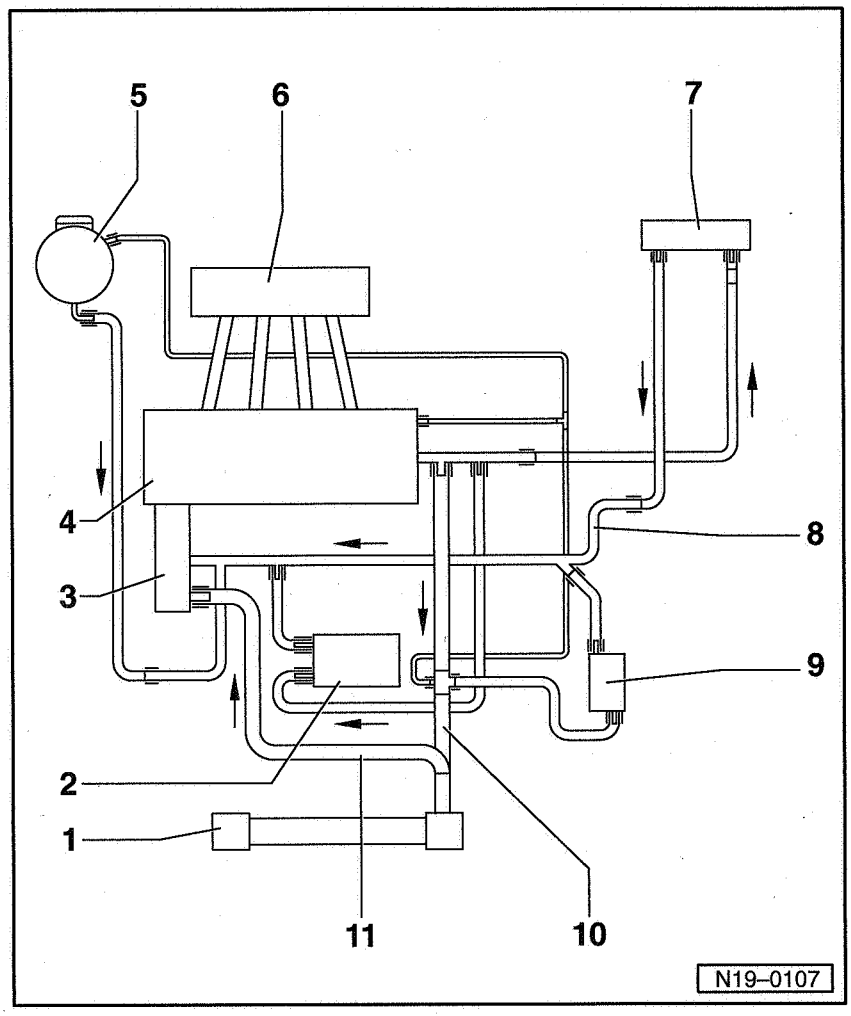
18 - To bottom of radiator
- ♦ Coolant hose connection diagram ⇒ Page 19-7

19 - Connecting piece
- ♦ For thermostat



20 - Coolant thermostat
- ♦ Removing and installing ⇒ Page 19-16
- ♦ Observe installation position, ⇒ Page 19-16 Removing and installing thermostat
- ♦ Checking: heat-up thermostat in water
- ♦ Opening commences approx. 85 °C
- ♦ Ends approx. 105 °C
- ♦ Opening lift min. 7 mm

21 - Oil cooler
- ♦ Removing and installing ⇒ Page 17-8, Item 3



Coolant hose connection diagram

1 - Radiator

2 - Oil cooler

3 - Coolant pump/thermostat

4 - Cylinder block

5 - Expansion tank

6 - Intake manifold

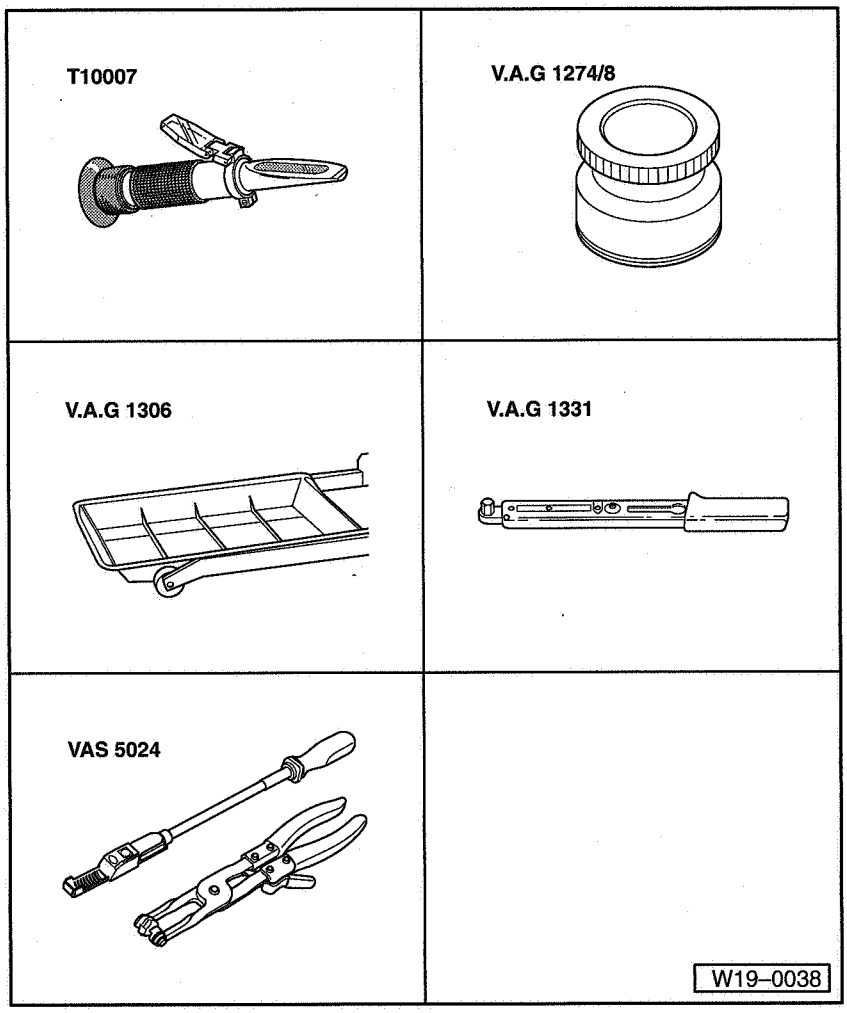
7 - Heating system heat exchanger

8 - Coolant pipe

9 - Gearbox oil cooler

10 - Upper coolant hose

11 - Lower coolant hose



Draining and filling cooling system

Special tools, workshop equipment, test and measuring appliances and auxiliary items required

- T10007 Refractometer
- V.A.G1274/8 Adapter
- V.A.G 1306 Drip tray
- V.A.G 1331 Torque wrench (5...50 Nm)
- VAS 5024 Assembly tool for spring-type clamps

Not illustrated:

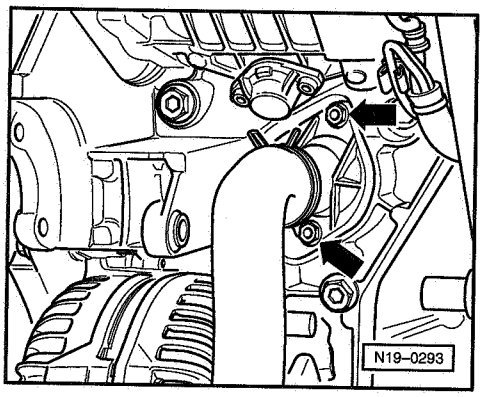
- VAS 6096 Cooling system charging unit

Draining

- Open cap on coolant expansion tank.

> ***Warning !***
> ***Steam can be released when the cap is removed from the expansion tank. Cover cap with a cloth and open carefully.***

- Pull off lower coolant hose at radiator using assembly tool for spring-type clamps VAS 5024.



◄ - To drain the coolant from the engine, remove the connecting piece with thermostat -arrows- in addition.

Note:

Observe disposal regulations for coolant!

Filling

Notes:

- *Only use coolant additive G 12 in accordance with TL VW 774 D. Distinguishing feature: coloured red*
- *On no account must G 12 be mixed with other coolant additives!*
- *If the fluid in expansion tank is brown, G 12 has been mixed with another coolant. In this case the coolant must be changed.*
- *G 12 and coolant additives marked "In accordance with TL VW 774 D" prevent frost and corrosion damage, scaling and also raise boiling point of coolant. For this reason the 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.*
- *Protection against frost must be assured to about -25 °C (in arctic climatic countries to about -35 °C).*
- *The coolant concentration must not be reduced by adding water even in warmer seasons and in warmer countries. The anti-freeze ratio must be at least 40 %.*
- *If for climatic reasons a greater frost protection is required, the amount of G 12 can be increased, but only up to 60 % (frost protec-*

tion to about -40 °C), as otherwise frost protection is reduced again and cooling effectiveness is also 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 portion	G 12[1)]	Water[1)]
-25 °C	40 %	2.4 ltr.	3.6 ltr.
-35 °C	50 %	3.0 ltr.	3.0 ltr.

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

- Secure lower coolant hose on connecting piece of radiator.

- Install the connecting piece with thermostat and new O ring ⇒ Page 19-16, Removing and installing thermostat.

Not using cooling system charging unit VAS 6096

- Fill with coolant up to max. mark on expansion tank.

- Fit expansion tank cap.

- Start engine and run at approx. 1500 rpm for max. 2 minutes and at the same time fill with coolant up to over-flow hole on expansion tank.

- Check coolant level and replenish as 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.

Warning !

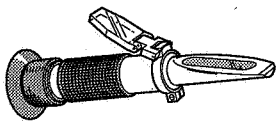
Steam can be released when the cap is removed from the expansion tank. Cover cap with a cloth and open carefully.

With cooling system charging unit VAS 6096

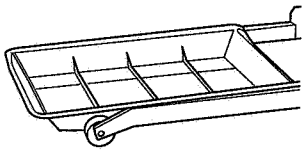
- Screw adapter V.A.G 1274/8 onto expansion tank.

- Fill coolant circuit using cooling system charging unit VAS 6096.
⇒ Operating instructions for cooling system charging unit VAS 6096

T10007

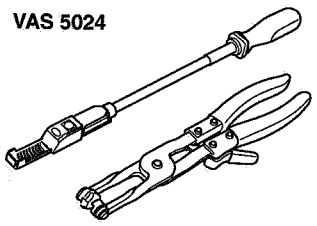


V.A.G 1306



V.A.G 1331

VAS 5024



W19–0019

Removing and installing coolant pump

Special tools, workshop equipment, test and measuring appliances and auxiliary items required

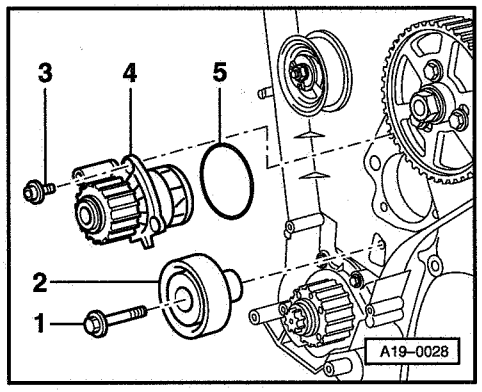
- T10007 Refractometer
- V.A.G 1306 Drip tray
- V.A.G 1331 Torque wrench (5...50 Nm)
- VAS 5024 Assembly tool for spring-type clamps

Removing

Notes:

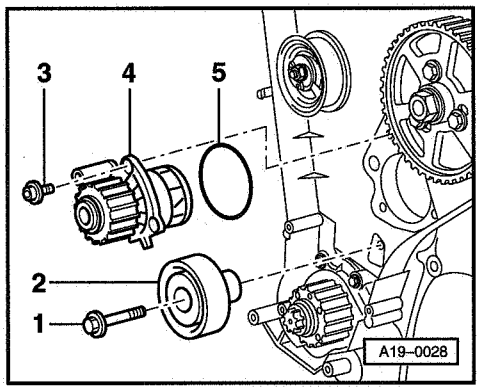
- *Always renew seals and gaskets.*
- *The lower part of the toothed belt guard need not be removed.*
- *The toothed belt should be left in position on the crankshaft sprocket.*
- *Cover toothed belt with a cloth to protect it from coolant before removing coolant pump.*

- Remove ribbed belt ⇒ Page 13-14.
- Remove upper and centre toothed belt guard ⇒ page 13-7.
- Take toothed belt off camshaft, injection pump and coolant pump sprocket ⇒ page 15-8, Removing, installing and tensioning toothed belt.
- Drain coolant ⇒ Page 19-8



- Unscrew securing bolt -1- from idler wheel -2- and push idler wheel approx. 30 mm downwards.

- Unscrew coolant pump securing bolts -3- and take coolant pump -4- out carefully.



Installing

Installation is carried out in the reverse order, when doing this note the following:

- Moisten new O ring -5- with coolant.

- Insert coolant pump -4- into cylinder block and tighten securing bolts -3-.
  Tightening torque: 15 Nm

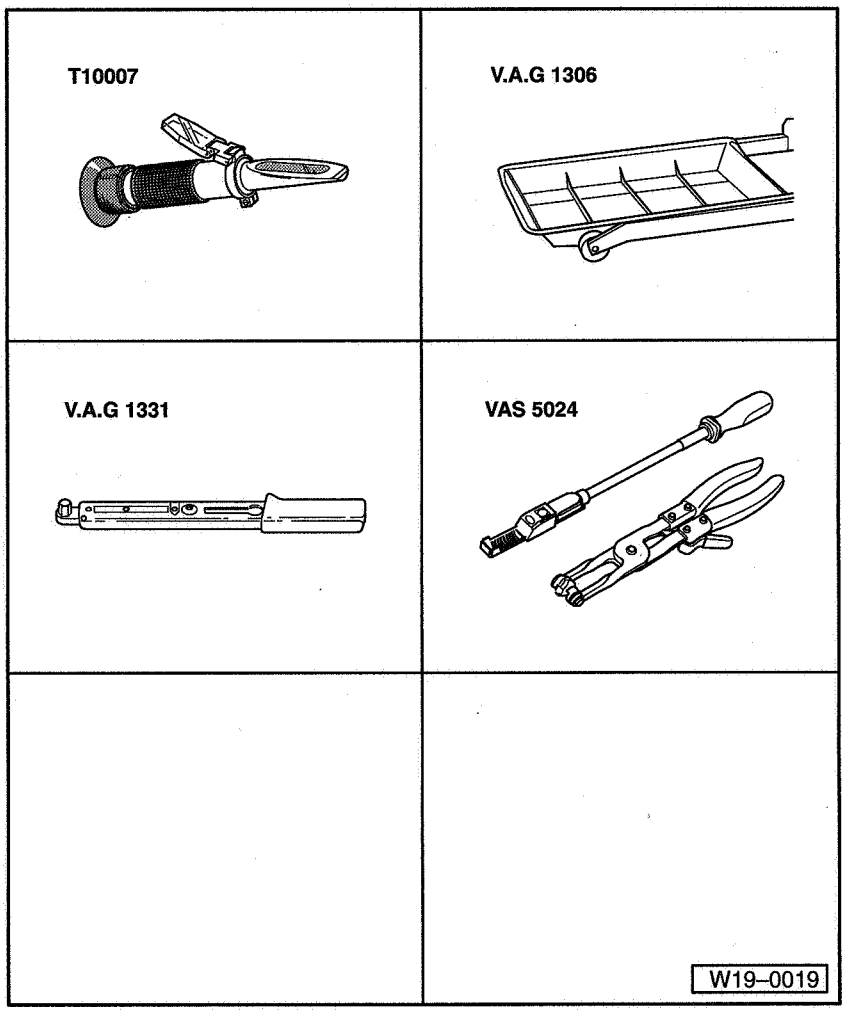
Note:

The coolant pump plug faces downwards.

- Install idler wheel -2- and tighten securing bolt -1- (replace).
  Tightening torque: 40 Nm + 90°(1/4 turn)

- Install and tension toothed belt ⇒ Page 15-8.

- Filling with coolant ⇒ Page 19-8



Removing and installing thermostat

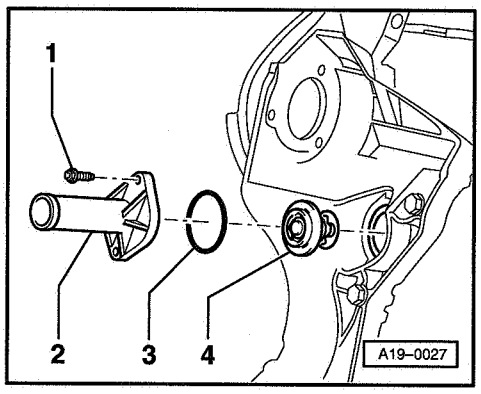
Special tools, workshop equipment, test and measuring appliances and auxiliary items required

- T10007 Refractometer
- V.A.G 1306 Drip tray
- V.A.G 1331 Torque wrench (5...50 Nm)
- VAS 5024 Assembly tool for spring-type clamps

Removing

Note:

♦ *Always renew seals and gaskets.*



- Drain coolant ⇒ Page 19-8

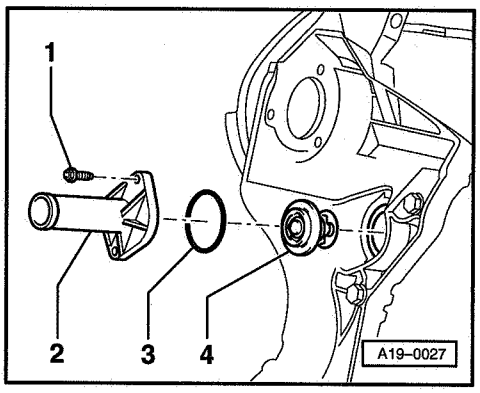
◄ - Pull coolant hose off connecting flange -2-.

- Unbolt securing bolts -1- of connecting flange -2- and remove connecting flange -2- with thermostat -4-.

- Turn thermostat -4- $^1/_4$ turn (90 °) to left and take out of connecting flange -2-.

Installing

Installation is carried out in the reverse order, when doing this note the following:



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

- Insert thermostat -4- into connecting flange -2- and turn $^1/_4$ turn (90 °) to right.

Note:

The brace on the thermostat must be almost vertical.

- Fit connecting flange -2- with thermostat -4- into engine block.

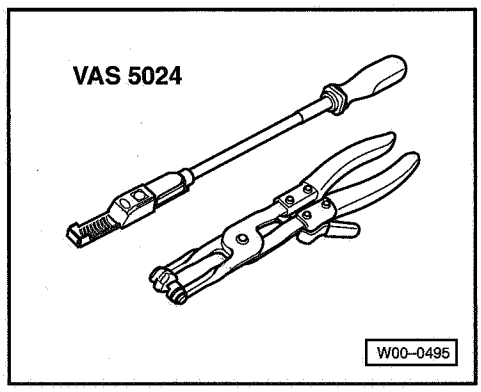
- Tighten securing bolts -1-.
  Tightening torque: 15 Nm

- Filling with coolant ⇒ Page 19-8

Removing and installing parts of fuel supply system

Notes:

- *Hose connections are secured with either spring-type or clamp-type clips.*
- *Always replace clamp-type clips with spring-type clips.*
- *Fuel hoses in engine compartment must only be secured with spring-type clips. The use of clamp or screw-type clips is not permissible.*



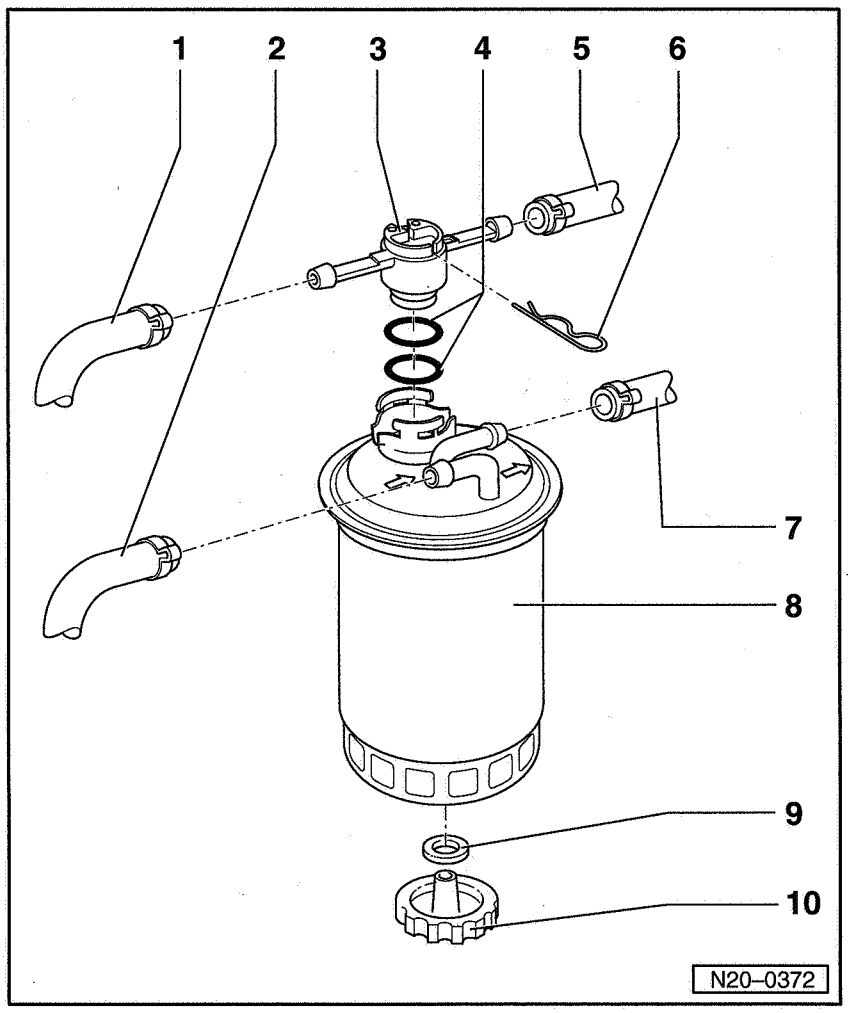
- *VAS 5024 pliers are recommended when installing spring-type clips.*

Servicing fuel filter ⇒ Page 20-2.

Observe safety precautions ⇒ Page 20-5.

Checking accelerator pedal position sender ⇒ page 20-7.

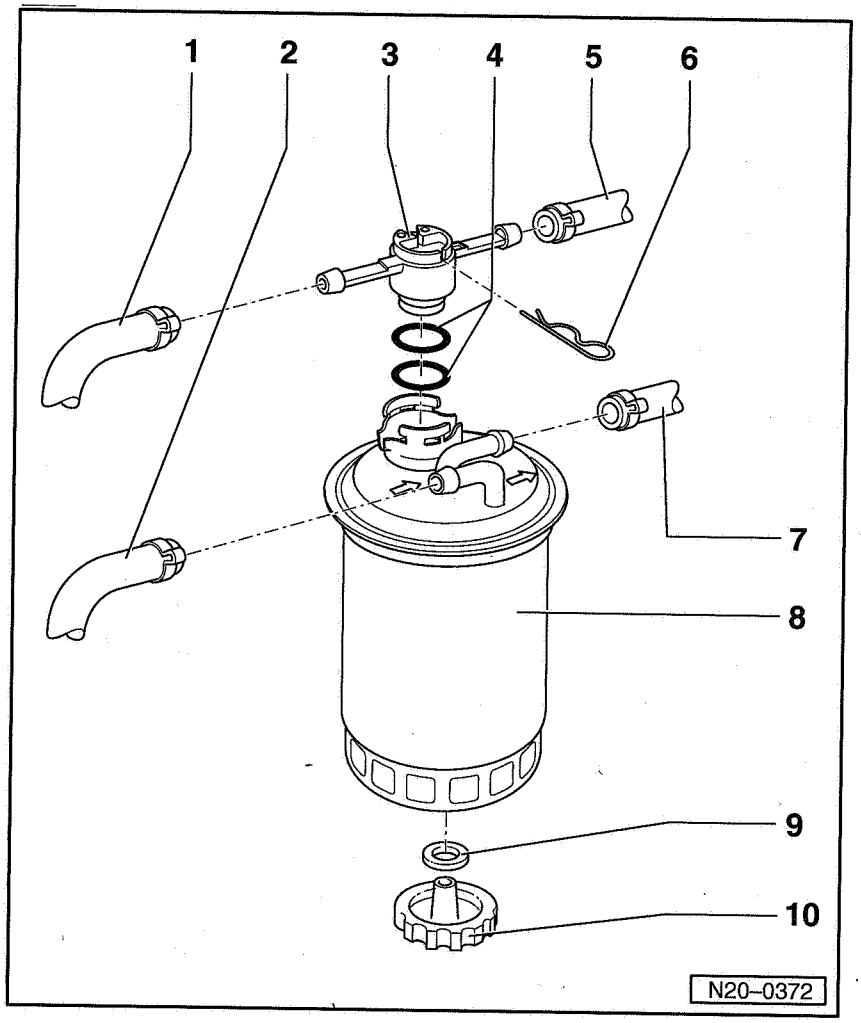
Observe rules for cleanliness ⇒ Page 23-4.



Servicing fuel filter

1 - Return pipe
- To fuel tank
- Blue or with blue marking
- Check securely seated

2 - Supply pipe
- From fuel tank
- White or with white marking
- Check securely seated

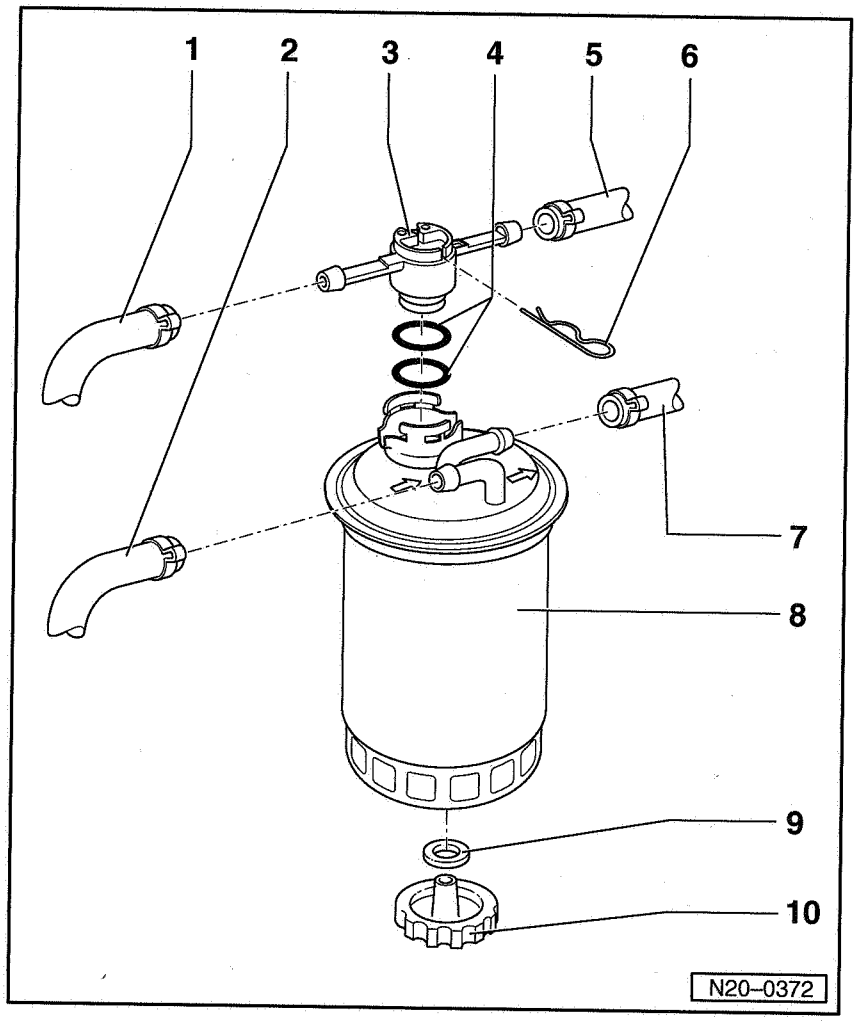


3 - Control valve
- ♦ Installation position: arrow points towards fuel tank
- ♦ When changing filter, remove securing clip and take control valve off complete with fuel pipes
- ♦ Below + 15 °C: Passageway to filter open
- ♦ Over + 31 °C: Passageway to filter closed
- ♦ Check securely seated

4 - O-ring
- ♦ Renew

5 - Return pipe
- ♦ From injection pump
- ♦ Blue or with blue marking
- ♦ Check securely seated

6 - Securing clip
- ♦ Check securely seated



7 - Supply pipe
- ♦ To injection pump
- ♦ White or with white marking
- ♦ Check securely seated

8 - Fuel filter
- ♦ Fill with diesel before installing
- ♦ Flow direction is marked by an arrow
- ♦ Do not interchange connections
- ♦ Renew if damaged

9 - Seal
- ♦ Renew if damaged

10 - Water drain plug
- ♦ To bleed remove securing clip and take control valve off complete with fuel pipes attached
- ♦ Loosen and allow approx. 100 cm^3 fluid to drain

Safety precautions when working on the fuel supply system

Warning!

When carrying out repair work, especially due to the cramped conditions, note the following:

- ***Route all lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant, refrigerant, brake fluid and vacuum pipes and hoses) and electrical wiring so that the original positions are restored.***
- ***Ensure sufficient clearance to all moving or hot components.***

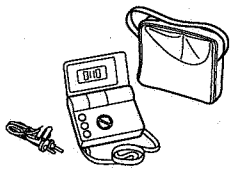
When working on a full or partly full fuel tank the following must be observed:

- Before commencing work, switch on exhaust extraction system and place an extraction hose close to the sender opening in the fuel tank to extract escaping fuel fumes.
  If no exhaust extraction system is available, a radial fan (as long as motor is not in air flow) with a displacement greater than 15 m^3/h can be used.
- Prevent skin contact with fuel! Wear fuel-resistant gloves!

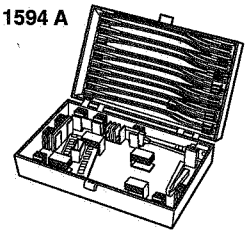
Warning!

- ***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!***

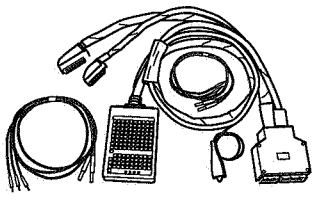
V.A.G 1526 A



V.A.G 1594 A



V.A.G 1598/31



W20–0033

Checking accelerator pedal position sender

Special tools, workshop equipment, test and measuring appliances and auxiliary items required

- V.A.G 1526 Hand multimeter
- V.A.G 1594 A Adapter set
- V.A.G 1598/31 Test box
- Fault reader V.A.G 1551 or vehicle system tester V.A.G 1552 with cable V.A.G 1551/3A

Note:

All functions that could previously be carried out using V.A.G 1551/1552 can now also be carried out using the new tester VAS 5051.

- Current flow diagram

Check conditions

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

Test sequence

Note:

Due to the various installation possibilities the following work steps contain general notes for checking throttle position sender.

- Connect the fault reader V.A.G 1551 (V.A.G 1552) and with ignition switched on select engine electronics control unit with the "Address word" 01.

  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Rapid data transfer	HELP
Select function XXX	

◄ Indicated on display:

- Press keys 0 and 8 for the function "Read measured value block" and confirm entry with Q key.

Read measured value block Input display group number XXX

◄ Indicated on display:

- Press keys 0, 0 and 2 for "Display group number 2" and confirm entry with Q key.

Read measured value block 2 →			
xxxxrpm	0.0 %	x1x	xxx.x °C

◄
- Check accelerator pedal position display in display zone 2. The accelerator pedal must not be depressed.
  Specification: 0.0 %
- In addition check the idling speed switch display in display zone 3. The centre position must show 1.
  Display: x1x

Read measured value block 2 →			
xxxxrpm	100.0 %	x0x	xxx.x °C

◄
- Depress accelerator pedal slowly until fully down, and observe display zones 2 and 3.

  ♦ Display zone 2:
  The accelerator pedal position figure must increase continuously.
  Specification at full throttle position: 100.0 %

  ♦ Display zone 3:
  The centre position must change to 0.
  Display: x0x

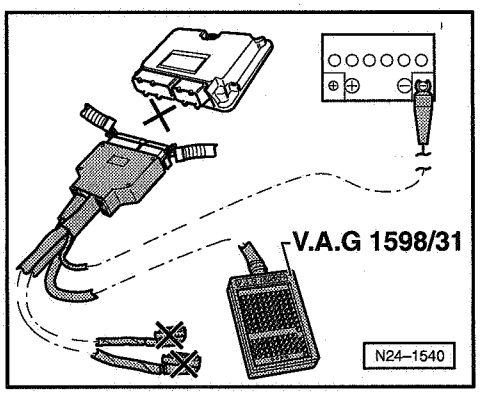
- Press the → key.
- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.
- Switch off ignition.

End specification value not achieved:

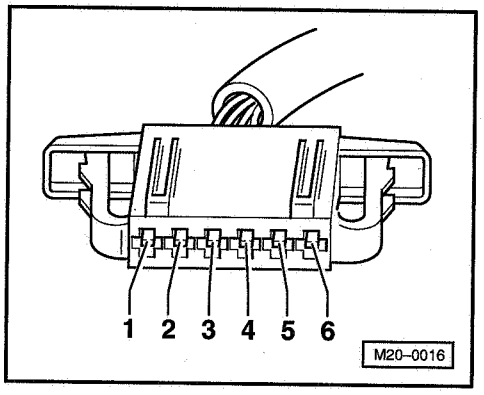
- Replace accelerator pedal position sender (G79).
- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

Display does not change or is erratic:

- Check accelerator pedal position sender wiring as follows:



◄
- Connect test box V.A.G 1598/31 to control unit wiring harness. The engine control unit remains disconnected.
- Disconnect 6-pin connector for accelerator pedal position sender.



◄ - Check wiring between test box and connector for open circuit according to current flow diagram.
  Contact 1+ socket 69
  Contact 2+ socket 12
  Contact 3+ socket 50
  Contact 4+ socket 70
  Contact 6+ socket 51
  Wire resistance: max. 1.5 Ω

- Additionally check wires for short to one another, to battery/vehicle earth and to battery positive.
  Specification: ∞Ω

If no fault is detected in the wiring:

- Replace accelerator pedal position sender (G79).

- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

Charge air system with turbocharger (engine code AVM)

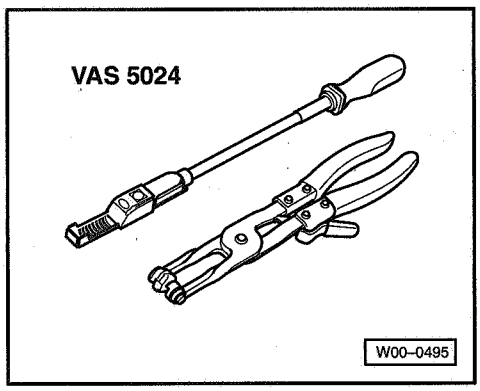
Observe safety precautions ⇒ Page 23-2.

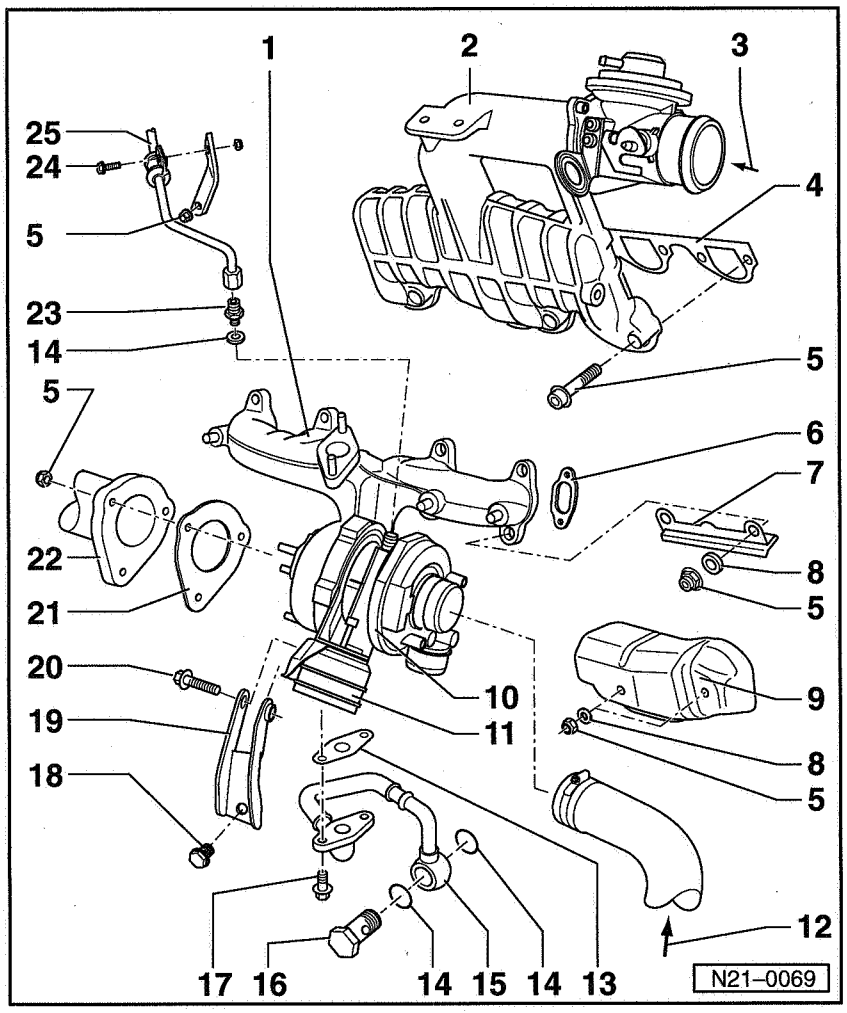
Observe rules for cleanliness ⇒ Page 23-4.

Removing and installing turbocharger with attachments

Notes:

- *Hoses are secured with spring-type clips. In cases of repair only use spring-type clips.*
- *VAS 5024 pliers are recommended when installing spring-type clips.*
- *Charge air system must be free of leaks.*
- *Renew self-locking nuts.*





1 - Exhaust manifold
- With exhaust turbocharger
- Only renew complete

2 - Intake manifold

3 - From charge air cooler

4 - Gasket
- Renew
- Coating (beading) towards intake manifold

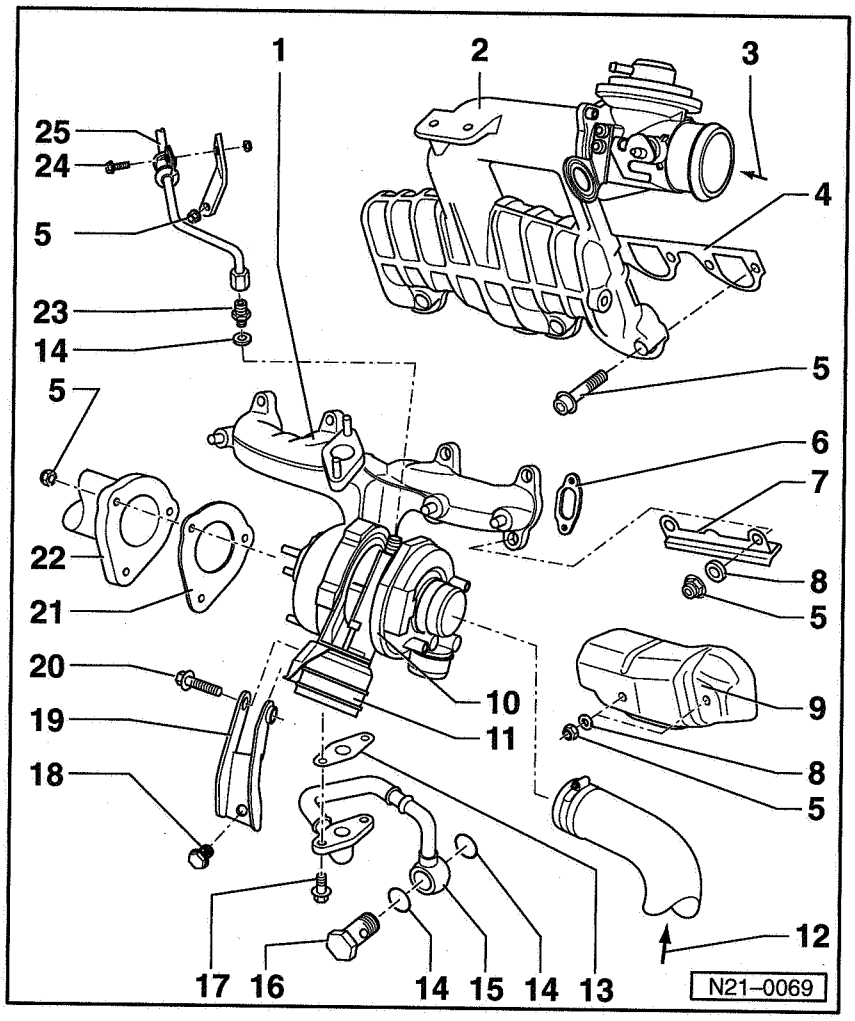
5 - 25 Nm

6 - Gasket
- Note installation position

7 - Bracket
- For heat shield item 9

8 - Washer

9 - Heat shield
- Engage in bracket item 7



10 - Turbocharger
- ♦ Can only be renewed with exhaust manifold
- ♦ Checking charge pressure control ⇒ Page 21-6

11 - Pressure unit
- ♦ For charge pressure control
- ♦ Integral part of turbocharger cannot be replaced

12 - From air cleaner

13 - Gasket
- ♦ Renew

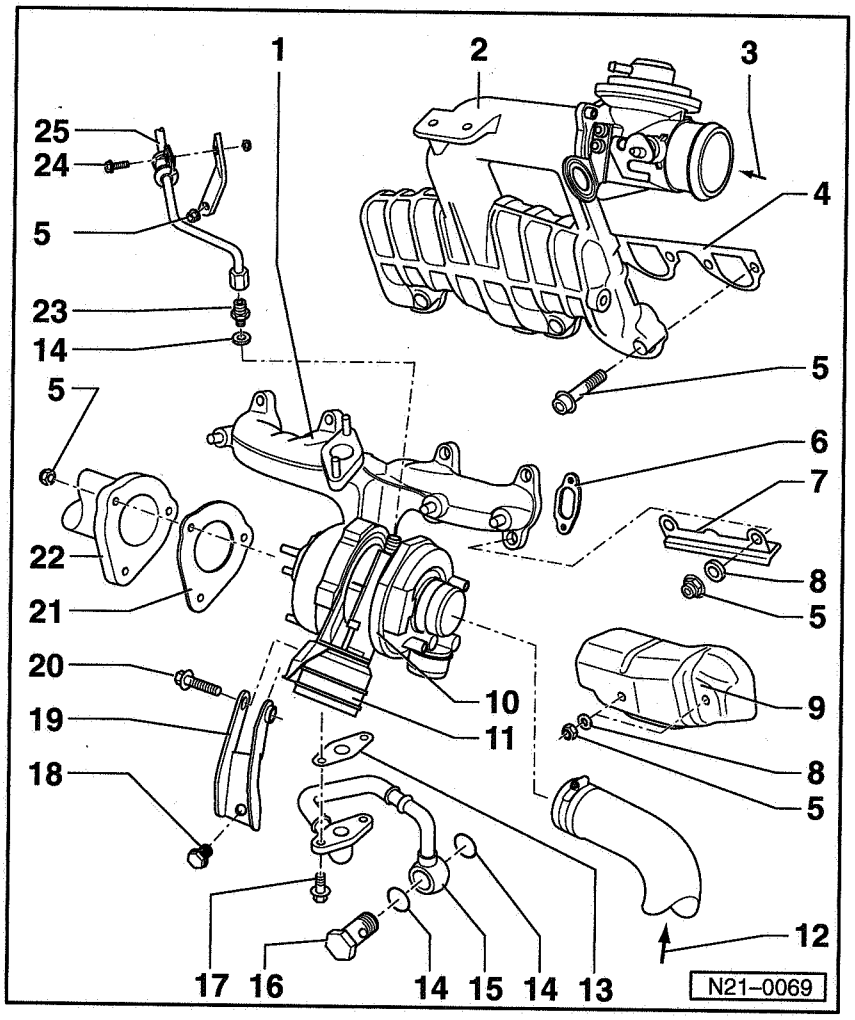
14 - Seal
- ♦ Renew

15 - Oil return pipe
- ♦ To cylinder block

16 - Banjo bolt, 40 Nm

17 - 15 Nm

18 - 40 Nm



19 - Retainer

20 - 25 Nm

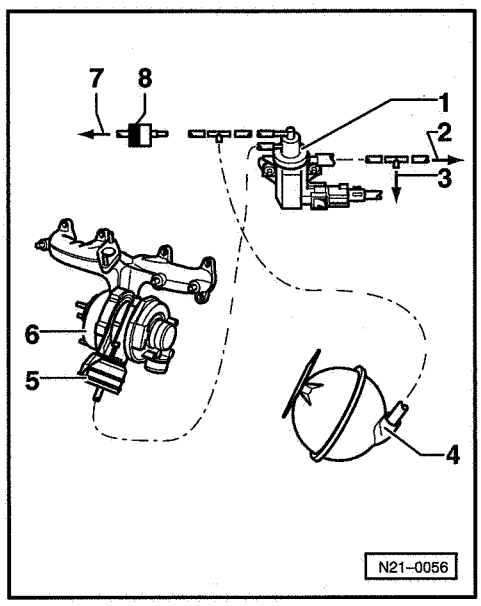
21 - Gasket
- ♦ Renew

22 - Front exhaust pipe

23 - Connection, 30 Nm
- ♦ Renew
- ♦ Coat threads and bolt head seating surface with "G 052 112 A3"

24 - 10 Nm

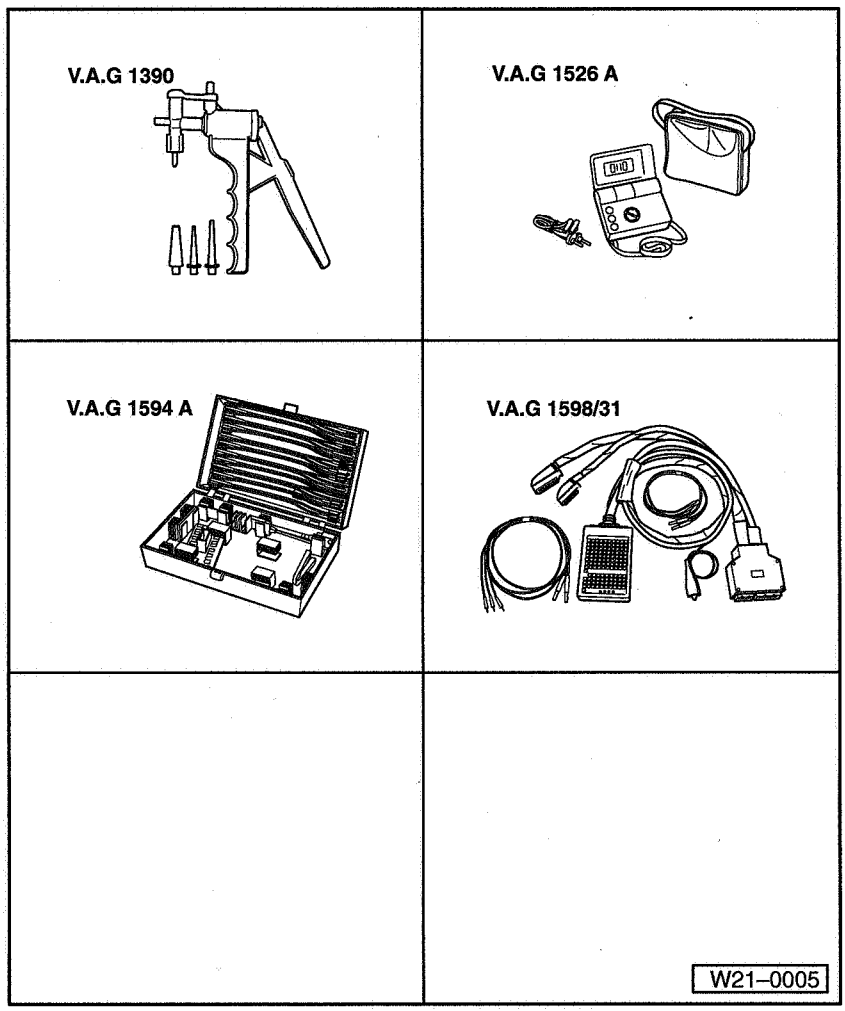
25 - Oil supply pipe, 22 Nm
- ♦ Before installing, fill turbocharger with engine oil via oil supply pipe connection



Turbocharger hose/pipe connections

◄

1 - Charge pressure control solenoid valve (N75)
2 - To exhaust gas recirculation valve (N18)
3 - To air cleaner
4 - Vacuum reservoir
5 - Charge pressure control valve pressure unit
6 - Exhaust turbocharger
7 - To T-piece ⇒ page 26-6, item15
8 - Non-return valve, white connection faces T-piece of charge pressure control solenoid valve (N75)/vacuum reservoir



Checking charge pressure system (engine code AVM)

Checking charge pressure control

Special tools, workshop equipment, test and measuring appliances and auxiliary items required

- V.A.G 1390 Hand vacuum pump
- V.A.G 1526 Hand multimeter
- V.A.G 1594 A Adapter set
- V.A.G 1598/31 Test box
- Fault reader V.A.G 1551 or vehicle system tester V.A.G 1552 with cable V.A.G 1551/3A

Note:

All functions that could previously be carried out using V.A.G 1551/1552 can now also be carried out using the new tester VAS 5051.

- Current flow diagram

Check conditions

- The 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.
- Engine oil temperature min. 80 °C
- No faults in engine and fuel injection system, e.g. commencement of injection, injectors and compression pressure.
- No faults must be stored in fault memory
  ⇒ Page 01-11, interrogating fault memory

Test sequence

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Rapid data transfer HELP Select function XXX

◄ Indicated on display:

- Press keys 0 and 8 for the function "Read measured value block" and confirm entry with Q key.

Read measured value block Input display group number XXX

◄ Indicated on display:

- Press keys 0, 1 and 1 for display group 11 and confirm entry by pressing Q.

Read measured value block 11 → 880 rpm xxxx mbar 978 mbar xx %

◄ - Indicated on display:

- Increase engine speed, under full load, from approx. 1500 rpm using full throttle (accelerator position sender on full throttle stop).

Note:

The brake pedal must not be operated whilst taking measurements. Otherwise the control unit reduces the fuel quantity which leads to incorrect measurements.

- Press PRINT key on V.A.G 1551 at approx. 2500 rpm.

Read measured value block 11 → 2520 rpm xxxx mbar 1917 mbar xx %

◄ - Indicated on display:

- Check specification for charge pressure (actual) in display zone 3: 1800...2150 mbar
- Press the → key.

- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.

- Switch off ignition.

If the specification is not obtained:

- Carry out final control diagnosis and activate the charge pressure control solenoid valve ⇒ page 01-53, Final control diagnosis.

Final control diagnosis →
Charge pressure control solenoid valve -N75

◄ Indicated on display:

The solenoid valve must click and the rod of the charge air control pressure unit on the turbocharger must move to and fro (at least 3...4 times, as long as there is vacuum in the vacuum reservoir).

Note:

The clicking of the valve is not audible due to engine noise. Therefore it can only be checked by touch.

- Proceed with final control diagnosis until completed.

- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.

- Switch off ignition.

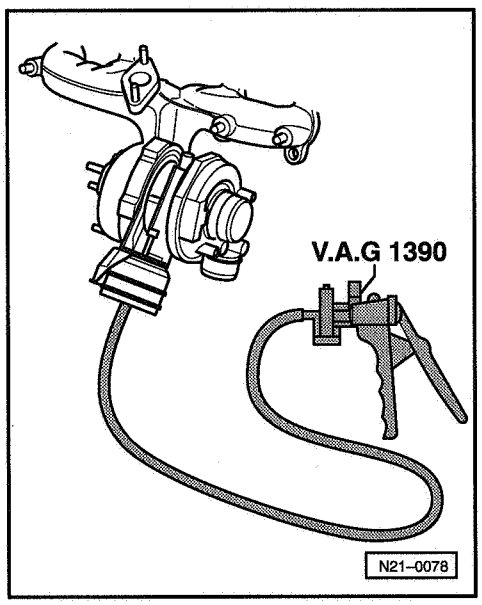
If the rod moves and the specification for charge pressure (actual) is not obtained:

- Turbocharger defective. Renew turbocharger ⇒ Page 21-1, Removing and installing turbocharger with attachments.

If rod does not move because solenoid valve is not working:

- Check solenoid valve for charge pressure control (N75) ⇒ Page 21-11

- Check vacuum hoses ⇒ page 21-5, Turbo charger line connections.



If the rod does not move but the solenoid operates:

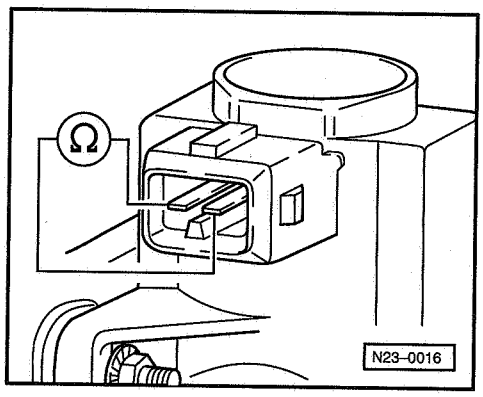
◄ - Connect hand-operated vacuum pump V.A.G 1390 to charge air control pressure unit and check rod for ease of movement.

If the rod is not free to move:

- Turbocharger defective. Renew turbocharger ⇒ Page 21-1, Removing and installing turbocharger with attachments.

Checking solenoid valve for charge pressure control (N75)

- Pull 2-pin connector off charge pressure control solenoid (N75) ⇒ page 23-5, Fitting location overview.



Checking resistance

◄ - Connect multimeter using aux. cables from V.A.G 1594 to measure resistance at solenoid contacts
Specification: 14.0...20.0 Ω

Note:

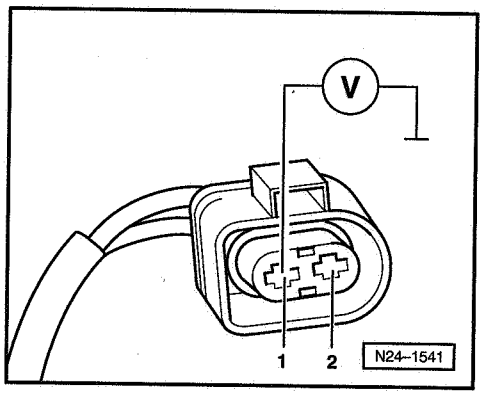
At room temperature the resistance lies in the the lower tolerance region and at operating temperature in upper tolerance region.

If the specification is not obtained:

- Replace charge pressure control solenoid valve (N75).

- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

If the specification is obtained:



Checking voltage supply

◄ - Connect multimeter using aux. cables from V.A.G 1594 to measure voltage at contact 1 of connector and engine earth.

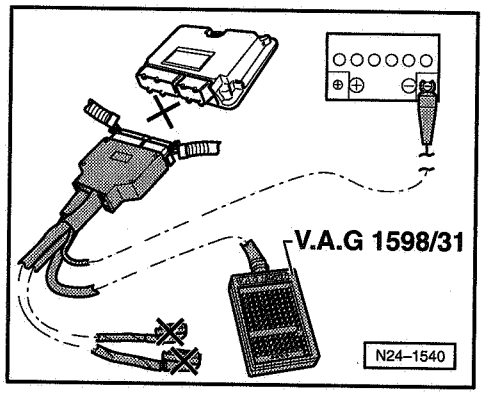
- Switch on ignition.
Specification: min. 11.5 V

- Switch off ignition.

If the specification is not obtained:

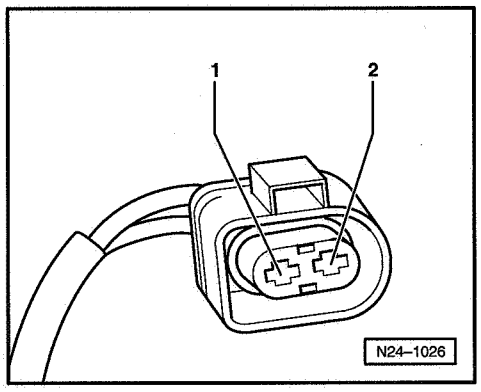
- Check voltage supply relay terminal 30 (J317) ⇒ page 27-20, Current flow diagrams.

- Check wiring connections for open circuit, short circuit and transfer resistance at contacts according to current flow diagram.



If the specification is obtained:

◄ - Connect test box V.A.G 1598/31 to control unit wiring harness. The engine control unit remains disconnected.



◄ - Check wiring between test box and connector for open circuit using current flow diagram.
  Contact 1+ socket 1
  Contact 1+ socket 2
  Contact 2+ socket 62
  Wire resistance: max. 1.5 Ω

- Additionally check wires for short to one another, to battery/vehicle earth and to battery positive.
  Specification: ∞Ω

If no fault is detected in the wiring:

- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.

Servicing Diesel direct injection system

The diesel direct injection system control unit is equipped with a fault memory. Before starting repairs or adjustments, or when fault finding, you must interrogate the fault memory ⇒ Page 01-11 and perform the final control diagnosis ⇒ Page 01-53.

Notes:

- *During some checks, it can happen that the control unit will recognise and store a fault. Therefore after completing all checks and repairs, you must interrogate the fault memory and erase it, if necessary. ⇒ Page 01-11, Interrogating fault memory*

- *For trouble-free operation of the electrical components, a voltage of at least 11.5 V is necessary.*

- *Renew self-locking nuts.*

Observe safety precautions ⇒ Page 23-2.

Observe rules for cleanliness ⇒ Page 23-4.

Safety precautions

Warning!

When carrying out repair work, especially due to the cramped conditions, note the following:

- ***Route all lines (e.g. for fuel, hydraulics, activated charcoal filter system, coolant, refrigerant, brake fluid and vacuum pipes and hoses) and electrical wiring so that the original positions are restored.***
- ***Ensure 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:

- The ignition must be switched off before connecting or disconnecting injection or glow plug system wiring or tester cables.

- If engine is to be cranked at starter speed without starting, e.g. when checking compressions, pull 10-pin connector off injection pump.

- Disconnecting and connecting the battery must only be undertaken when the ignition switched off otherwise the Diesel direct injection system control unit may be damaged.

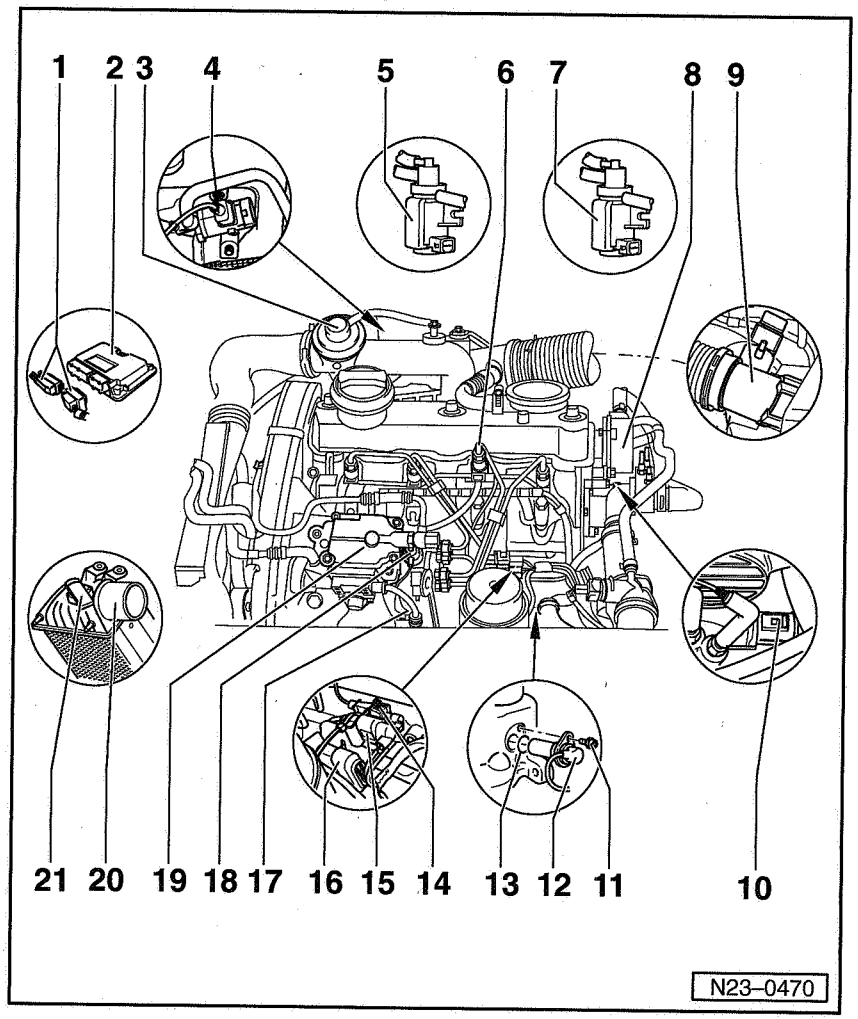
Observe following if test and measuring instruments are required during a test drive:

- Test and measuring instruments must be secured to rear seat and operated by a 2nd person.

Rules for cleanliness

When working on the fuel supply/injection system, pay careful attention to the following "6 rules":

- Thoroughly clean all unions and the adjacent areas before disconnecting.
- Place parts that have been removed on a clean surface and cover. Do not use fluffy cloths!
- Carefully cover opened components or seal, if the repair cannot be carried out immediately.
- Only install clean components:
  Only unpack replacement parts immediately prior to installation.
  Do not use parts that have been stored loose (e.g. in tool boxes etc.).
- When the 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 runs onto the coolant hoses. Hoses coming in contact with fuel must be cleaned immediately. Damaged hoses must be replaced.



Fitting locations overview (engine code AVM)

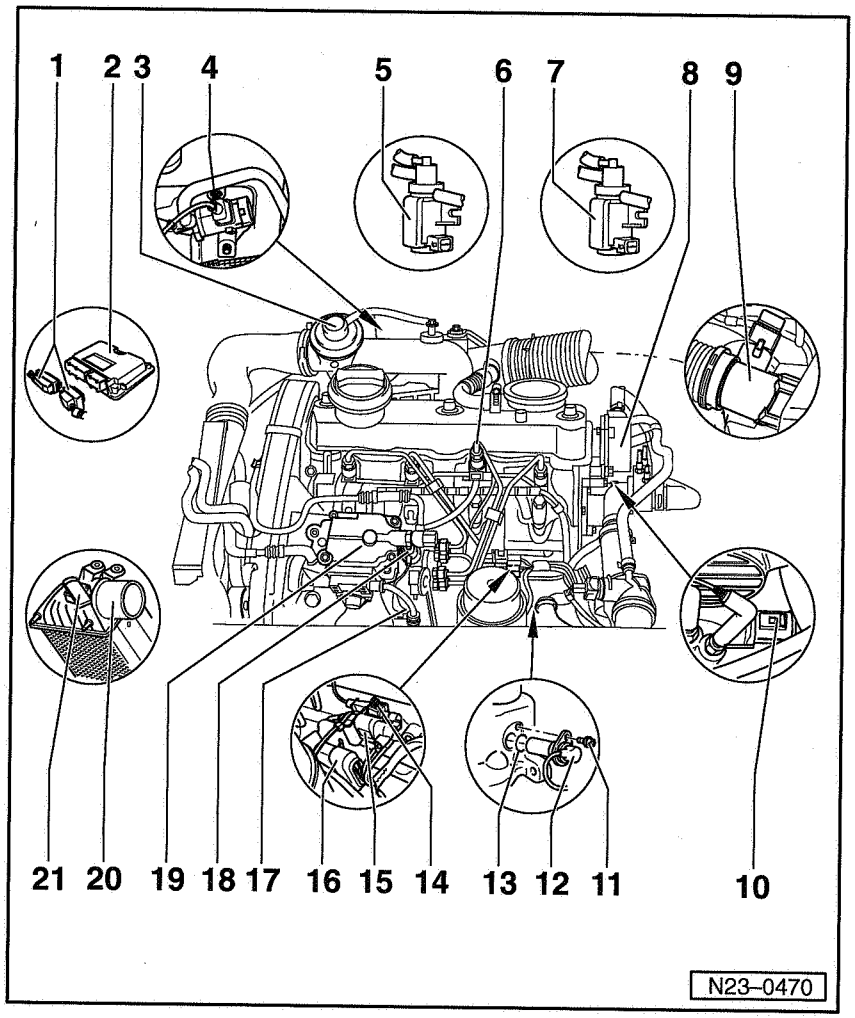
Notes:

- *Due to the range of installation options for industrial engines, the components shown in the diagram can deviate in fitting location.*
- *Components A to C are not illustrated.*

A - Brake pedal switch (F47)
- Checking ⇒ page 23-109

B - Brake light switch (F)
- Checking ⇒ page 23-109

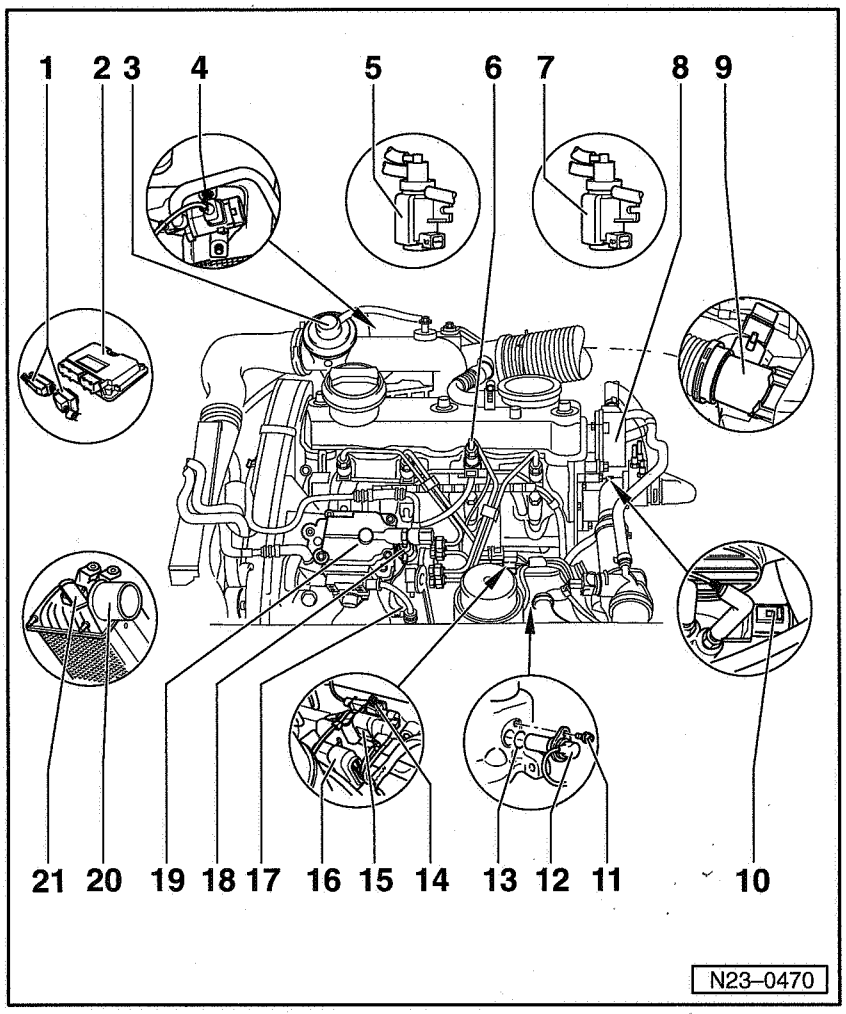
C - Accelerator pedal position sender (G79)
- Not adjustable
- Checking ⇒ Page 20-7



1 - Connector
- Only disconnect or connect with ignition switched off
- Release to disconnect

2 - Diesel direct injection system control unit (J248)
- With elevation sender (F96)
- Checking elevation sender ⇒ Page 23-82, Checking intake manifold pressure sender and elevation sender
- Checking voltage supply for diesel direct injection system ⇒ Page 23-48
- Renewing ⇒ page 23-115
- Coding ⇒ page 23-117

3 - Exhaust gas recirculation valve (mechanical)
- Component part of intake connecting flange
- Can only be replaced together with intake connecting flange
- Checking ⇒ Page 26-7



4 - Intake manifold change-over valve (N239)
- ♦ Checking ⇒ Page 23-95

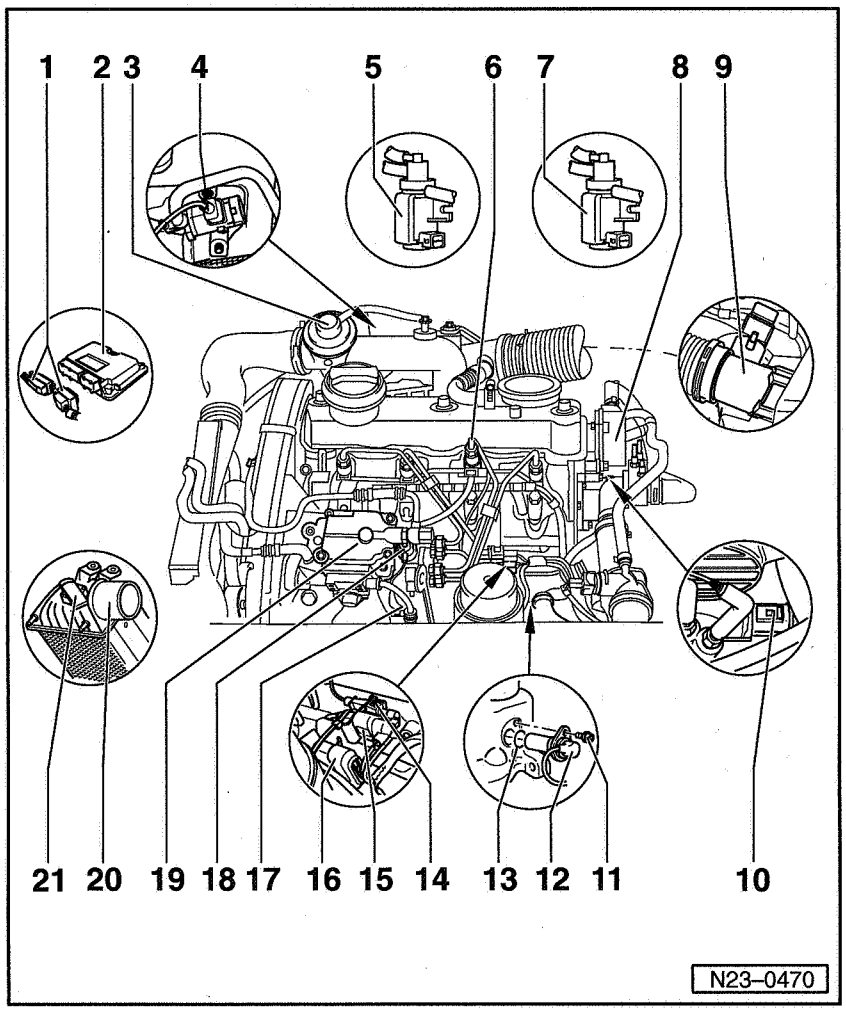
5 - Exhaust gas recirculation valve (N18)
- ♦ Checking ⇒ Page 01-53, final control diagnosis

6 - Injector with needle lift sender (G80)

7 - Charge pressure control solenoid valve (N75)
- ♦ Checking ⇒ Page 01-53, final control diagnosis

8 - Vacuum pump

9 - Air mass meter (G70)
- ♦ Checking⇒ Page 23-87



10 - Coolant temperature sender (G62)
- ♦ For engine control unit
- ♦ With coolant temperature gauge sender (G2)
- ♦ If necessary release pressure in cooling system before removing
- ♦ Checking ⇒ Page 23-53

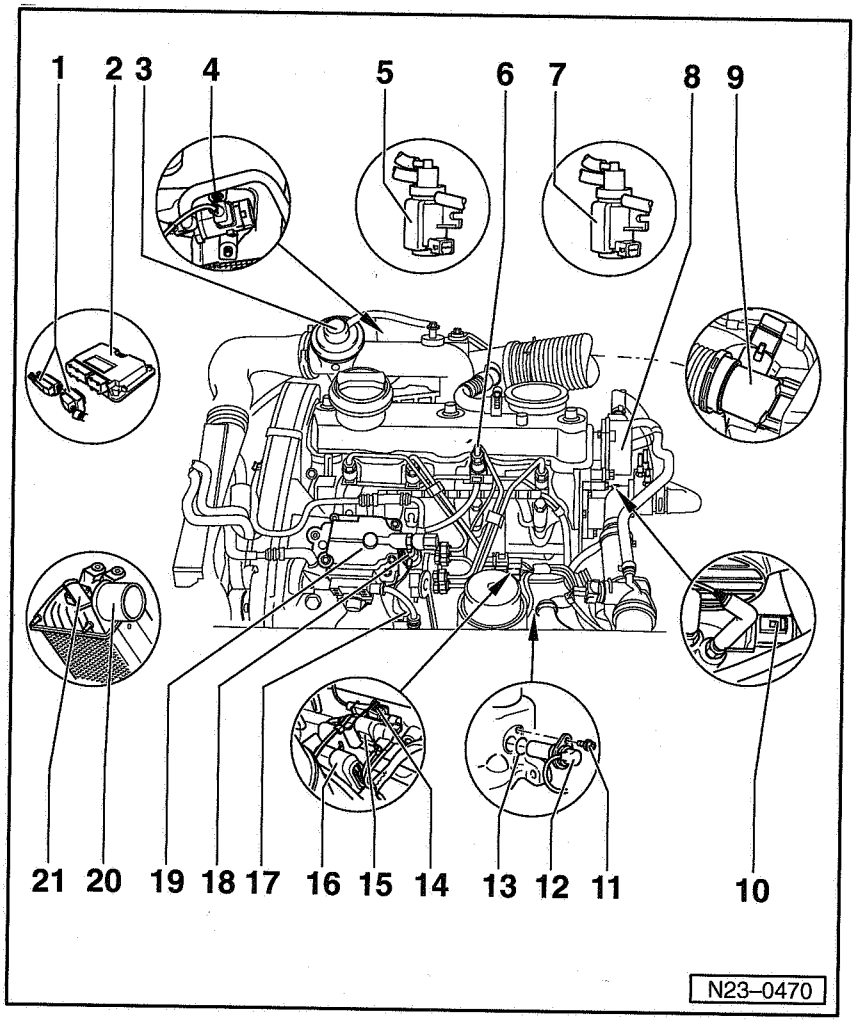
11 - 10 Nm

12 - Engine speed sender (G28)
- ♦ Checking ⇒ Page 23-50

13 - O-ring
- ♦ Renew

14 - 2 pin connector
- ♦ For needle lift sender (G80)

15 - 3 pin connector
- ♦ For engine speed sender (G28)



16 - 10 pin connector

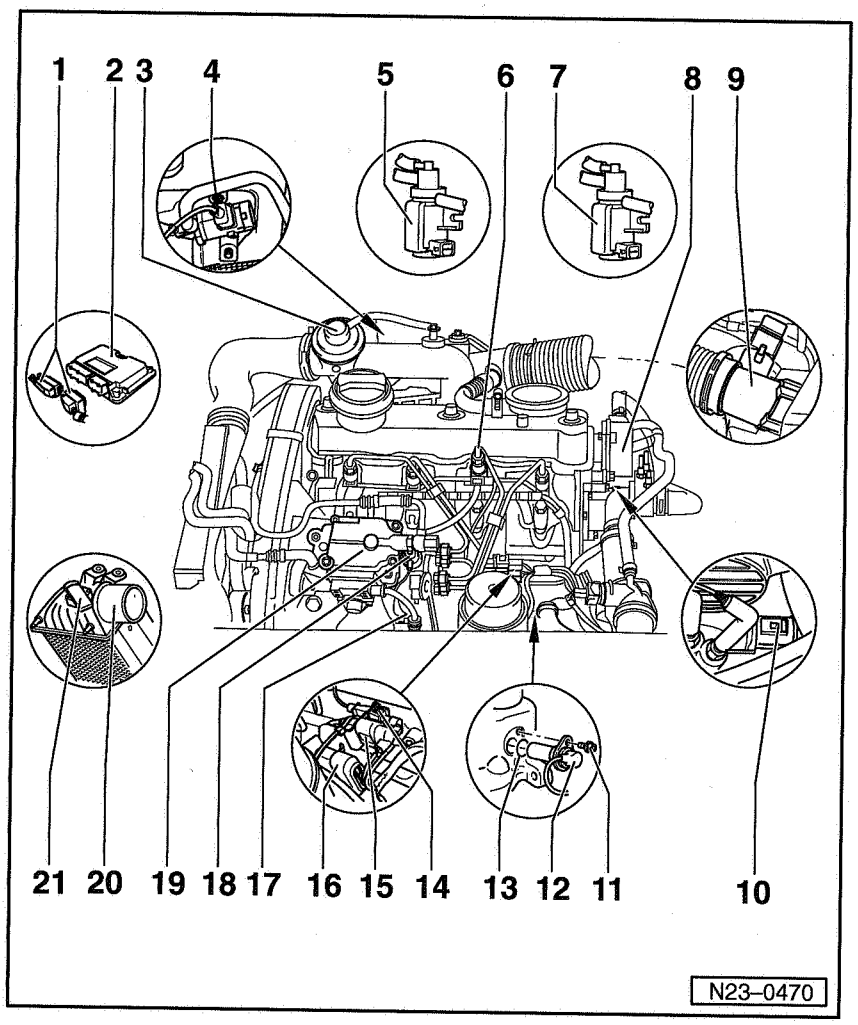
- For fuel temperature sender (G81)
- For quantity adjuster (N146)
- For modulating piston movement sender (G149)
- For fuel shut-off valve (N109)
- For commencement of injection valve (N108)

17 - Commencement of injection valve (N108)

- Checking ⇒ Page 01-53, final control diagnosis

18 - Fuel cut-off valve (N109)

- Checking ⇒ Page 01-53, final control diagnosis



19 - Injection pump

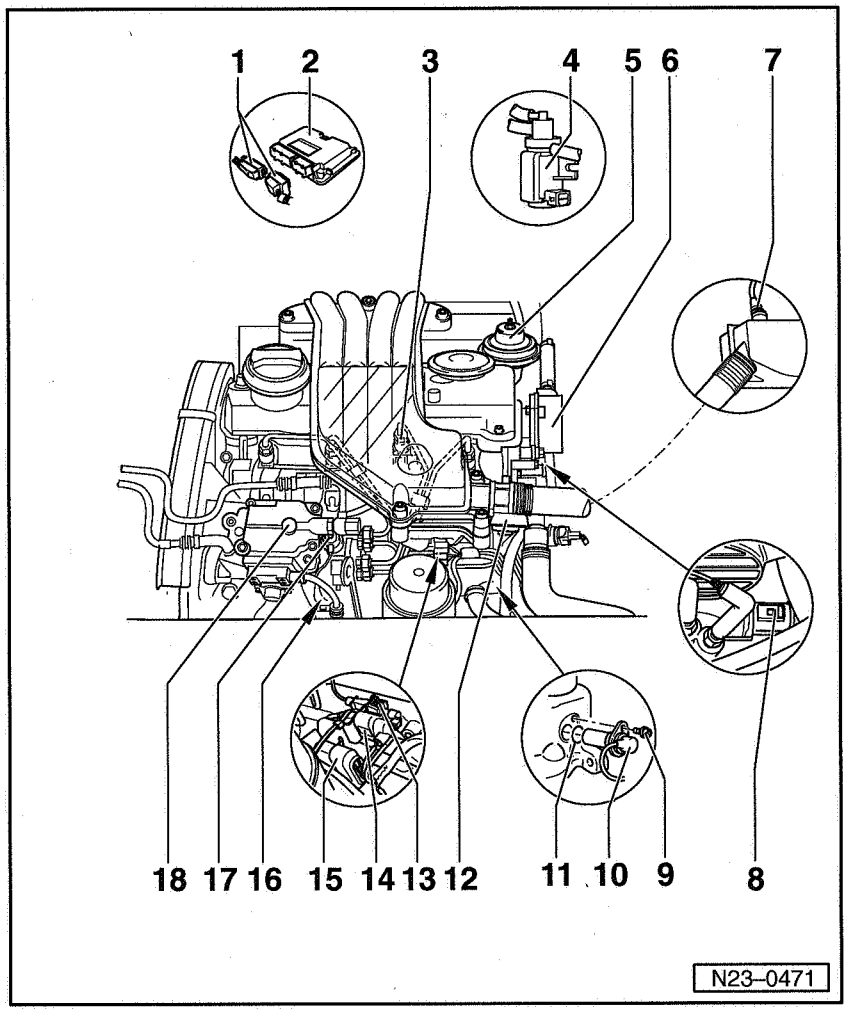
- With quantity adjuster (metering)
- With quantity adjuster (N146)
- With modulating piston movement sender (G149)
- With fuel temperature sender (G81)

- Removing and installing ⇒ Page 23-28
- Dynamically checking and adjusting commencement of injection ⇒ Page 23-35

20 - Charge air cooler

21 - Intake manifold pressure (G71) and intake manifold temperature sender (G72)

- Check intake manifold pressure sender ⇒ Page 23-82, checking intake manifold pressure sender and elevation sender
- Check intake manifold temperature sender ⇒ Page 23-58



Fitting locations overview (engine codes ARD and BEQ)

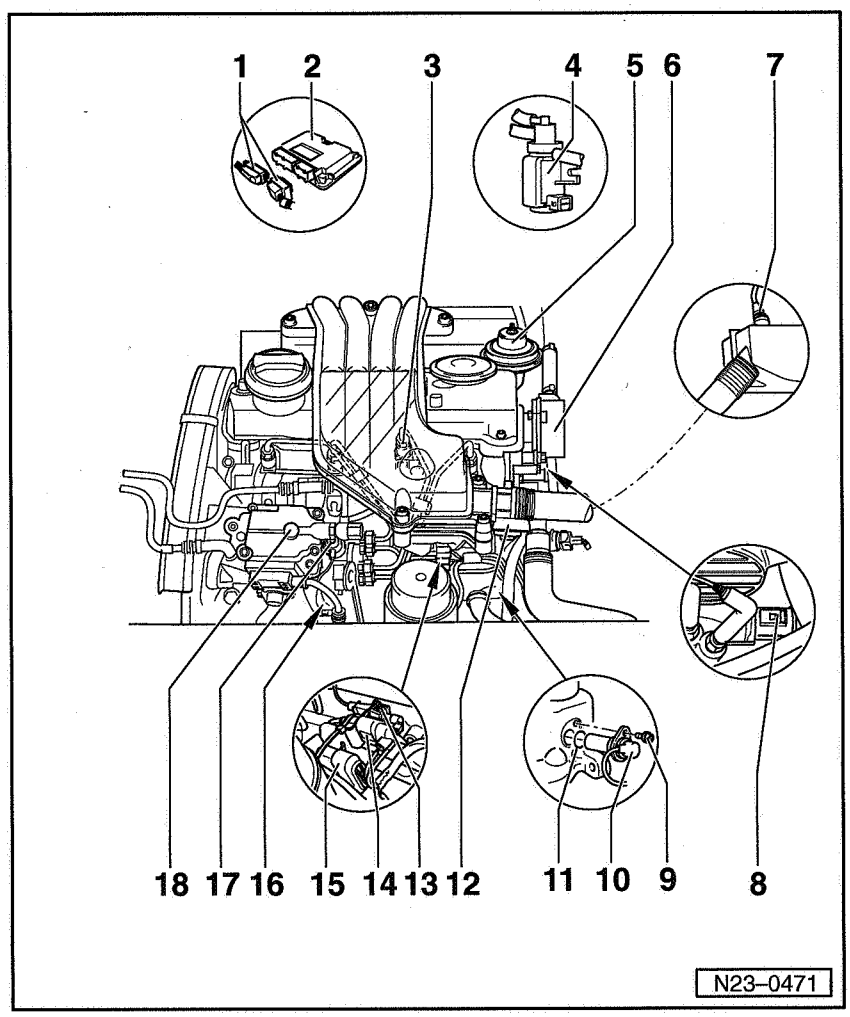
Notes:

- *Due to the range of installation options for industrial engines, the components shown in the diagram can deviate in fitting location.*
- *Components A to C are not illustrated.*

A - Brake pedal switch (F47)
- Checking ⇒ page 23-109

B - Brake light switch (F)
- Checking ⇒ page 23-109

C - Accelerator pedal position sender (G79)
- Not adjustable
- Checking ⇒ Page 20-7



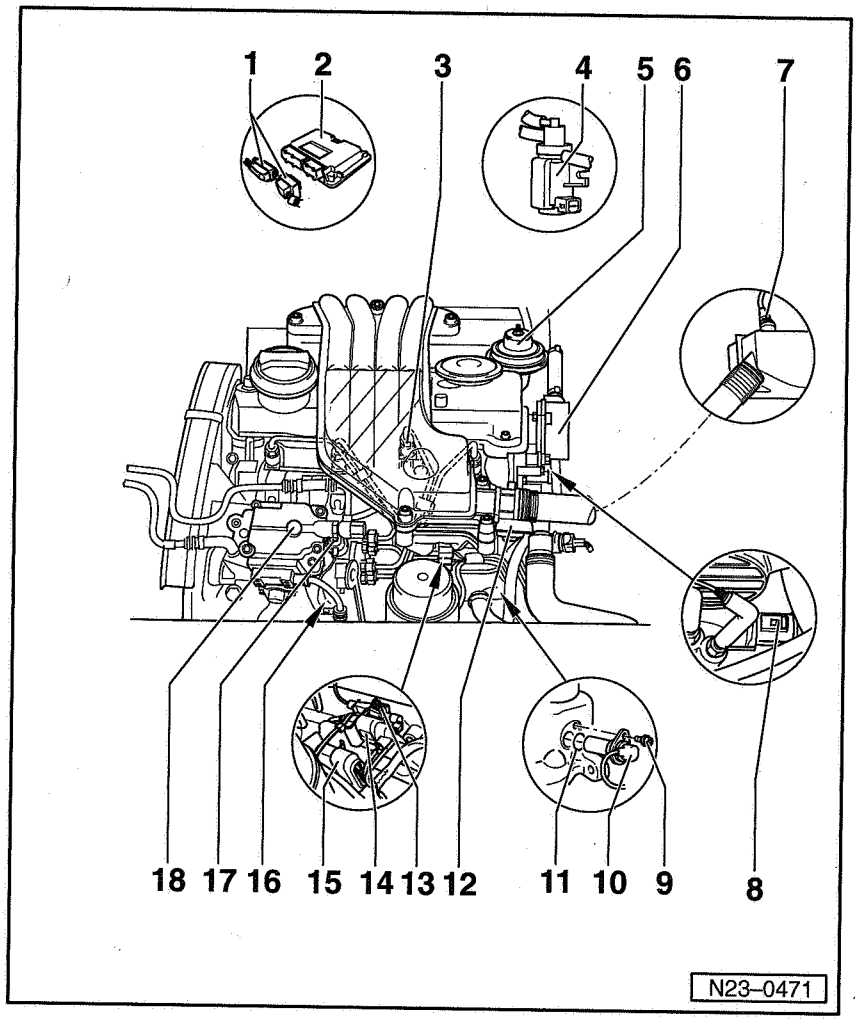
1 - Connector
- Only disconnect or connect with ignition switched off
- Release to disconnect

2 - Diesel direct injection system control unit (J248)
- With elevation sender (F96)
- Checking voltage supply for diesel direct injection system ⇒ Page 23-48
- Renewing ⇒ page 23-115
- Coding ⇒ page 23-117

3 - Injector with needle lift sender (G80)

4 - Exhaust gas recirculation valve (N18)
- Checking ⇒ page 01-53, Final control diagnosis (engine code BEQ only)

5 - Exhaust gas recirculation valve (mechanical)
- Checking ⇒ page 26-18 (engine code BEQ only)



6 - Vacuum pump

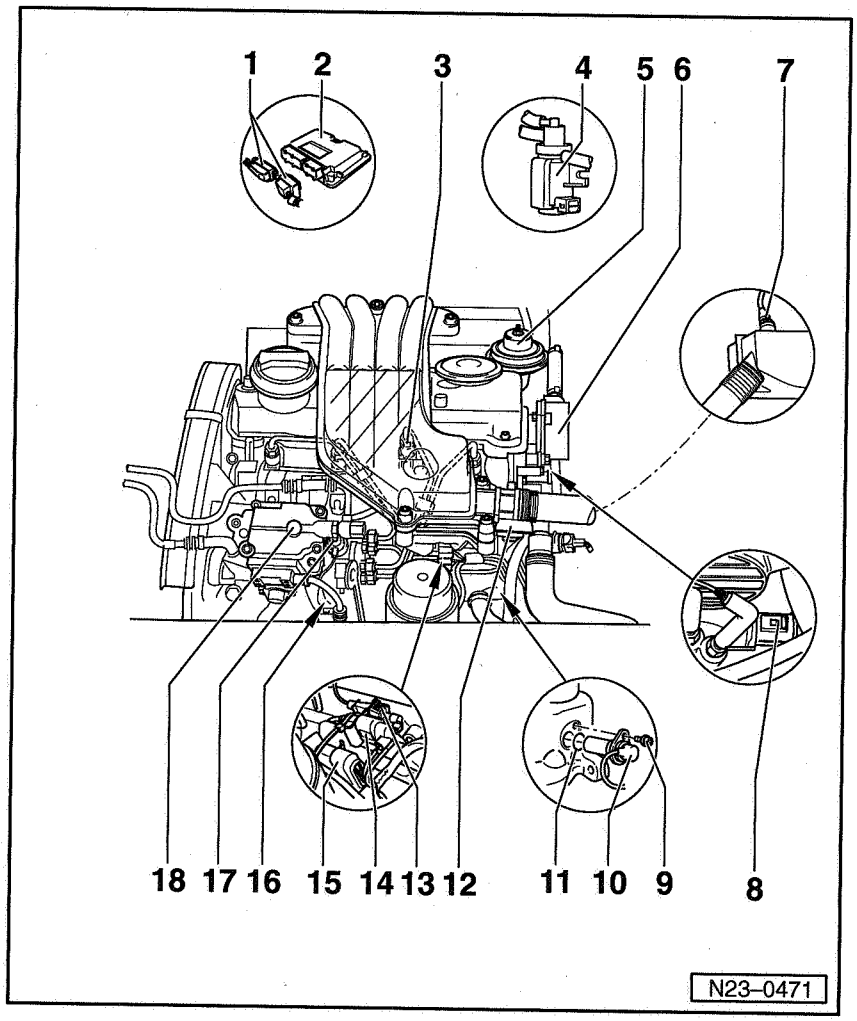
7 - Intake manifold temperature sender (G72)
- ♦ Checking ⇒ page 23-58

8 - Coolant temperature sender (G62)
- ♦ For engine control unit
- ♦ With coolant temperature gauge sender (G2)
- ♦ If necessary release pressure in cooling system before removing
- ♦ Checking ⇒ Page 23-53

9 - 10 Nm

10 - Engine speed sender (G28)
- ♦ Checking ⇒ Page 23-50

11 - O-ring
- ♦ Renew

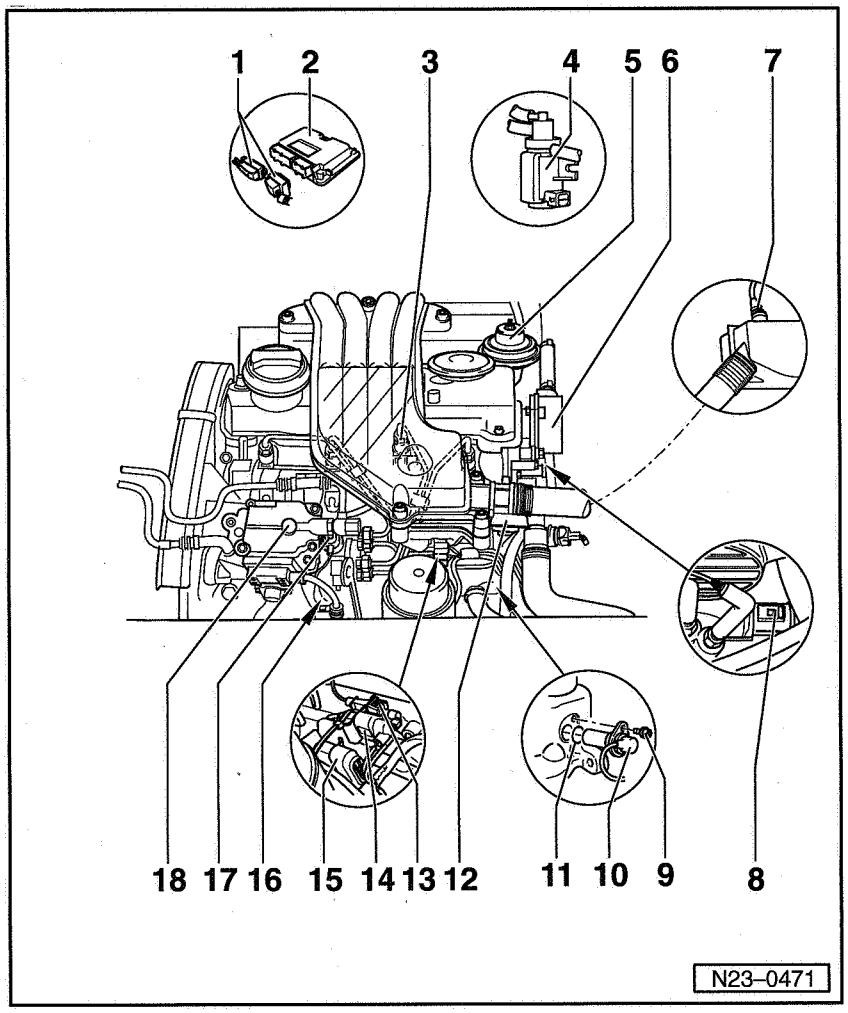


12 - Intake manifold flap motor (V157)
- ♦ Checking ⇒ page 23-98 (engine code BEQ only)

13 - 2 pin connector
- ♦ For needle lift sender (G80)

14 - 3 pin connector
- ♦ For engine speed sender (G28)

15 - 10 pin connector
- ♦ For fuel temperature sender (G81)
- ♦ For quantity adjuster (N146)
- ♦ For modulating piston movement sender (G149)
- ♦ For fuel shut-off valve (N109)
- ♦ For commencement of injection valve (N108)

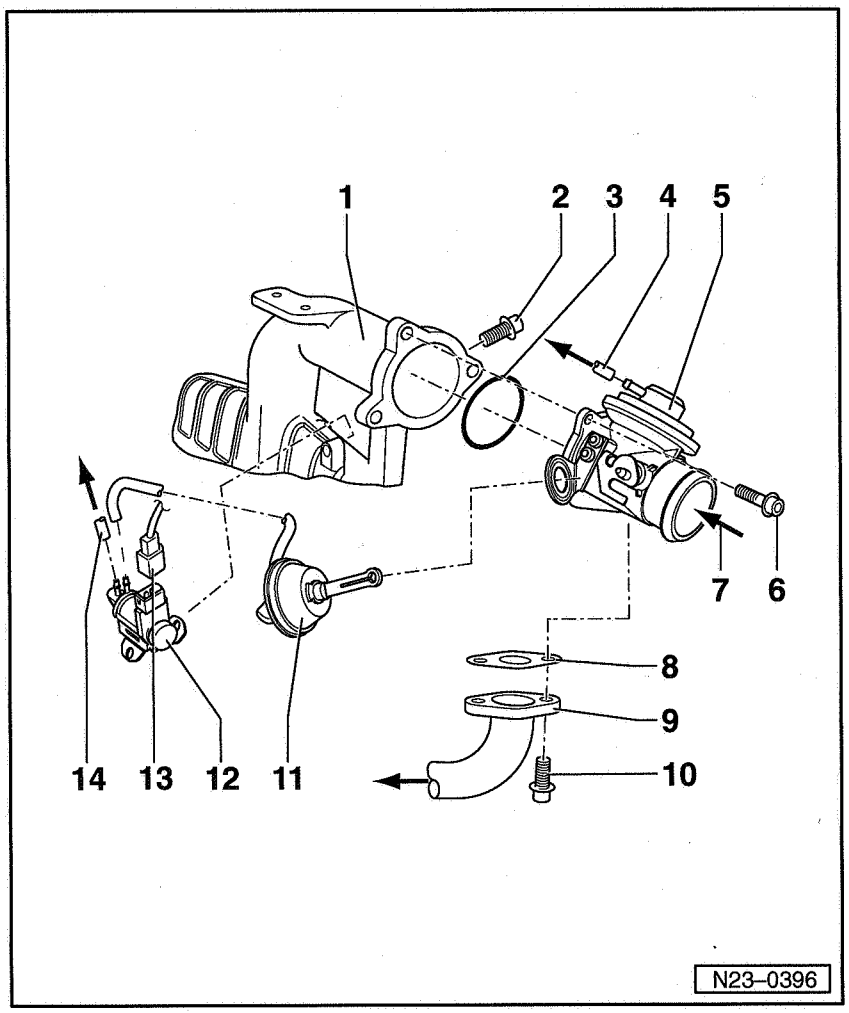


16 - Commencement of injection valve (N108)
- ♦ Checking ⇒ Page 01-53, final control diagnosis

17 - Fuel cut-off valve (N109)
- ♦ Checking ⇒ Page 01-53, final control diagnosis

18 - Injection pump
- ♦ With quantity adjuster (metering)
- ♦ With quantity adjuster (N146)
- ♦ With modulating piston movement sender (G149)
- ♦ With fuel temperature sender (G81)

- ♦ Removing and installing ⇒ page 23-28
- ♦ Dynamically checking and adjusting commencement of injection ⇒ Page 23-35



Dismantling and assembling parts of intake manifold (engine code AVM)

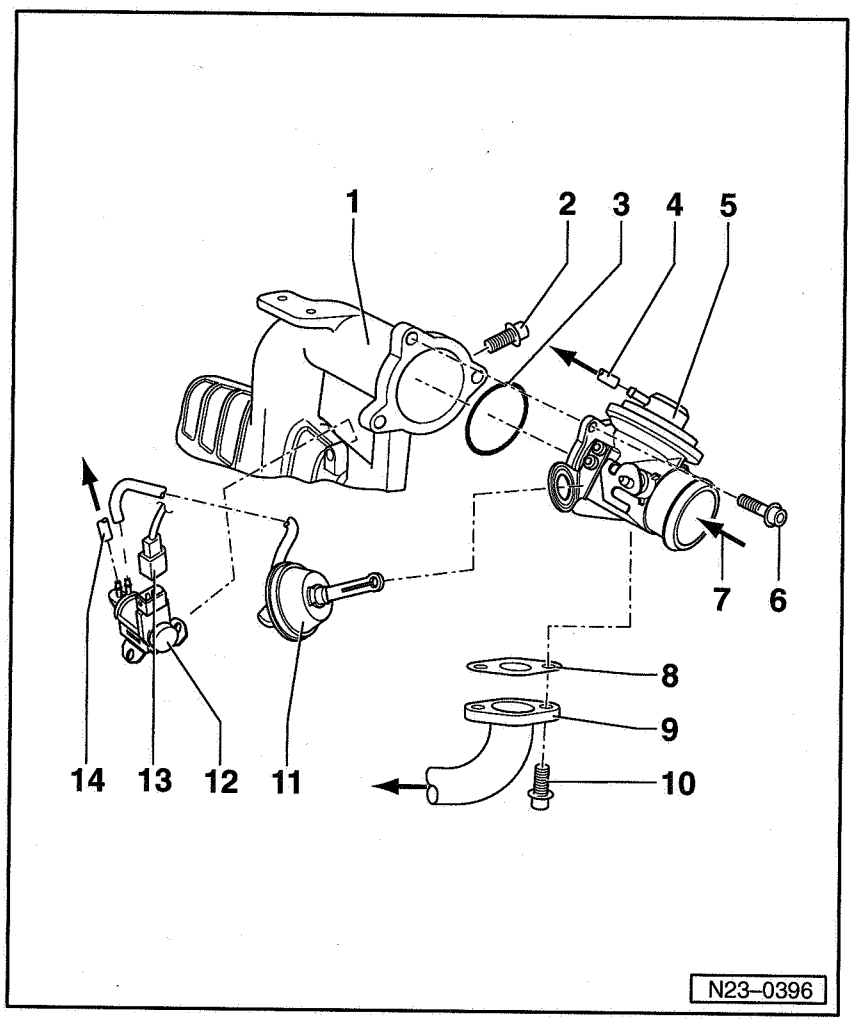
The intake manifold flap is closed for approx. 3 seconds when stopping engine and then opens again. This reduces the stop jolt.

1 - Intake manifold

2 - 10 Nm

3 - O-ring
- ♦ Renew

4 - Vacuum pipe
- ♦ To EGR valve (N18)



5 - Air intake connecting piece
- ♦ With exhaust gas recirculation valve and intake manifold flap
- ♦ Only renew complete
- ♦ Checking intake manifold flap change-over ⇒ Page 23-93
- ♦ Checking EGR valve ⇒ page 26-7

6 - 10 Nm

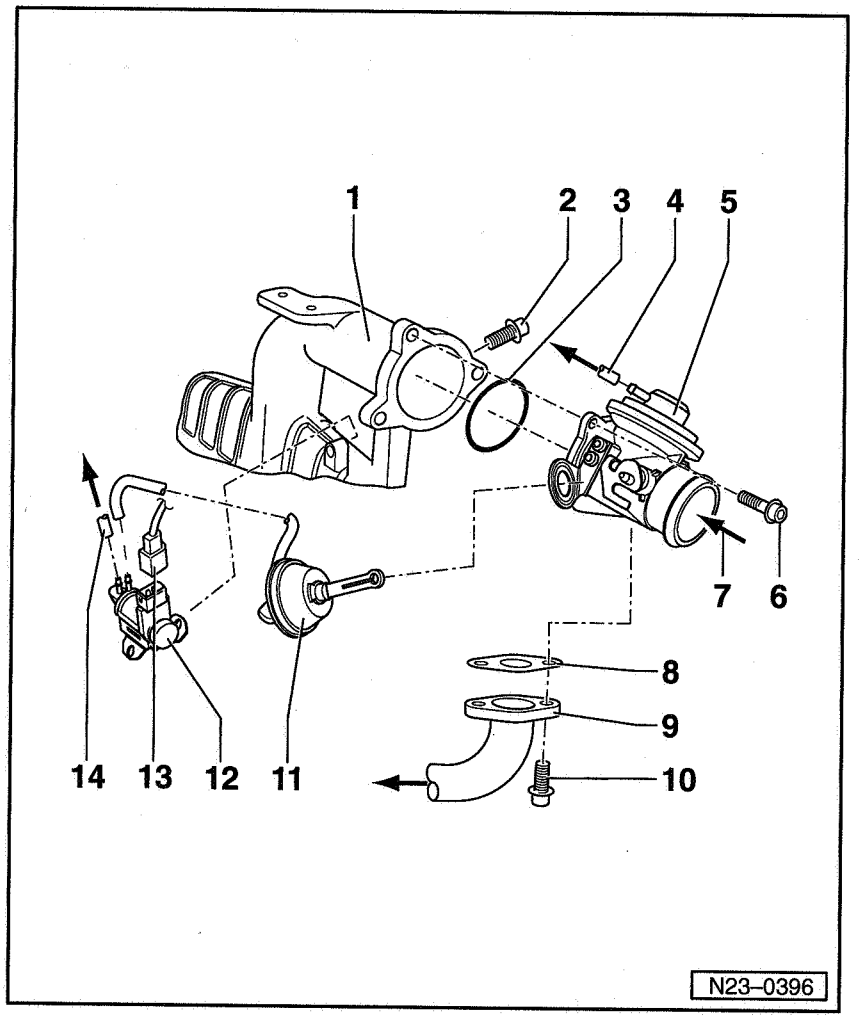
7 - From charge air cooler

8 - Gasket
- ♦ Renew

9 - Connecting pipe
- ♦ To exhaust manifold

10 - 22 Nm
- ♦ Renew

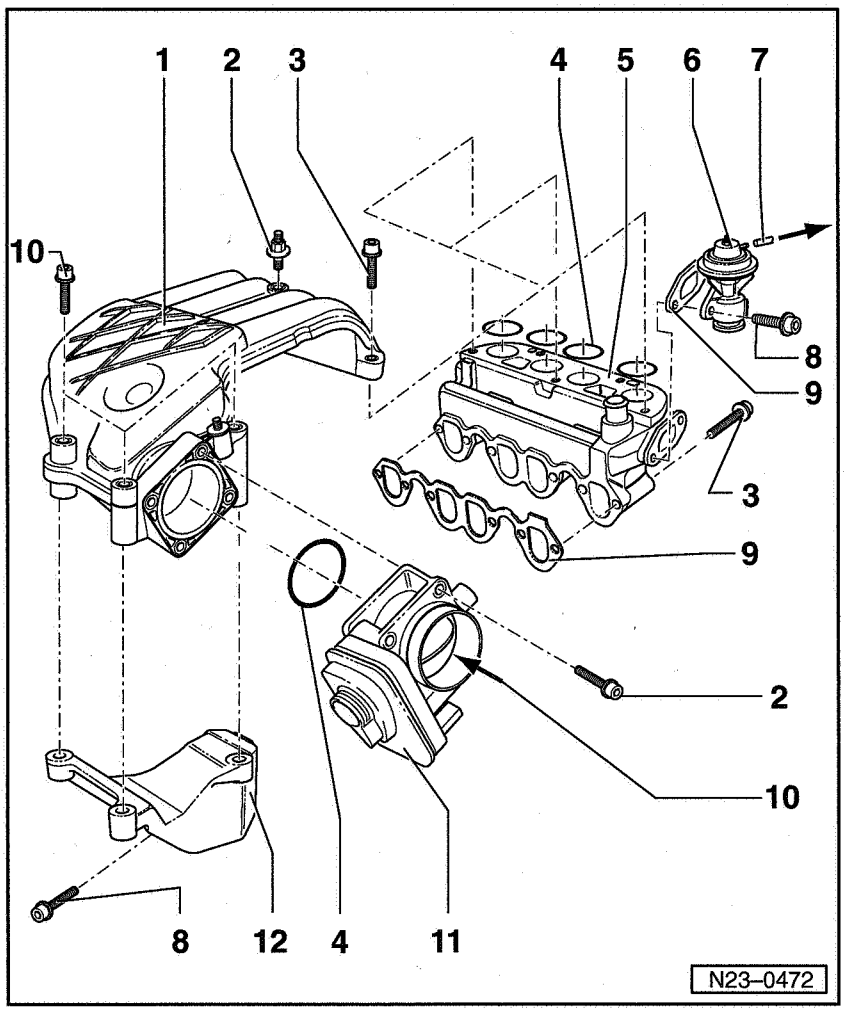
11 - Vacuum control element
- ♦ Checking intake manifold flap change-over ⇒ Page 23-93



12 - Intake manifold flap change-over valve (N239)
- ♦ Checking ⇒ Page 23-95

13 - Connector
- ♦ Black, 2-pin
- ♦ For intake manifold flap change-over valve (N239)

14 - Vacuum hose
- ♦ From T-piece ⇒ page 26-5, item 7



Dismantling and assembling parts of intake manifold (engine codes ARD and BEQ)

At low engine speeds the depression in the inlet manifold is insufficient to guarantee a perfect function of the exhaust gas recirculation system. Therefore the throttle valve is closed to increase the depression when starting the engine and when running the engine at low throttle or load conditions.

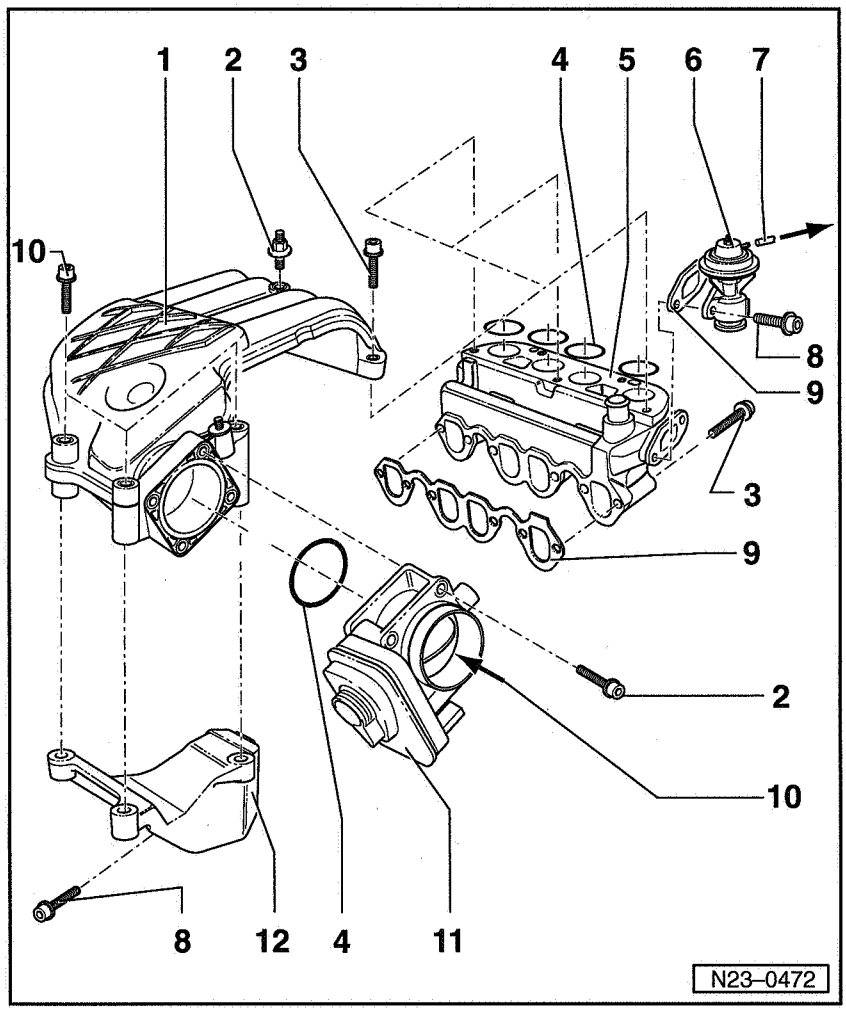
1 - Intake manifold - upper part

2 - 10 Nm

3 - 20 Nm

4 - O-ring
- ♦ Renew

5 - Intake manifold - lower part



6 - Exhaust gas recirculation valve (mechanical)
- ♦ Checking ⇒ page 26-18 (engine code BEQ only)

7 - Vacuum pipe
- ♦ To EGR valve (N18) (engine code BEQ only)

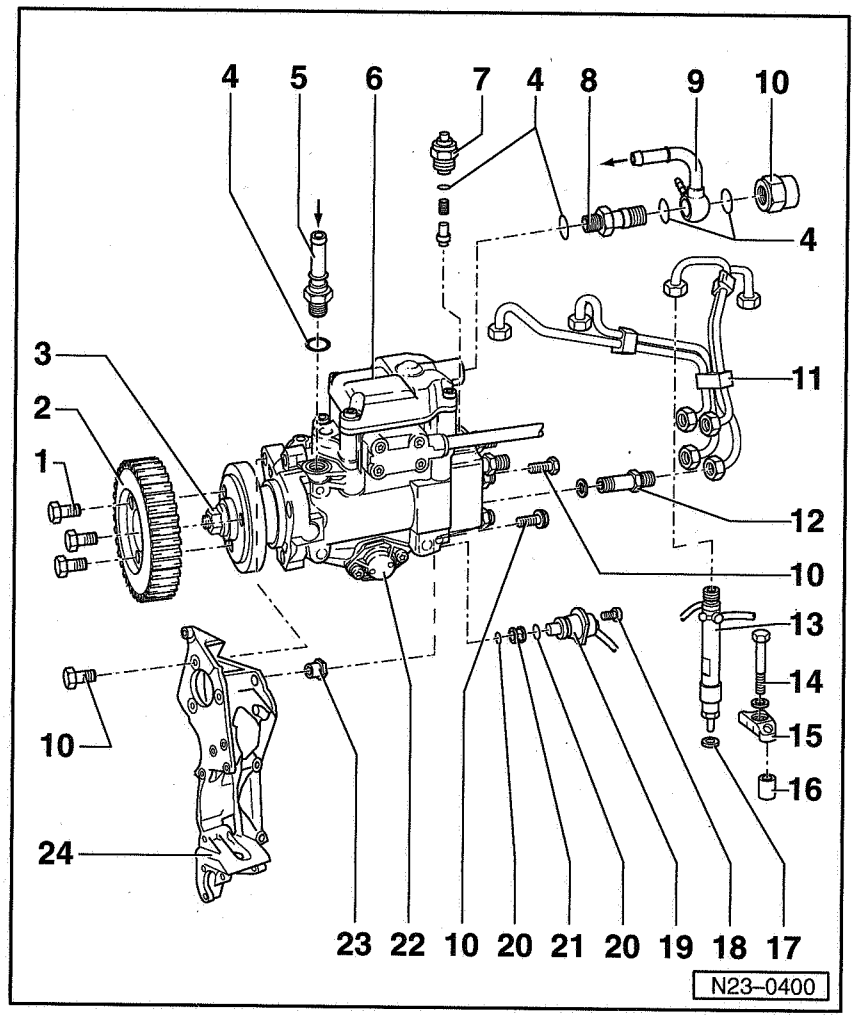
8 - 25 Nm

9 - Gasket
- ♦ Renew

10 - From air cleaner

11 - Intake manifold flap motor (V157)
- ♦ Checking ⇒ page 23-98 (engine code BEQ only)

12 - Bracket

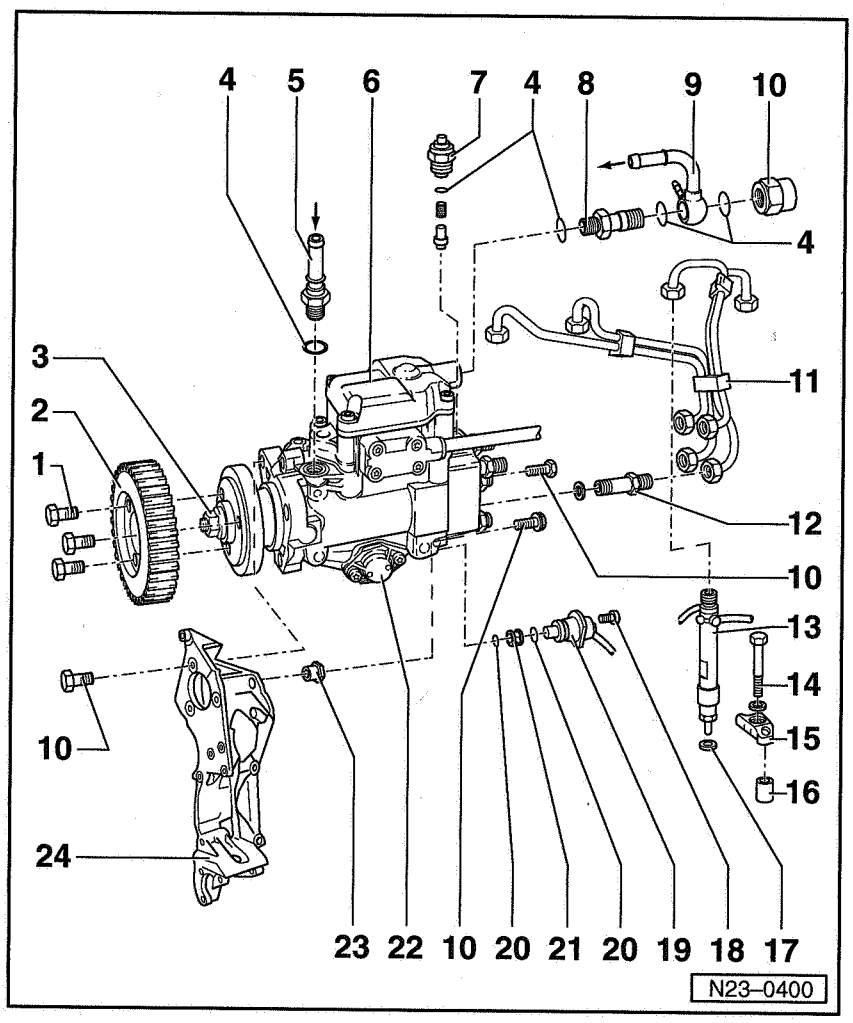


Servicing injection pump

- ♦ Removing and installing injection pump ⇒ page 23-28.
- ♦ Dynamically checking and adjusting injection pump ⇒ page 23-35.
- ♦ Always renew seals and O-rings.

1 - Injection pump sprocket securing bolts
- ♦ Take note of different types and torque settings ⇒ Fig. 1

2 - Injection pump sprocket
- ♦ Take note of different types (Part No.) ⇒ Fig. 1
- ♦ Removing and installing ⇒ Page23-28, Removing and installing injection pump



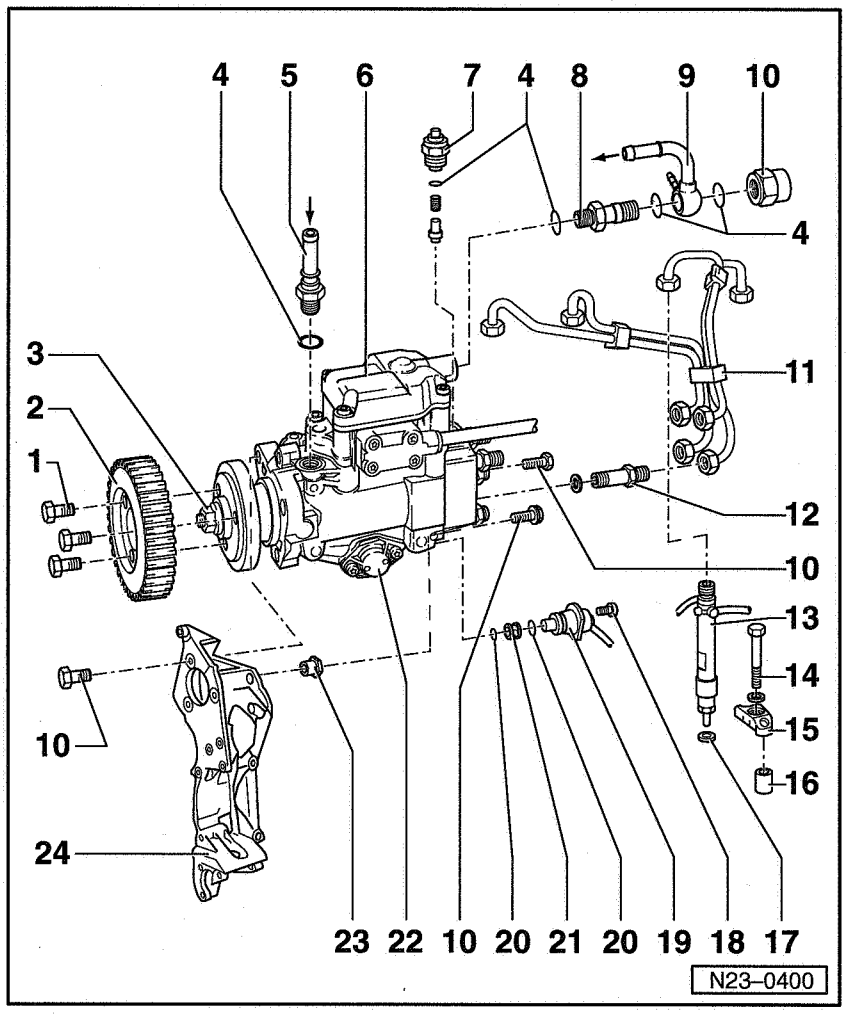
3 - Nut
- ♦ For hub
- ♦ Do not loosen. Otherwise the injection pump basic setting may be altered and this cannot be reset with normal workshop equipment

4 - Seal
- ♦ Renew

5 - Pipe union, 25 Nm
- ♦ For supply pipe
- ♦ From fuel filter

6 - Injection pump
- ♦ With quantity adjuster (metering)
- ♦ With quantity adjuster (N146)
- ♦ With modulating piston movement sender (G149)
- ♦ With fuel temperature sender (G81)

- ♦ Removing and installing ⇒ page 23-28
- ♦ Dynamically checking and adjusting commencement of injection ⇒ Page 23-35



7 - Fuel shut-off valve (N109), 40 nm

- ♦ Checking ⇒ Page 01-53, final control diagnosis

8 - Pipe union, 25 Nm

- ♦ For return pipe

9 - Return pipe

- ♦ To control valve/fuel filter

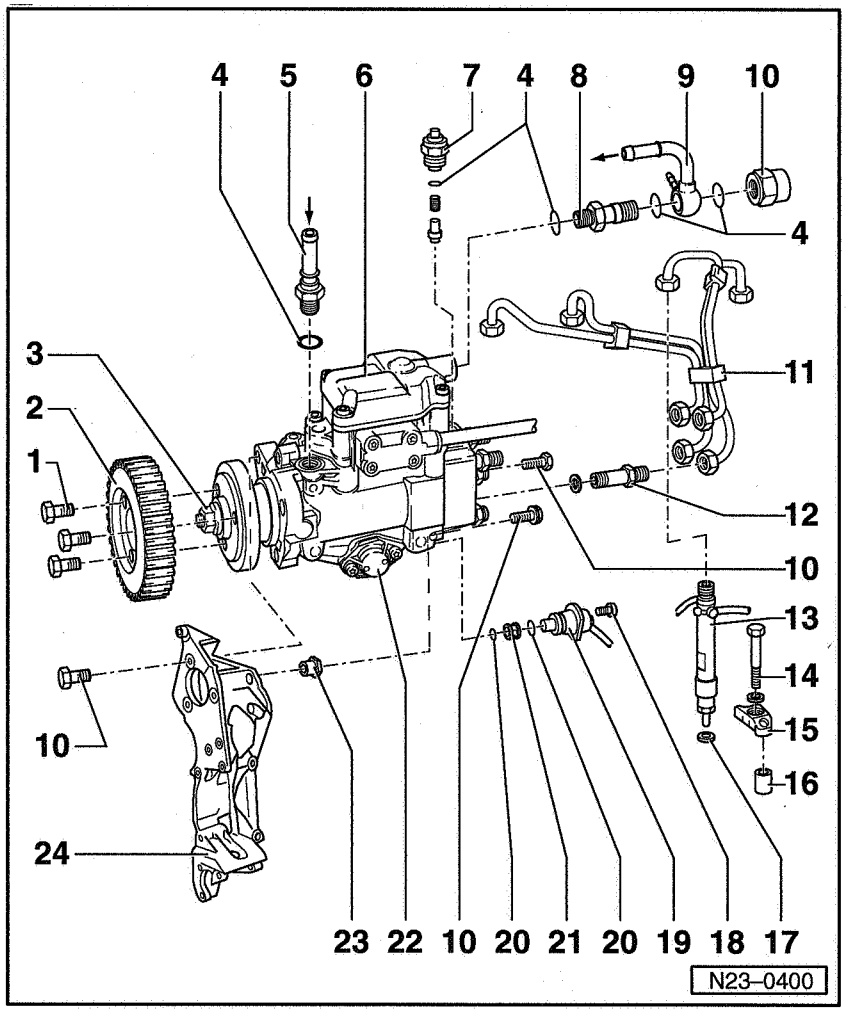
10 - 25 Nm

11 - Injector pipes

- ♦ Tighten to 25 Nm
- ♦ Remove with ring spanner 3035
- ♦ Always remove pipework complete
- ♦ Do not alter shape

12 - Pipe union, 45 Nm

- ♦ With pressure valve



13 - Injector

- ♦ Removing and installing ⇒ Page 23-42
- ♦ Checking ⇒ Page 23-45
- ♦ For 3rd cylinder with needle lift sender (G80)
- ♦ Checking needle lift sender ⇒ Page 23-75

14 - 20 Nm

15 - Retainer

16 - Mounting

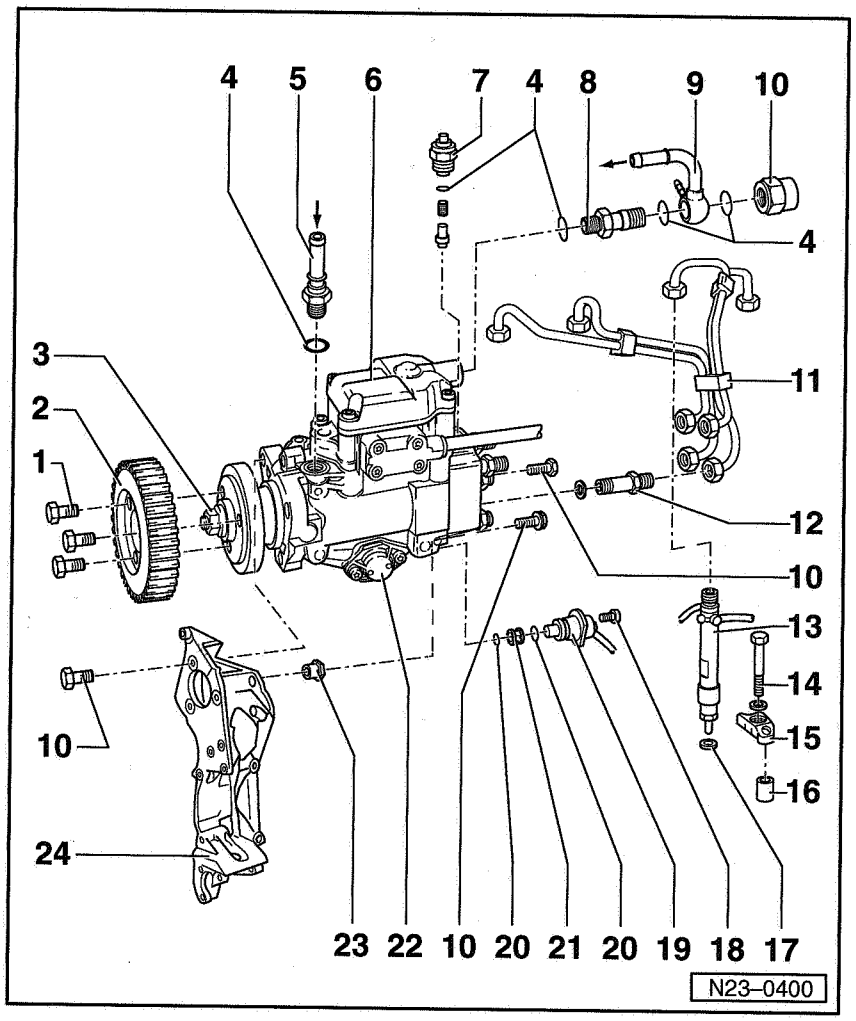
17 - Heat insulation seal

- ♦ Renew

18 - 10 Nm

19 - Commencement of injection valve (N108)

- ♦ Checking ⇒ Page 01-53, final control diagnosis

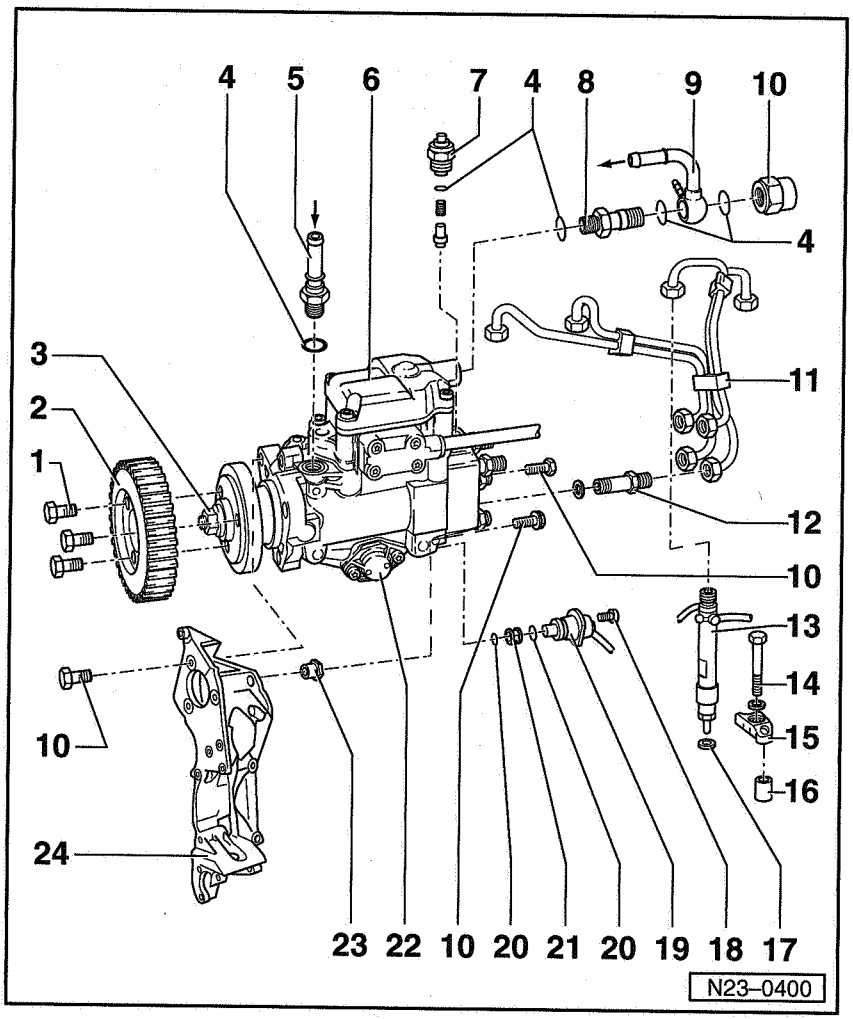


20 - O-ring
- ♦ Renew

21 - Strainer
- ♦ Clean strainer if soiled

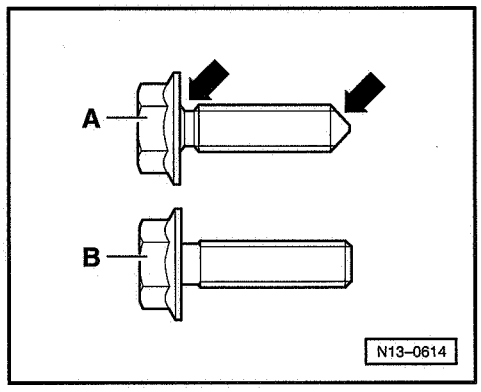
22 - Timing control cover
- ♦ If leaking, replace O-ring ⇒ Page 23-47

23 - Sleeve
- ♦ With securing nut



24 - Compact bracket
- ♦ For injection pump, alternator and vane pump for power assisted steering
- ♦ For units without air conditioner
- ♦ Removing and installing ⇒ page 13-11, item 26
- ♦ Removing and installing compact bracket on units with air conditioner:

⇒ Golf 1998 ➤, Bora 1999 ➤; Heater, air conditioner; Repair group 87; Removing and installing compressor bracket



◄ **Fig. 1 Types of injection pump sprocket securing bolts**

Version -A-:
Securing bolts with chamfer on shaft and pointed end -arrows-

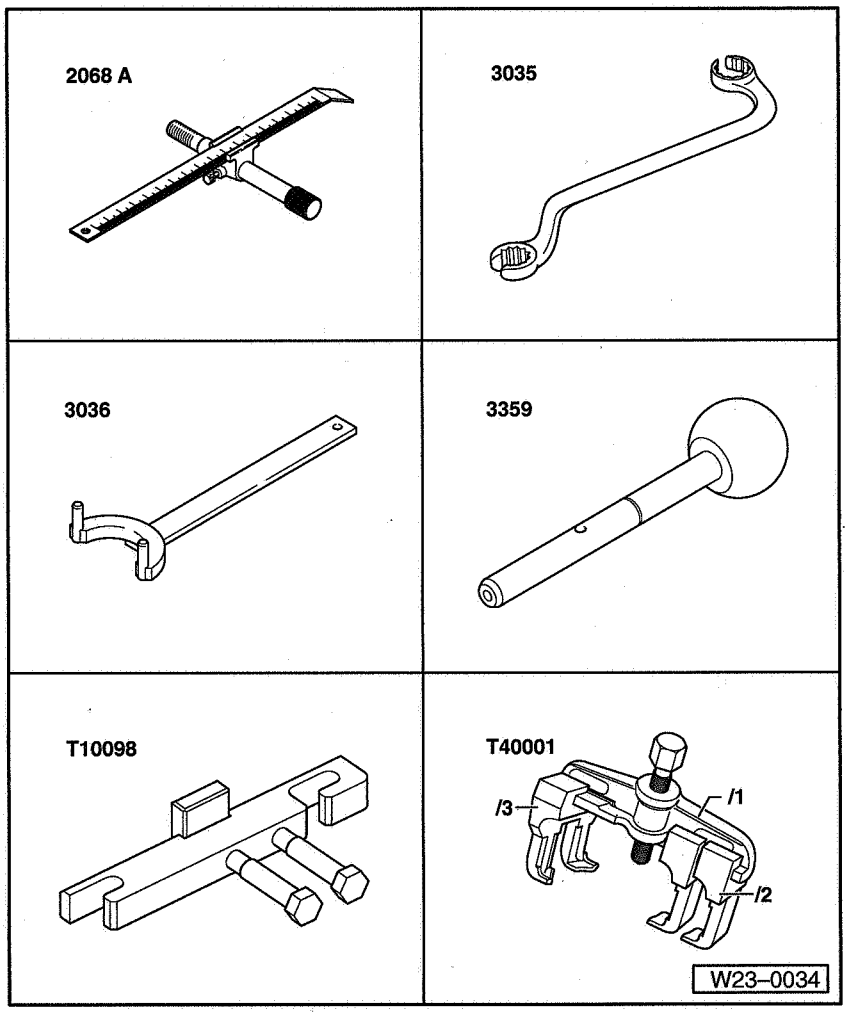
- Part number on injection pump sprocket:
  038 130 111 A
- Torque setting of securing bolts:
  20 Nm + $^1/_4$ turn (90°)
- Renew securing bolts

Note:

The securing bolt -A- is a stretch bolt and must always be replaced.

Version -B-: Securing bolts without chamfer on shaft and without pointed end

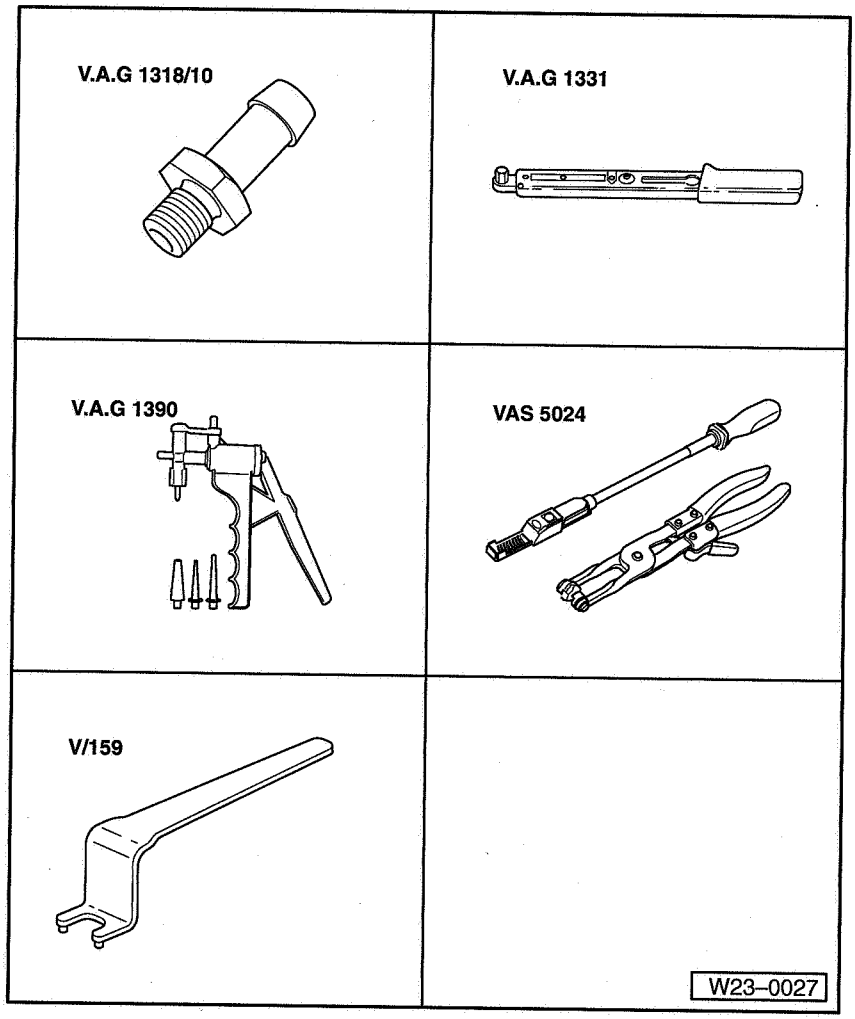
- Part number on injection pump sprocket:
  038 130 111 B
- Torque setting of securing bolts:
  25 Nm
- Securing bolts need not be renewed



Removing and installing injection pump

Special tools, workshop equipment, test and measuring appliances and auxiliary items required

- 2068 A TDC setting device
- 3035 Open ring spanner
- 3036 Counter hold tool
- 3359 Locking pin
- T10098 Camshaft bar
- T40001 Puller



- ♦ V.A.G 1318/10 Adapter
- ♦ V.A.G 1331 Torque wrench (5...50 Nm)
- ♦ V.A.G 1390 Hand vacuum pump
- ♦ VAS 5024 Assembly tool for spring-type clamps
- ♦ V/159 Pin wrench, Matra
  (for engines with engine code AVM)

Removing

- Relieve toothed belt tension and take toothed belt off camshaft and injection pump sprockets and injection pump ⇒ page 15-8, Removing, installing, tensioning toothed belt.

Note:

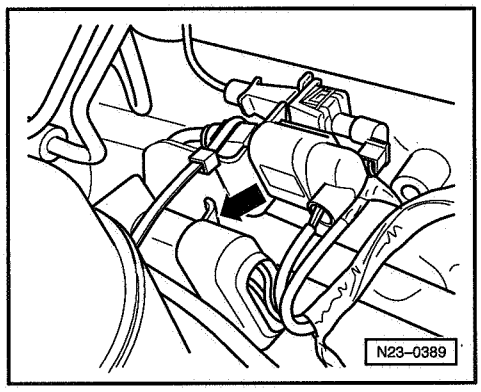
The vibration damper/belt pulley and the centre and lower toothed belt guard need not be removed.

- Unbolt all fuel lines at fuel pump.

Notes:

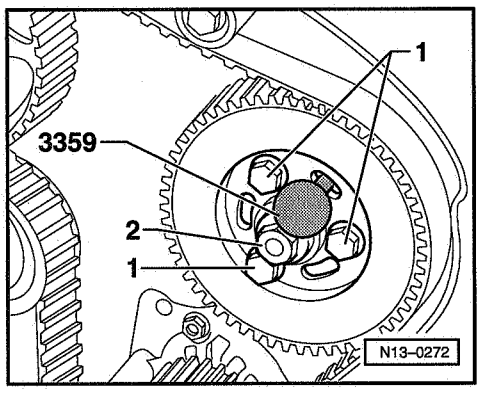
- ♦ *To remove injector pipe set, use open ring spanner 3035.*
- ♦ *To not alter the shapes of the bends.*

- Pull off supply and return lines on injection pump union.
- Unscrew return line connection out of injection pump.
- Seal the pipes so that the fuel system is not contaminated by dirt etc.
- Observe rules for cleanliness ⇒ page 23-4.



- Cover openings with a clean cloth.

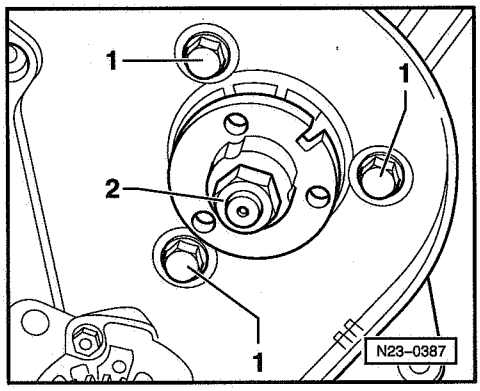
◄ - Separate 10-pin connector to injection pump -arrow- and pull connector out of bracket.



◄ - Remove loosened injection pump sprocket securing bolts -1-.

Notes:

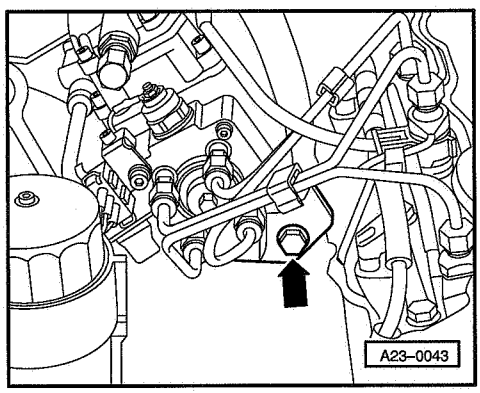
- *Unscrew securing bolts with chamfer on shaft and pointed end, one after the other, and renew. (Part No. of injection pump sprocket 038 130 111 A).*
- *Securing bolts without chamfer on shaft and pointed end need not be renewed. (Part No. of injection pump sprocket 038 130 111 B).*
- *The nut -2- on the pump shaft should never be loosened. Otherwise the basic pump setting will be altered and will not be able to be corrected with normal workshop tools.*



◄ - Remove securing bolts -1- from compact bracket.

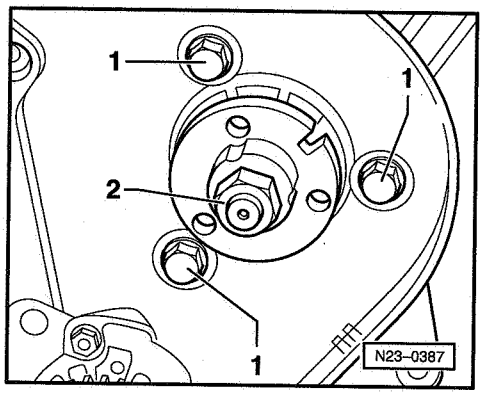
Note:

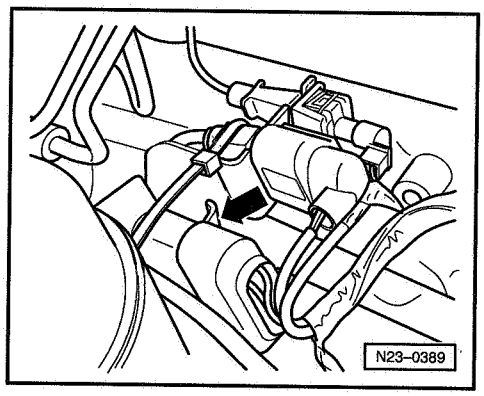
On no account must the nut -2- for the hub be loosened. Otherwise the injection pump basic setting will be altered and this cannot be reset with normal workshop equipment.



◄ - Then remove bolt from rear support -arrow-.

- Take off injection pump.





Installing

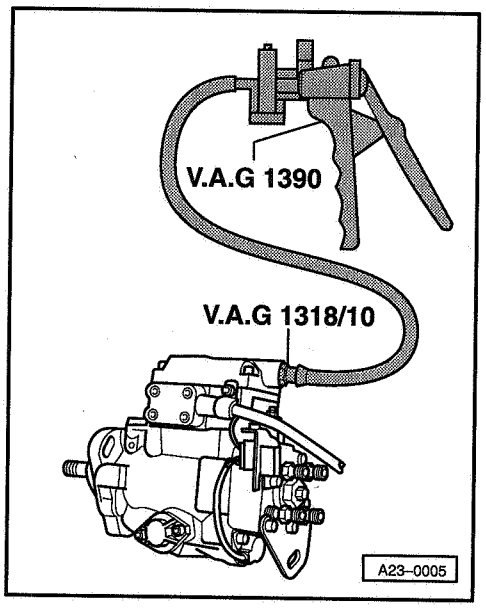
- Insert injection pump into compact bracket and then tighten securing nut on bolt of rear support first.
  Torque setting: 25 Nm

◄ - Screw in securing bolts -1- and tighten.

  Tightening torque: 25 Nm

- Install and tension toothed belt ⇒ Page 15-8.
- Install injector lines.
  Torque setting: 25 Nm
- Secure supply line to injection pump union.

◄ - Connect 10-pin connector to injection pump -arrow- and fit connector onto bracket.



◄ Fill injection pump with diesel as follows:

- Screw adapter 1318/10 into injection pump return supply opening.
- Connect hand vacuum pump 1390 with approx. 1 m transparent plastic hose to adapter.
- Operate vacuum pump until fuel flows out of opening for return line. Do not draw fuel into vacuum pump.
- Remove adapter 1318/10 and connect return line with connection piece.
  Torque setting: 25 Nm
- Dynamically check commencement of injection and adjust if necessary ⇒ Page 23-35.
- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

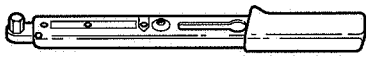
Dynamically checking and adjusting commencement of injection

Notes:

- *Dynamically checking and correcting commencement of injection is only possible in function 04 "Engine basic setting".*
- *The commencement of injection must always be checked after renewing the toothed belt or loosening the injection pump bolts or toothed belt sprockets and if necessary adjusted.*

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

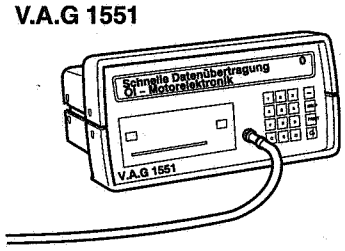
V.A.G 1331



W00-0427

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

V.A.G 1551



W00-0459

- Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3

Note:

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051.

Checking and adjustment conditions

- Mechanical engine basic setting OK.
- Toothed belt tension OK.

Work sequence

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Rapid data transfer HELP
Select function XXX

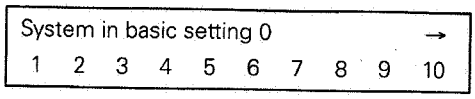
◄ Indicated on display:

- Press keys 0 and 4 for the function "Introduction of basic setting" and confirm entry with Q key.

Basic setting
Input display group number XXX

◄ Indicated on display:

- Press key 0 three times for "Display group number 0" and confirm entry with Q key.



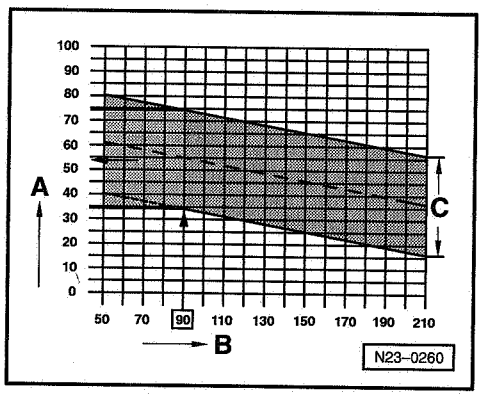
◄ Indicated on display:
(1...10 = Display zones)

- Check coolant temperature in display zone 7.
  Specification: less than 73 (equates to 85 °C)

Continue with check only when coolant temperature is attained.

Engine code AVM

The commencement of injection in display zone 2 is dependent on the fuel temperature in display zone 9.



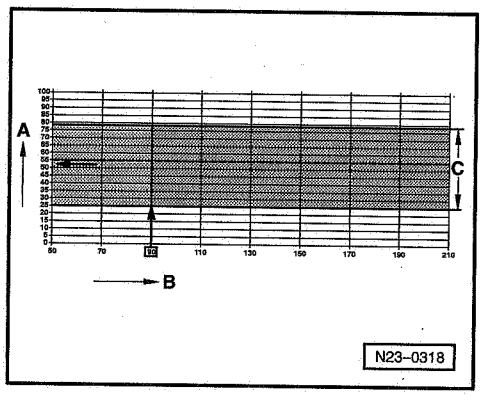
◄ A - Display zone 2 commencement of injection
B - Display zone 9 fuel temperature
C - Specified range for commencement of injection

Example:

The numerical value 90 in display zone 9 (B) corresponds to a numerical value range of 34...73 in display zone 2 (A).

Engine codes ARD and BEQ

The commencement of injection in display zone 2 is not dependent on the fuel temperature in display zone 9.



◄ A - Display zone 2 commencement of injection
B - Display zone 9 fuel temperature
C - Specified range for commencement of injection

Example:

The numerical value 90 in display zone 9 (B) corresponds to a numerical value range of 25...78 in display zone 2 (A).

Continued for all engine codes

- Press the → key.

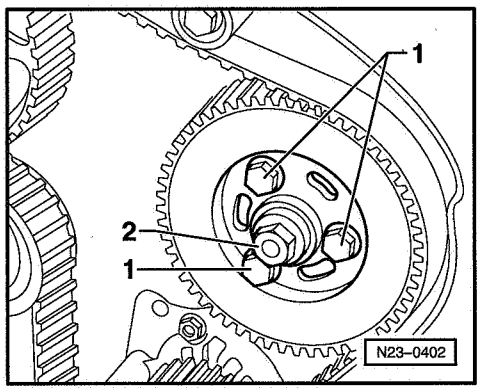
- Press keys 0 and 6 for the "End output" function and confirm input with the Q key.

- Switch off ignition.

Notes:

♦ *If when checking the commencement of injection the specifications are within zone -C- then no adjustment is required. After repairs e.g. removing and installing injection pump, adjusting timing then the commencement of injection is to be set to the mean valve (dashed line) of specification zone -C-.*

If the commencement of injection (timing) is outside the specification tolerances, adjust commencement of injection as follows:



- Remove upper toothed belt guard.

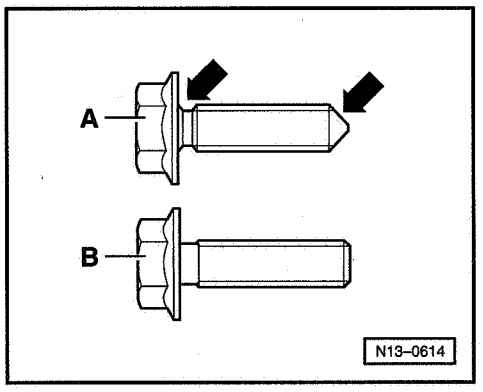
◄ - Loosen two injection pump sprocket securing bolts -1-.

- Fit a 22 mm AF ring spanner onto the hub nut -2- to counter-hold the pump shaft.

Note:

On no account must the nut -2- for the hub be loosened. Otherwise the injection pump basic setting will be altered and this cannot be reset with normal workshop equipment.

- Loosen the 3rd injection pump sprocket securing bolt and turn the pump shaft slightly:
  To left = retards commencement of injection
  To right = advances commencement of injection



Version -A-: Securing bolts with chamfer on shaft and point -arrows-

- Tighten new injection pump sprocket securing bolts.

  Tightening torque: 20 Nm

Notes:

- *After dynamic test of commencement of injection, securing bolts must be tightened 90° (1/4 turn) further.*
- *Because they are stretch bolts they must only be used once.*

Version -B-: Securing bolts without chamfer on shaft and without point

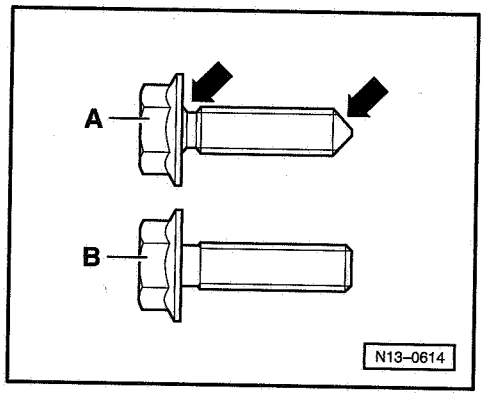
- Tighten old injection pump sprocket securing bolts.
  Tightening torque: 25 Nm

Note:

Do not renew securing bolts.

Continuation for all versions

- Observe value in zone 2 and, if necessary, repeat adjustment until the displayed value stays at the mean value of specified range -C-.



Version -A-: Securing bolts with chamfer on shaft and point -arrows-

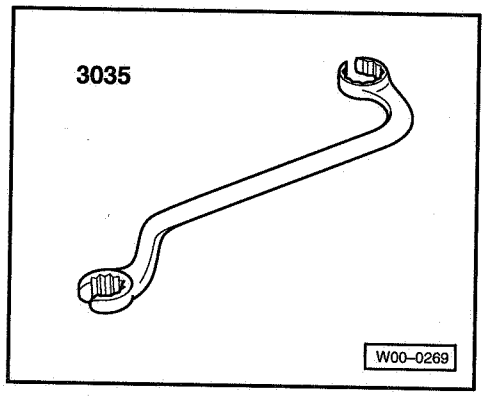
- Tighten new injection pump sprockets securing bolts $^1/_4$ turn (90°) further.

Continuation for all versions

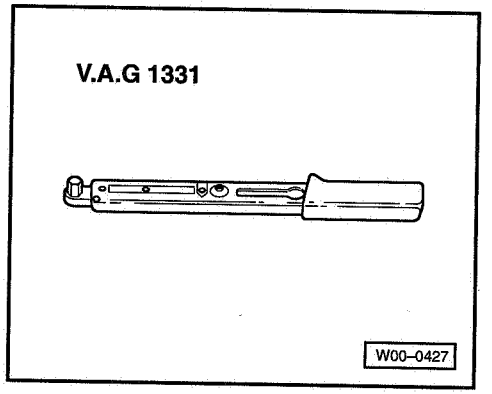
- Press the → key.
- Press keys 0 and 6 for the "End output" function and confirm input with the Q key.
- Switch off ignition.
- Install upper toothed belt guard.

Removing and installing injectors

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



♦ 3035 Ring spanner



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

Note:

Defective injectors cause the following faults:

- *Misfiring*
- *Knocking in one or more cylinders*
- *Engine over-heating*
- *Loss of power*
- *Excessive black exhaust smoke*
- *Higher fuel consumption*
- *Excessive blue smoke when starting from cold*

Defective injectors can be located by loosening the high pressure pipe union on each injector in turn with the engine running at a fast idling speed. If engine speed remains constant after loosening a pipe union, this indicates a defective injector.

Removing

Engine codes ARD and BEQ

- Remove intake manifold upper part ⇒ page 23-19, Dismantling and assembling parts of intake manifold.

Continued for all engine codes

- Remove injection pipes with an slotted ring spanner 3035.

Note:

Always remove pipe set complete. Do not alter pipe shape.

- Remove securing nut, take off retainer and take out injector.

Installing

Note:

Always renew heat insulating seal between cylinder head and injectors.

- Insert injector.
- Check mounting is seated correctly in cylinder head.
- Fit retainer.

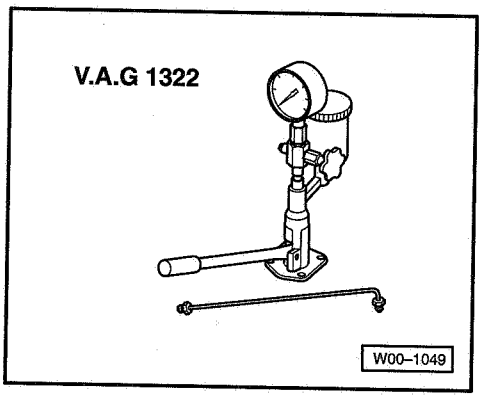
Torque settings:
Injection pipes = 25 Nm
Retainer screw = 20 Nm

Engine codes ARD and BEQ

- Install intake manifold upper part ⇒ page 23-19, Dismantling and assembling parts of intake manifold.

Checking injectors

This engine is equipped with dual spring injectors. The fuel injected therefore occurs in 2 stages.
If faults occur with these injectors then they are to be exchanged as neither servicing nor pressure setting is possible.



Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

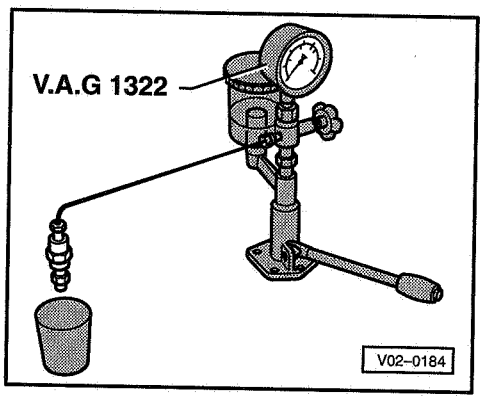
♦ Injector test unit V.A.G 1322 with pressure pipe V.A.G 1322/2

Test conditions

- Pressure gauge on

Checking injection pressure

> ***Warning!***
> ***When testing injectors ensure that the jet of fuel does not contact the hands as the high pressure will cause the fuel to penetrate the skin and may cause severe injuries.***



- Remove injectors ⇒ Page 23-42.

◄

- Connect injector to injector test unit V.A.G 1322.
- Press pump lever down slowly. When spray begins, read off opening pressure. For deviations from specification renew injector.

Engine code AVM

Specification:
New injectors: 220 ... 230 bar
Wear limit: 200 bar

Engine codes ARD and BEQ

Specification:
New injectors: 190 ... 200 bar
Wear limit: 170 bar

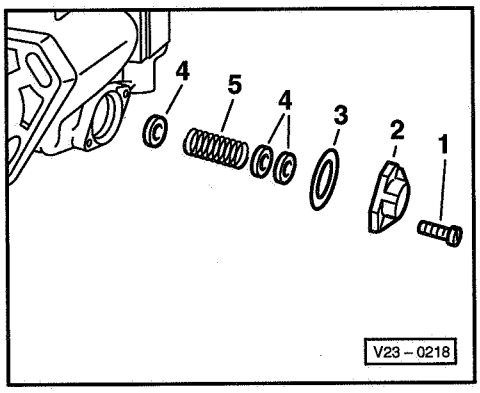
Checking for leaks

- Move pump lever down slowly and maintain a pressure of approx. 150 bar for 10 seconds. No fuel should leak from the nozzle tip.

- If injector leaks, replace.

Renewing injection timing device cover O-ring

- Place a clean cloth under the injection pump.



◄ - Remove cover screws -1- with commercially available key for Torx socket head screws, e.g. Hazet 2115-T30.

- Remove cover -2- and clean it.

- Renew O-ring -3- and install cover with existing shims -4-.

Checking components and functions

The components and functional checks described and the current flow diagrams from Page 27-20 relate to standard components.

Refer to the industrial engine customer's literature for other components and wiring.

Checking Diesel direct injection system voltage supply

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

♦ Hand multimeter V.A.G 1526 or multimeter V.A.G 1715

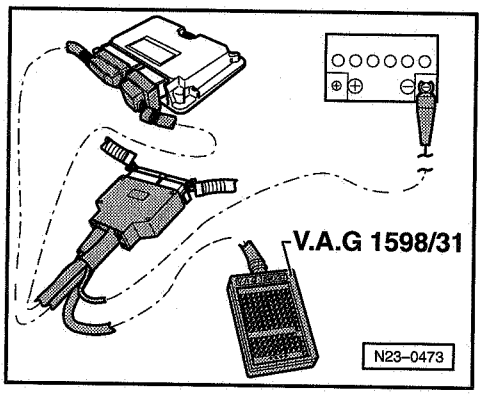
♦ Adapter set V.A.G 1594

♦ Test box V.A.G 1598/31

♦ Current flow diagram

Check conditions

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



Test sequence

- Connect test box V.A.G 1598/31 to control unit and wiring harness.

- Measure voltage between following sockets:
  1/2 and 4/5
  37 and 4/5
  Specification: Approx. 0 V

- Switch on ignition.

- Again measure voltage between sockets:
  1/2 and 4/5
  37 and 4/5
  Specification approx. battery voltage

- Switch off ignition.

If the specifications are not obtained:

- Check voltage supply relay terminal 30 (J317) ⇒ page 27-20, Current flow diagrams.

- Check wiring connections for open circuit, short circuit and transfer resistance at contacts according to current flow diagram.

If no fault is found in wiring and relay:

- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.

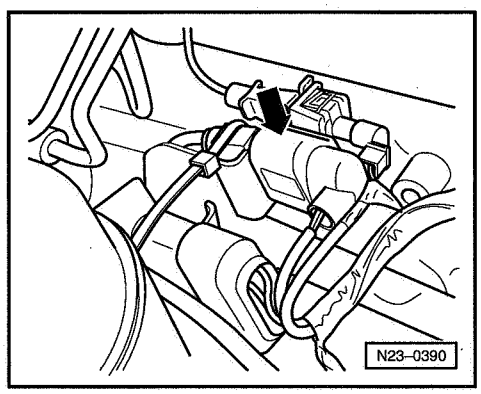
Checking engine speed sender

Function

The 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.

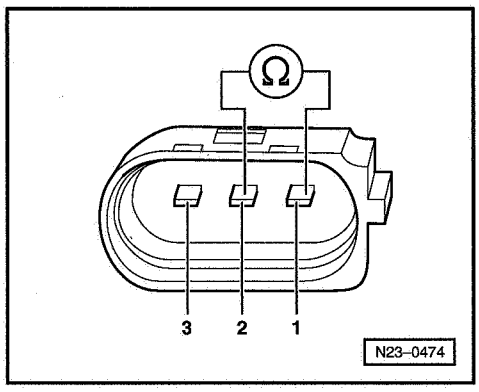
Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

- ♦ Hand multimeter V.A.G 1526 or multimeter V.A.G 1715
- ♦ Adapter set V.A.G 1594
- ♦ Test box V.A.G 1598/31
- ♦ Current flow diagram



Test sequence

◄ - Separate black 3-pin connector to engine speed sender -arrow-.



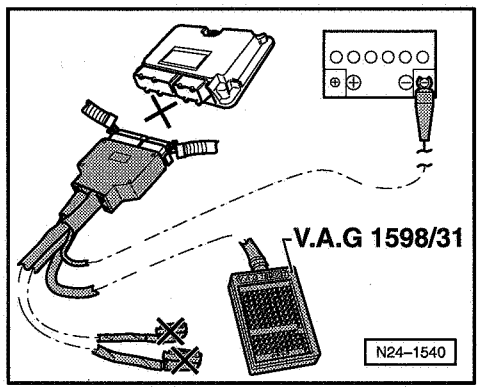
◄ - Measure resistance between connector contacts 1+2.
Specification: 1.1 ... 1.6 kΩ

If the specification is not obtained:

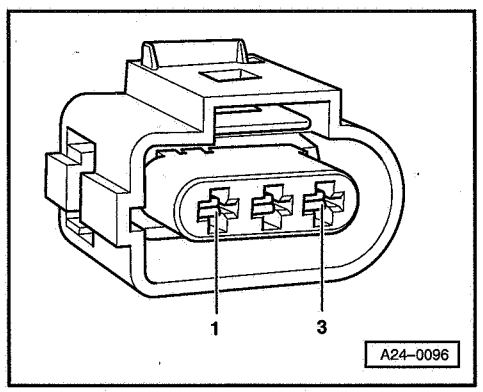
- Renew engine speed sender (G28):
Engine code AVM
⇒ page 23-8, item 12,
Engine codes ARD and BEQ
⇒ page 23-13, item 10.

- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

If the specification is obtained:



◄ - Connect test box V.A.G 1598/31 to control unit wiring harness. The engine control unit remains disconnected.



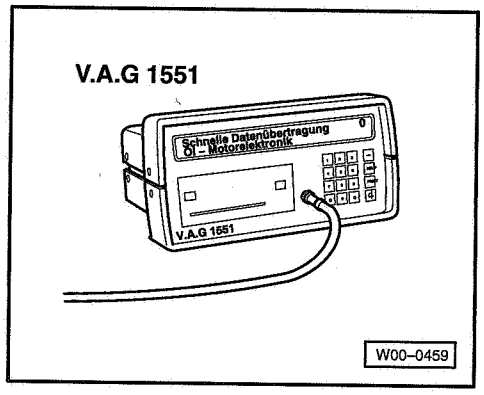
◄ - Check wiring between test box and 3-pin connector for open circuit according to current flow diagram.
Contact 1+ socket 102
Contact 2+ socket 110
Contact 3+ socket 86
Wire resistance: max. 1.5 Ω

- Check wiring at 3 pin connector for short circuit to one another according to current flow diagram.
Specification: ∞ Ω

If no fault is detected in the wiring:

- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.

Checking coolant temperature sender



Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

- Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3

Note:

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051.

- Hand multimeter V.A.G 1526 or multimeter V.A.G 1715
- Adapter set V.A.G 1594
- Test box V.A.G 1598/31
- Current flow diagram

Test conditions

- Engine must be cold.

Test sequence

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Rapid data transfer	HELP
Select function XXX	

◄ Indicated on display:

- Press keys 0 and 8 for the function "Read measured value block" and confirm entry with Q key.

Read measured value block
Input display group number XXX

◄ Indicated on display:

- Press keys 0, 0 and 7 for "Display group number 7" and confirm entry with Q key.

Read measured value block 7	→	
xxx.x °C	xxx.x °C	16.7 °C

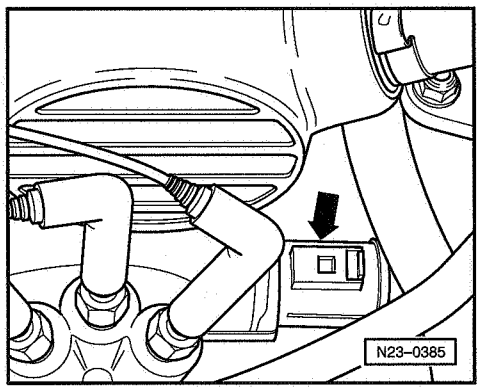
◄ - Indicated on display:

- Observe coolant temperature figure in display zone 4. The temperature figure must
  Increase uniformly and without interruption.
- If a fault is present either the fuel temperature or a value of - 4.5 °C will be displayed.

- If no realistic display appears in display zone 4 or either the fuel temperature or - 4.5 °C is displayed as a substitute, check coolant temperature sender and wiring connections to sender as follows:

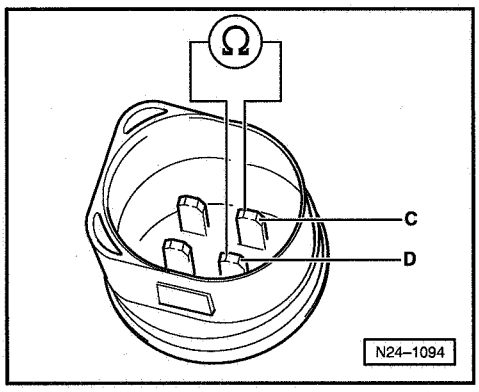
- Press the → key.

- Press keys 0 and 6 for the "End output" function and confirm input with the Q key.

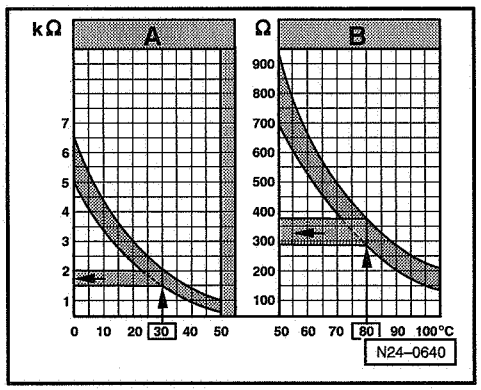


- Switch off ignition.

◄ - Pull the 4 pin connector off coolant temperature sender (G62) with coolant temperature gauge sender (G2) -arrow-.



◄ - Measure resistance at coolant temperature sender (G62) contact C (signal) and D (earth).



◄ Scale A shows resistance values for temperature range 0...50 °C and scale B the values for temperature range 50...100 °C.

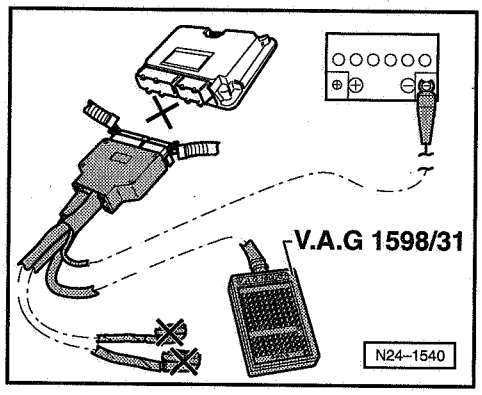
Examples:

♦ 30 °C is in range A and corresponds to a resistance of 1.5...2.0 kΩ

♦ 80 °C is in range B and corresponds to a resistance of 275...375 Ω

If the specification is not obtained:

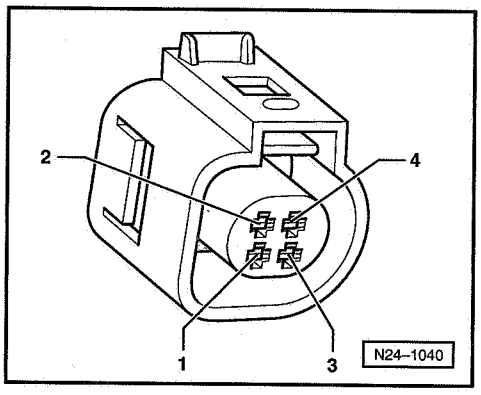
- Replace coolant temperature sender (G62) with coolant temperature gauge sender (G2) ⇒ page 19-4, item 8.



- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

If the specification is obtained:

◄ - Connect test box V.A.G 1598/31 to control unit wiring harness. The engine control unit remains disconnected.



◄ - Check wiring between test box and 4-pin connector for open circuit using current flow diagram.
Contact 3+ socket 112
Contact 4+ socket 104
Wire resistance: max. 1.5 Ω

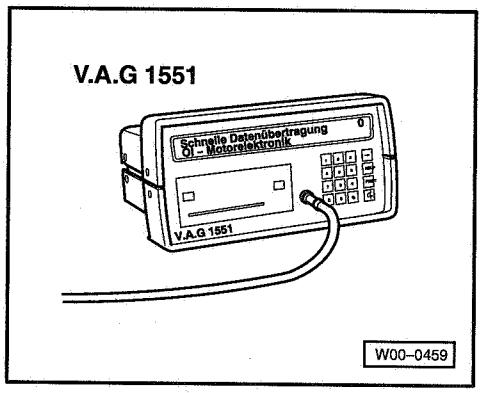
- Additionally, check wires for short to one another, to battery/vehicle earth and to battery positive.
Specification: ∞Ω

If no fault is detected in the wiring:

- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.

Checking intake manifold temperature sender

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3

Note:

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051.

♦ Hand multimeter V.A.G 1526 or multimeter V.A.G 1715

♦ Adapter set V.A.G 1594

♦ Test box V.A.G 1598/31

♦ Current flow diagram

Test sequence

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
(Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Rapid data transfer	HELP
Select function XXX	

◄ Indicated on display:

- Press keys 0 and 8 for the function "Read measured value block" and confirm entry with Q key.

Read measured value block
Input display group number XXX

◄ Indicated on display:

- Press keys 0, 0 and 7 for "Display group number 7" and confirm entry with Q key.

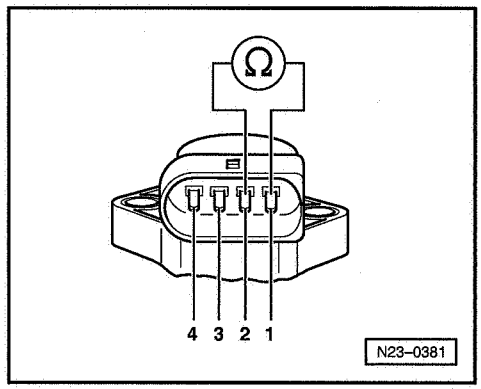
Read measured value block 7		→
xxx.x °C	15.9 °C	xxx.x °C

◄ - Indicated on display:

- Check value for intake manifold temperature in display zone 3. The value must be
  about ambient temperature.
- In case of a fault, a constant intake manifold temperature of 136.8°C will be displayed.
- If no realistic display appears in display zone 3 or a substitute temperature of 136.8 °C is displayed, check intake manifold temperature sender and the wiring to the sender as follows:
- Press the → key.
- Press keys 0 and 6 for the "End output" function and confirm input with the Q key.

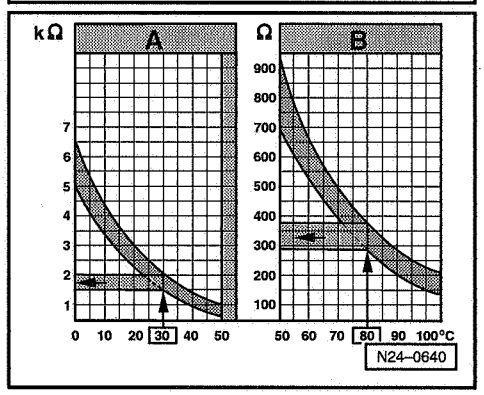
- Switch off ignition.

Engine code AVM



- Pull 4-pin connector -arrow- off intake manifold pressure sender (G71) with intake manifold pressure sender (G72) ⇒ page 23-5, Fitting locations overview.

◄ - Measure resistance of intake manifold pressure sender (G72) at contacts 1 and 2.



◄ 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 1.5...2.0 kΩ

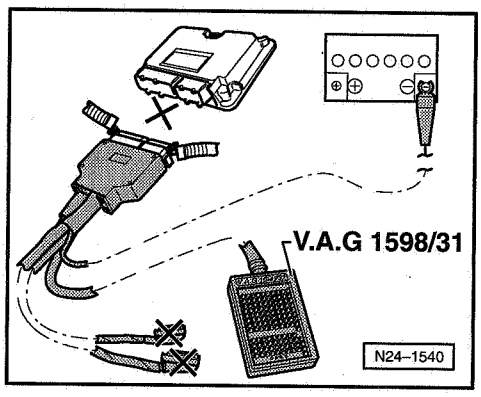
♦ 80 °C is in range B and corresponds to a resistance of 275...375 Ω

If the specification is not obtained:

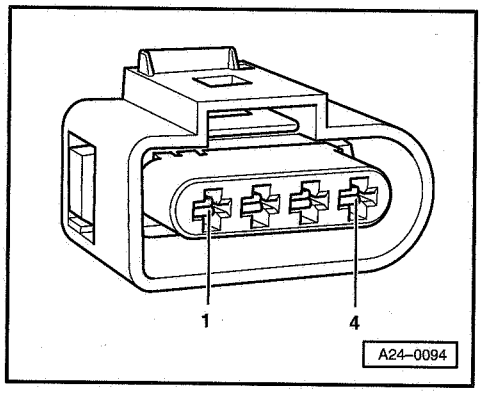
- Renew intake manifold pressure sender (G71) with intake manifold temperature sender (G72).

- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

If the specification is obtained:



◄ - Connect test box V.A.G 1598/31 to control unit wiring harness. The engine control unit remains disconnected.

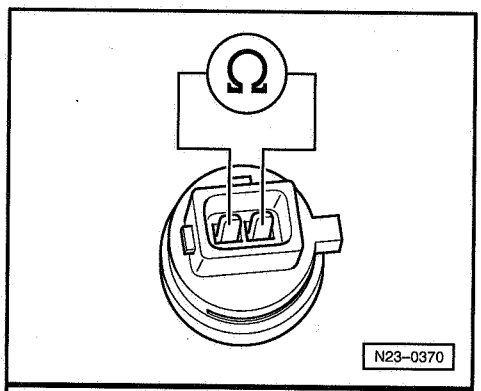


◄ - Check wiring between test box and connector for open circuit using current flow diagram.
Contact 1+ socket 52
Contact 2+ socket 73
Wire resistance: max. 1.5 Ω

- Additionally check wires for short to one another, to battery/vehicle earth and to battery positive.
Specification: ∞Ω

If no fault is detected in the wiring:

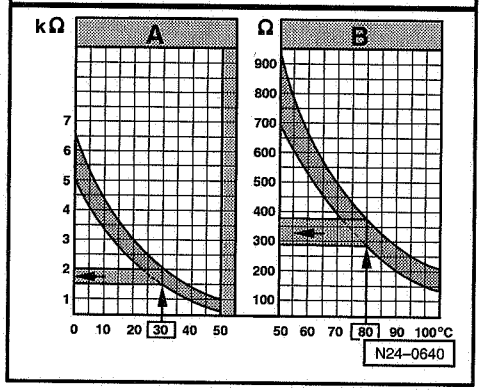
- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.



Engine codes ARD and BEQ

- Pull 2-pin connector off intake manifold temperature sender (G72) ⇒ page 23-11, Fitting locations overview.

◄ - Measure resistance of intake manifold pressure sender (G72) between contacts.



◄ Scale A shows resistance values for temperature range 0...50 °C and scale B the values for temperature range 50...100 °C.

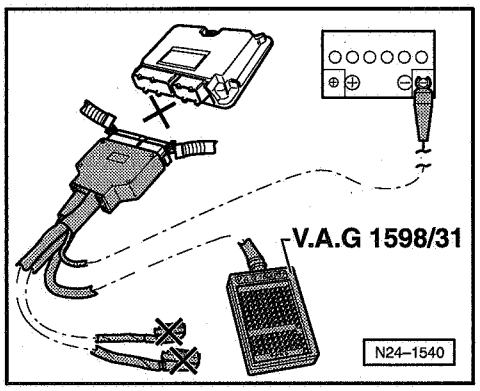
Examples:

♦ 30 °C is in range A and corresponds to a resistance of 1.5...2.0 kΩ

♦ 80 °C is in range B and corresponds to a resistance of 275...375 Ω

If the specification is not obtained:

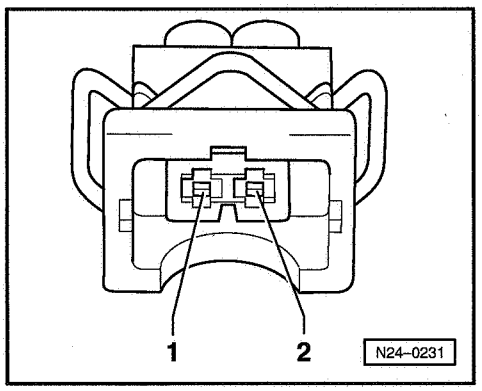
- Replace intake manifold temperature sender (G72).



- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

If the specification is obtained:

◄ - Connect test box V.A.G 1598/31 to control unit wiring harness. The engine control unit remains disconnected.



◄ - Check wiring between test box and connector for open circuit using current flow diagram.
Contact 1+ socket 73
Contact 2+ socket 54
Wire resistance: max. 1.5 Ω

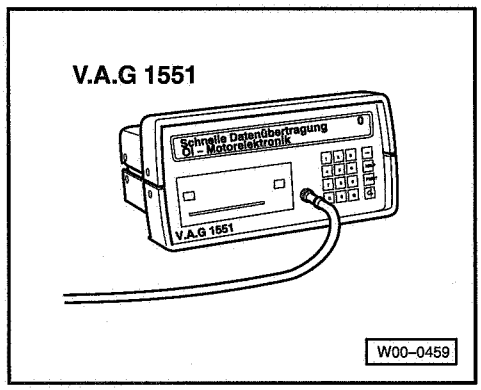
- Additionally check wires for short to one another, to battery/vehicle earth and to battery positive.
Specification: ∞Ω

If no fault is detected in the wiring:

- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.

Checking fuel temperature sender

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3

Note:

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051.

♦ Hand multimeter V.A.G 1526 or multimeter V.A.G 1715

♦ Adapter set V.A.G 1594

♦ Test box V.A.G 1598/31

♦ Current flow diagram

Test sequence

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
(Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Rapid data transfer HELP
Select function XXX

◄ Indicated on display:

- Press keys 0 and 8 for the function "Read measured value block" and confirm entry with Q key.

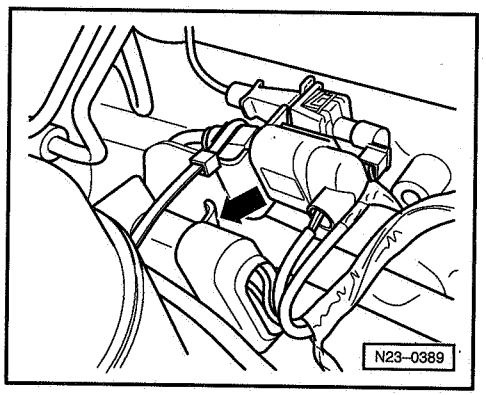
Read measured value block
Input display group number XXX

◄ Indicated on display:

- Press keys 0, 0 and 7 for "Display group number 7" and confirm entry with Q key.

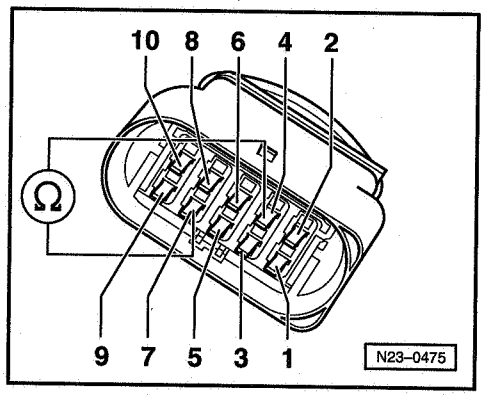
Read measured value block 7 →		
15.4 °C	xxx.x °C	xxx.x °C

◄
- Indicated on display:
- Check value for fuel temperature in display zone 1. The temperature must be
  about ambient temperature.
- In case of a fault, a constant temperature of -5.4 °C will be displayed.
- If no realistic display appears in display zone 1 or a substitute temperature of -5.4 °C is displayed, check fuel temperature sender and wiring to the sender as follows:
- Press the → key.
- Press keys 0 and 6 for the "End output" function and confirm input with the Q key.

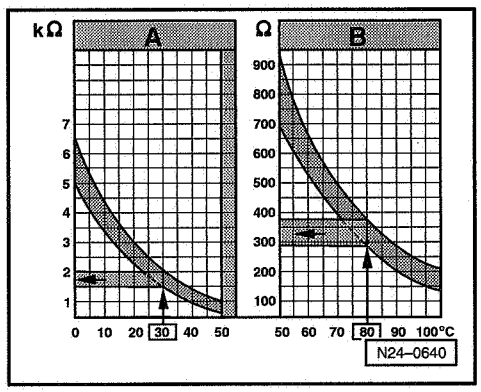


- Switch off ignition.

◄
- Disconnect 10-pin connector for fuel temperature sender (connection to injection pump metering control).



- Measure resistance between sender contacts 4 and 7.



◄ 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 1.5...2.0 kΩ

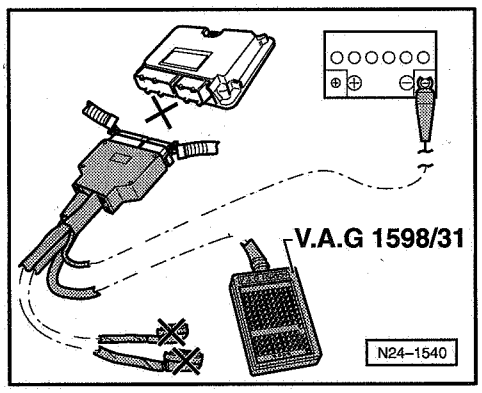
♦ 80 °C is in range B and corresponds to a resistance of 275...375 Ω

If the specification is not obtained:

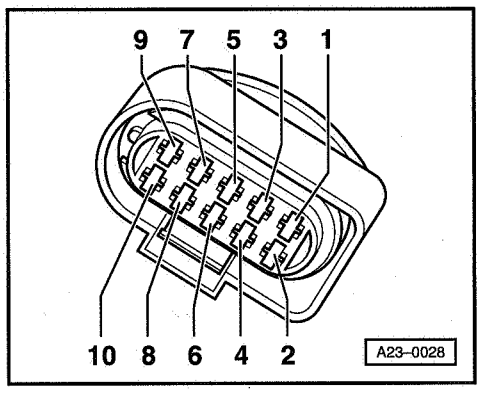
- Renew injection pump ⇒ Page 23-28, Removing and installing injection pump.

- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

If the specification is obtained:



◄ - Connect test box V.A.G 1598/31 to control unit wiring harness. The engine control unit remains disconnected.



◄ - Check wiring between test box and connector for open circuit according to current flow diagram.
  Contact 7+ socket 111
  Contact 4+ socket 103
  Wire resistance: max. 1.5 Ω

- Additionally check wires for short to one another, to battery/vehicle earth and to battery positive.
  Specification: ∞Ω

If no fault is detected in the wiring:

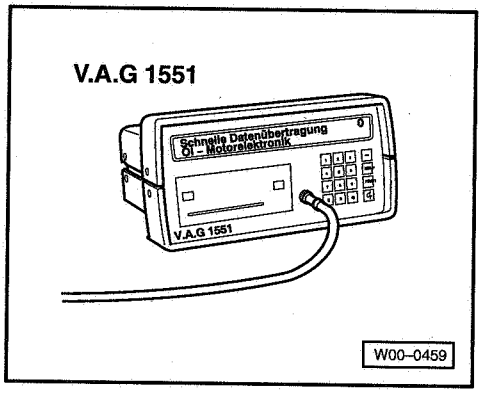
- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.

Checking modulating piston movement sender and quantity adjuster

Function

The quantity adjuster is an electromagnetic swivelling positioner which is controlled by the control unit via a directed duty cycle (on-off ratio). The eccentric shaft on the quantity adjuster moves the modulating piston on the high pressure piston and thereby regulates the quantity of fuel injected.

The modulating piston movement sender informs the control unit of the position of quantity adjuster -N146 and therefore stipulates the amount injected.



Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3

Note:

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051.

♦ Hand multimeter V.A.G 1526 or multimeter V.A.G 1715

♦ Adapter set V.A.G 1594

♦ Test box V.A.G 1598/31

♦ Current flow diagram

Test sequence

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Rapid data transfer HELP
Select function XXX

◄ Indicated on display:

- Press keys 0 and 8 for the function "Read measured value block" and confirm entry with Q key.

Read measured value block
Input display group number XXX

◄ Indicated on display:

- Press keys 0, 0 and 1 for "Display group number 1" and confirm entry with Q key.

Read measured value block 1 →			
xxxx rpm	xxx.x mg/H	1.480 V	87.3 °C

◄ Indicated on display:

- Check coolant temperature in display zone 4.
  Specification: at least 80 °C

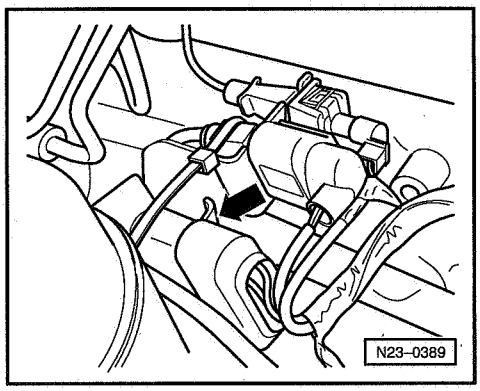
Continue with check only when coolant temperature is attained.

Read measured value block 1 →			
xxxx rpm	xxx.x mg/H	1.480 V	87.3 °C

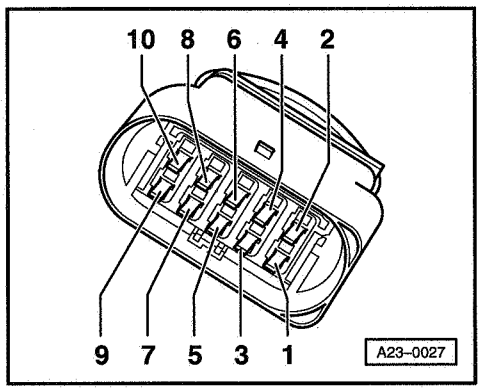
◄

- Check voltage for modulating piston movement in display zone 3:
  Engine code AVM
  Specification: 1.450...1.950 V
  Engine codes ARD and BEQ
  Specification: 1.600...2.100 V
- Press the → key.
- Press keys 0 and 6 for the "End output" function and confirm input with the Q key.
- Switch off ignition.
- If specification is not obtained, check modulating piston movement sender and quantity adjuster as described in following:

Checking modulating piston movement sender (G149).



◄ - Disconnect 10-pin connector for modulating piston movement sender (connection to injection pump metering control).

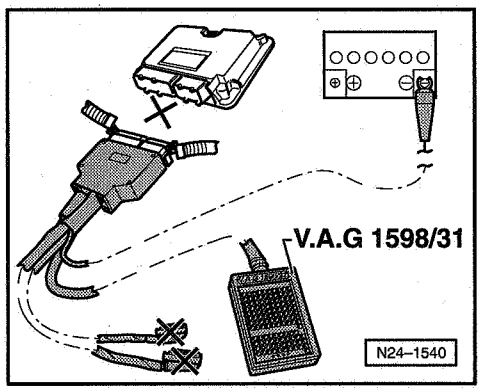


◄ - Measure resistance between contacts 1 + 2 and 2 + 3 of sender.
Specification: 4.9 ... 7.5 Ω

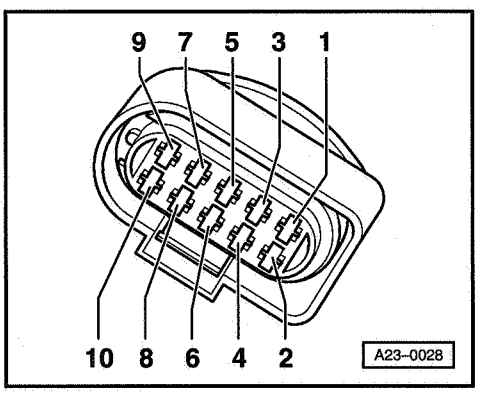
If the specification is not obtained:

- Renew injection pump ⇒ Page 23-28, Removing and installing injection pump.
- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

If the specification is obtained:



◄ - Connect test box V.A.G 1598/31 to control unit wiring harness. The engine control unit remains disconnected.

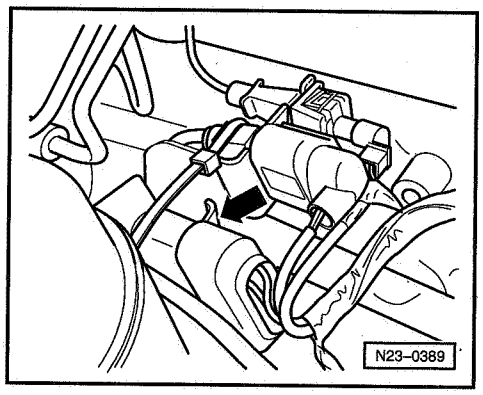


◄ - Check wiring between test box and connector for open circuit according to current flow diagram.
Contact 1+ socket 108
Contact 2+ socket 106
Contact 3+ socket 99
Wire resistance: max. 1.5 Ω

- Additionally check wires for short to one another, to battery/vehicle earth and to battery positive.
Specification: ∞Ω

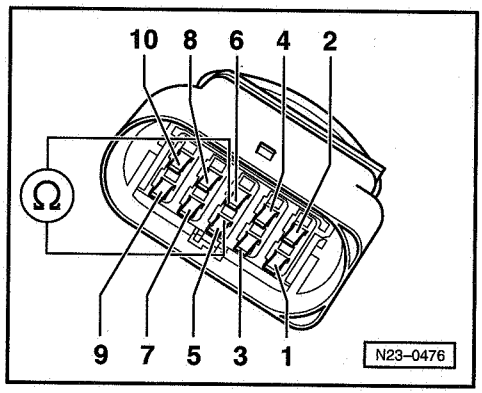
If no fault is detected in the wiring:

- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.



Checking quantity adjuster (N146)

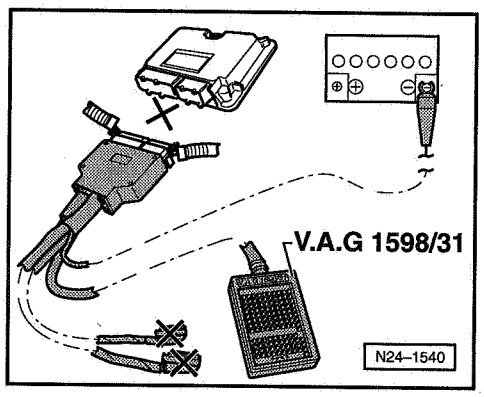
◄ - Disconnect 10-pin connector (connection to injection pump metering control).



◄ - Measure resistance between contacts 5+6 of quantity adjusters.
Specification: 0.5...2.5 Ω

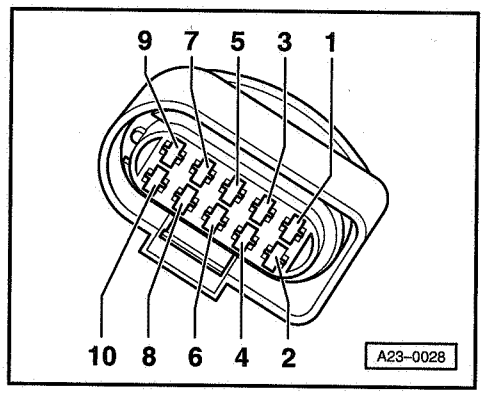
If the specification is not obtained:

- Renew injection pump ⇒ Page 23-28, Removing and installing injection pump.
- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.



If the specification is obtained:

◄ - Connect test box V.A.G 1598/31 to control unit wiring harness. The engine control unit remains disconnected.



◄ - Check wiring between test box and 10-pin connector for open circuit using current flow diagram.
Contact 5+Socket 1
Contact 5+Socket 2
Contact 6+Socket 116
Contact 6+Socket 121
Wire resistance: max. 1.5 Ω

- Additionally check wires for short to one another, to battery/vehicle earth and to battery positive.
Specification: ∞Ω

If no fault is detected in the wiring:

- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.

Checking needle lift sender

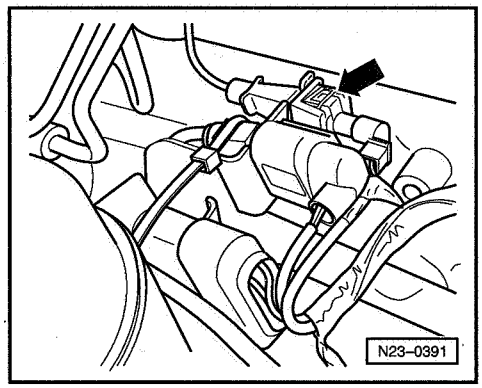
Function

The needle lift sender signal is used to determine the commencement of injection. If it fails the commencement of injection switches to open-loop control (according to engine speed and engine load). During normal operation the commencement of injection is controlled by a closed-loop function (according to engine speed, engine load and temperature).

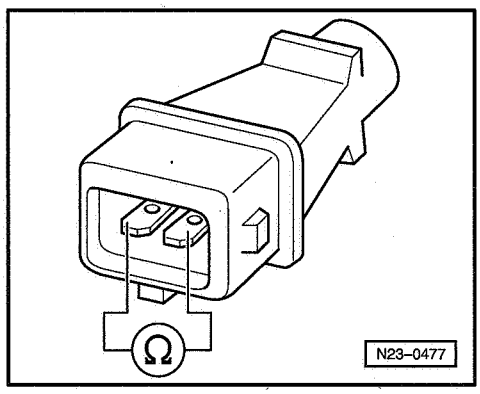
Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

- ♦ Hand multimeter V.A.G 1526 or multimeter V.A.G 1715
- ♦ Adapter set V.A.G 1594
- ♦ Test box V.A.G 1598/31
- ♦ Current flow diagram

Test sequence



- Disconnect 2-pin connector for needle lift sender (G80) -arrow-.

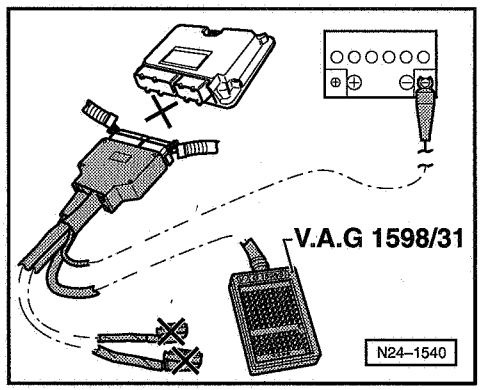


◄ - Measure resistance between connector contacts.
Specification: 80...120 Ω

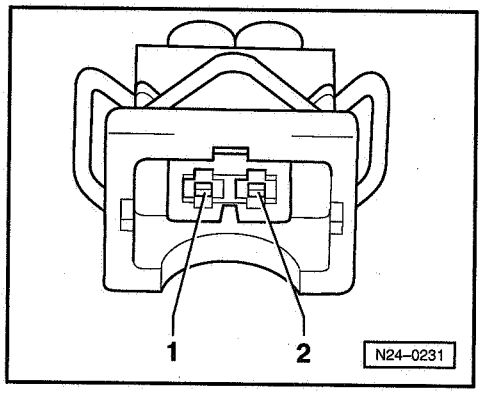
If the specification is not obtained:

- Replace No. 3 cylinder injector with needle lift sender (G80) ⇒ page 23-42, Removing and installing injector.
- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

If the specification is obtained:



◄ - Connect test box V.A.G 1598/31 to control unit wiring harness. The engine control unit remains disconnected.

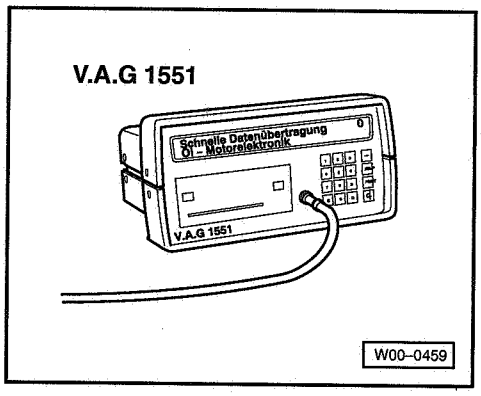


- Check wiring between test box and connector for open circuit according to current flow diagram.
  Contact 1+ socket 109
  Contact 2+ socket 101
  Wire resistance: max. 1.5 Ω

- Additionally check wires for short to one another, to battery/vehicle earth and to battery positive.
  Specification: ∞Ω

If no fault is detected in the wiring:

- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.



Checking injection timing control range

Checking the function of the injection timing control regulating range is undertaken in function 04 (Basic settings). Using this procedure the injection commencement valve is pulsed so that the extreme values for advanced (early) and retarded (late) positions for the timing control can be read in measured value block 004, display zone 3.

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3

Note:

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051.

♦ Hand multimeter V.A.G 1526 or multimeter V.A.G 1715

♦ Adapter set V.A.G 1594

♦ Test box V.A.G 1598/31

♦ Current flow diagram

Check conditions

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

Test sequence

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Rapid data transfer	HELP
Select function XXX	

◄ Indicated on display:

- Press keys 0 and 4 for the function "Introduction of basic setting" and confirm entry with Q key.

Basic setting
Input display group number XXX

◄ Indicated on display:

- Press keys 0, 0 and 4 for "Display group number 4" and confirm entry with Q key.

System in basic setting	4	→
xxxx rpm	advanced 7.9° BTDC	xx %

◄ Indicated on display:

Specification in display zone 3:
advanced 7.0...9.0° BTDC

After approx. 10 seconds the timing device is moved to the retarded position.

System in basic setting	4	→
xxxx rpm	retarded 3.9° BTDC	xx %

◄ Indicated on display:

Specification in display zone 3:
retarded 3.0...5.0° BTDC

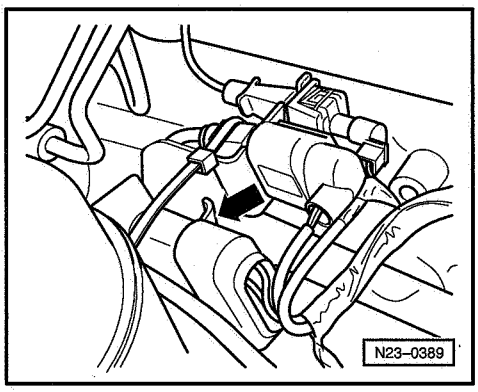
- Press the → key.

- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.

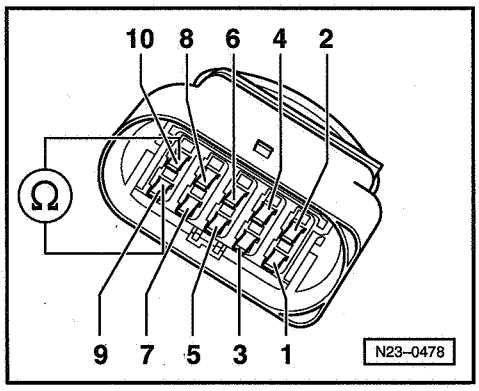
- Switch off ignition.

If the specifications are not obtained:

- Check commencement of injection valve as follows:



◄ - Disconnect 10-pin connector for commencement of injection valve (connection to injection pump metering control).

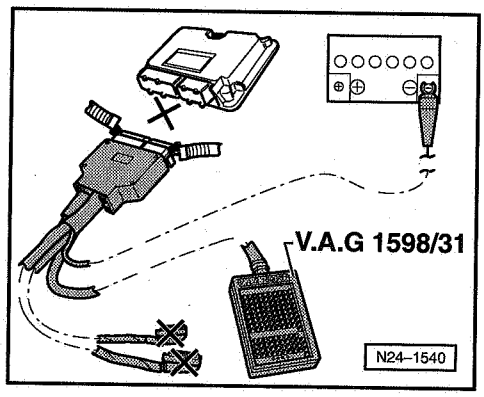


◄ - Measure resistance between contacts 9+10 of commencement of injection valve.
Specification: 12...20 Ω

If the specification is not obtained:

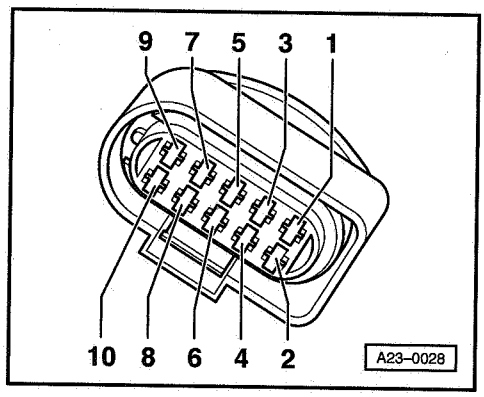
- Renew commencement of injection valve (N108)
⇒ page 23-24, item 19.

- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.



If the specification is obtained:

◄ - Connect test box V.A.G 1598/31 to control unit wiring harness. The engine control unit remains disconnected.



◄ - Check wiring between test box and 10-pin connector for open circuit using current flow diagram.
  Contact 9 + socket 114
  Contact 10 + socket 1
  Contact 10 + socket 2
  Wire resistance: max. 1.5 Ω

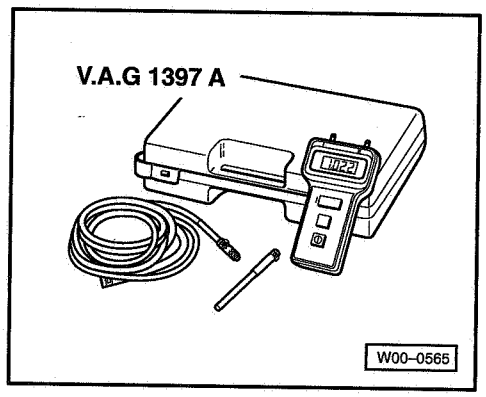
- Additionally check wires for short to one another, to battery/vehicle earth and to battery positive.
  Specification: ∞Ω

If no fault is detected in the wiring:

- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.

Checking intake manifold pressure sender and altitude sender (engine code AVM)

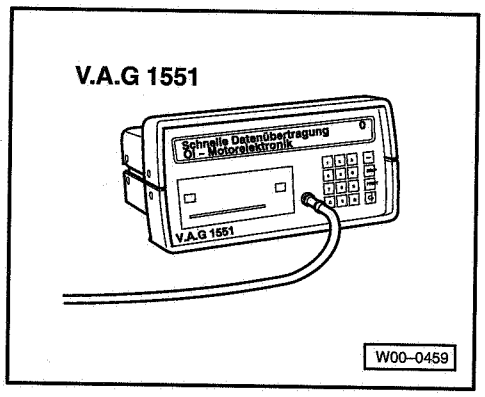
Function



The altitude sender is located in the Diesel direct injection system control unit. The intake manifold pressure sender is a separate component and is located together with the intake manifold temperature sender in a housing on charge air cooler.

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

♦ V.A.G 1397 A Turbocharger tester



♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3

Note:

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051.

♦ Hand multimeter V.A.G 1526 or multimeter V.A.G 1715

♦ Adapter set V.A.G 1594

♦ Test box V.A.G 1598/31

♦ Current flow diagram

Test sequence

- Connect the fault reader V.A.G 1551 (V.A.G 1552) and with ignition switched on select engine electronics control unit with the "Address word" 01.

  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Rapid data transfer HELP Select function XXX

◄ Indicated on display:

- Press keys 0 and 8 for the function "Read measured value block" and confirm entry with Q key.

Read measured value block Input display group number XXX

◄ Indicated on display:

- Press keys 0, 1 and 0 for "Display group number 10" and confirm entry with Q key.

Read measured value block 10 → xxx mg/H 1027 mbar 1013 mbar x.x %

◄
- Compare display in zone 2 (altitude sender -F96) with display in zone 3 (intake manifold pressure sender -G71) and display on turbocharger tester V.A.G 1397/A with one another.
  Specification: The pressures must be the same (tolerance ± 30 mbar)

Note:

The turbocharger test unit is required to provide an independent figure for comparison. The turbocharger test unit must be set to measuring range I (absolute pressure). A barometer can be used instead.

If value in display zone 2 deviates:

- Press the → key.
- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.
- Switch off ignition.
- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.

Value in display zone 3 deviates:

- Press the → key.
- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.
- Start engine and select function 08 "Read measured value block" again.

Read measured value block Input display group number XXX

◄ Indicated on display:

- Press keys 0, 1 and 0 for "Display group number 10" and confirm entry with Q key.

- Pull 4-pin connector -arrow- off intake manifold pressure sender (G71) with intake manifold pressure sender (G72) ⇒ page 23-5, Fitting locations overview.

- Observe figures in display zone 3 (intake manifold pressure sender).

Read measured value block 10	→
xxx mg/H 1009mbar 1009 mbar	x.x %

◄ - It must fall briefly to about 400 mbar and then assume the same value as the altitude sender (display zone 2).

- Press the → key.

- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.

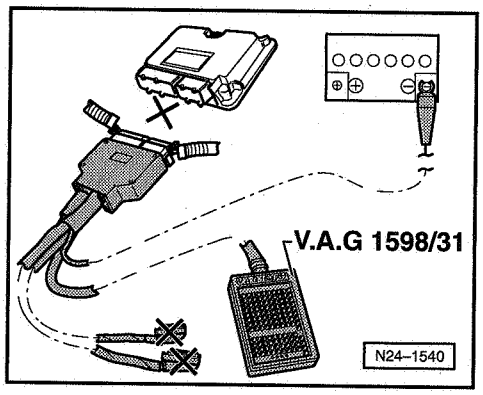
- Switch off ignition.

If the specification is obtained:

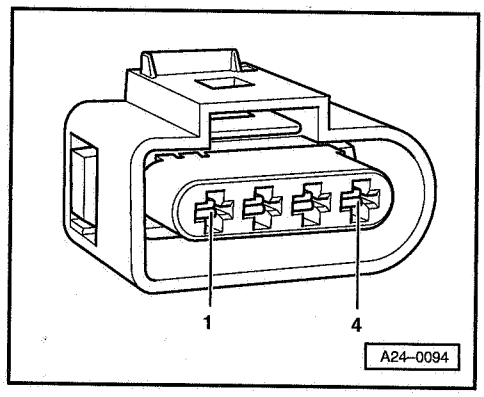
- Renew intake manifold pressure sender (G71) with intake manifold temperature sender (G72).

- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

If the specification is not obtained:



◄ - Connect test box V.A.G 1598/31 to control unit wiring harness. The engine control unit remains disconnected.



◄ - Check wiring between test box and connector for open circuit using current flow diagram.
  Contact 3+ socket 31
  Contact 4+ socket 71
  Wire resistance: max. 1.5 Ω

- Additionally check wires for short to one another, to battery/vehicle earth and to battery positive.
  Specification: ∞Ω

If no fault is detected in the wiring:

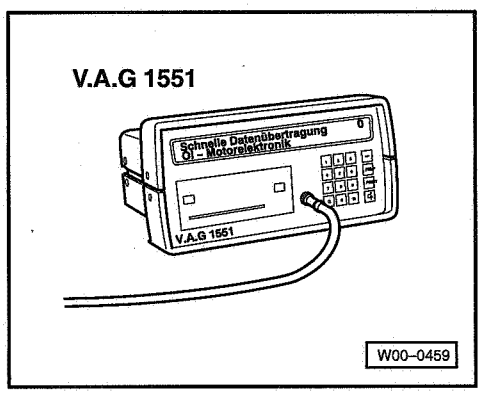
- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.

Checking air mass meter (engine code AVM)

Function

The air mass meter signal is used by the 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.

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3

Note:

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051.

- ♦ Hand multimeter V.A.G 1526 or multimeter V.A.G 1715
- ♦ Adapter set V.A.G 1594
- ♦ Test box V.A.G 1598/31
- ♦ Current flow diagram

Check conditions

- The 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
  ⇒ Page 01-11, interrogating fault memory

Test sequence

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Rapid data transfer HELP
Select function XXX

◄ Indicated on display:

- Press keys 0 and 8 for the function "Read measured value block" and confirm entry with Q key.

Read measured value block
Input display group number XXX

◄ Indicated on display:

- Press keys 0, 1 and 0 for "Display group number 10" and confirm entry with Q key.

Read measured value block 10 →
400 mg/H xxxx mbar xxxx mbar xxx.x %

◄ Indicated on display:

- Check mass of air drawn in display zone 1.
  Specification: 360...480 mg/H

If the specification is not obtained:

- Check the exhaust gas recirculation system ⇒ page 26-7.

If the specification is obtained:

- Increase engine speed, under full load, from approx. 1500 rpm using full throttle (accelerator position sender on full throttle stop).

Note:

The brake pedal must not be operated whilst taking measurements. Otherwise the control unit reduces the fuel quantity which leads to incorrect measurements.

- Press PRINT key on V.A.G 1551 at approx. 2500 rpm.

Read measured value block 10 →
xxx mg/H xxxx mbar xxxx mbar 100.0 %

◄ Indicated on display:

- Check specification from accelerator pedal position sender in display zone 4.
  Specification: 100.0 %

If the specification is not obtained:

- Check accelerator pedal position sender (G79) ⇒ page 20-7.

If the specification is obtained:

- Repeat test and accelerate at full load to approx. 1500 rpm.

Note:

The brake pedal must not be operated whilst taking measurements. Otherwise the control unit reduces the fuel quantity which leads to incorrect measurements.

- Press PRINT key on V.A.G 1551 at approx. 2500 rpm.

Read measured value block 10 →
830 mg/H xxxx mbar xxxx mbar 100.0 %

◄ Indicated on display:

- Check specification from air mass meter (amount of drawn air) in display zone 1.
  Specification: 700...850 mg/H

- Press the → key.

- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.

- Switch off ignition.

If the specification is not obtained:

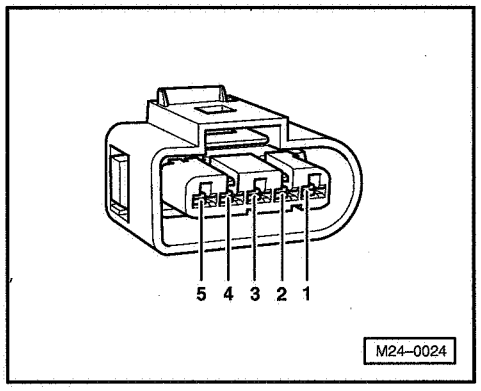
- Renew air mass meter (G70).

- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

If a constant 550 mg/H (predetermined replacement value) is displayed in display zone 1.

- Pull 5-pin connector off air mass meter (G70) ⇒ page 23-5, Fitting locations overview.

- Switch on ignition.

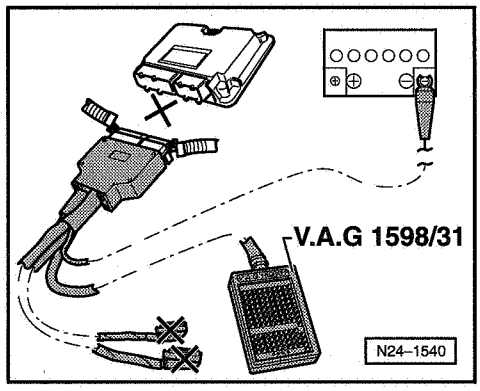


◄ - Measure air mass meter voltage supply between following connector contacts:

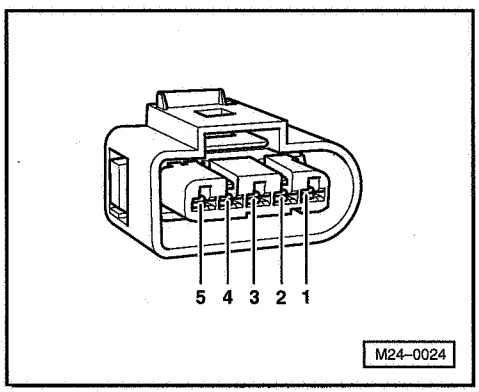
Connector on -G70 contact:	Specification
2 + earth	About battery voltage
2 + 3	App. battery voltage
4 + earth	Approx. 5 V
4 + 3	Approx. 5 V

- Switch off ignition.

If the specifications are not obtained:



◄ - Connect test box V.A.G 1598/31 to control unit wiring harness. The engine control unit remains disconnected.

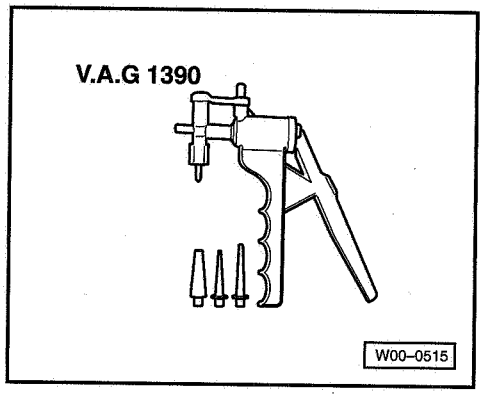


◄ - Check wiring between test box and connector for open circuit using current flow diagram.
  Contact 2 + socket 1
  Contact 2 + socket 2
  Contact 3 + socket 49
  Contact 4 + socket 30
  Contact 5 + socket 68
  Wire resistance: max. 1.5 Ω

- Additionally check wires for short to one another, to battery/vehicle earth and to battery positive.
  Specification: ∞Ω

If no fault is detected in the wiring:

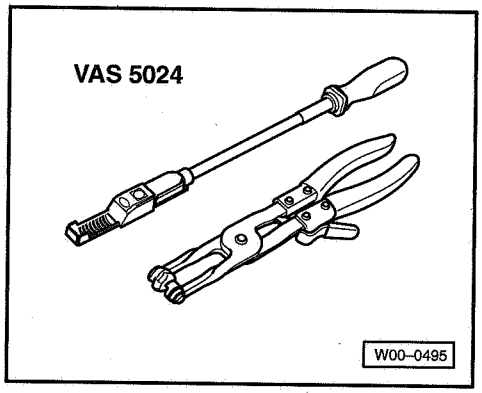
- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.



Checking intake manifold flap change-over (engine code AVM)

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

♦ Hand vacuum pump V.A.G 1390



♦ VAS 5024 Assembly tool for spring-type clips

Checking function

The intake manifold flap closes for about 3 seconds when the engine is shut off and then opens again in order to reduce the stop jolt.

- Remove connecting hose between charge air cooler and air intake connecting piece at air intake connecting piece.
- Start engine and run at idling speed.
- Switch off ignition.
- Observe position of intake manifold flap (2nd person required).

The intake manifold flap must close after the ignition is switched

off and open again after about 3 seconds.

If change-over does not occur, the following checks must be carried out.

- Check intake manifold flap change-over mechanics for freedom of movement. To do this operate rods by hand.
- Check function of vacuum positioning element with hand vacuum pump V.A.G 1390.
- Check vacuum pipes for correct connection ⇒ page 26-5, Vacuum hose connection diagram.

If no fault is found in the mechanical components:

- Check intake manifold flap change-over valve ⇒ Page 23-95.

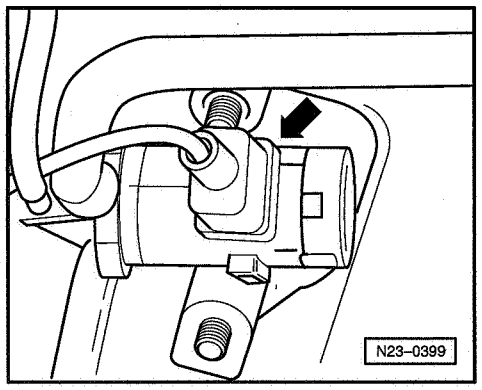
Checking intake manifold flap change-over valve (engine code AVM)

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

- ♦ Hand multimeter V.A.G 1526 or multimeter V.A.G 1715
- ♦ Adapter set V.A.G 1594
- ♦ Test box V.A.G 1598/31
- ♦ Current flow diagram

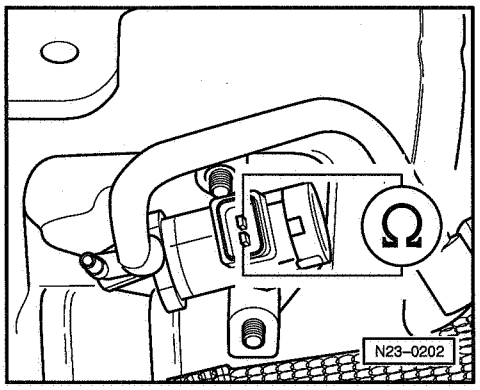
Check conditions

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



Test sequence

- Pull 2-pin connector off intake manifold flap change-over valve (N239) -arrow-.



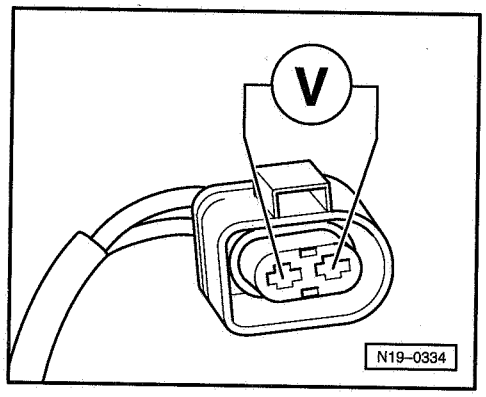
◄ - Measure resistance between change-over valve contacts:
Specification: 25.0 ... 45.0 Ω

Note:

At room temperature the resistance lies in the the lower tolerance region and at operating temperature in upper tolerance region.

If the specification is not obtained:

- Renew intake manifold flap change-over valve (N239)⇒ page 23-18, item 12.



- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

If the specification is obtained:

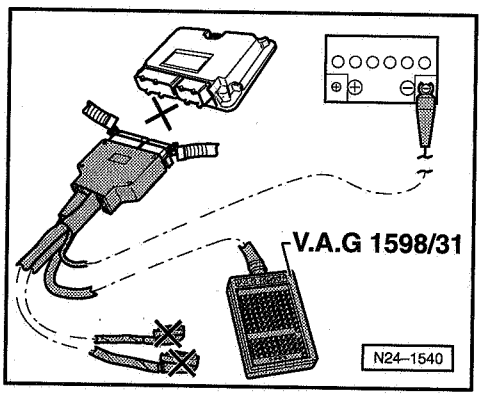
◄ - Set multimeter to measure voltage and connect to contacts 1 and 2 of disconnected connector from intake manifold flap change-over valve.

- Start engine and run at idling speed.
  Specification: Approx. battery voltage

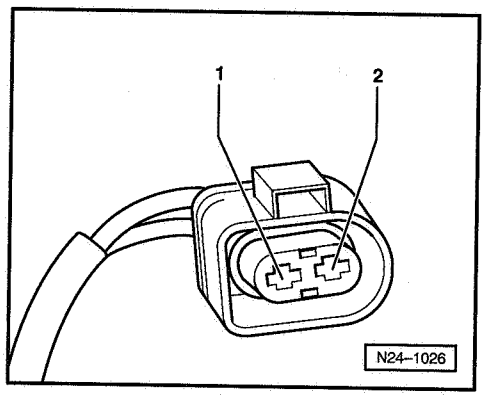
- Switch off ignition. Value for voltage must drop to

  0.0 V after about 3 seconds.

If the voltage values do not change as described:



◄ - Connect test box V.A.G 1598/31 to control unit wiring harness. The engine control unit remains disconnected.



◄ - Check wiring between test box and connector for open circuit using current flow diagram.
  Contact 1 + socket 1
  Contact 1 + socket 2
  Contact 2 + socket 81
  Wire resistance: max. 1.5 Ω

- Additionally check wires for short to one another, to battery/vehicle earth and to battery positive.
  Specification: ∞Ω

If no fault is detected in the wiring:

- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.

Checking intake manifold flap motor (engine code BEQ)

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

♦ Hand multimeter V.A.G 1526 or multimeter V.A.G 1715

♦ Adapter set V.A.G 1594

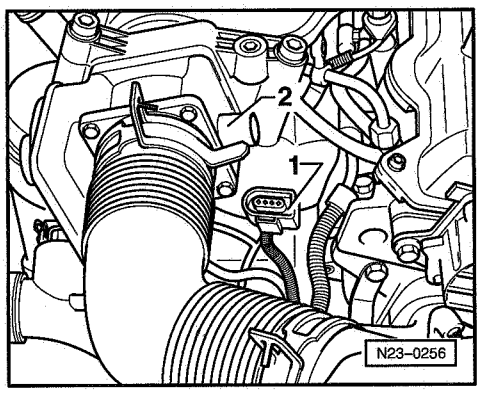
♦ Test box V.A.G 1598/31

♦ Current flow diagram

Check conditions

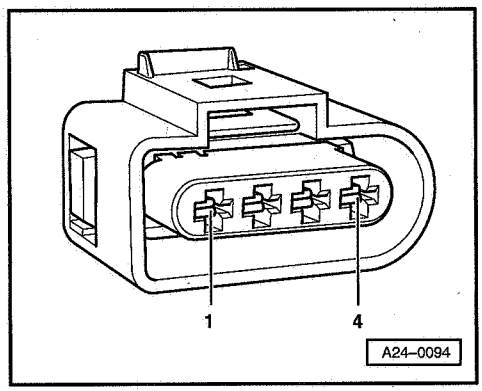
- The fuses must be OK.
- The battery voltage must be at least 11.5 V.
- Earth connections OK.
- All electrical consumers must be switched off.

Test sequence



◄ - Pull connector -1- off intake manifold flap motor -2-.

- Switch on ignition.

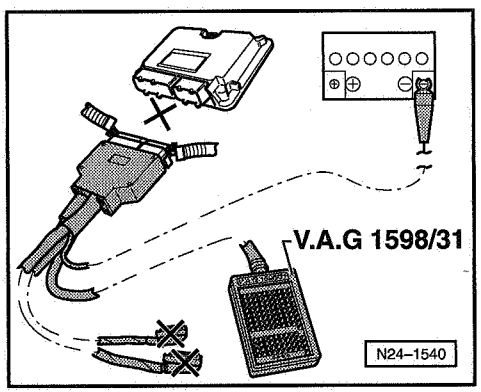


◄ - Measure intake manifold flap motor voltage supply between following connector contacts:

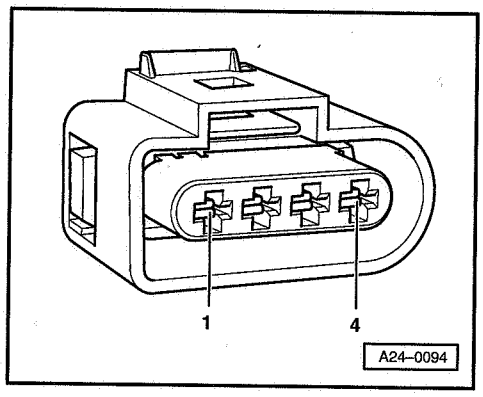
Connector on V157 contact:	Specification
4 + earth	App. battery voltage
4 + 1	App. battery voltage

- Switch off ignition.

If the specifications are not obtained:



◄ - Connect test box V.A.G 1598/31 to control unit wiring harness. The engine control unit remains disconnected.



◄ - Check wiring between test box and connector for open circuit using current flow diagram.
  Contact 1+ socket 4
  Contact 1+ socket 5
  Contact 2+ socket 81
  Contact 3+ socket 75
  Contact 4+ socket 1
  Contact 4+ socket 2
  Wire resistance: max. 1.5 Ω

- Additionally check wires for short to one another, to battery/vehicle earth and to battery positive.
  Specification: ∞Ω

If no fault is detected in the wiring:

- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.

Checking additional signals

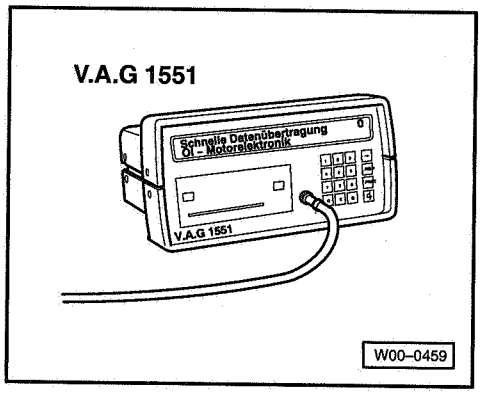
Checking speed signal for working speed governor

Note:

Due to the various installation possibilities of industrial engines, the following is designed to give just general information on checking.

The cruise control system (CCS) function in the Diesel direct injection system control unit is used for the working speed governor (WSG). The engine speed signal from the engine speed sender (G28) is used as a replacement signal for the speed signal.

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3

Note:

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051.

♦ Hand multimeter V.A.G 1526 or multimeter V.A.G 1715

♦ Adapter set V.A.G 1594

♦ Test box V.A.G 1598/31

♦ Current flow diagram

Check conditions

- The fuses must be OK.
- The battery voltage must be at least 11.5 V.
- Earth connections OK.
- All electrical consumers must be switched off.
- Engine speed sender (G28) OK., checking ⇒ page 23-50.

Test sequence

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Rapid data transfer	HELP
Select function XXX	

◄ Indicated on display:

- Press keys 0 and 8 for the function "Read measured value block" and confirm entry with Q key.

Read measured value block
Input display group number XXX

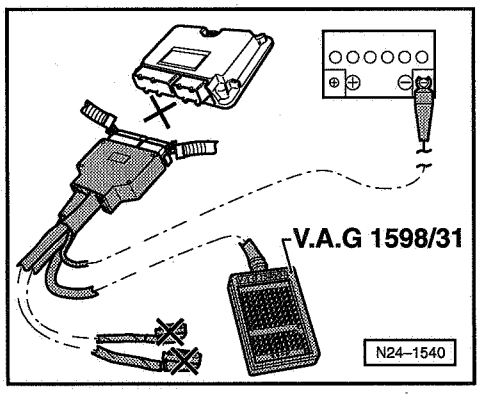
◄ Indicated on display:

- Press keys 0, 0 and 6 for "Display group number 6" and confirm entry with Q key.

Read measured value block 6			→
57 km/h	xxx	xxxxxx	xxx

◄
- Check speed signal in display zone 1:
  Specification: 50...70 km/h
- Press the → key.
- Press keys 0 and 6 for the "End output" function and confirm input with the Q key.
- Switch off ignition.

If the specification is not obtained:



◄
- Connect test box V.A.G 1598/31 to control unit wiring harness. The engine control unit remains disconnected.
- Check wiring/connections to engine control unit for open/short circuit using current flow diagram ⇒ Page 27-20.

If no fault is detected in the wiring:

- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.

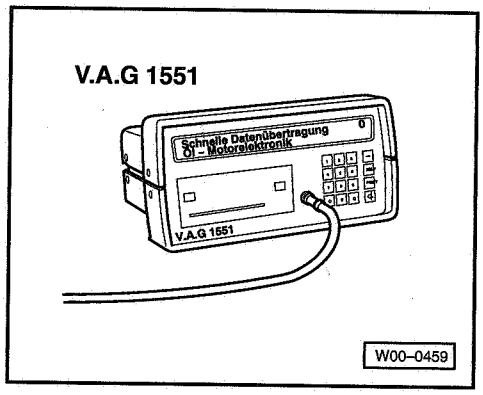
Checking working speed governor (WSG)

Note:

Due to the various installation possibilities of industrial engines, the following is designed to give just general information on checking.

The cruise control system (CCS) function in the Diesel direct injection system control unit is used for the working speed governor (WSG). The engine speed signal from the engine speed sender (G28) is used as a replacement signal for the speed signal.

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3

Note:

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051.

Check conditions

- The fuses must be OK.
- The battery voltage must be at least 11.5 V.

- Earth connections OK.
- All electrical consumers must be switched off.

Test sequence

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Rapid data transfer	HELP
Select function XXX	

◄ Indicated on display:

- Press keys 0 and 8 for the function "Read measured value block" and confirm entry with Q key.

Read measured value block
Input display group number XXX

◄ Indicated on display:

- Press keys 0, 0 and 6 for "Display group number 6" and confirm entry with Q key.

Read measured value block 6			→
57 km/h	xxx	xxxxxx	xxx

◄ - Check speed signal in display zone 1:
  Specification: 50...70 km/h

If the specification is not obtained:

- Checking speed signal for working speed governor ⇒ 23-102.

If the specification is obtained:

Read measured value block 6			→
57 km/h	x00	xxxxxx	0

◄ - Check display value in display zone 4.
Specification: 0

If the value 255 is displayed in display zone 4:

- Check engine control unit coding ⇒ Page 23-117.

If the specification is obtained:

Read measured value block 6			→
57 km/h	x00	xxxxxx	0

◄ - Check display value in display zone 2.
Specification: x00

- Press the → key.

- Press keys 0 and 6 for the "End output" function and confirm input with the Q key.

- Switch off ignition.

If the specification is not obtained:

- Check brake light switch and brake pedal switch ⇒ page 23-109.

Checking engine speed signal

Note:

Due to the various installation possibilities of industrial engines, the following is designed to give just general information on checking.

Function

The engine speed sender signal cannot be used further in its direct form, therefore it is processed by the engine control unit for further consumers. The signal is required, among other things for the rev counter in the dash panel.

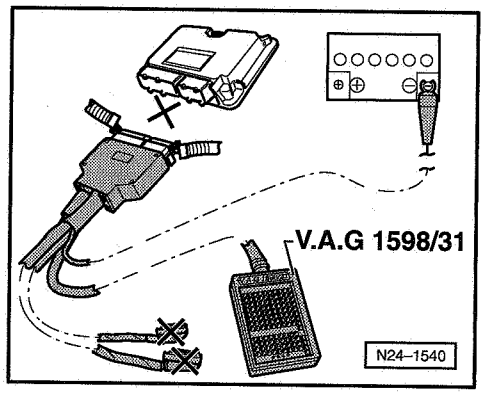
Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

♦ Hand multimeter V.A.G 1526 or multimeter V.A.G 1715

♦ Adapter set V.A.G 1594

♦ Test box V.A.G 1598/31

♦ Current flow diagram



Test sequence

- Connect test box V.A.G 1598/31 to control unit wiring harness. The engine control unit remains disconnected.

- Test for open circuit in wiring between dash panel insert and contact 27 on the test box using current flow diagram ⇒ page 27-20.

Checking brake light switch and brake pedal switch

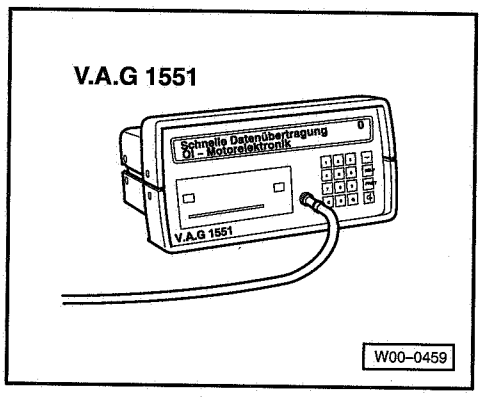
Note:

Due to the various installation possibilities of industrial engines, the following is designed to give just general information on checking.

Function

Because the injection system operates with an accelerator pedal sender (potentiometer) which may be defective, the engine is regulated for reasons of safety when the brakes are operated. To do this the control unit requires signals from the brake light switch and also the brake pedal switch. This means that if the brakes are operated when the accelerator pedal is held at a constant position the engine is immediately reduced to idling speed. Incorrectly adjusted switches may lead to unrequired regulating action

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3

Note:

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051.

♦ Hand multimeter V.A.G 1526 or multimeter V.A.G 1715

♦ Adapter set V.A.G 1594

♦ Test box V.A.G 1598/31

♦ Current flow diagram

Check conditions

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

Test sequence

- Connect the fault reader V.A.G 1551 (V.A.G 1552) and with ignition switched on select engine electronics control unit with the "Address word" 01.

  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Rapid data transfer	HELP
Select function XXX	

◄ Indicated on display:

- Press keys 0 and 8 for the function "Read measured value block" and confirm entry with Q key.

Read measured value block
Input display group number XXX

◄ Indicated on display:

- Press keys 0, 0 and 6 for "Display group number 6" and confirm entry with Q key.

Read measured value block 6			→
xxx km/h	x00	xxxxxx	xxx

◄
- Check display values in display zone 2 (2nd + 3rd positions from the left):
  Specification: x00

  ♦ 2nd position from the left = Brake pedal switch

  ♦ 3rd position from the left = Brake light switch

Read measured value block 6			→
xxx km/h	x11	xxxxxx	xxx

◄
- Depress brake pedal and check display values in display zone 2.
  Specification: x11
- Release brake pedal slowly into rest position again.

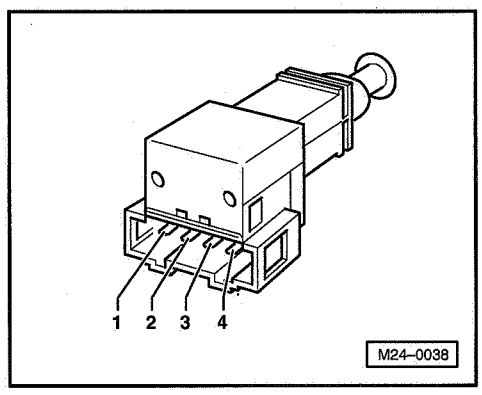
Read measured value block 6			→
xxx km/h	x00	xxxxxx	xxx

◄ Both displays must change from 1 to 0 again.
  Specification: x00
- Press the → key.
- Press keys 0 and 6 for the "End output" function and confirm input with the Q key.

- Switch off ignition.

If the specifications are not obtained:

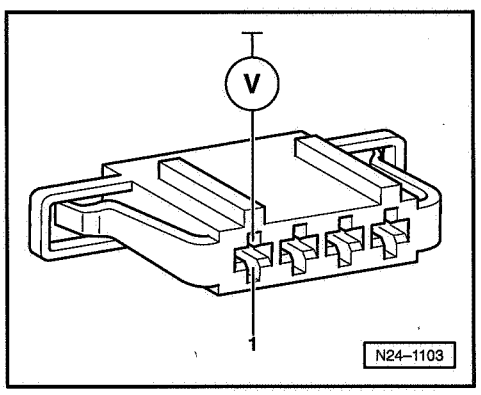
- Pull 4-pin connector off brake light switch and brake pedal switch.



◄
- Measure resistance between contacts 1+4 of the switch.
  Specification
  Brake pedal not depressed: ∞ Ω
  Brake pedal depressed: Max. 1.5 Ω
- Measure resistance between contacts 2+3 of the switch.
  Specification
  Brake pedal not depressed: Max. 1.5 Ω
  Brake pedal depressed: ∞ Ω

If the specifications are not obtained:

- Replace the brake light switch (F) and brake pedal switch (F47).
- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

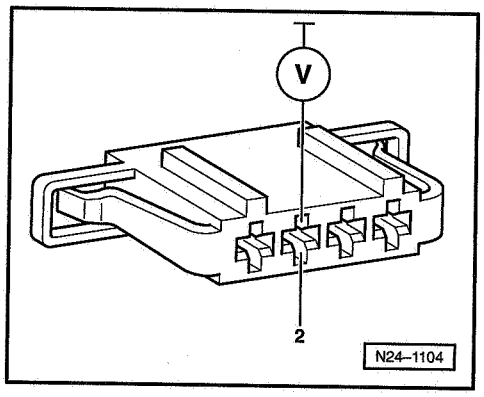


If the specifications are obtained:

◄
- Connect multimeter to measure voltage between contact 1 and earth.
  Specification: at least 11.5 V

If the specification is not attained:

- Check wiring connection to fuse carrier for open circuit using current flow diagram.
  Specification: max. 1.5 Ω



If the specification is obtained:

◄ - Connect multimeter to measure voltage between contact 2 and earth.

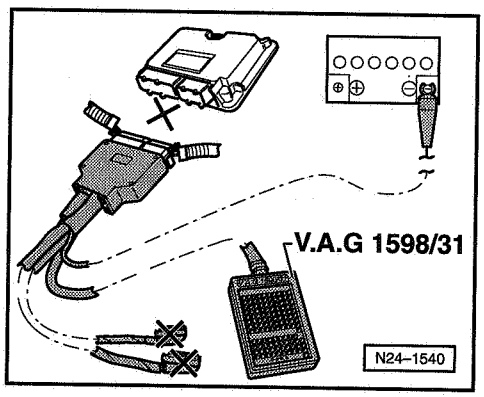
- Switch on ignition.
  Specification: min. 11.5 V

- Switch off ignition.

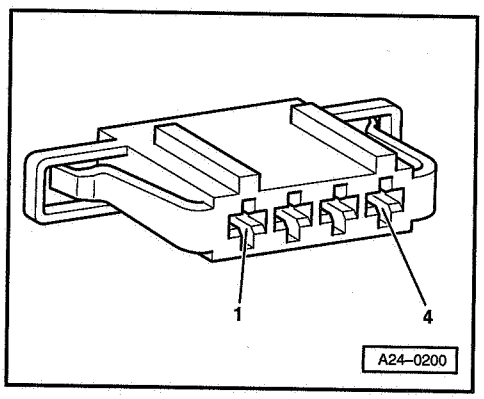
If the specification is not attained:

- Check wiring connection to fuse carrier for open circuit using current flow diagram.
  Specification: max. 1.5 Ω

If the specification is obtained:



◄ - Connect test box V.A.G 1598/31 to control unit wiring harness. The engine control unit remains disconnected.



◄ - Check wiring between test box and connector for open circuit using current flow diagram.
  Contact 3 + socket 4
  Contact 3 + socket 5
  Contact 4 + socket 65
  Wire resistance: max. 1.5 Ω

- Additionally check wires all for short to one another.
  Specification: ∞Ω

If no fault is detected in the wiring:

- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.

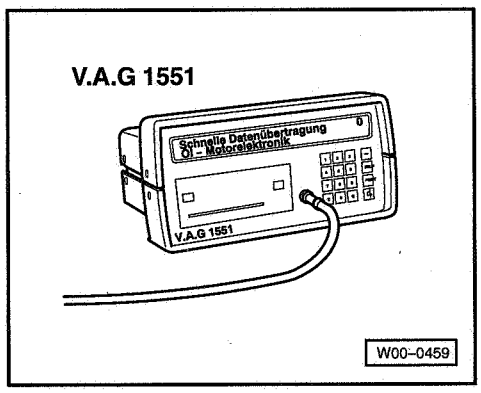
Engine control unit

Replacing engine control unit

Note:

As the diesel direct injection system control unit (J248) cannot be adapted to the immobilizer control unit (J334), both control units can only be renewed together.

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3

Note:

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051.

Work sequence

- First print out the control unit identification and thereby the previous control unit coding as follows:

- Connect the fault reader V.A.G 1551 (V.A.G 1552) and with ignition switched on select engine electronics control unit with the "Address word" 01.

  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

038906012EE 1.9 l R4 IMO A000SG 3303 →
Coding 00002 WSC xxxxx

◄ The control unit identification and coding are indicated on the display, e.g.:

- Print out the control unit identification by pressing the fault reader print button.
- Press the → key.
- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.
- Switch off ignition.
- Release connector from diesel direct injection system control unit (J248) and pull off.
- Pull off connector for immobilizer control unit (J334).
- Renew diesel direct injection system control unit (J248) only in conjunction with immobilizer control unit (J334).
- Install control unit connector and lock.
- Code diesel direct injection system control unit (J248) ⇒ page 23-117.

- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

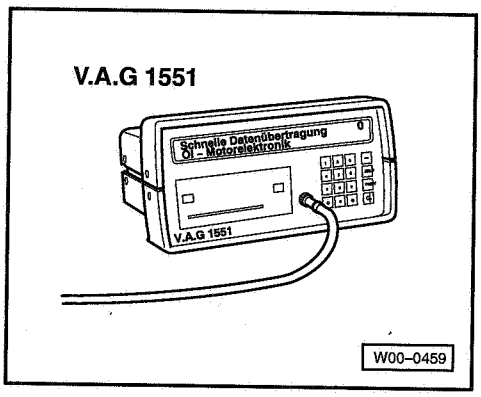
Coding engine control unit

Notes:

- *A 5-character code must always be displayed during the control unit identification.*
- *Various engine output data can be selected through the control unit coding ⇒ page 23-120, Engine control unit code variations.*
- *The control unit must be recoded if the vehicle relevant coding is not displayed or the control unit has been renewed.*

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

- Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3



Note:

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051.

Work sequence

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select engine electronics control unit with the "Address word" 01. When doing this the ignition must be switched on.
  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

- Press → key.

Rapid data transfer	HELP
Select function XXX	

◄ Indicated on display:

- Press keys 0 and 7 for the function "Code control unit" and confirm entry with Q key.

Coding control unit	Q
Enter code number XXXXX	(0-32000)

◄ Indicated on display:

- Enter the appropriate code number for this vehicle and confirm with Q key.

  Coding variations for engine control unit ⇒ Page 23-120.

038906012EE 1.9 l R4 IMO A000SG 3303 →	
Coding 00002	WSC xxxxx

◄ The control unit identification and coding are indicated on the display, e.g.:

- Switch ignition off for at least 10 seconds.
- Switch on ignition.

Note:

The coding entered will be activated by switching the ignition off and then on again. If after entering the valid code the ignition is not switched off and on again, the fault "Control unit incorrectly coded" in the fault memory cannot be erased.

- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

Engine control unit code variations

Data set[1)]	Control unit code
1	00001
2	00002
3	00003
4	00004
5	00005
6	00006
7	00007

[1)] The relevant data set for the engine control unit coding can be found in the:
⇒ Handbook for Volkswagen industrial engines with universal control unit

Checking data bus

Note:

Due to the various installation possibilities of industrial engines, the following is designed to give just general information on checking.

Function

The engine control unit communicates with other data bus-compatible control units via a CAN data bus.

These data bus-capable components are connected by a pair of twisted data bus wires (CAN high and CAN low) and exchange information (messages). Information missing from the data bus is recognised as an error and stored.

The data bus requires a matching resistor to function fault free. This central matching resistor is located in the engine control unit.

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

- ♦ Hand multimeter V.A.G 1526 or multimeter V.A.G 1715
- ♦ Adapter set V.A.G 1594
- ♦ Test box V.A.G 1598/31
- ♦ Current flow diagram

Test conditions

- A fault has been recognised by the CAN data bus self-diagnosis ⇒ page 01-11, Interrogating fault memory.

Test sequence

- Unlock the engine control unit connector and pull it off.
- Connect test box V.A.G 1598/31 to engine control unit. The control unit wiring harness is not connected by this action.

- Check end resistor in engine control unit.
- To do this perform a resistance measurement between the test box sockets
  Sockets 6 + 7:
  Specification: 60 ...72 Ω

If the resistance measurement is outside the specified range:

- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.

If the resistance value is within the specified range:

- Rectify fault in wiring and in other data bus components using current flow diagram ⇒ page 27-20.
- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

Removing and installing parts of exhaust system

Notes:

- *Due to the various installation possibilities for industrial engines the following work steps contain general notes.*
- *After working on the exhaust system ensure that the system is not under stress, and that it has sufficient clearance to the bodywork. If necessary, align silencer and exhaust pipe so that sufficient clearance is maintained to the bodywork and the supports are evenly loaded.*
- *Renew self-locking nuts.*

Engine code AVM

- Removing and installing exhaust manifold ⇒ page 21-1, Removing and installing turbo charger with attachments.

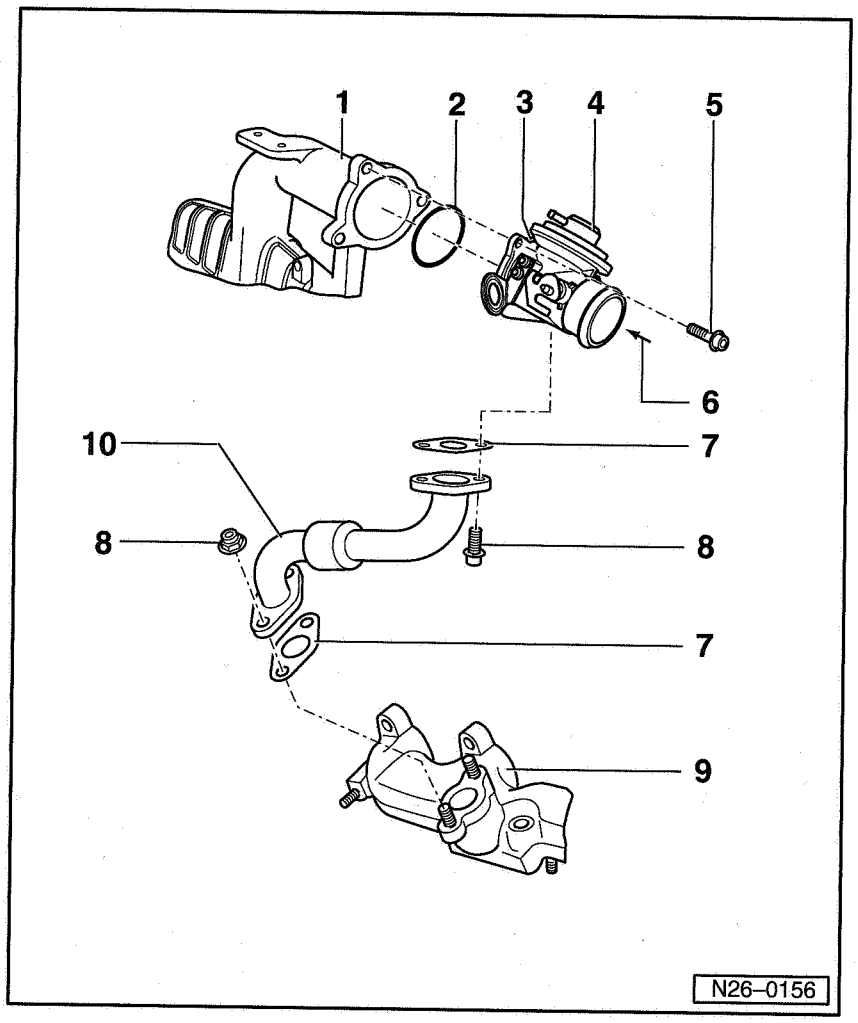
Exhaust gas recirculation system (engine code AVM)

Notes:

- *The control of the exhaust gas recirculation system is undertaken by diesel direct injection system control unit (J248) via EGR valve (N18) (electric) to 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 makes every conceivable valve position possible.*
- *Renew self-locking nuts.*

Observe safety precautions ⇒ Page 23-2.

Observe rules for cleanliness ⇒ Page 23-4.



Removing and installing parts of exhaust gas recirculation system

1 - Intake manifold

2 - O-ring
- ♦ Renew

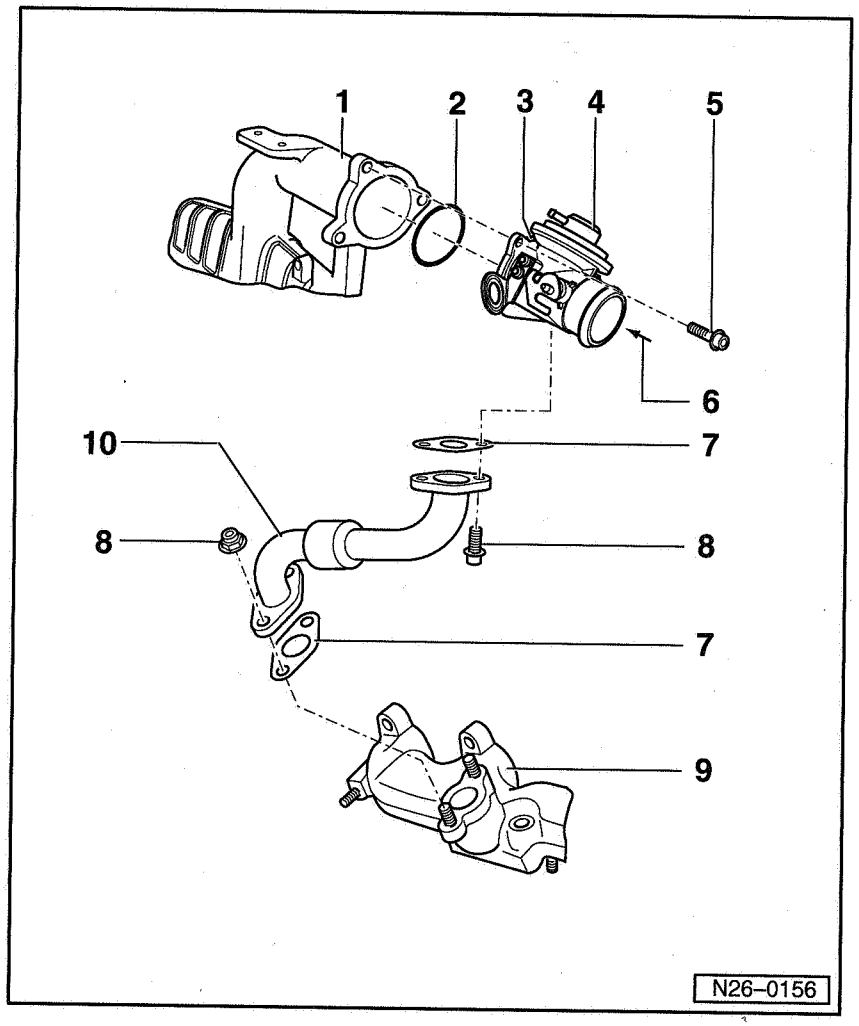
3 - Air intake connecting piece
- ♦ With exhaust gas recirculation valve and intake manifold flap
- ♦ Only renew complete
- ♦ Checking intake manifold flap change-over ⇒ Page 23-93

4 - Exhaust gas recirculation valve (mechanical)
- ♦ Part of intake connecting flange
- ♦ Can only be replaced together with intake connecting flange
- ♦ Checking ⇒ Page 26-7

5 - 10 Nm

6 - From charge air cooler

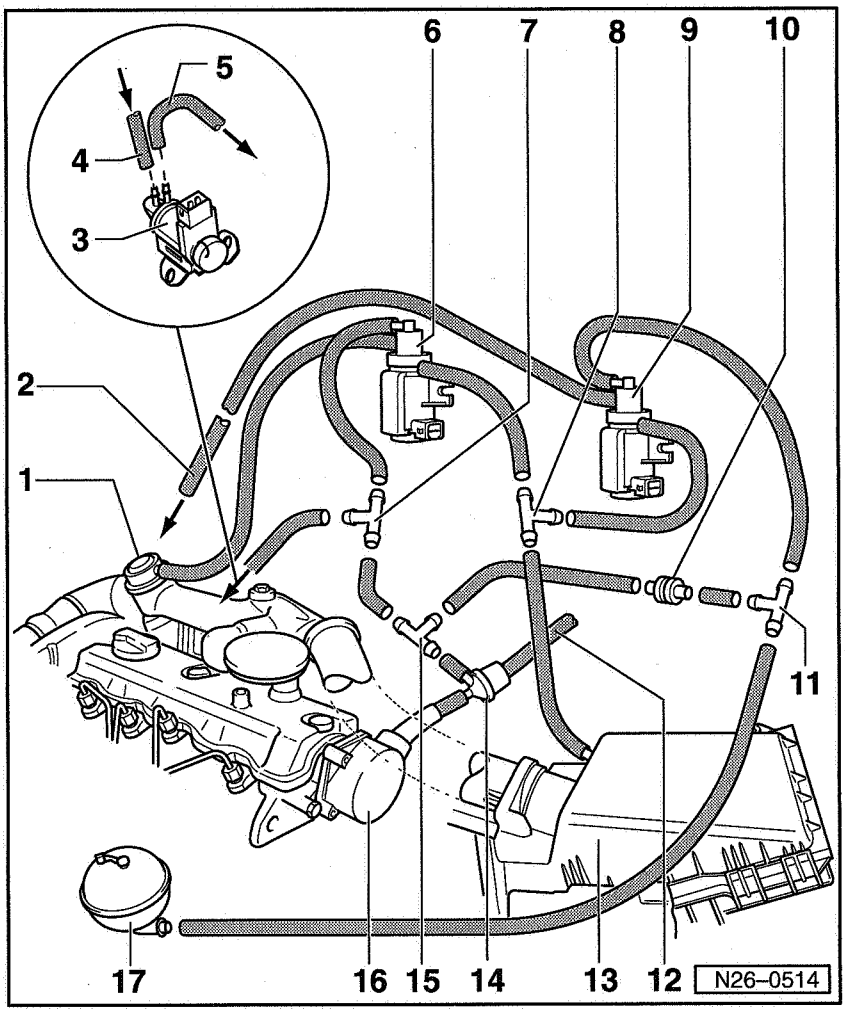
7 - Gasket
- ♦ Renew



8 - 22 Nm
- ♦ Renew

9 - Exhaust manifold

10 - Connecting pipe



Vacuum hose connection diagram

1 - Exhaust gas recirculation valve

2 - Vacuum hose
- ♦ To vacuum unit for charge pressure control on turbo charger

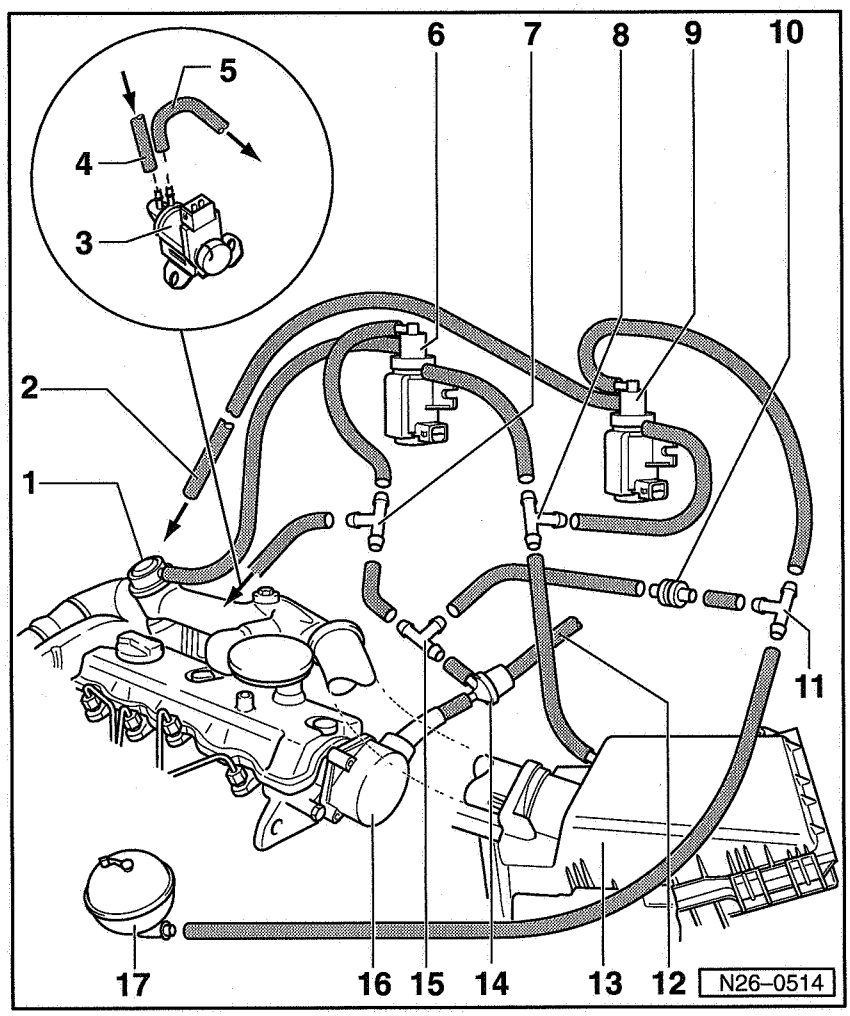
3 - Intake manifold flap change-over valve (N239)

4 - Vacuum hose
- ♦ From T-piece, item 7

5 - Vacuum hose
- ♦ To vacuum unit for intake manifold flap
  ⇒ page 23-17, item 11

6 - Exhaust gas recirculation valve (N18)

7 - T-piece



8 - Junction piece

9 - Charge pressure control solenoid valve (N75)

10 - Non-return valve
- ♦ Note fitting position: white connection faces T-piece, item 11

11 - T-piece

12 - Vacuum supply

13 - Air cleaner

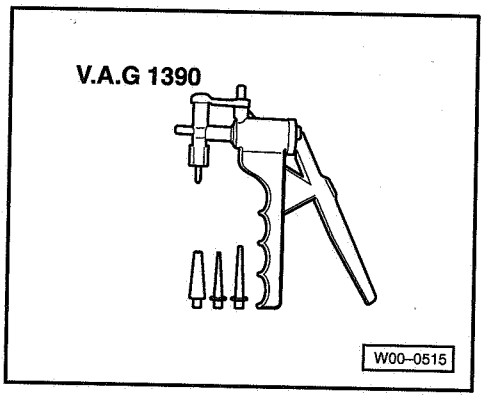
14 - Non-return valve
- ♦ Note fitting position

15 - T-piece

16 - Vacuum pump

17 - Vacuum reservoir

Checking exhaust gas recirculation valve (mechanical)

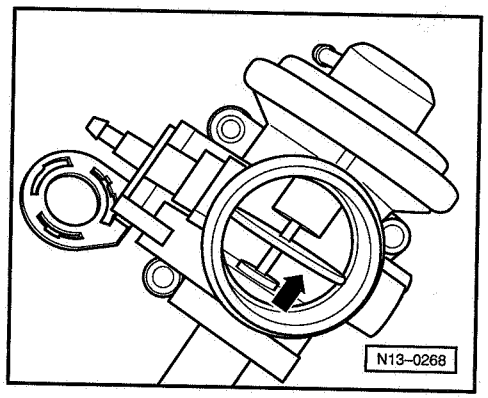


Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

♦ V.A.G 1390 Hand vacuum pump

Test sequence

- Remove connecting hose to charge air cooler at intake connecting pipe of intake manifold.
- Pull vacuum hose off (mechanical) exhaust gas recirculation valve.
- Connect hand vacuum pump V.A.G 1390 to valve.

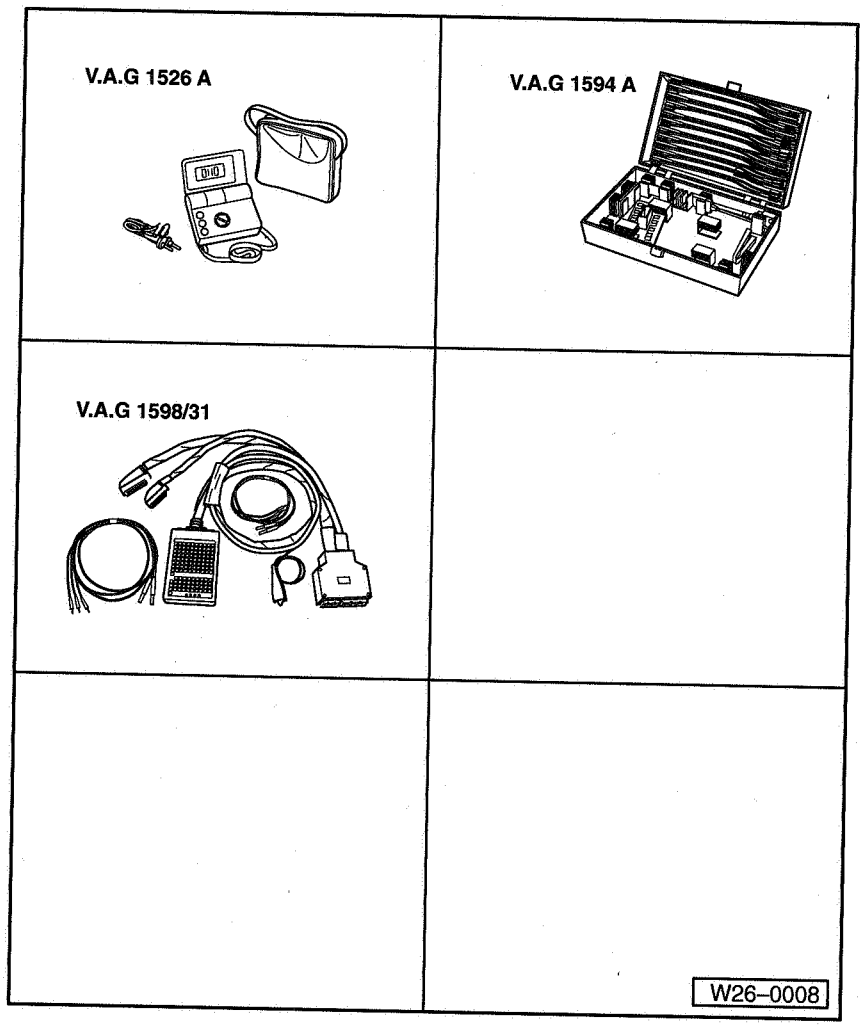


◄ - Operate pump and observe membrane rod.

The membrane rod must move in direction of arrow.

- Pull hand vacuum pump hose off exhaust gas recirculation valve.

The membrane rod must move back against the direction of arrow to its original position.



Checking exhaust gas recirculation

Special tools, workshop equipment, test and measuring appliances and auxiliary items required

♦ V.A.G 1526 Hand multimeter

♦ V.A.G 1594 A Adapter set

♦ V.A.G 1598/31 Test box

♦ Fault reader V.A.G 1551 or vehicle system tester V.A.G 1552 with cable V.A.G 1551/3A

Note:

All functions that could previously be carried out using V.A.G 1551/1552 can now also be carried out using the new tester VAS 5051.

♦ Current flow diagram

Check conditions

- The 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.
- Engine oil temperature min. 80 °C
- No faults in engine and fuel injection system, e.g. commencement of injection, injectors and compression pressure.
- No faults must be stored in fault memory
  ⇒ Page 01-11, interrogating fault memory

Test sequence

The exhaust gas recirculation function is checked in function 04 (basic setting). With this method, the EGR valve (electric) is pulsed every 10 seconds so that the extreme values for exhaust gas recirculation (air mass meter) measured value block 003 can be read in display zone 3.

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
  (Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Rapid data transfer HELP
Select function XXX

◄ Indicated on display:

- Press keys 0 and 4 for the function "Introduction of basic setting" and confirm entry with Q key.

Basic setting
Input display group number XXX

◄ Indicated on display:

- Press keys 0, 0 and 3 for "Display group number 3" and confirm entry with Q key.

System in basic setting 3 →
xxxx rpm EGRn.active xxx mg/H 3 %

◄ Indicated on display:

The display in display zone 2 must fluctuate every 10 secs. between "EGR active" and "EGRn.active".

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

Note:

If a constant value of 550 mg/H is indicated in display zone 3, check air mass meter ⇒ page 23-87.

Display zone 2: EGRn.active

- Specification in display zone 3
  at least 100 mg/H greater than EGR.active
- Specification in display zone 4
  0...5%

Display zone 2: EGR.active

- Specification in display zone 3
  at least 100 mg/H less than EGRn.active
- Specification in display zone 4
  95...100 %

- Press the → key.
- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.
- Switch off ignition.

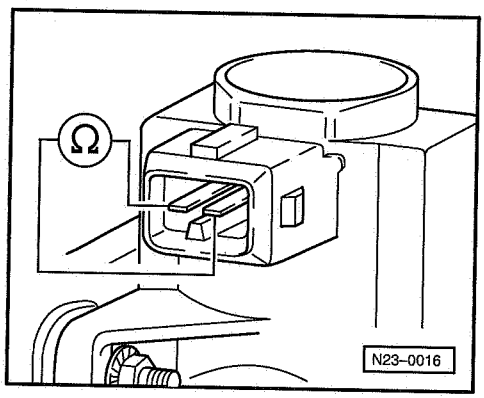
If the specifications are not obtained:

- Check mechanical exhaust gas recirculation valve ⇒ Page 26-7.
- Check exhaust gas recirculation valve (N18) ⇒ Page 26-12.
- Check vacuum hoses ⇒ Page 26-5.

Checking exhaust gas recirculation valve (N18)

- Pull 2-pin connector off exhaust gas recirculation valve (N18) ⇒ page 23-5, Fitting location overview.

Checking resistance



◄

- Connect multimeter using aux. cables from V.A.G 1594 to measure resistance at solenoid contacts
  Specification: 14.0...20.0 Ω

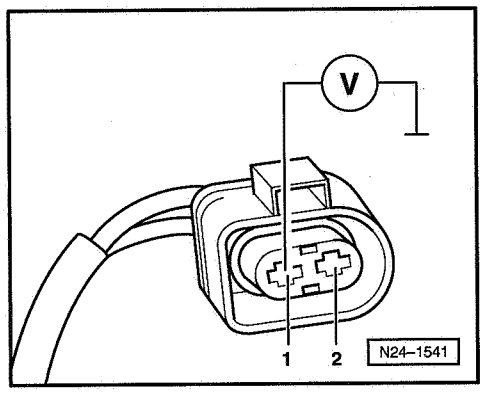
Note:

At room temperature the resistance lies in the the lower tolerance region and at operating temperature in upper tolerance region.

If the specification is not obtained:

- Renew EGR valve (N18).
- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

If the specification is obtained:

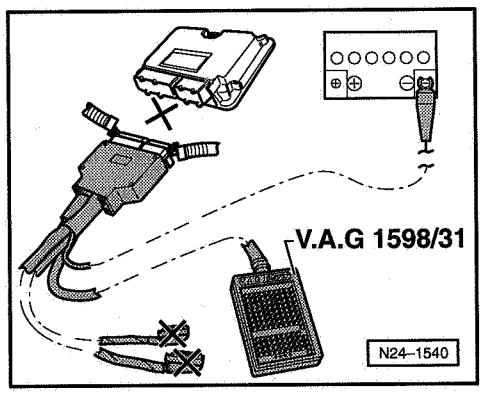


Checking voltage supply

- Connect multimeter using aux. cables from V.A.G 1594 to measure voltage at contact 1 of connector and engine earth.
- Switch on ignition.
  Specification: min. 11.5 V
- Switch off ignition.

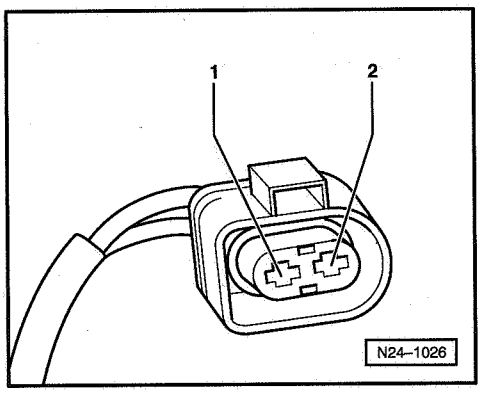
If the specification is not obtained:

- Check voltage supply relay terminal 30 (J317) ⇒ page 27-20, Current flow diagrams.
- Check wiring connections for open circuit, short circuit and transfer resistance at contacts according to current flow diagram.



If the specification is obtained:

- Connect test box V.A.G 1598/31 to control unit wiring harness. The engine control unit remains disconnected.



- Check wiring between test box and connector for open circuit using current flow diagram.
  Contact 1 + socket 1
  Contact 1 + socket 2
  Contact 2 + socket 61
  Wire resistance: max. 1.5 Ω
- Additionally check wires for short to one another, to battery/vehicle earth and to battery positive.
  Specification: ∞Ω

If no fault is detected in the wiring:

- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.

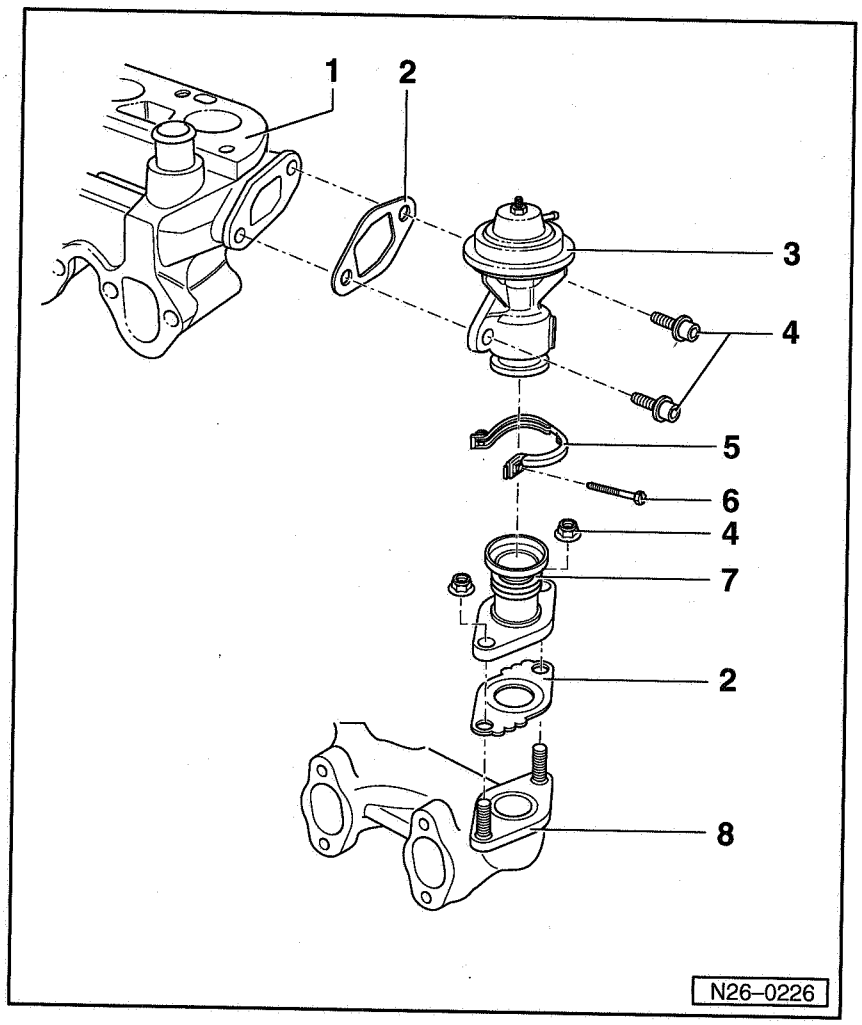
Exhaust gas recirculation system (engine code BEQ)

Notes:

- *The control of the exhaust gas recirculation system is undertaken by diesel direct injection system control unit (J248) via EGR valve (N18) (electric) to 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 makes every conceivable valve position possible.*
- *Renew self-locking nuts.*

Observe safety precautions ⇒ Page 23-2.

Observe rules for cleanliness ⇒ Page 23-4.



Removing and installing parts of exhaust gas recirculation system

1 - Intake manifold lower part

2 - Gasket
- ♦ Renew

3 - Exhaust gas recirculation valve (mechanical)
- ♦ Checking ⇒ page 26-18

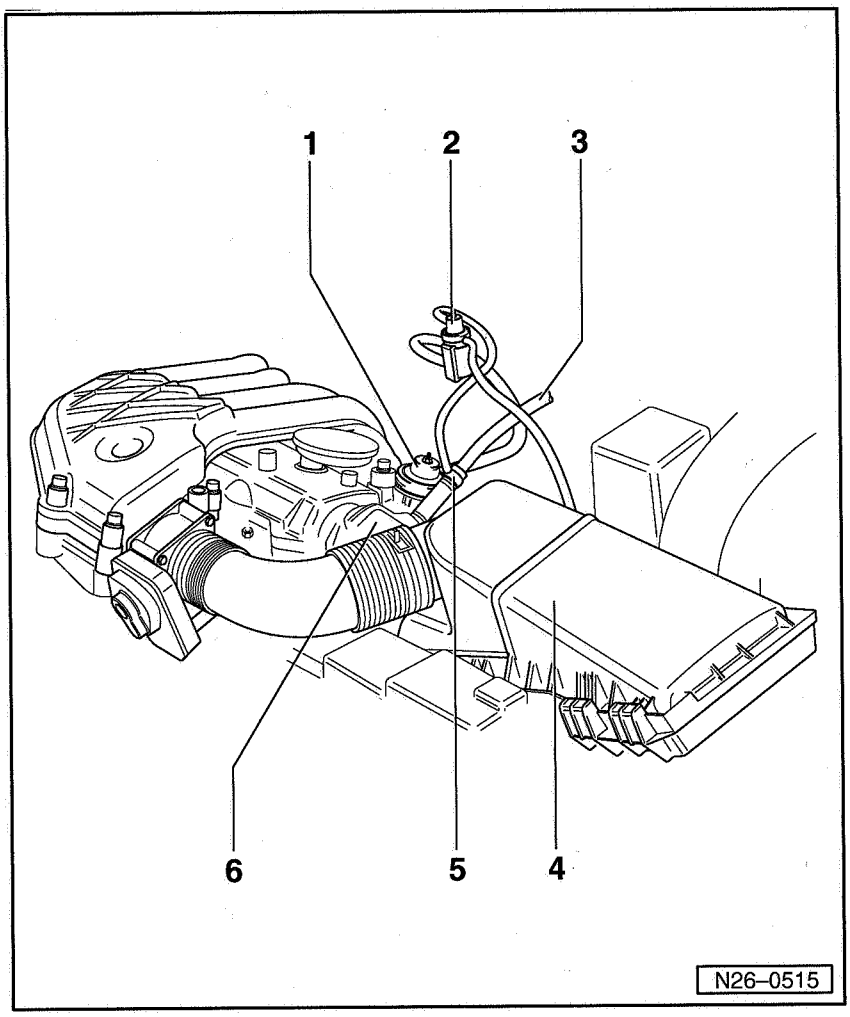
4 - 22 Nm
- ♦ Renew

5 - Clamp

6 - 10 Nm

7 - Connecting pipe

8 - Exhaust manifold



Vacuum hose connection diagram

1 - Exhaust gas recirculation valve

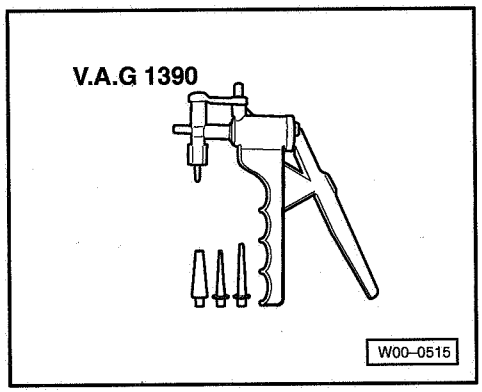
2 - Exhaust gas recirculation valve (N18)

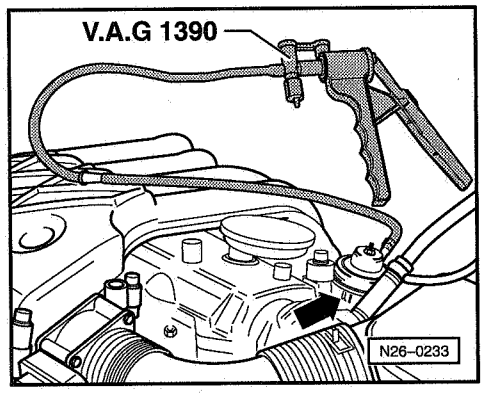
3 - Vacuum supply

4 - Air cleaner

5 - Non-return valve
♦ Note fitting position

6 - Vacuum pump





Checking exhaust gas recirculation valve (mechanical)

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

♦ V.A.G 1390 Hand vacuum pump

Test sequence

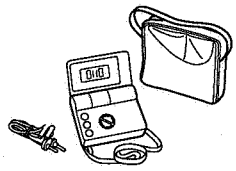
- Pull vacuum hose off (mechanical) exhaust gas recirculation valve.

- Connect hand vacuum pump V.A.G 1390 to valve.

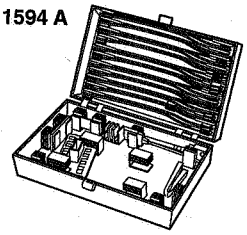
◄ - Operate pump.
Membrane must move in direction of vacuum connection
(establish by feeling from below -arrow-).

- Pull hand vacuum pump hose off (mechanical) exhaust gas recirculation valve.
The valve must clearly be heard to close (membrane moves in direction of exhaust manifold).

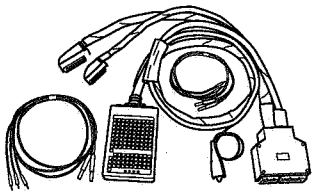
V.A.G 1526 A



V.A.G 1594 A



V.A.G 1598/31



W26-0008

Checking exhaust gas recirculation

Special tools, workshop equipment, test and measuring appliances and auxiliary items required

- V.A.G 1526 Hand multimeter
- V.A.G 1594 A Adapter set
- V.A.G 1598/31 Test box
- Fault reader V.A.G 1551 or vehicle system tester V.A.G 1552 with cable V.A.G 1551/3A

Note:

All functions that could previously be carried out using V.A.G 1551/1552 can now also be carried out using the new tester VAS 5051.

- Current flow diagram

Check conditions

- The 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.
- Engine oil temperature min. 80 °C
- No faults in engine and fuel injection system, e.g. commencement of injection, injectors and compression pressure.
- No faults must be stored in fault memory
  ⇒ Page 01-11, interrogating fault memory

Test sequence

The exhaust gas recirculation function is checked in function 04 (basic setting). With this method, the EGR valve (electric) is pulsed every 10 seconds so that the extreme values for exhaust gas recirculation (air mass meter) measured value block 003 can be read in display zone 3.

- Connect fault reader V.A.G 1551 (V.A.G 1552) and select engine electronics control unit with the "Address word" 01. When doing this the engine must be running at idling speed.
(Connecting fault reader and selecting engine electronics control unit ⇒ Page 01-5.)

Rapid data transfer HELP
Select function XXX

◄ Indicated on display:

- Press keys 0 and 4 for the function "Introduction of basic setting" and confirm entry with Q key.

Basic setting
Input display group number XXX

◄ Indicated on display:

- Press keys 0, 0 and 3 for "Display group number 3" and confirm entry with Q key.

System in basic setting 3 →
xxxx rpm EGRn.active 3 %

◄ Indicated on display:

The display in display zone 2 must fluctuate every 10 secs. between "EGR active" and "EGRn.active".

The displays in display zone 4 must fluctuate within following control range:

Display zone 2: EGRn.active

- Specification in display zone 4
  0...5%

Display zone 2: EGR.active

- Specification in display zone 4
  95...100 %

- Press the → key.
- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.
- Switch off ignition.

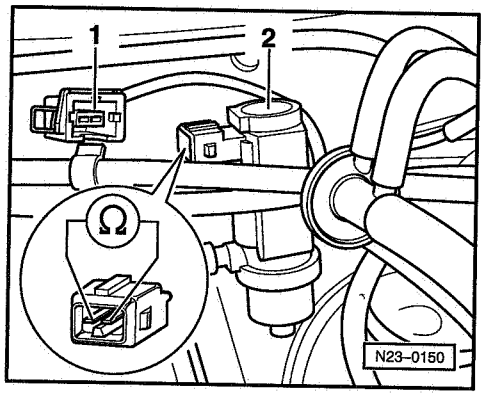
If the specifications are not obtained:

- Check mechanical exhaust gas recirculation valve ⇒ page 26-18.
- Check exhaust gas recirculation valve (N18) ⇒ page 26-23.
- Check vacuum hoses ⇒ page 26-17.

If the specifications are not obtained:

Checking exhaust gas recirculation valve (N18)

Checking resistance



- Pull connector -1- off exhaust gas recirculation valve -2-.

- Connect multimeter using aux. cables from V.A.G 1594 to measure resistance at contacts of solenoid valve.
  Specification: 14.0...20.0 Ω

Note:

At room temperature the resistance lies in the the lower tolerance region and at operating temperature in upper tolerance region.

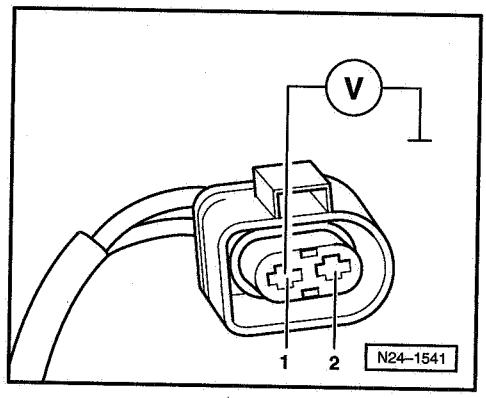
If the specification is not obtained:

- Renew EGR valve (N18).

- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

If the specification is obtained:

Checking voltage supply



- Connect multimeter using aux. cables from V.A.G 1594 to measure voltage at contact 1 of connector and engine earth.

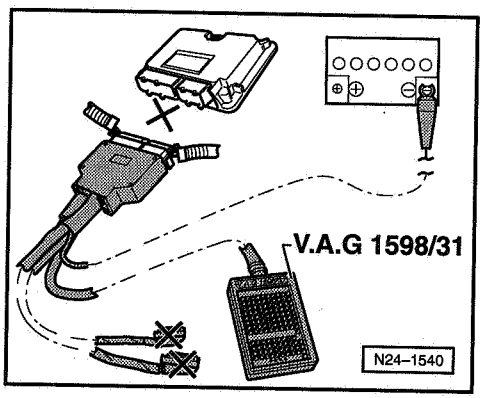
- Switch on ignition.
  Specification: min. 11.5 V

- Switch off ignition.

If the specification is not obtained:

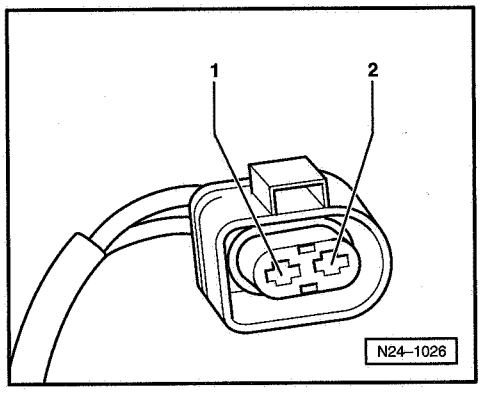
- Check voltage supply relay terminal 30 (J317) ⇒ page 27-20, Current flow diagrams.

- Check wiring connections for open circuit, short circuit and transfer resistance at contacts according to current flow diagram.



If the specification is obtained:

- Connect test box V.A.G 1598/31 to control unit wiring harness. The engine control unit remains disconnected.



◄ - Check wiring between test box and connector for open circuit using current flow diagram.
  Contact 1 + socket 1
  Contact 1 + socket 2
  Contact 2 + socket 61
  Wire resistance: max. 1.5 Ω

- Additionally check wires for short to one another, to battery/vehicle earth and to battery positive.
  Specification: ∞Ω

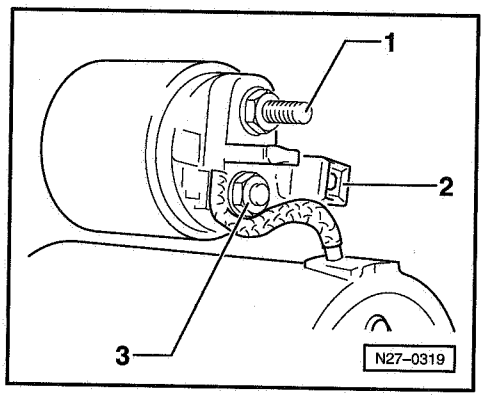
If no fault is detected in the wiring:

- Renew diesel direct injection system control unit (J248) ⇒ Page 23-115.

Checking starter

Observe safety precautions ⇒ Page 23-2.

Observe rules for cleanliness ⇒ Page 23-4.



◄ **Wiring connections on solenoid switch**

1 - Terminal 30 - from battery

2 - Terminal 50 - from ignition/starter switch

3 - Field winding connection

Starter does not turn

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

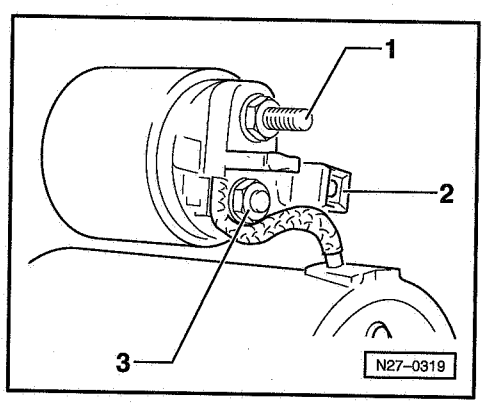
♦ Adapter set V.A.G 1594

♦ Hand multimeter V.A.G 1526 or multimeter V.A.G 1715

Test conditions

- The fuses must be OK.
- Battery charged and checked.
- Earth connections OK.
- All electrical consumers must be switched off.
- Wiring connections on solenoid switch and earth strap, between engine, unit and battery, must be tight and not oxidised.

Test sequence



◄ - Connect multimeter to measure voltage between terminal 50 -2- (with connector fitted) and battery/engine earth.

- Operate starter switch and check the voltage supply.
  Specification: at least 8 V

If voltage is present at terminal 50 -2- on solenoid switch:

- Measure voltage at connection for field winding -3- on battery/engine earth.

- Operate starter switch and check the voltage supply.
  Specification: at least 8 V

If the specification is obtained:

- Service starter motor.

If the specification is not attained:

- Renew solenoid switch.

If no voltage is present at terminal 50 -2- on solenoid switch:

- Measure voltage at terminal 50 on ignition/starter switch using current flow diagram ⇒ page 27-20, Current flow diagrams.
  Specification: at least 8 V

- Operate starter switch and check the voltage supply.
  Specification: at least 8 V

If the specification is not attained:

- Renew ignition/starter switch.

If the specification is obtained:

- Check wiring for open circuit between ignition/starter switch and starter using current flow diagram.
  Wire resistance: max. 1.5 Ω

Starter turns too slowly and does not crank engine

Test conditions

- Battery charged and checked.
- Ribbed belt tension OK and alternator mounted securely.
- All electrical consumers must be switched off.
- Wiring connections on solenoid switch and earth strap, between engine, unit and battery, must be tight and not oxidised.

Test sequence

- Operate starter switch.

If starter does not crank engine over:

- With ignition switched off disconnect battery earth strap.

- Clean connections on starter and earth strap between engine and unit. Do not loosen earth strap on unit.

- Ensure connections are tight after cleaning.

- Install earth strap to battery.

- Operate starter switch.

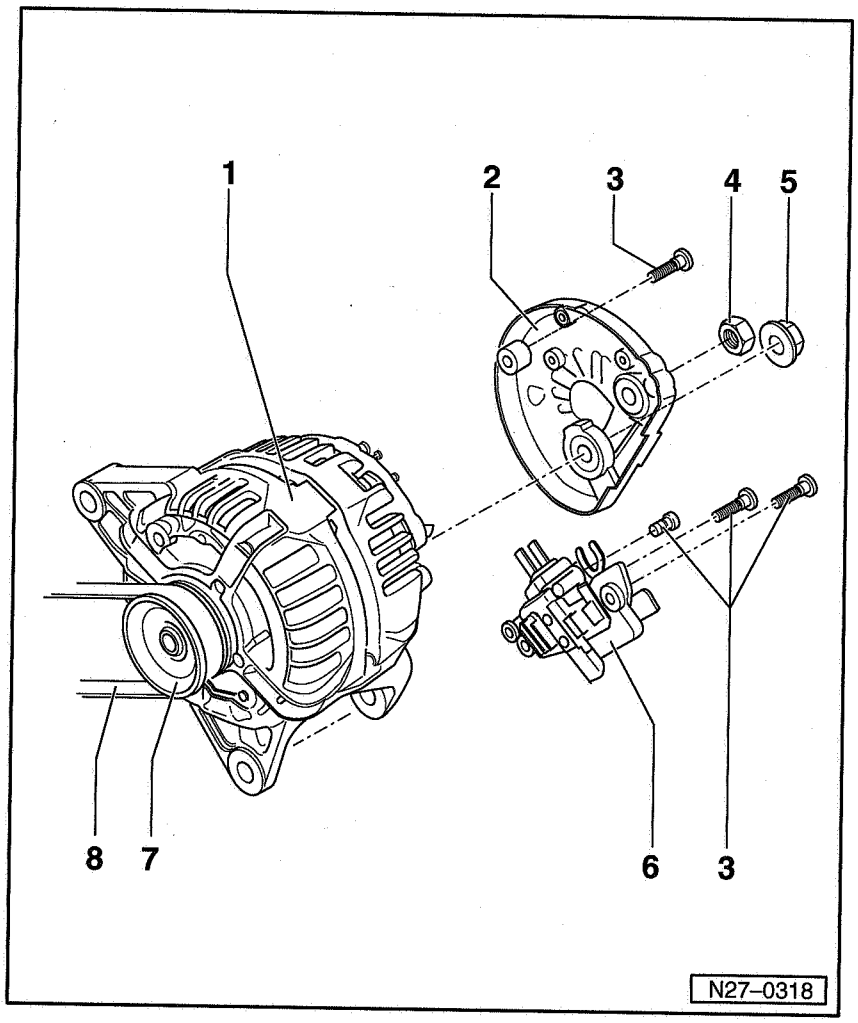
If starter again does not crank engine over the following may be the cause of the fault:

♦ Insufficient contact between carbon brushes and collector

- Check carbon brushes for wear. Renew if necessary.

♦ Collector scored or burnt or dirty.

- Renew armature.



Removing and installing parts of alternator

Observe safety measures
⇒ page 23-2.

Observe rules for cleanliness
⇒ page 23-4.

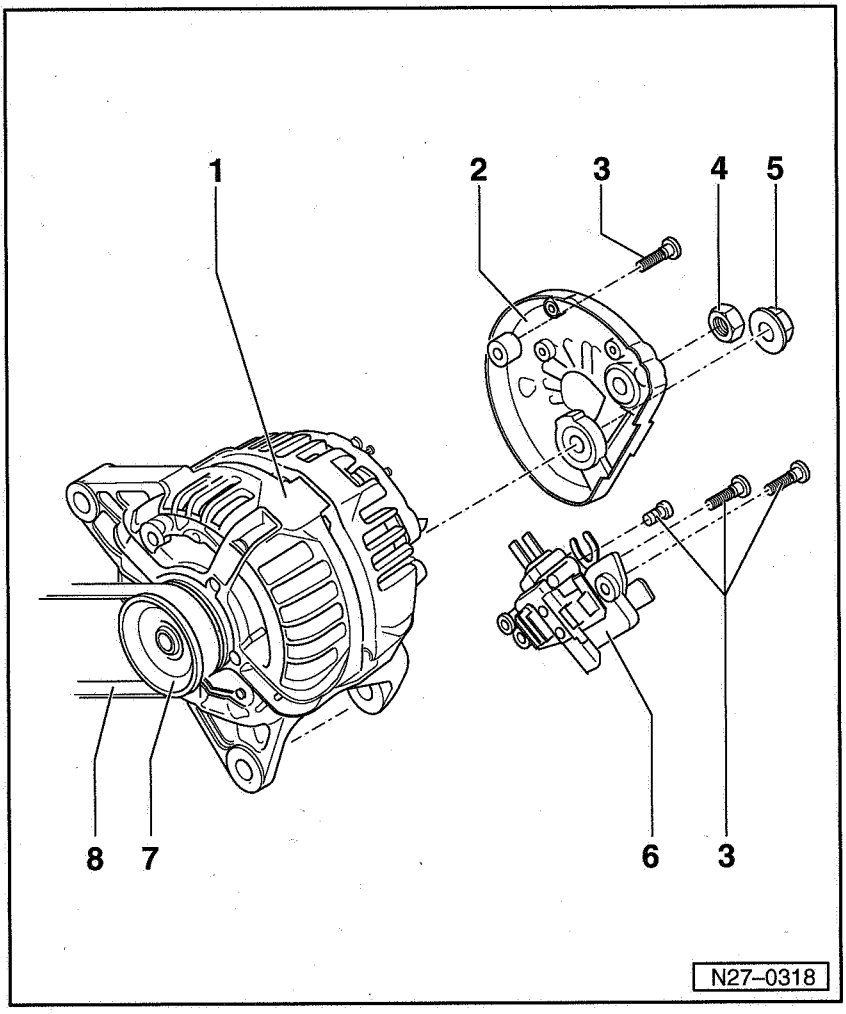
1 - Alternator
- ♦ Securing "B+ wire" to alternator ⇒ fig. 1
- ♦ Checking ⇒ page 27-9, Checking alternator and voltage regulator

2 - Protective cap

3 - Cross-head screw

4 - Hexagon nut
- ♦ 25 Nm

5 - Shouldered hexagon nut
- ♦ 25 Nm



6 - Voltage regulator (C1)

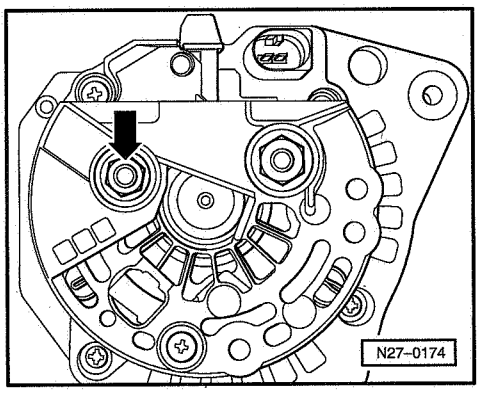
- ♦ Checking ⇒ page 27-9, Checking alternator and voltage regulator
- ♦ Removing and installing ⇒ page 27-11
- ♦ Checking carbon brushes ⇒ page 27-12

7 - Ribbed belt

- ♦ Renewing ⇒ page 27-13
- ♦ Removing and installing ribbed belt pulley with freewheel ⇒ page 27-15
- ♦ Checking function of freewheel clutch ⇒ page 27-18

8 - Ribbed belt

- ♦ Mark direction of rotation before removing
- ♦ Check for wear
- ♦ Do not kink
- ♦ Removing and installing ⇒ Page 13-14
- ♦ Checking ⇒ page 13-17



◄ **Fig. 1 Securing "B+ wire" to alternator**

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

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

Notes:

The threaded connection for the + wire on the alternator is designated B1+!

If the B1+ wire is not secured with the prescribed tightening torque the following may occur:

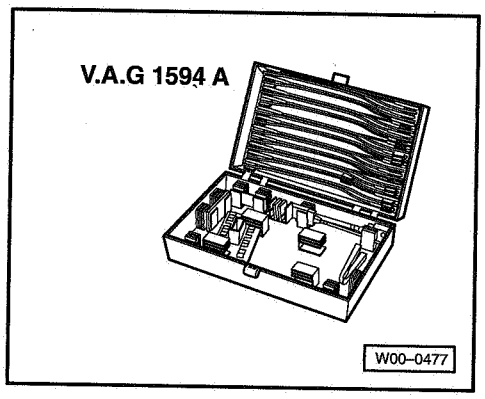
- ♦ *Battery not charged completely.*
- ♦ *Complete failure of vehicle electrics/electronics.*
- ♦ *Danger of fires from sparks.*
- ♦ *Damage to electronic components and control units due to excessive voltages.*

- With ignition switched off disconnect battery earth strap.

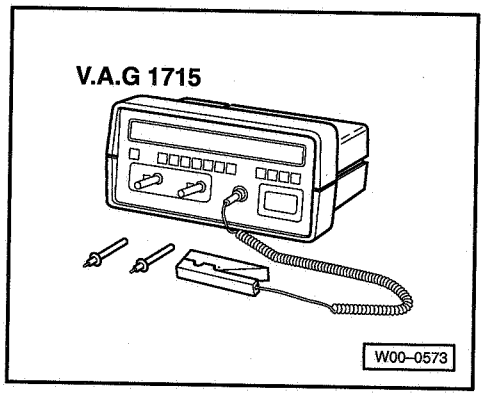
- Tighten securing nut for "B1+ wire" -arrow-.
  Torque setting: 15 Nm

Checking alternator and voltage regulator

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



♦ Adapter set V.A.G 1594



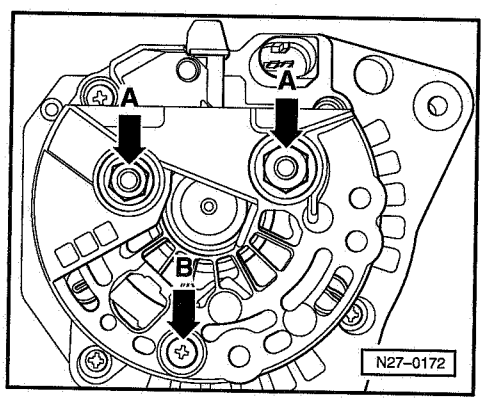
♦ V.A.G 1715 Multimeter

Test conditions

- The fuses must be OK.
- Battery charged and checked.
- Earth connections OK.
- Ribbed belt tension OK and alternator mounted securely.

- No faults must be stored in fault memory
  ⇒ Page 01-11, interrogating fault memory
- Function of freewheel in belt pulley OK., Checking ⇒ page 27-18.

Test sequence



◄

- Remove securing nuts -arrow A- and securing screw -arrow B- for protective cap and take protective cap off.

- Switch on Multimeter V.A.G 1715.
- Connect black test wire (-) to battery earth strap.

- Connect red test wire (+) to terminal D+ on alternator.
- Switch on all electrical consumers.
- Start engine and run at
  1500...2000 rpm
  for a few seconds.

If display on V.A.G 1715 shows "Not in order":

- For test: Replace voltage regulator (C1) ⇒ page 27-11, Removing and installing voltage regulator.
- Repeat test sequence.

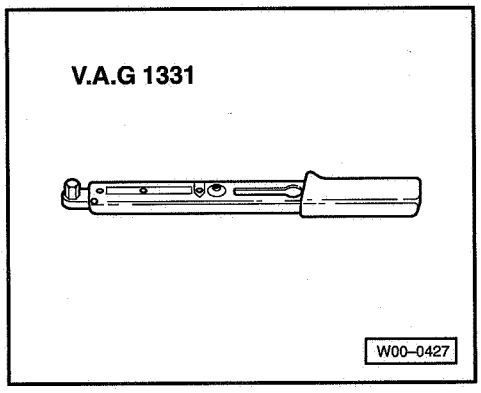
If display on V.A.G 1715 shows "Not in order" again:

- Renew alternator (C).

Removing and installing voltage regulator

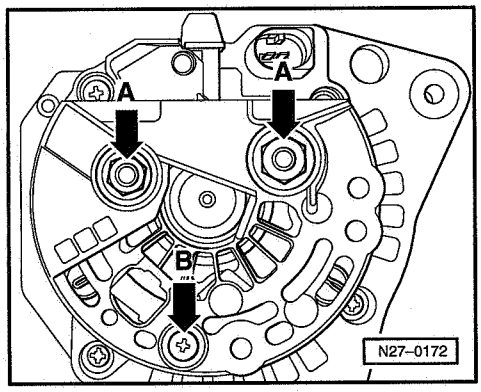
Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

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

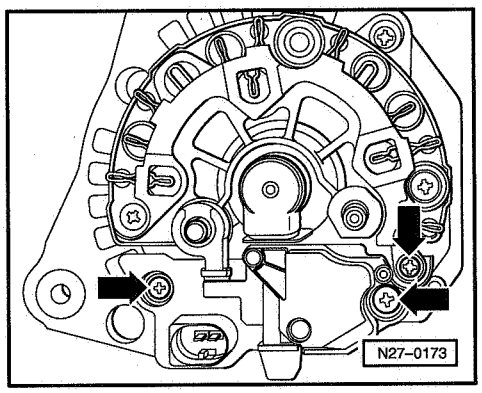


Removing

- With ignition switched off disconnect battery earth strap.



◄ - Remove securing nuts -arrow A- and securing screw -arrow B- for protective cap and take protective cap off.



◄ - Remove screws -arrows- securing voltage regulator and take voltage regulator out.

Installing

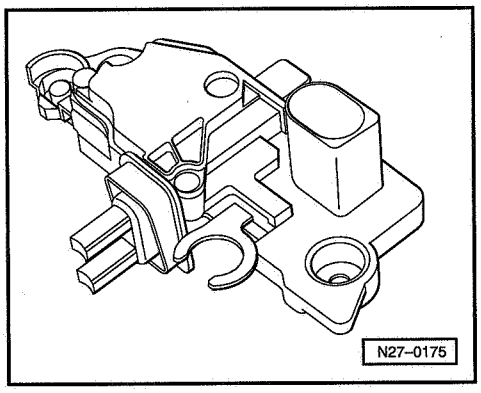
Installation is carried out in the reverse sequence.

- Install protective cap.
  Torque setting: 25 Nm
  (Hexagon nut with and without collar)

Checking alternator carbon brushes

Test sequence

- Remove voltage regulator ⇒ page 27-11.



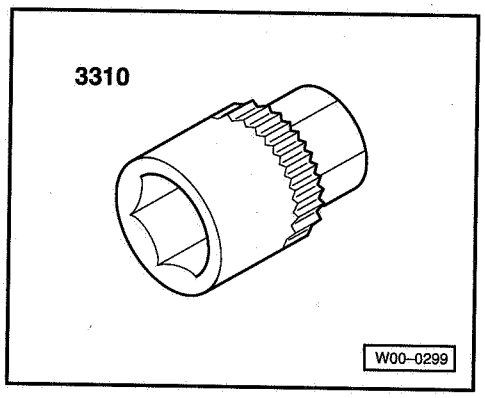
◄ Length of new carbon brushes = 12mm

Wear limit = 5mm

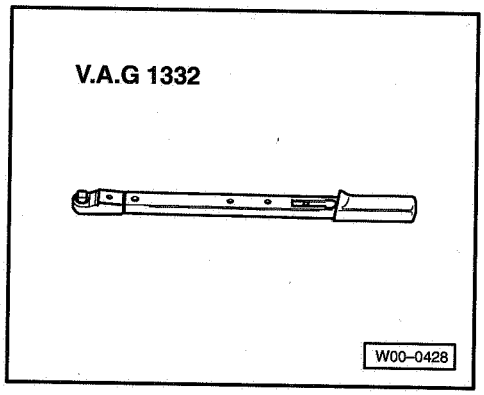
Carbon brush tolerance to one another = 1mm

Replacing alternator ribbed belt pulley

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

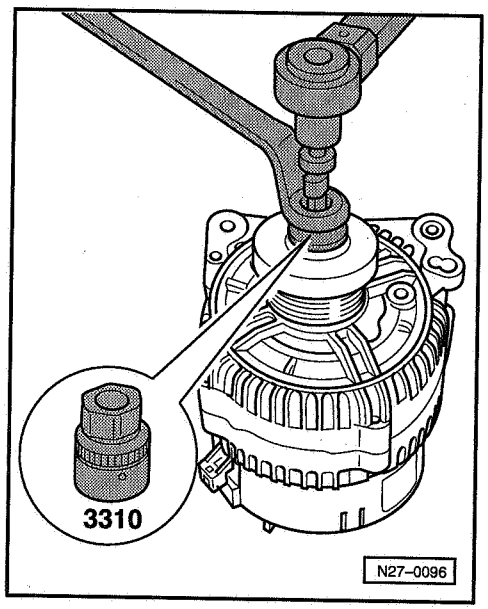


♦ 3310 Socket



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

Work sequence

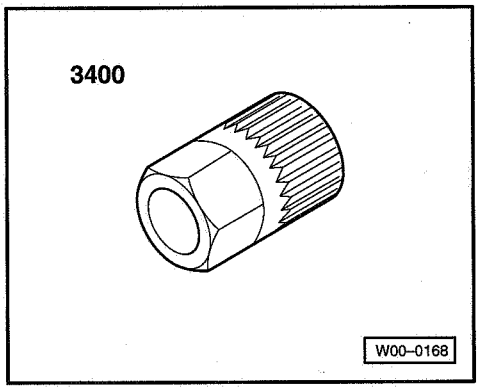


- Remove ribbed belt ⇒ Page 13-14.

◄ The special tool -socket 3310- is required to loosen/tighten the ribbed belt pulley on alternator.

- Tighten securing nut of ribbed belt pulley.
  Torque setting: 65 Nm

Removing and installing ribbed belt pulley with freewheel

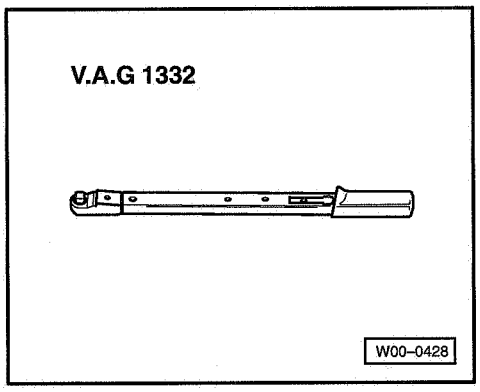


Note:

The ribbed belt pulley with freewheel is the same for all alternators (various manufacturers), fitted in vehicles 05.99 ➤

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

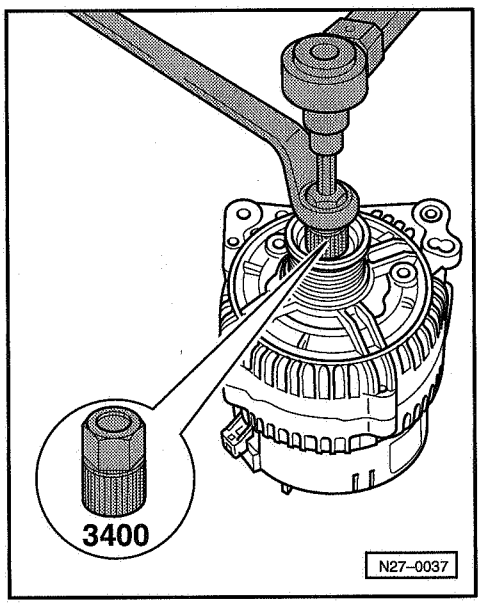
♦ 3400 Multi-spline adapter



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

Removing

- Remove ribbed belt ⇒ Page 13-14.
- Remove protective dust cap from freewheel disc.



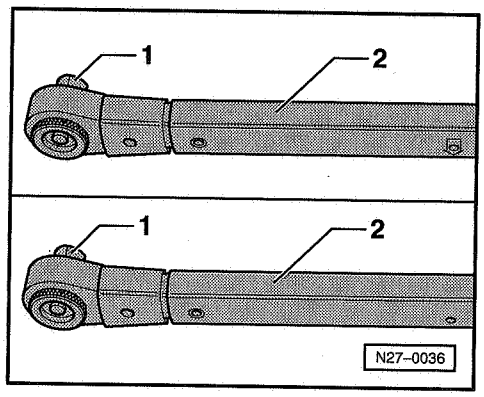
- Fit 6 mm AF hexagon key/bit onto alternator shaft.

◄ - Counter-hold on multi-spline adapter 3400 using 17 mm AF ring spanner and loosen freewheel disc by turning alternator drive shaft clockwise.

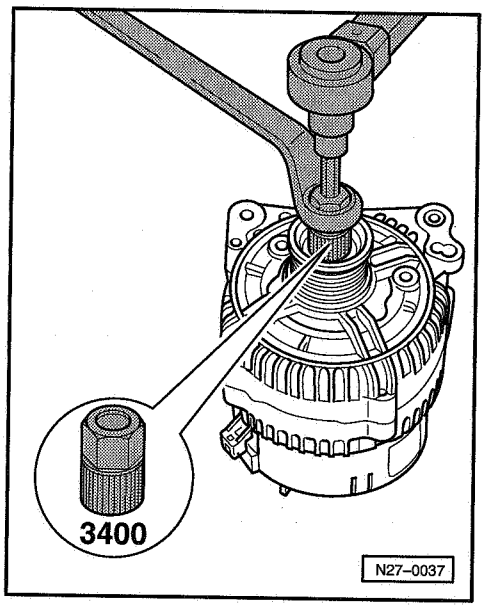
Installing

- Insert multi-spline adapter 3400 in freewheel disc.
- Screw freewheel disc by hand onto alternator drive shaft onto stop.

The torque wrench must be rearranged before installing the freewheel disc as follows:



- Release socket drive -1- and pull off grip -2-.
- Turn torque wrench grip -2- by 180° and reinsert socket drive.
- Set wrench direction of turn on socket drive to anti-clockwise.
- Fit 6 mm AF hexagon key/bit onto alternator shaft.

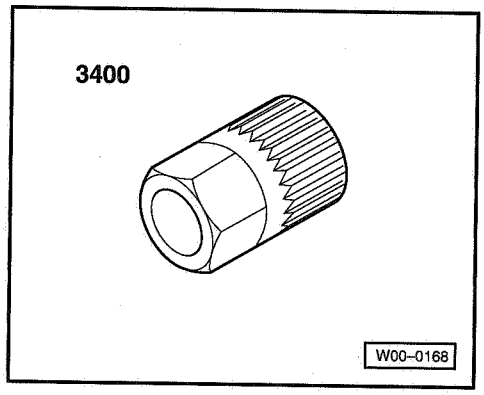


- Counter-hold multi point key 3400 using 17 mm AF ring spanner and tighten freewheel disc by turning alternator drive shaft anti-clockwise with torque wrench.
  Torque setting: 80 Nm
- Clip protective cap onto freewheel disc.
- Install ribbed belt ⇒ Page 13-14.

Checking function of freewheel clutch

Note:

The ribbed belt pulley with freewheel is the same for all alternators (various manufacturers), fitted in vehicles 05.99 ➤



Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

♦ 3400 Multi-spline adapter

Test conditions

- Ribbed belt tension OK and alternator mounted securely.

Test sequence

- Remove protective dust cap from freewheel disc.
- Fit multi-spline adapter 3400 in freewheel disc.
- Turn alternator drive shaft anti-clockwise using a 17 mm AF ring spanner and multi-spline adapter 3400 on ribbed belt pulley.

If drive shaft in ribbed belt pulley turns but belt pulley running surface remains stationary:

- Renew ribbed belt pulley with freewheel clutch ⇒ page 27-15.

If ribbed belt pulley running surface turns together with drive shaft in ribbed belt:

- Clip protective cap onto freewheel disc.
- Check alternator and voltage regulator ⇒ Page 27-9.

Current flow diagrams

Notes:

- *Due to the range of installation possibilities for industrial engines, the following current flow diagrams are just examples.*
- *Average figures are minimum values. Increased cross sections are dependent on the unit and should be observed in case of repair.*

> ***Warning!***
>
> ***Before working on the electrical system disconnect the battery earth strap.***

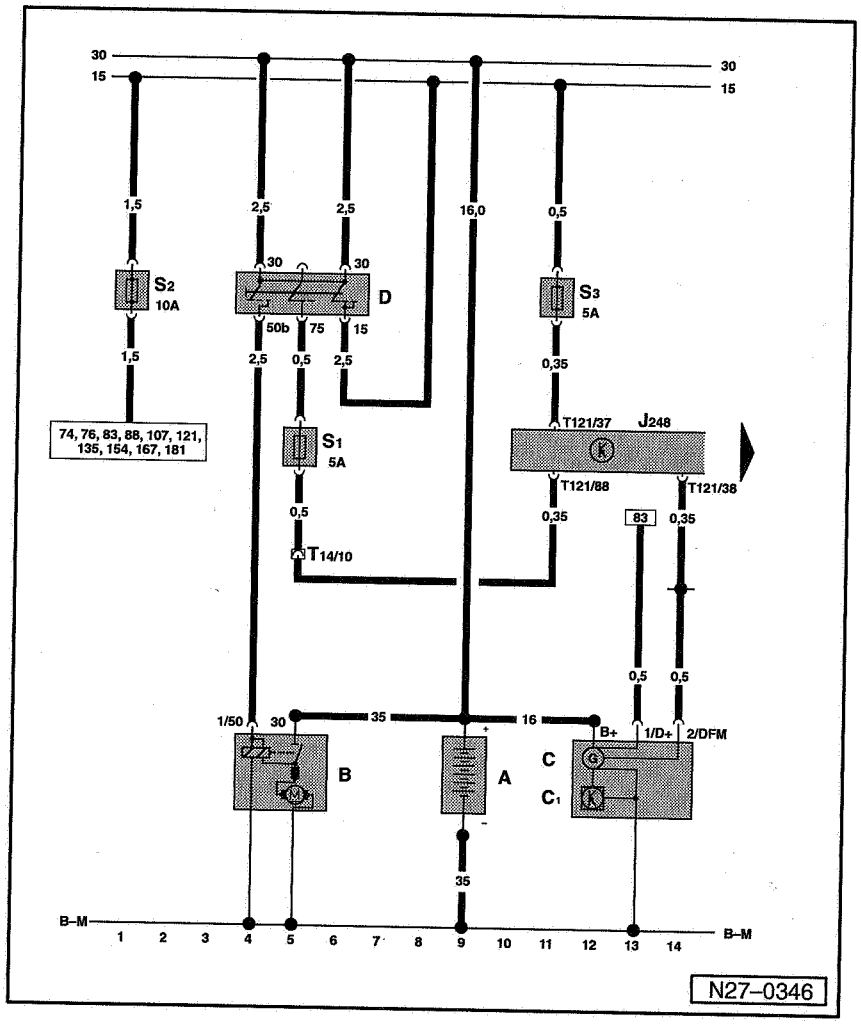
Observe safety precautions ⇒ Page 23-2.

Observe rules for cleanliness ⇒ Page 23-4.

Current flow diagrams: Engine code ARD
⇒ page 27-21.

Current flow diagrams: Engine code AVM
⇒ page 27-44.

Current flow diagrams: Engine code BEQ
⇒ page 27-69.



Current flow diagrams: Engine code ARD

Base equipment: Voltage supply, part 1

Battery, starter, alternator, voltage regulator, ignition/starter switch

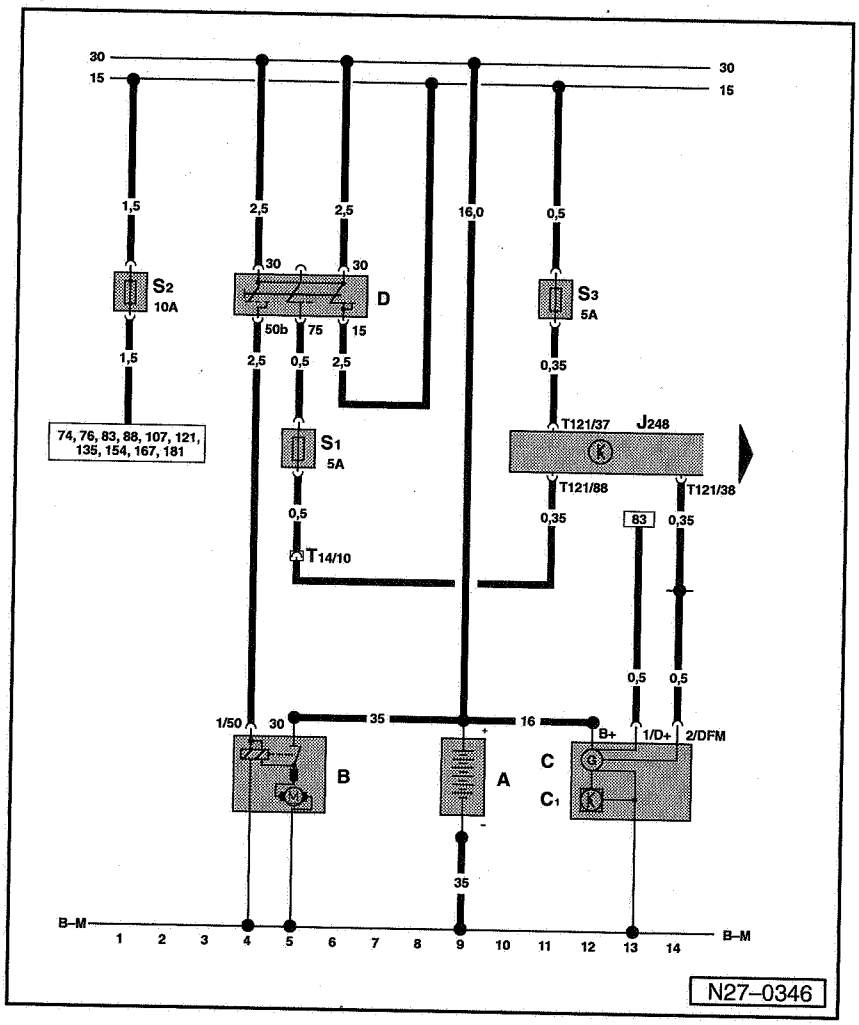
A - Battery

B - Starter

C - Alternator

C1 - Voltage regulator

D - Ignition/starter switch



J248 - Diesel direct injection system control unit

S1 - Fuse 1 (5 A)

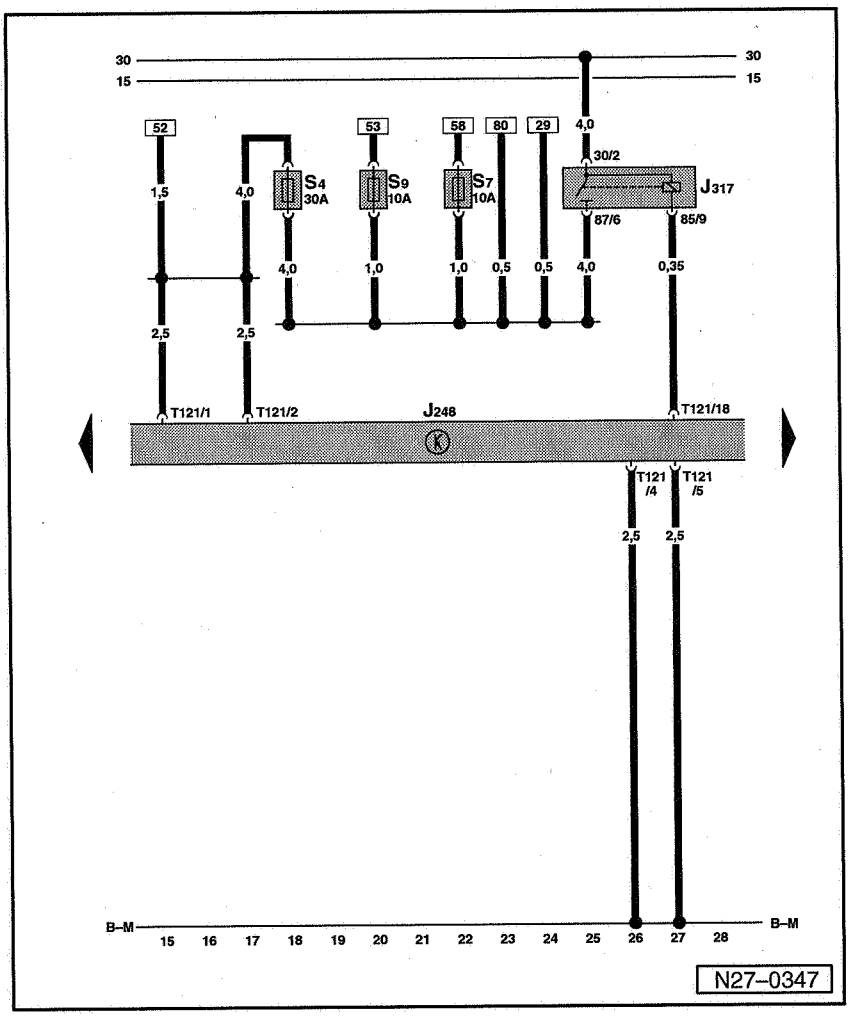
S2 - Fuse 2 (10 A)

S3 - Fuse 3 (5 A)

T14 - Connector, 14-pin

T121 - Connector, 121-pin

B-M - Battery earth/engine earth



Base equipment: Voltage supply, part 2

Voltage supply relay

J248 - Diesel direct injection system control unit

J317 - Voltage supply relay

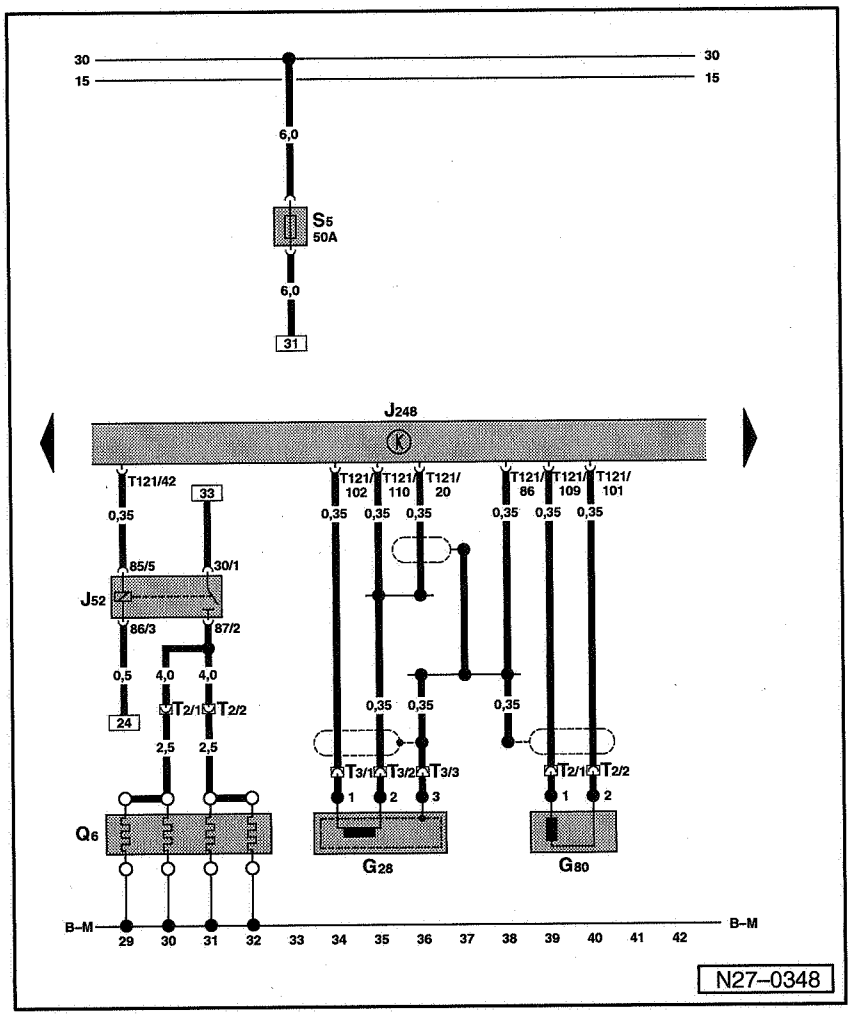
S4 - Fuse 4 (30 A)

S7 - Fuse 7 (10 A)

S9 - Fuse 9 (10 A)

T121 - Connector, 121-pin

B-M - Battery earth/engine earth



Base equipment: Components, part 1

Engine speed sender, needle lift sender, glow plg relay, glow plugs - engine

G28 - Engine speed sender

G80 - Needle lift sender

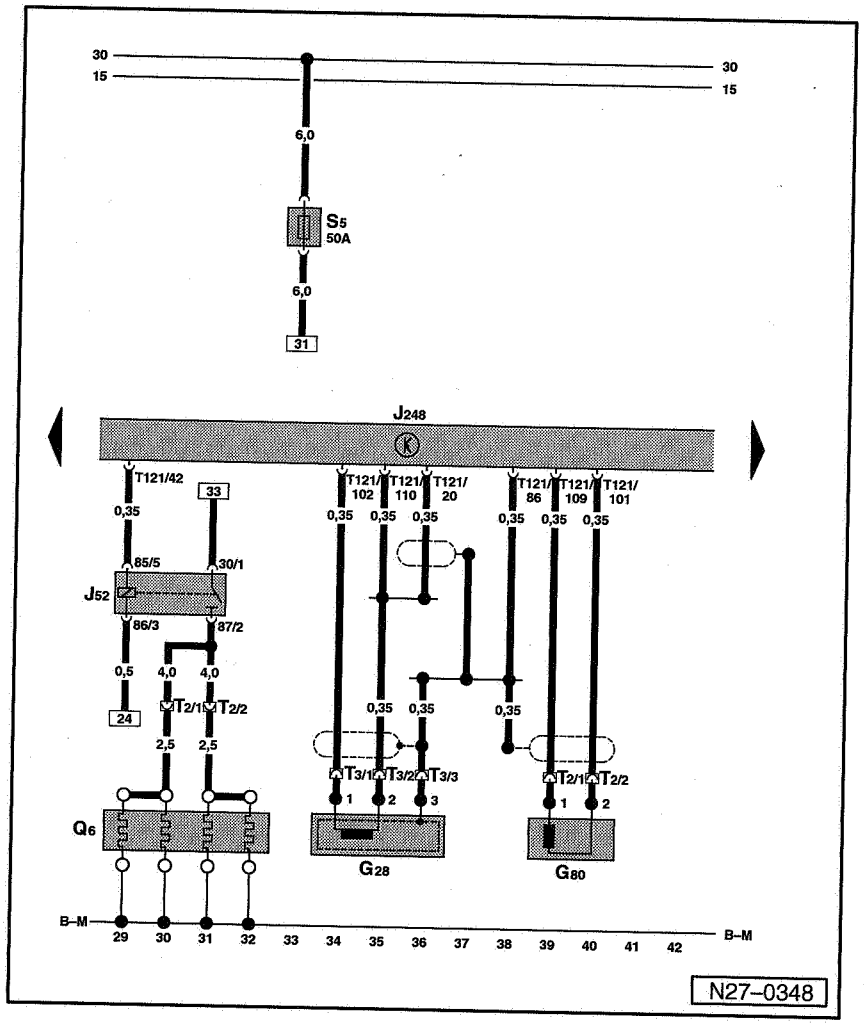
J52 - Glow plug relay

J248 - Diesel direct injection system control unit

Q6 - Glow plugs - engine

S5 - Fuse 5 (50 A)

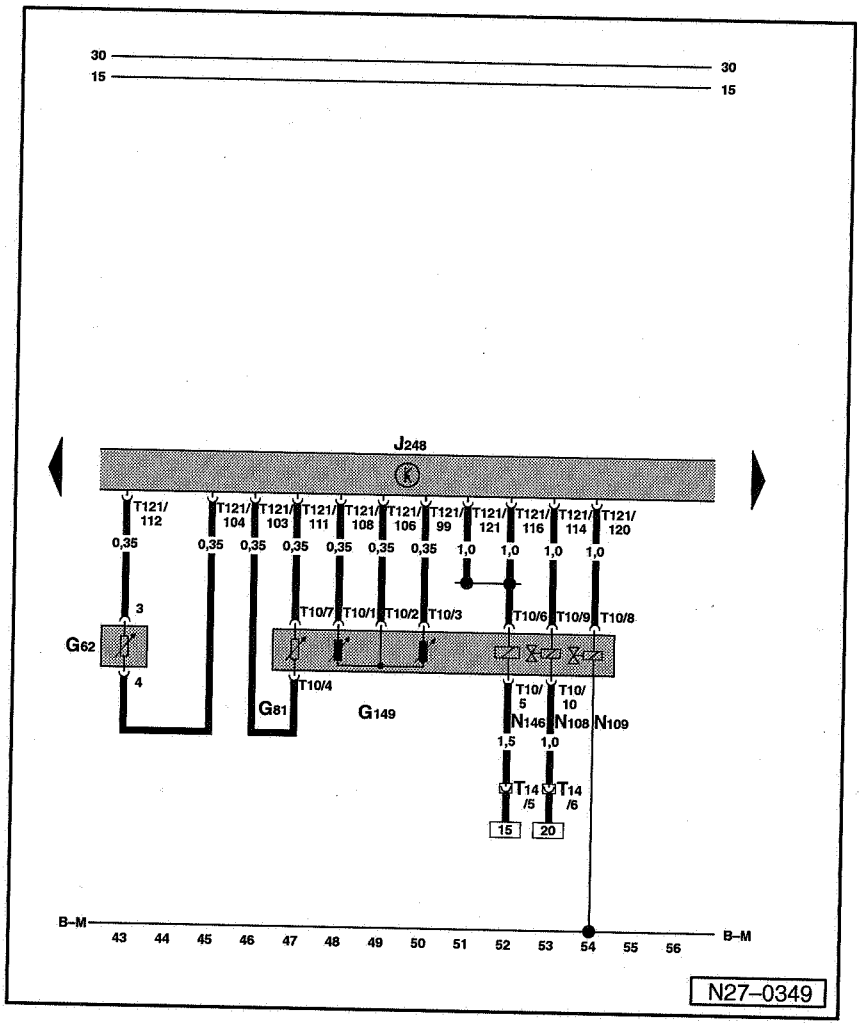
T2 - Connector, 2-pin



T3 - Connector, 3-pin

T121 - Connector, 121-pin

B-M - Battery earth/engine earth



Base equipment: Components, part 2

Coolant temperature sender, fuel temperature sender, modulating piston movement sender, commencement of injection valve, fuel cut-off valve, quantity adjuster

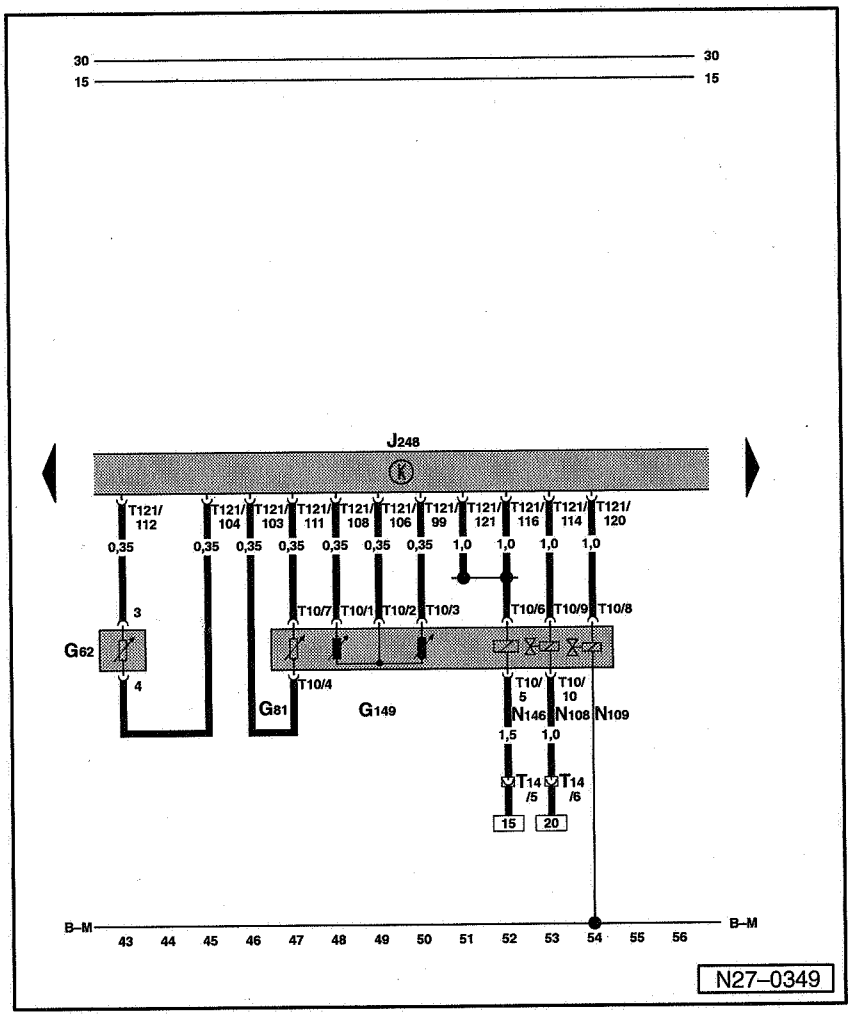
G62 - Coolant temperature sender

G81 - Fuel temperature sender

G149 - Modulation piston movement sender

J248 - Diesel direct injection system control unit

N108 - Commencement of injection valve



N109 - Fuel cut-off valve

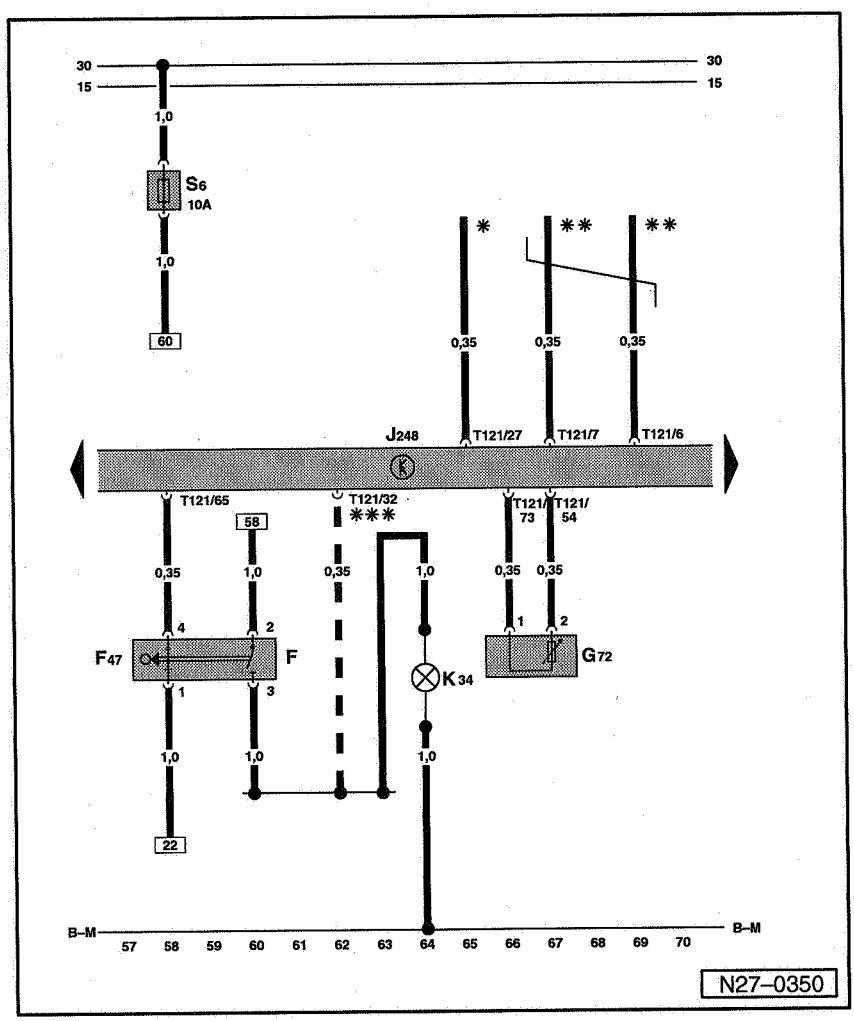
N146 - Quantity adjuster

T10 - Connector, 10-pin

T14 - Connector, 14-pin

T121 - Connector, 121-pin

B-M - Battery earth/engine earth



Base equipment: Components, part 3

Brake light switch, brake pedal switch, intake manifold temperature sender, brake light warning lamp

F - Brake light switch

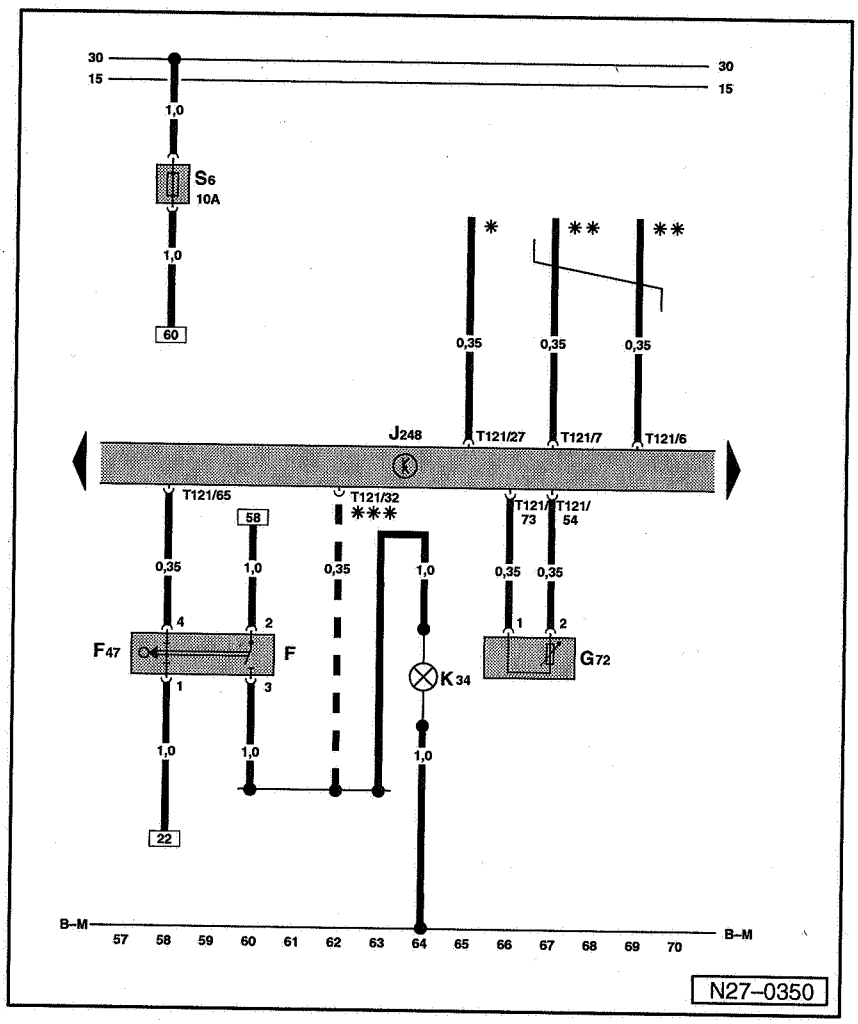
F47 - Brake pedal switch

G72 - Intake manifold temperature sender

J248 - Diesel direct injection system control unit

K34 - Brake light warning lamp

S6 - Fuse 6 (10 A)



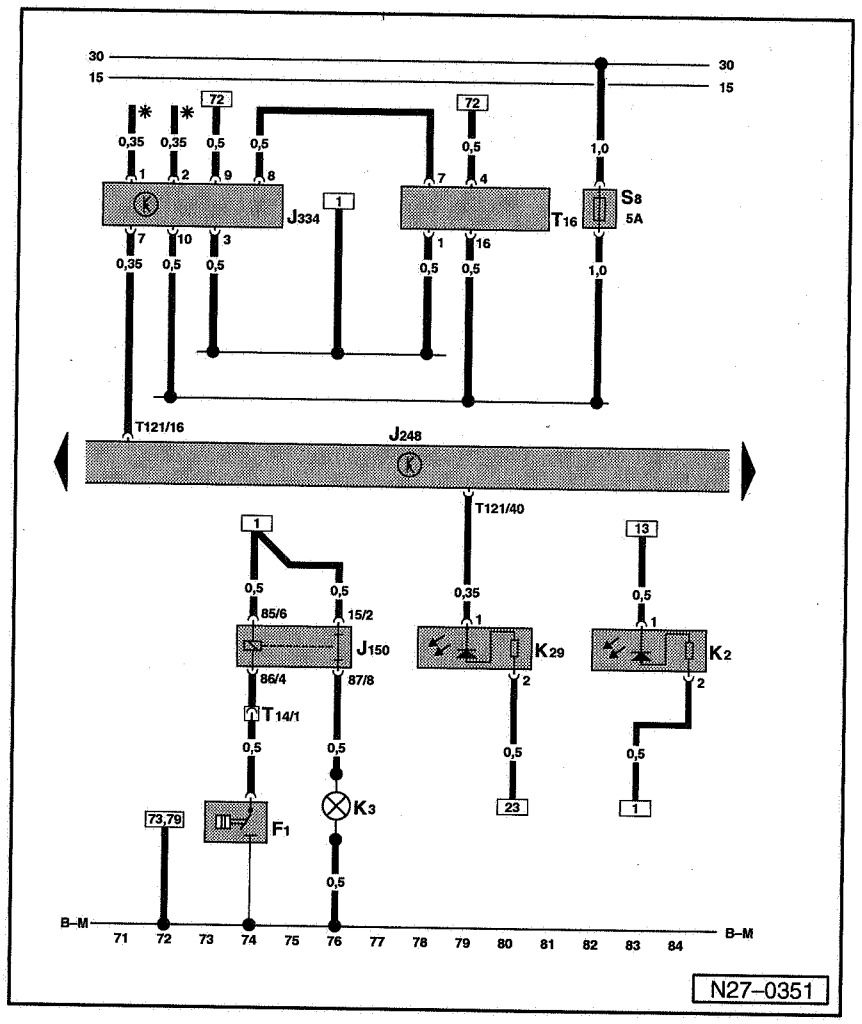
T121 - Connector, 121-pin

B-M - Battery earth/engine earth

* - Speed signal connection

** - Datenbus connection:
T121/6 CAN_low,
T121/7 CAN_high

*** - Data set connection: 1...6
♦ Stationary operation



Additional circuit diagram: Components

Oil pressure switch, oil pressure monitor delay relay, immobilizer control unit, warning lamps

F1 - Oil pressure swicth

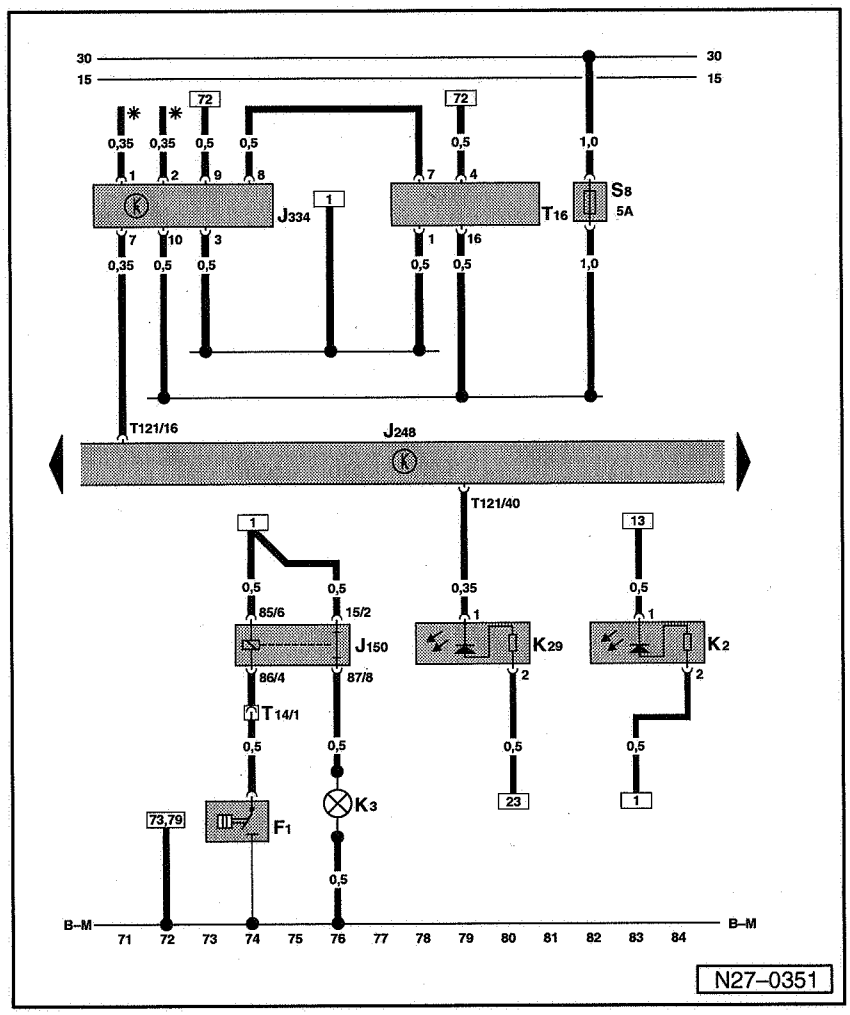
J150 - Oil pressure monitor delay relay

J248 - Diesel direct injection system control unit

J334 - Immobilizer control unit

K2 - Alternator warning lamp

K3 - Oil pressure warning lamp



K29 - Glow period warning lamp

S8 - Fuse 8 (5 A)

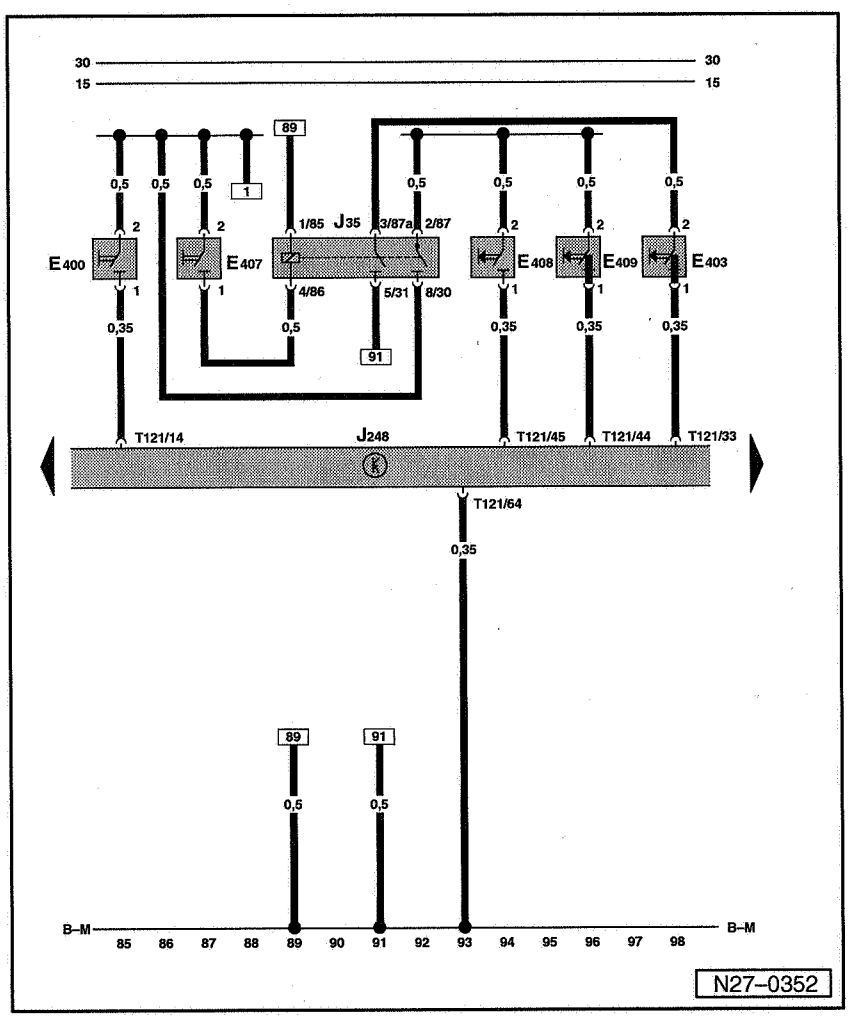
T14 - Connector, 14-pin

T16 - 16-pin connector, diagnosis connection

T121 - Connector, 121-pin

B-M - Battery earth/engine earth

* - Datenbus connection:
1 CAN_low,
2 CAN_high



Additional circuit diagram: Working speed governor (WSG), part 1

Switches, buttons, speed relays

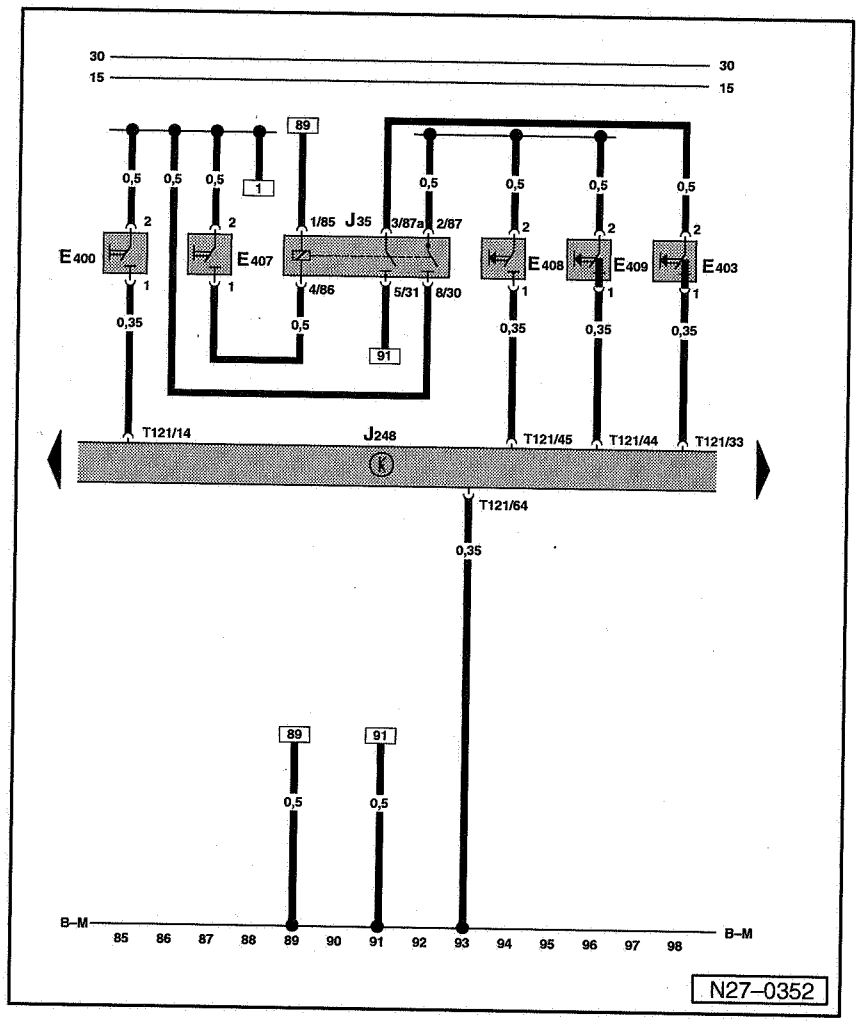
E400 - Switch for activation of working speed governor when engine started

E403 - Working speed governor button (restart)

E407 - Safety contact switch

E408 - TIP DOWN button

E409 - TIP UP button

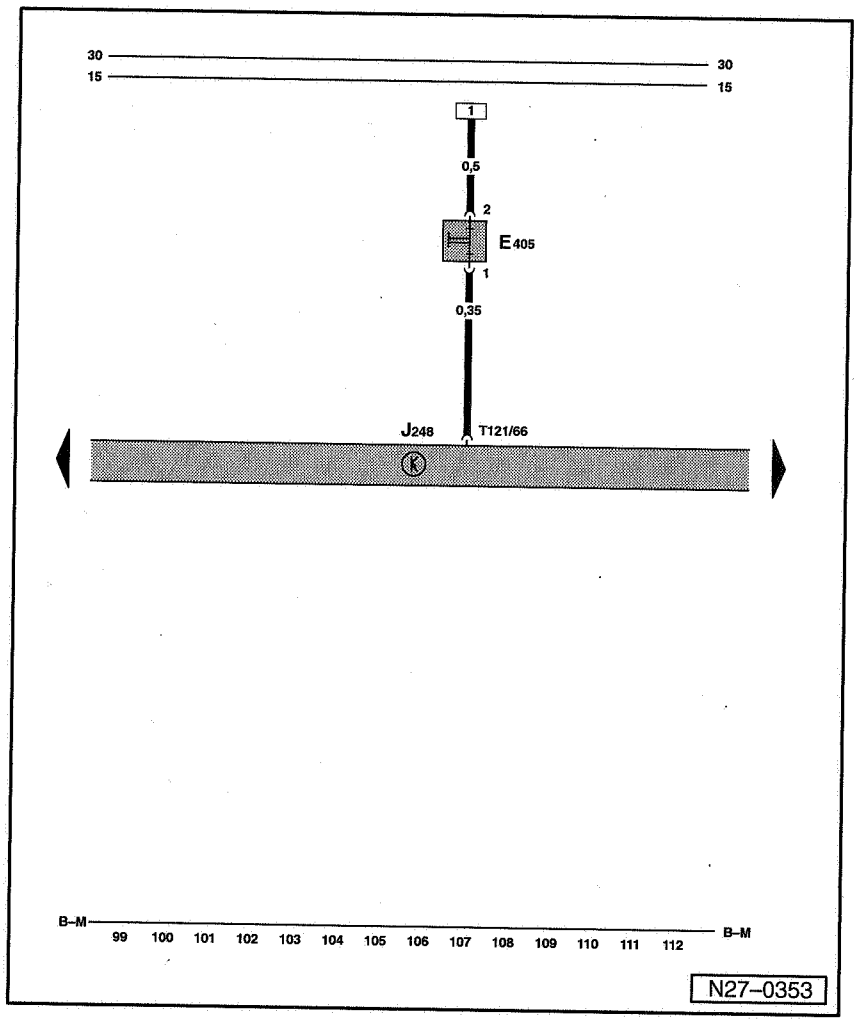


J35 - Speed relay

J248 - Diesel direct injection system control unit

T121 - Connector, 121-pin

B-M - Battery earth/engine earth



Additional circuit diagram: Working speed governor (WSG), part 2

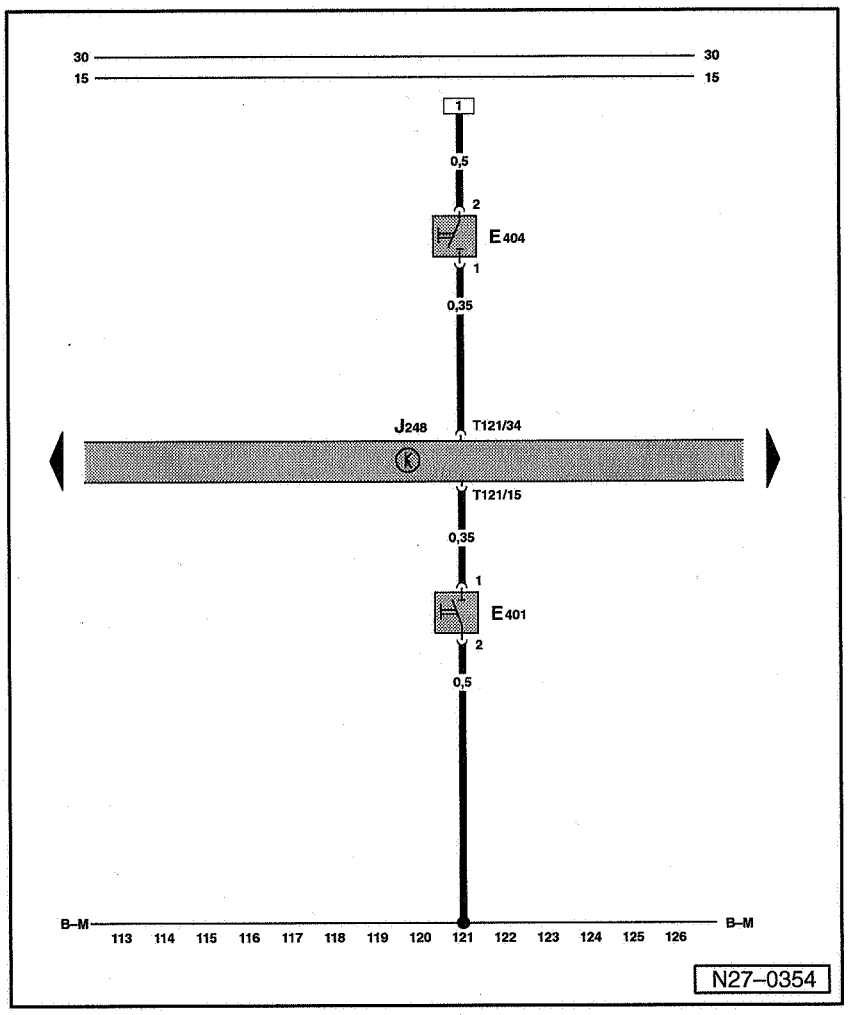
Swicthes

E405 - Idling switch
"harder"/"softer"
- ♦ E405 shut:
"harder" idling activated
- ♦ E405 open:
"softer" idling activated

J248 - Diesel direct injection system control unit

T121 - Connector, 121-pin

B-M - Battery earth/engine earth



Additional circuit diagram: Working speed governor (WSG), part 3

Swicthes

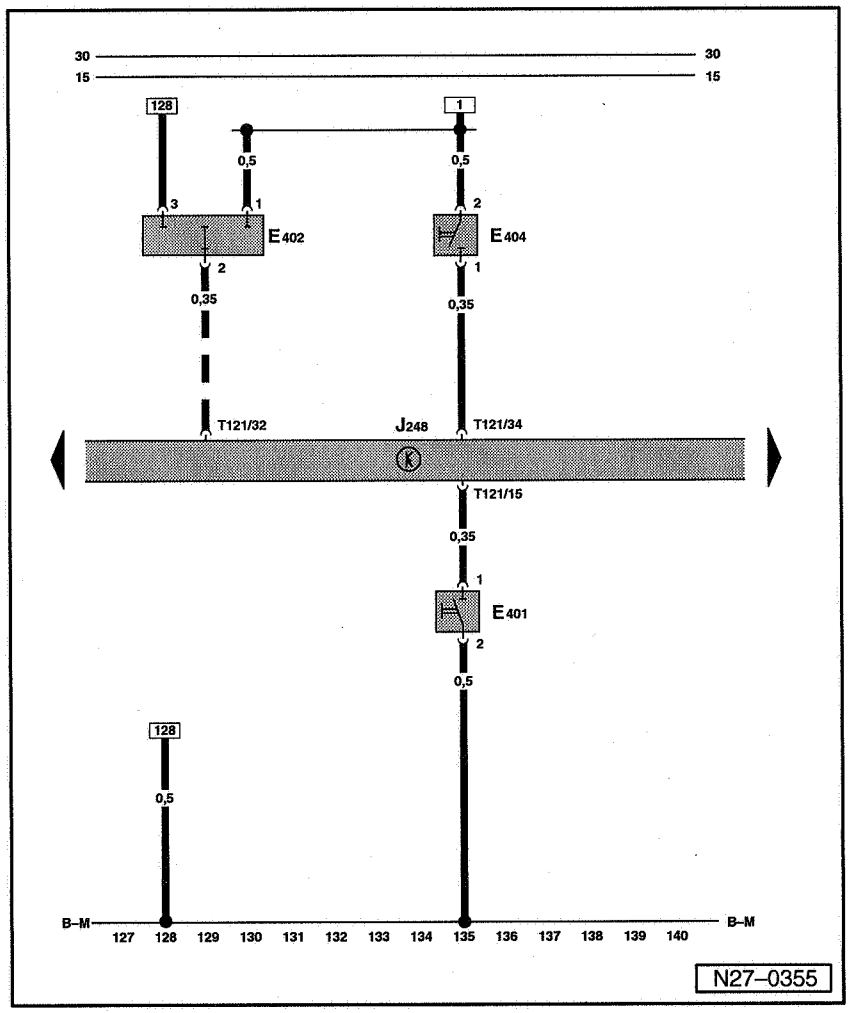
E401 - Increased idling speed switch
♦ 1100 rpm

E404 - Increased idling speed
♦ 1900 rpm

J248 - Diesel direct injection system control unit

T121 - Connector, 121-pin

B-M - Battery earth/engine earth



Additional circuit diagram: Data set 7, stationary operation

Note:

Data set 1...6 (stationary operation) ⇒ page 27-28, Base equipment: Components, part 3.

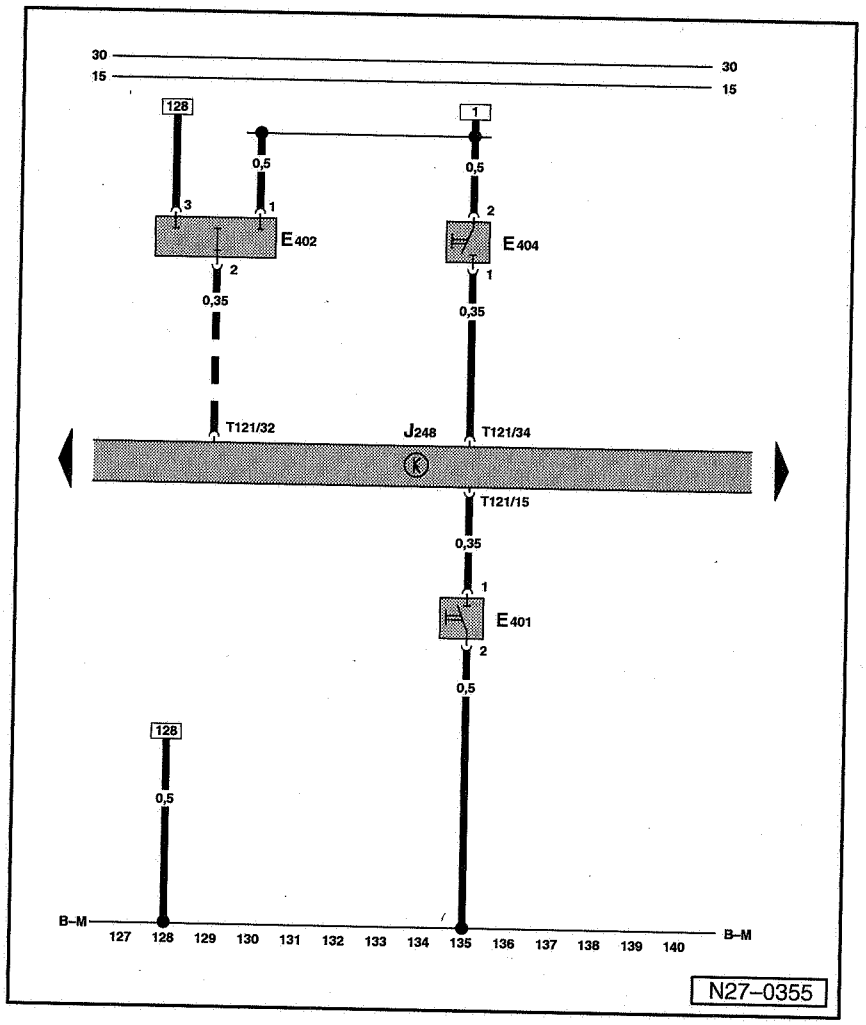
Swicthes

E401 - Idling speed switch
♦ 1500 rpm

E402 - Idling speed switch
♦ 1200 rpm

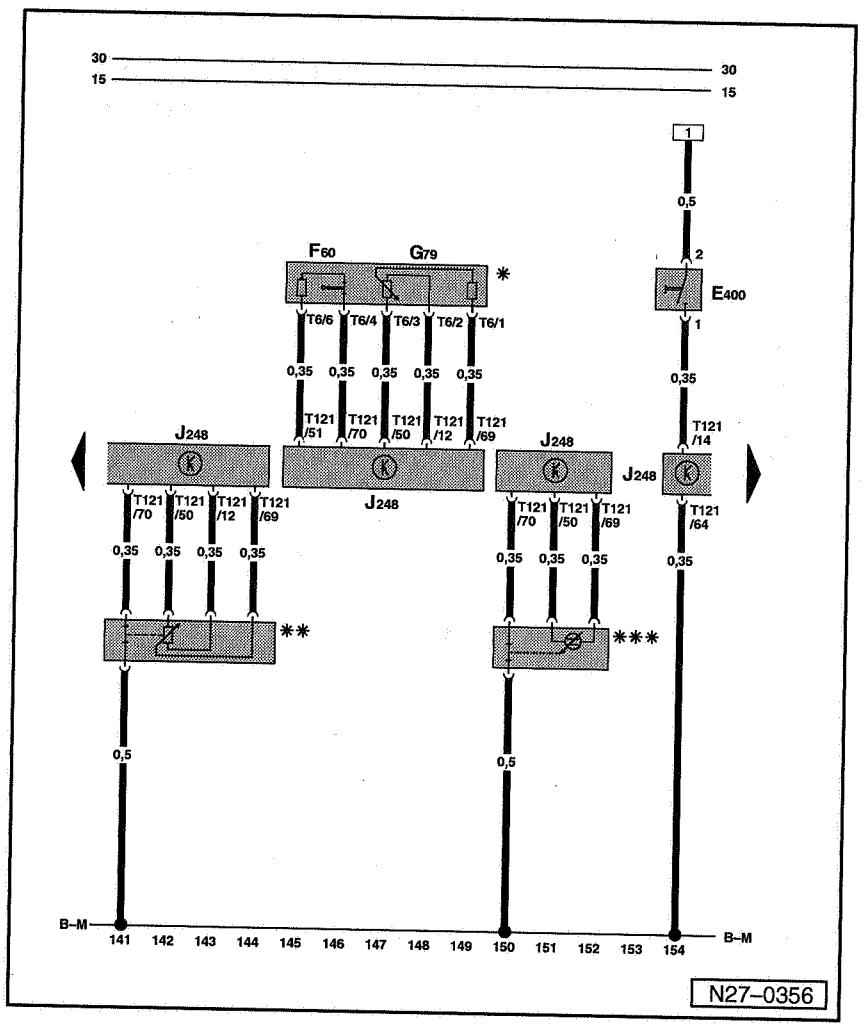
E404 - Idling speed switch
♦ 1800 rpm

J248 - Diesel direct injection system control unit



T121 - Connector, 121-pin

B-M - Battery earth/engine earth



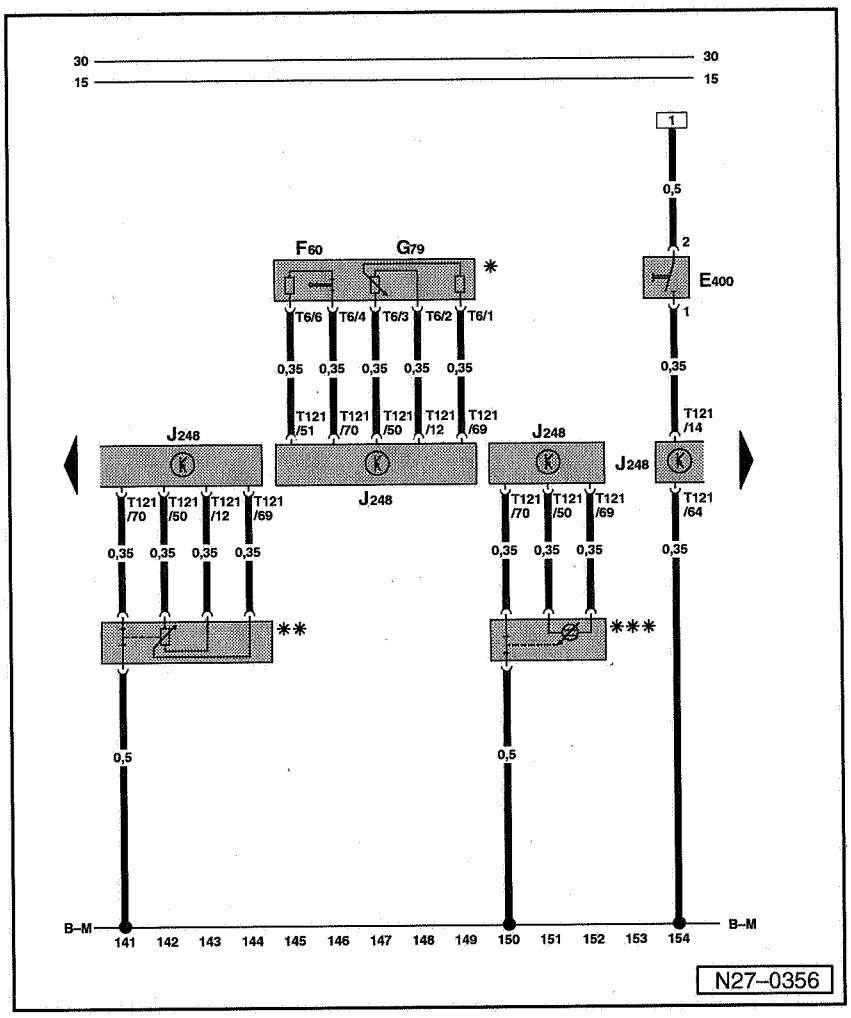
Additional circuit diagram: Data set 1, 2, 3 and 6, drive

Activation of PI control switch, idling speed switch, accelerator pedal position sender

E400 - Activation of PI control switch
- ♦ E400 closed: PI control active
- ♦ E400 open: Dependent on engine control unit coding, PI control or automotive drive active

F60 - Idling speed switch

G79 - Accelerator pedal position sender



J248 - Diesel direct injection system control unit

T6 - Connector, 6-pin

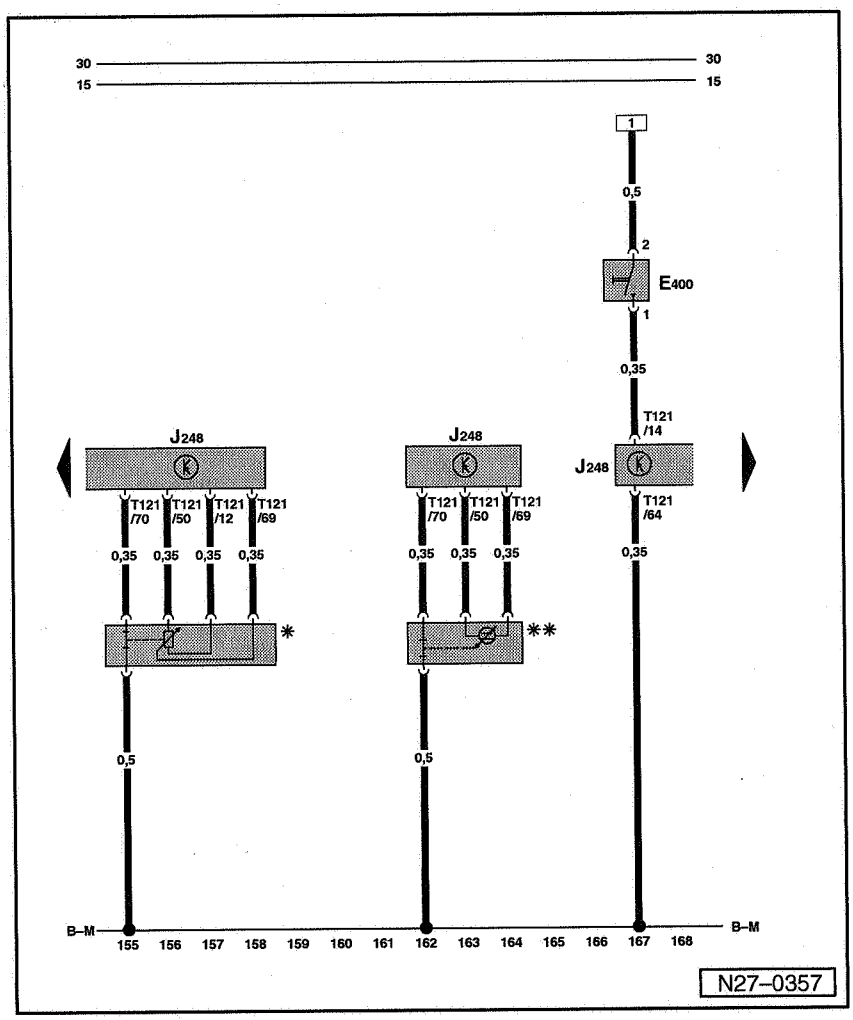
T121 - Connector, 121-pin

B-M - Battery earth/engine earth

* - Selection 1: Accelerator pedal

** - Selection 2: Potentiometer

*** - Selection 3: External voltage source



Additional circuit diagram: Data set 4, 0...5 V interface

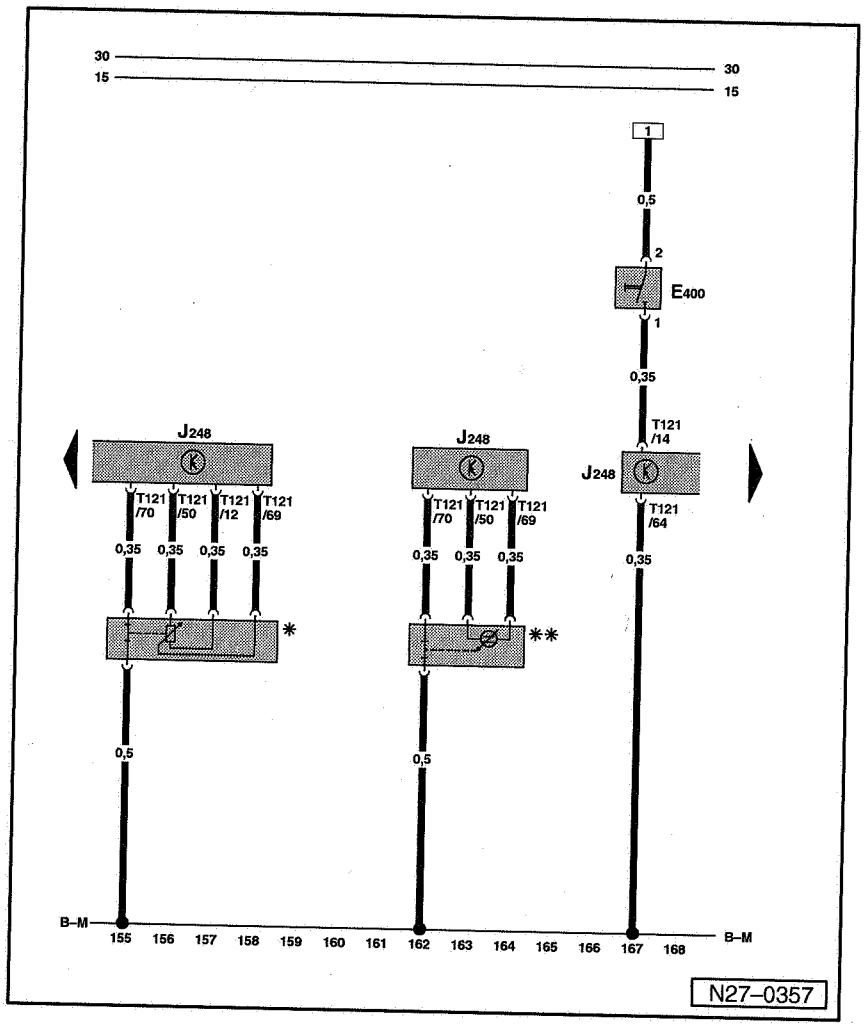
Activation of PI control switch

E400 - Activation of PI control switch
- ♦ E400 closed: PI control with safety concept active
- ♦ E400 open: Dependent on engine control unit coding, active

J248 - Diesel direct injection system control unit

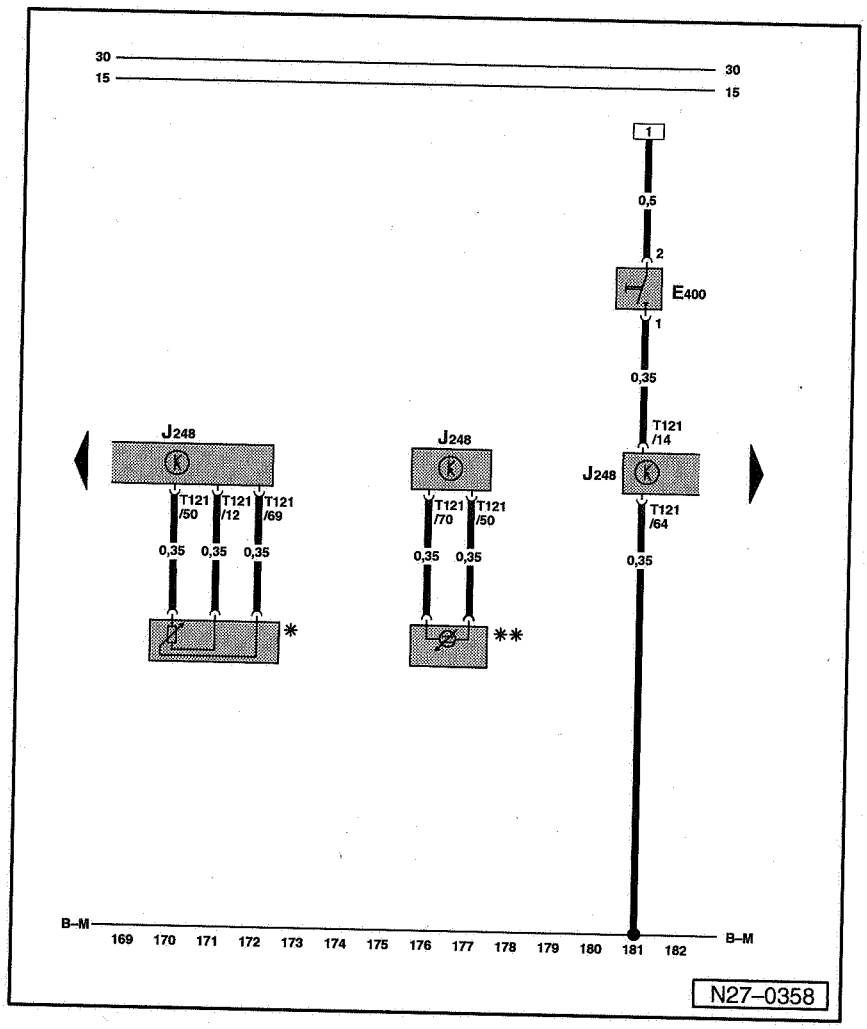
T121 - Connector, 121-pin

B-M - Battery earth/engine earth



* - Selection 1:
Potentiometer

** - Selection 2:
External voltage source



Additional circuit diagram: Data set 5 and 7

Activation of PI control switch

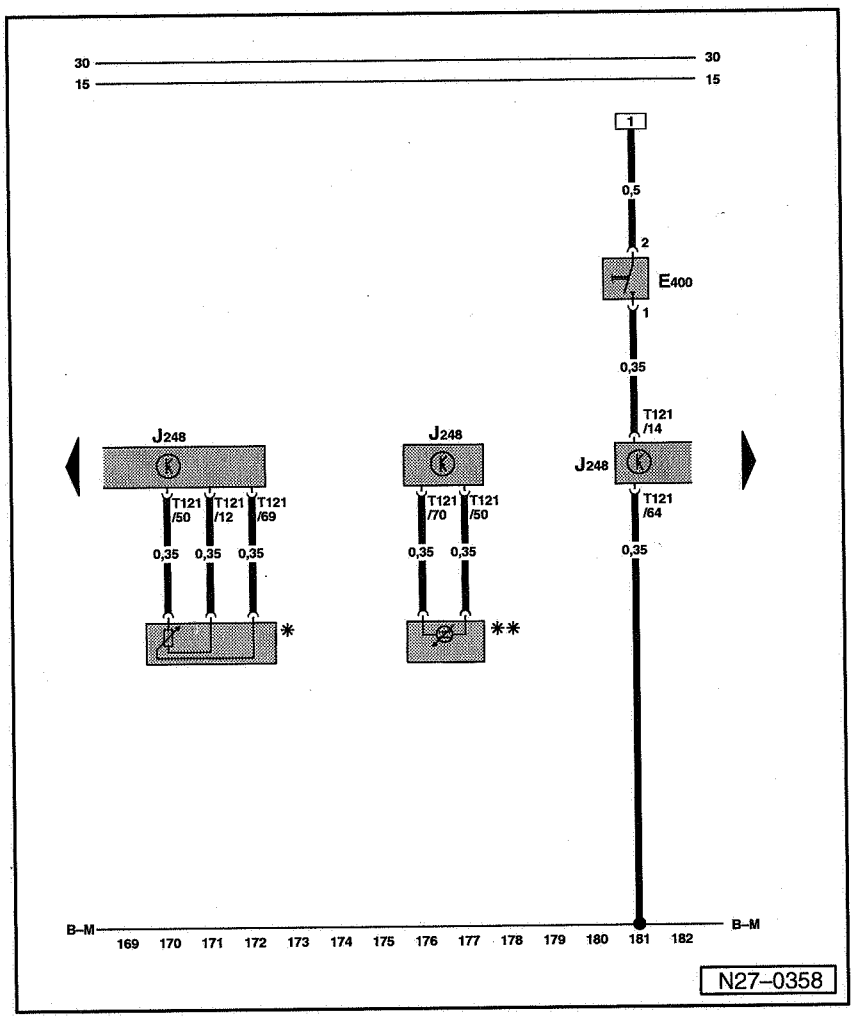
E400 - Activation of PI control switch

Data set 5

- E400 closed:
  PI control without safety concept
- E400 open:
  Dependent on engine control unit coding, active

Data set 7

- E400 closed:
  Speed 1900, 3000, 3100 or 3600 rpm
- E400 open:
  Idling speed



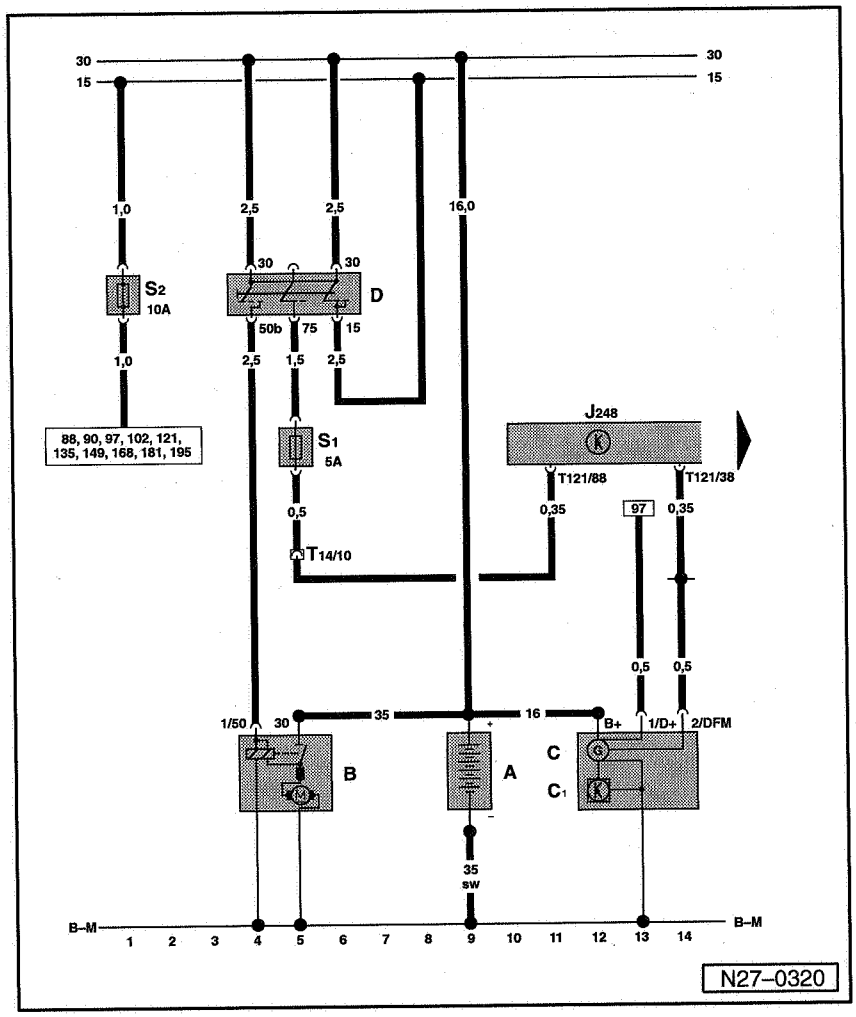
J248 - Diesel direct injection system control unit

T121 - Connector, 121-pin

B-M - Battery earth/engine earth

* - Selection 1: Potentiometer

** - Selection 2: External voltage source



Current flow diagrams: Engine code AVM

Base equipment: Voltage supply, part 1

Battery, starter, alternator, voltage regulator, ignition/starter switch

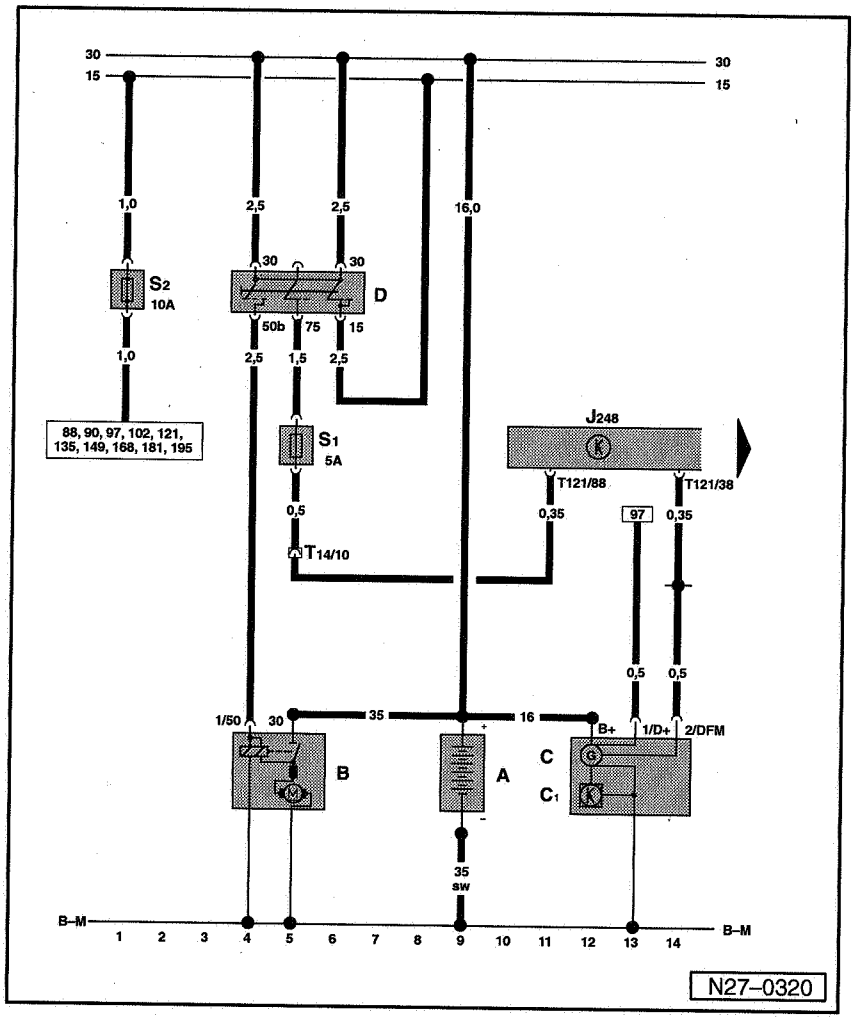
A - Battery

B - Starter

C - Alternator

C1 - Voltage regulator

D - Ignition/starter switch



J248 - Diesel direct injection system control unit

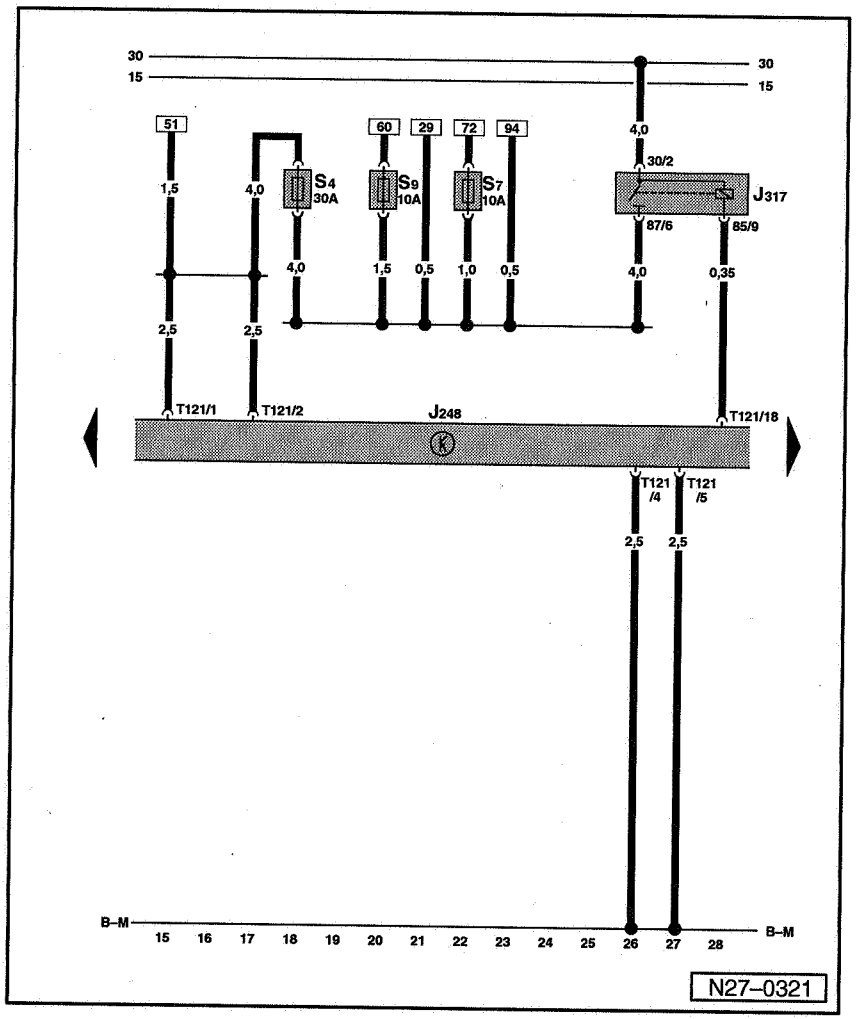
S1 - Fuse 1 (5 A)

S2 - Fuse 2 (10 A)

T14 - Connector, 14-pin

T121 - Connector, 121-pin

B-M - Battery earth/engine earth



Base equipment: Voltage supply, part 2

Voltage supply relay

J248 - Diesel direct injection system control unit

J317 - Voltage supply relay

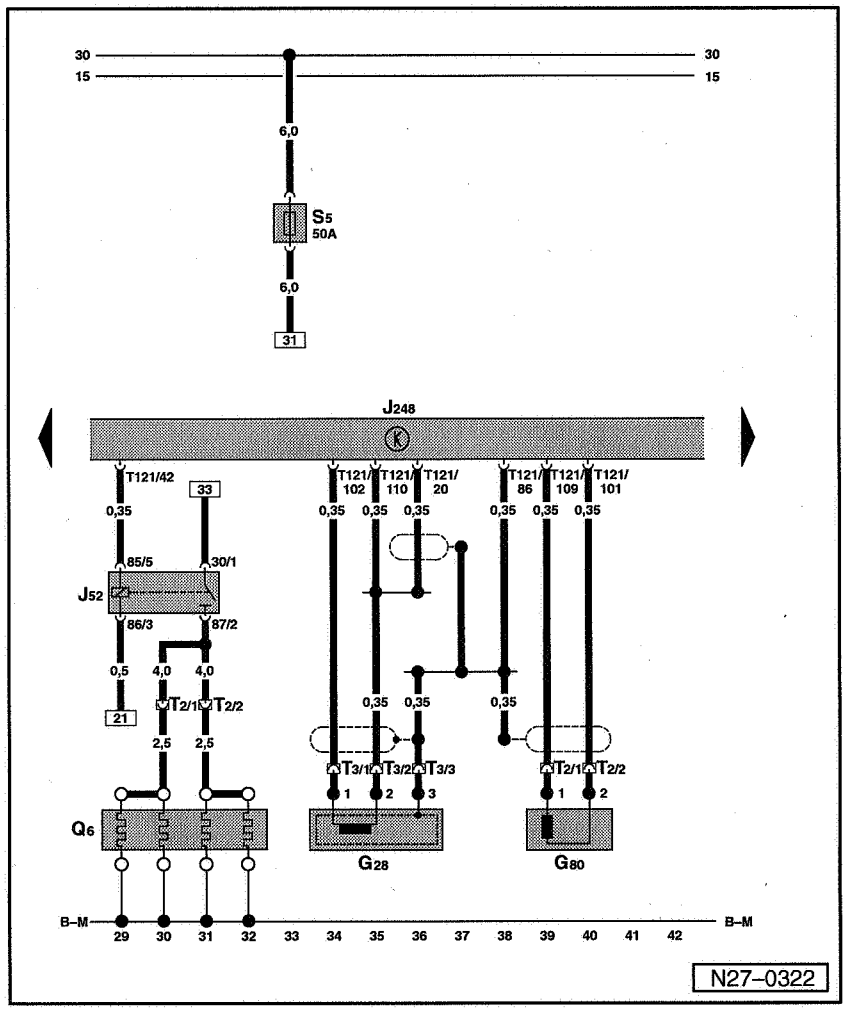
S4 - Fuse 4 (30 A)

S7 - Fuse 7 (10 A)

S9 - Fuse 9 (10 A)

T121 - Connector, 121-pin

B-M - Battery earth/engine earth



Base equipment: Components, part 1

Engine speed sender, needle lift sender, glow plg relay, glow plugs - engine

G28 - Engine speed sender

G80 - Needle lift sender

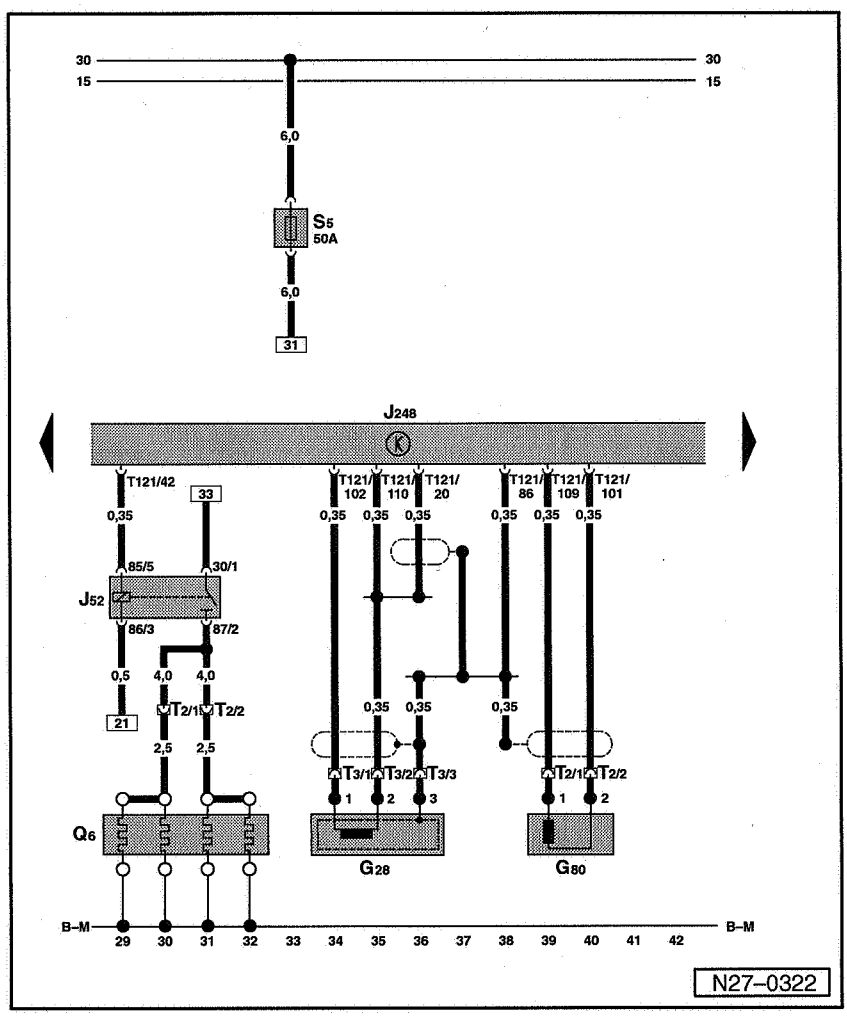
J52 - Glow plug relay

J248 - Diesel direct injection system control unit

Q6 - Glow plugs - engine

S5 - Fuse 5 (50 A)

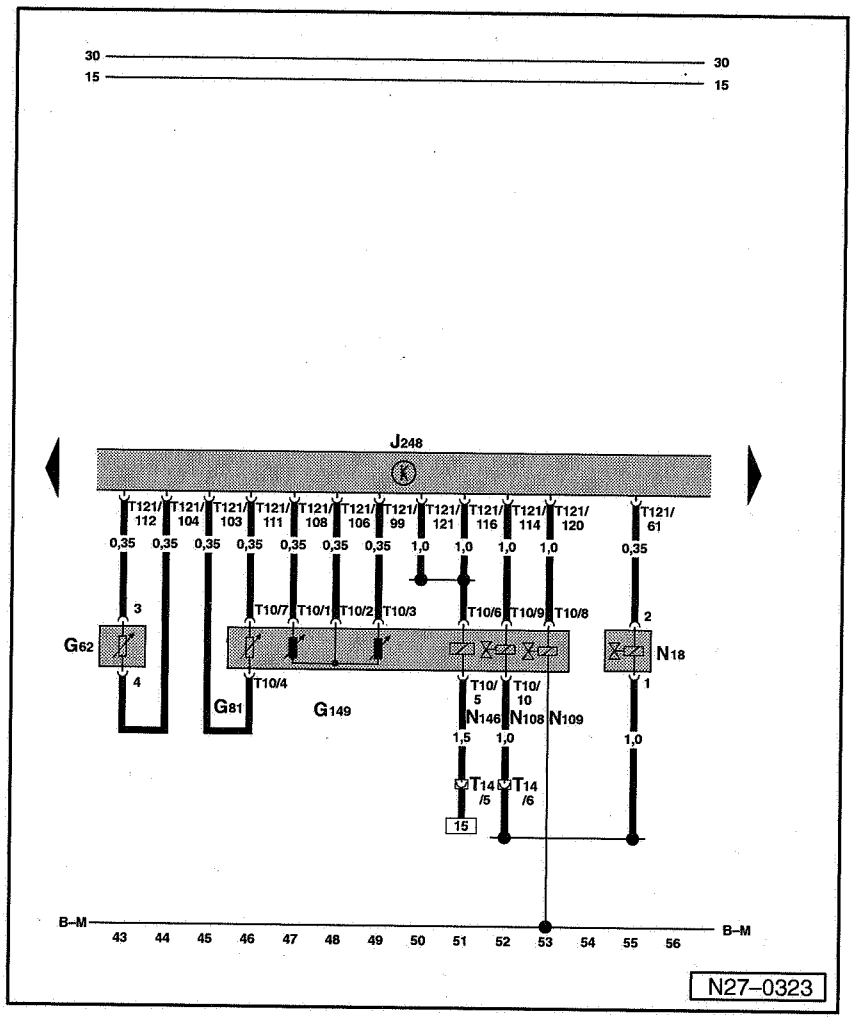
T2 - Connector, 2-pin



T3 - Connector, 3-pin

T121 - Connector, 121-pin

B-M - Battery earth/engine earth



Base equipment: Components, part 2

Coolant temperature sender, fuel temperature sender, modulating piston movement sender, exhaust gas recirculation valve, commencement of injection valve, fuel cut-off valve, quantity adjuster

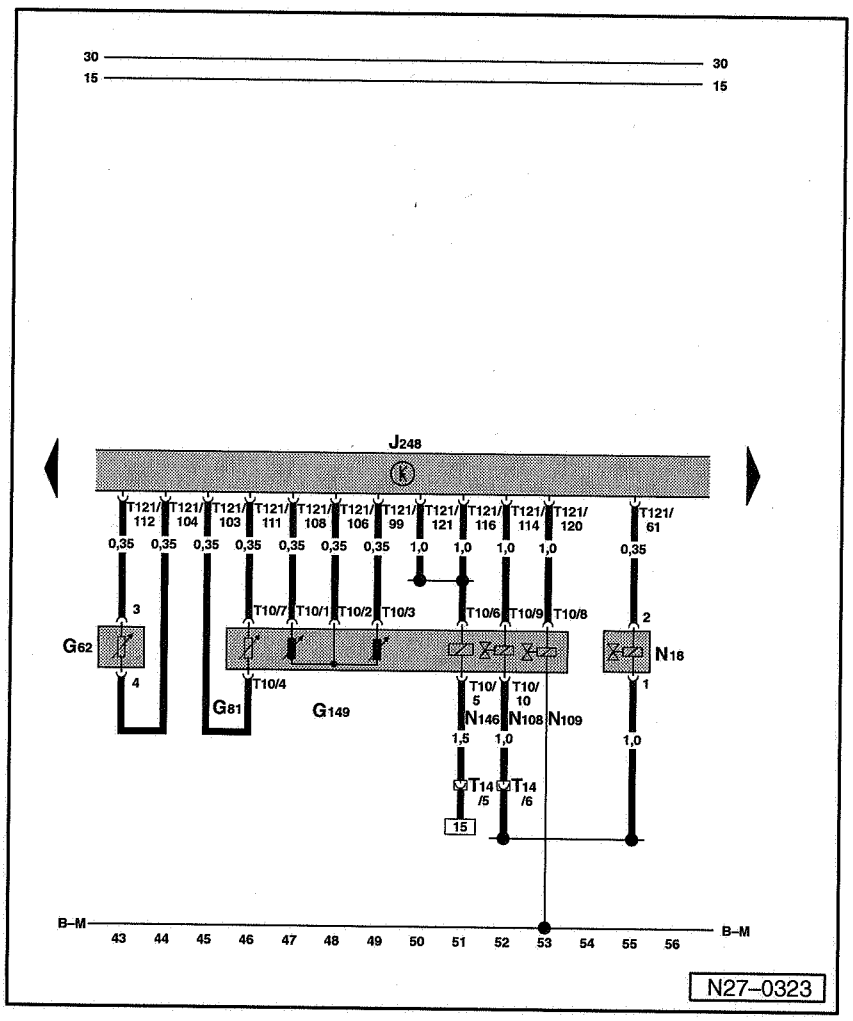
G62 - Coolant temperature sender

G81 - Fuel temperature sender

G149 - Modulation piston movement sender

J248 - Diesel direct injection system control unit

N18 - Exhaust gas recirculation valve



N108 - Commencement of injection valve

N109 - Fuel cut-off valve

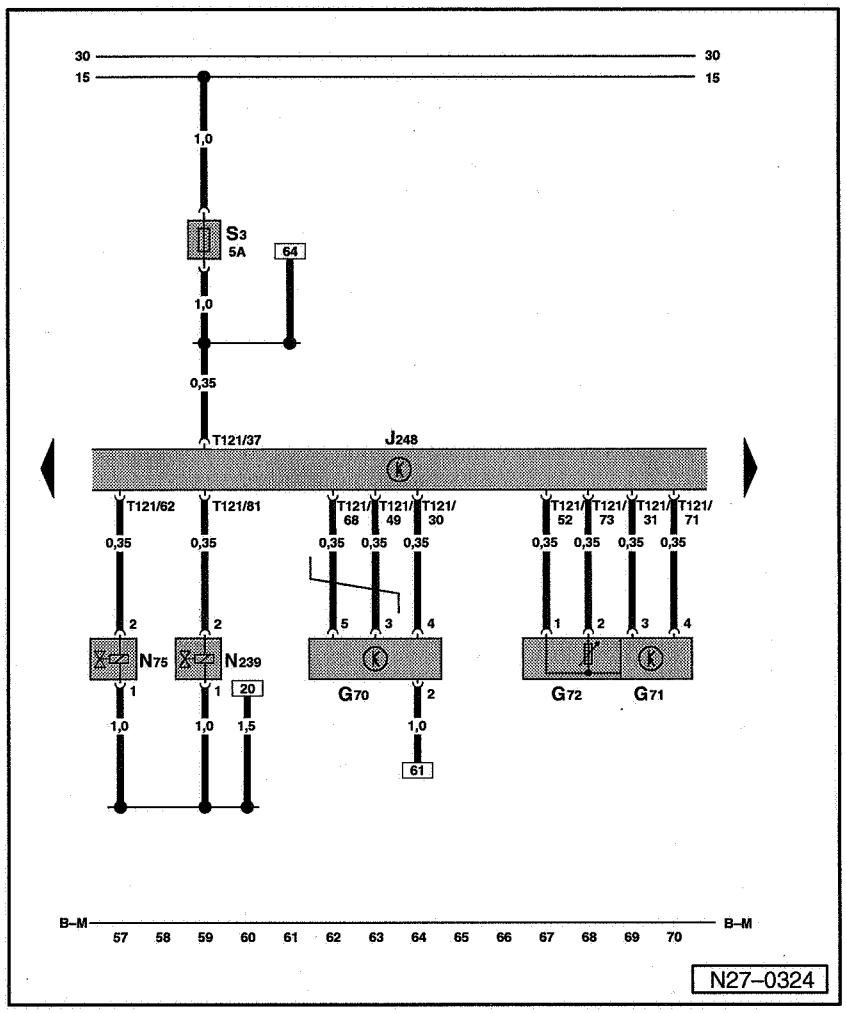
N146 - Quantity adjuster

T10 - Connector, 10-pin

T14 - Connector, 14-pin

T121 - Connector, 121-pin

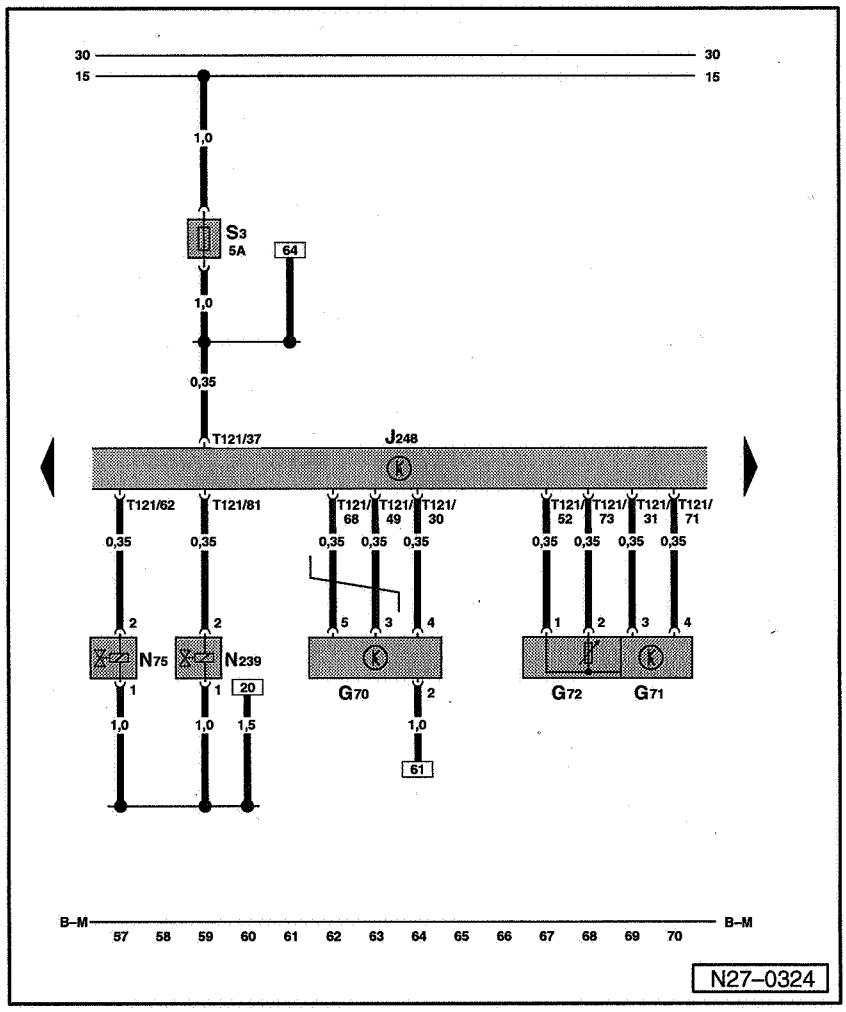
B-M - Battery earth/engine earth



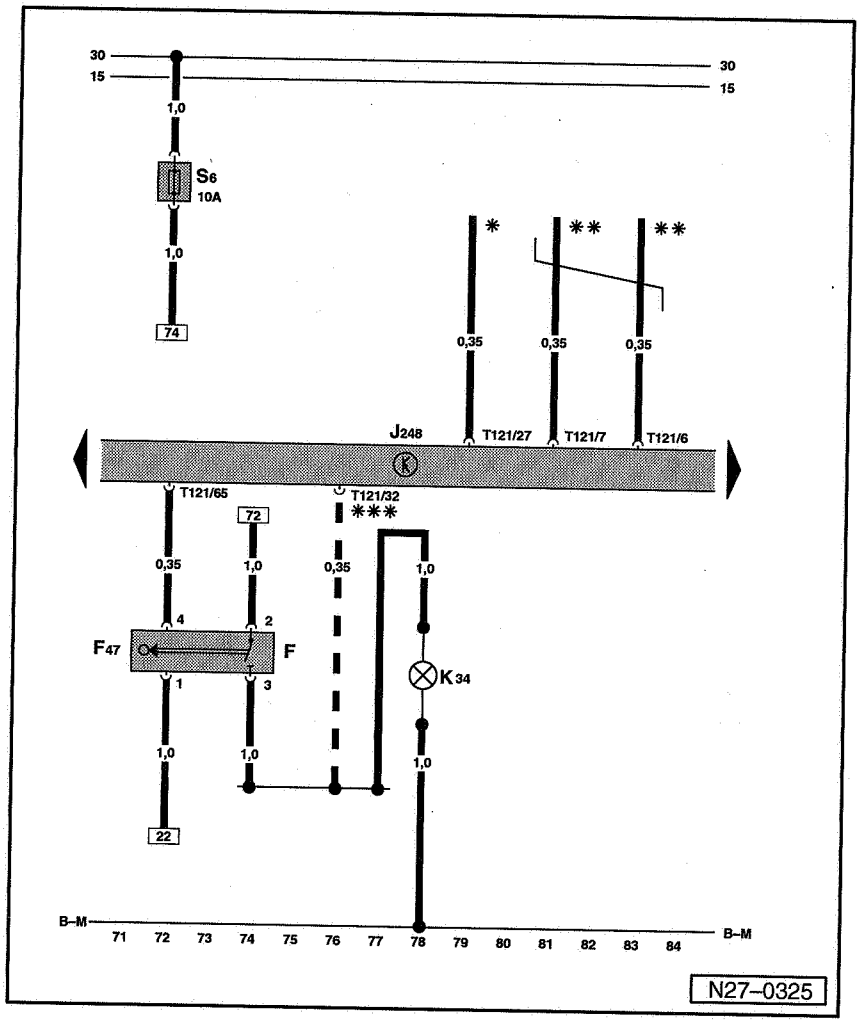
Base equipment: Components, part 3

Air mass meter, intake manifold pressure sender, charge pressure control solenoid valve, intake manifold changeover valve

- G70 - Air mass meter
- G71 - Intake manifold pressure sender
- G72 - Intake manifold temperature sender
- J248 - Diesel direct injection system control unit
- N75 - Charge pressure control solenoid valve



- N239 - Intake manifold changeover valve
- S3 - Fuse 3 (5 A)
- T121 - Connector, 121-pin
- B-M - Battery earth/engine earth



Base equipment: Components, part 4

Brake light switch, brake pedal switch, brake light warning lamp

F - Brake light switch

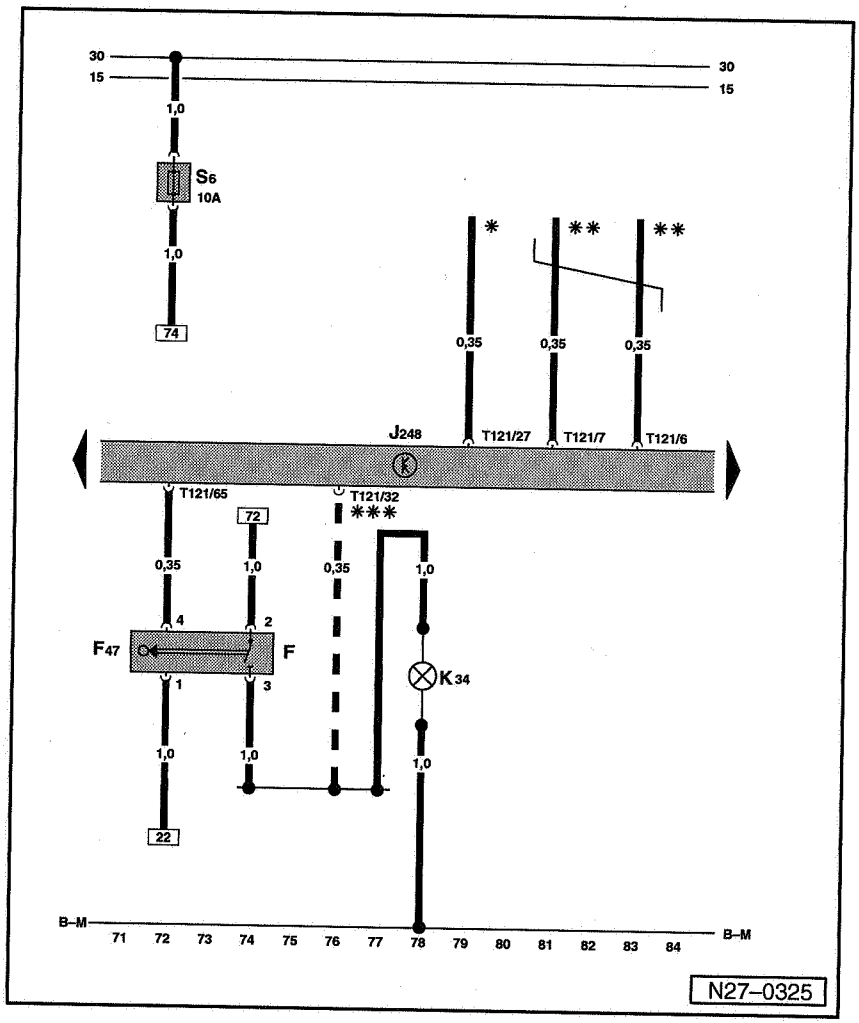
F47 - Brake pedal switch

J248 - Diesel direct injection system control unit

K34 - Brake light warning lamp

S6 - Fuse 6 (10 A)

T121 - Connector, 121-pin

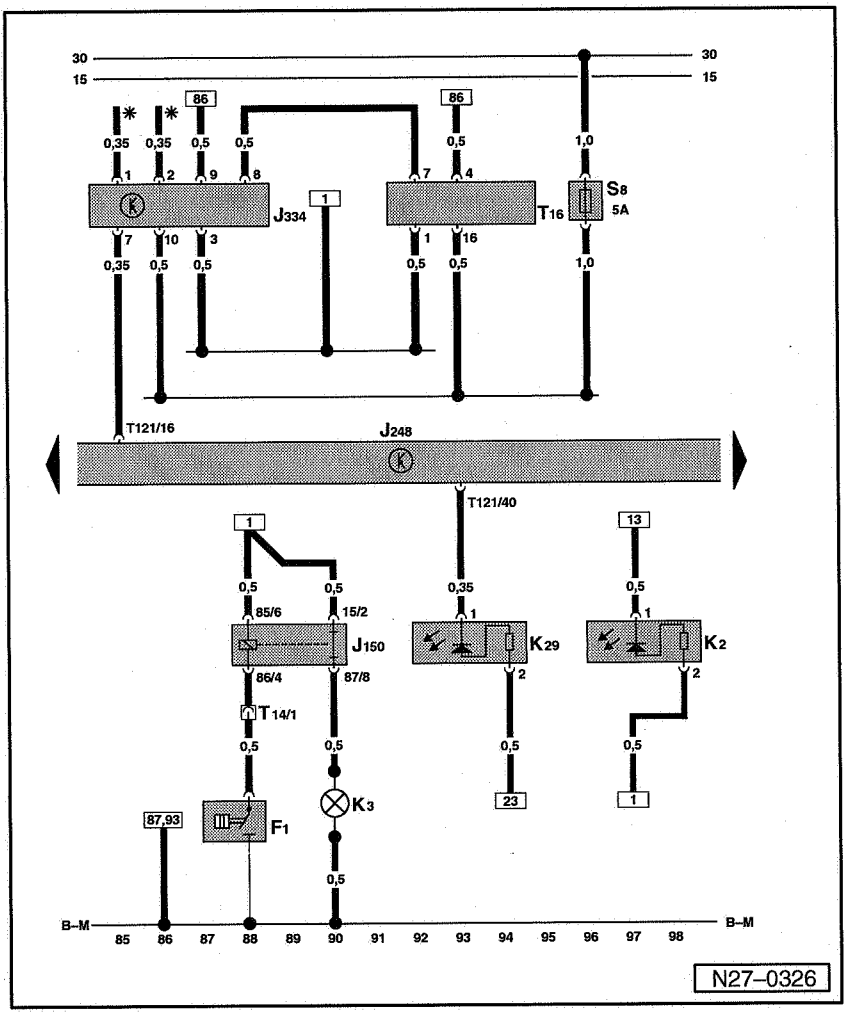


B-M - Battery earth/engine earth

* - Speed signal connection

** - Datenbus connection:
T121/6 CAN_low,
T121/7 CAN_high

*** - Data set connection: 1...6
♦ Stationary operation



Additional circuit diagram: Components

Oil pressure switch, oil pressure monitor delay relay, immobilizer control unit, warning lamps

F1 - Oil pressure swicth

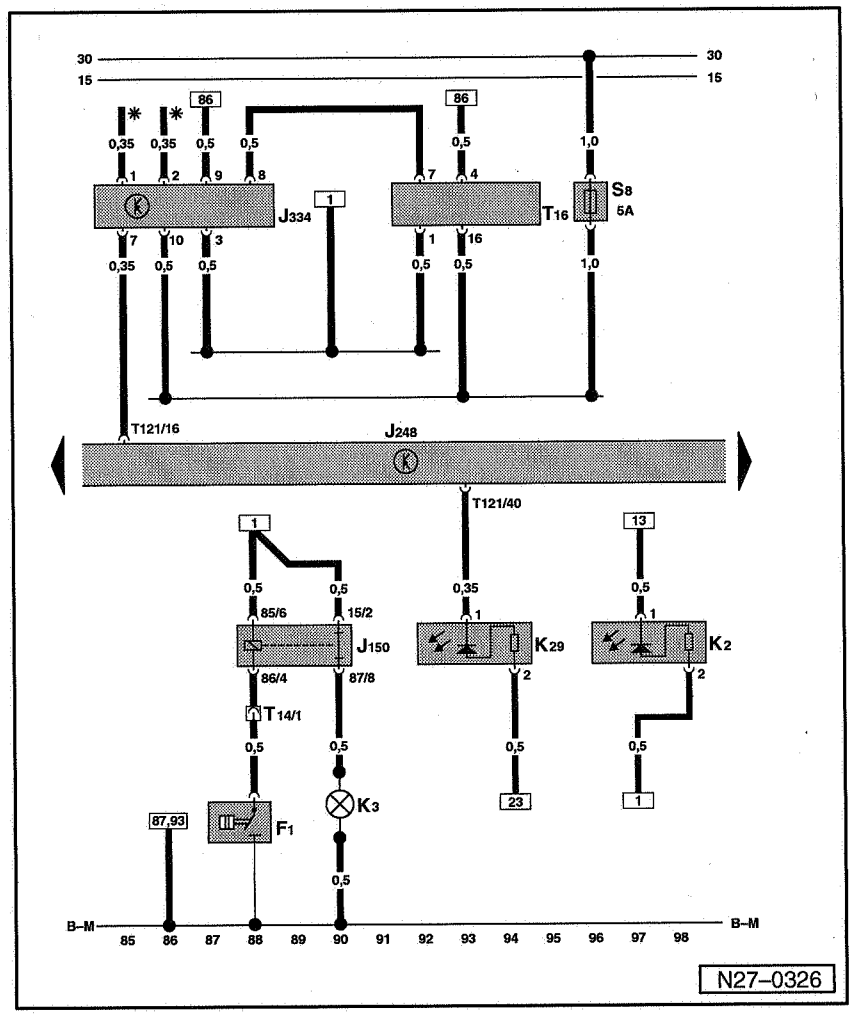
J150 - Oil pressure monitor delay relay

J248 - Diesel direct injection system control unit

J334 - Immobilizer control unit

K2 - Alternator warning lamp

K3 - Oil pressure warning lamp



K29 - Glow period warning lamp

S8 - Fuse 8 (5 A)

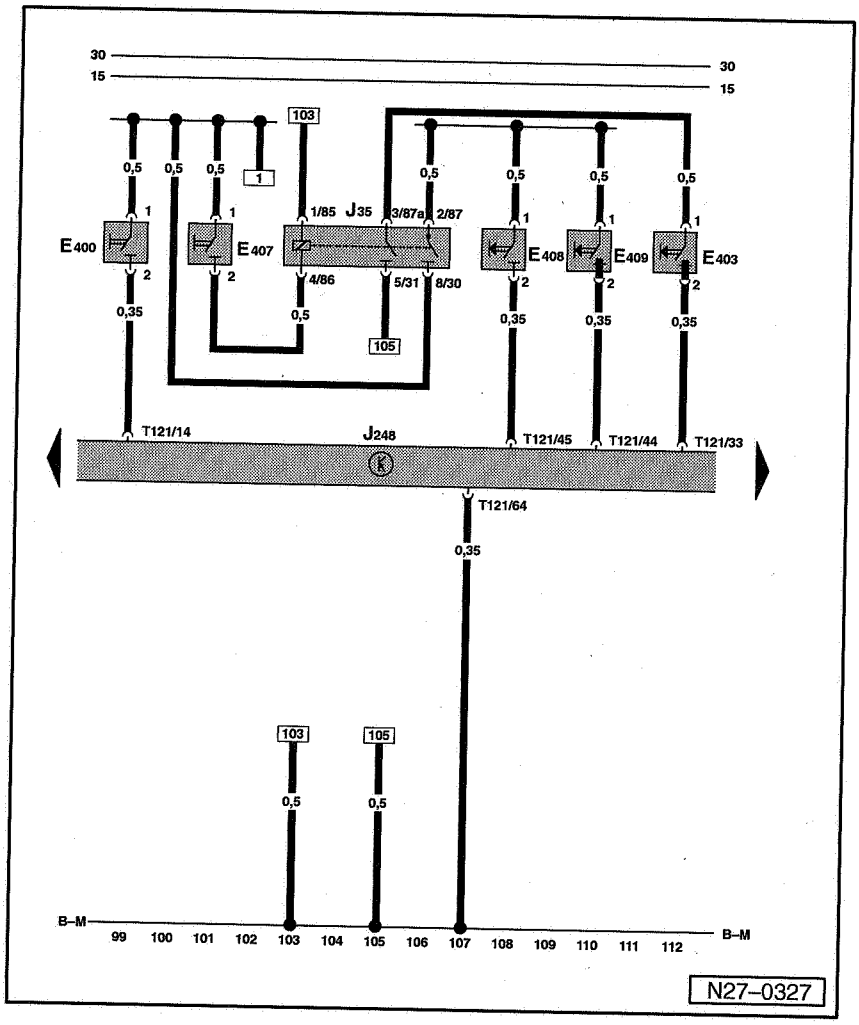
T14 - Connector, 14-pin

T16 - 16-pin connector, diagnosis connection

T121 - Connector, 121-pin

B-M - Battery earth/engine earth

* - Datenbus connection:
1 CAN_low,
2 CAN_high



Additional circuit diagram: Working speed governor (WSG), part 1

Switches, buttons, speed relays

E400 - Switch for activation of working speed governor when engine started

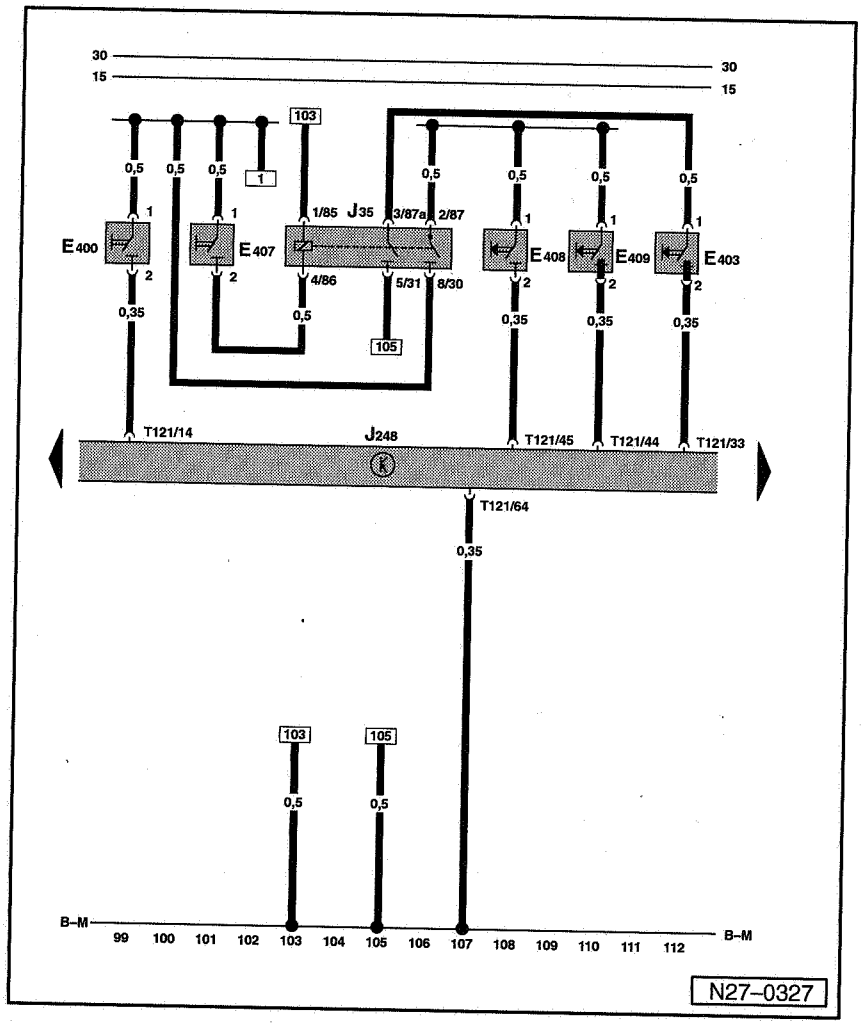
E403 - Working speed governor button (restart)

E407 - Safety contact switch

E408 - TIP DOWN button

E409 - TIP UP button

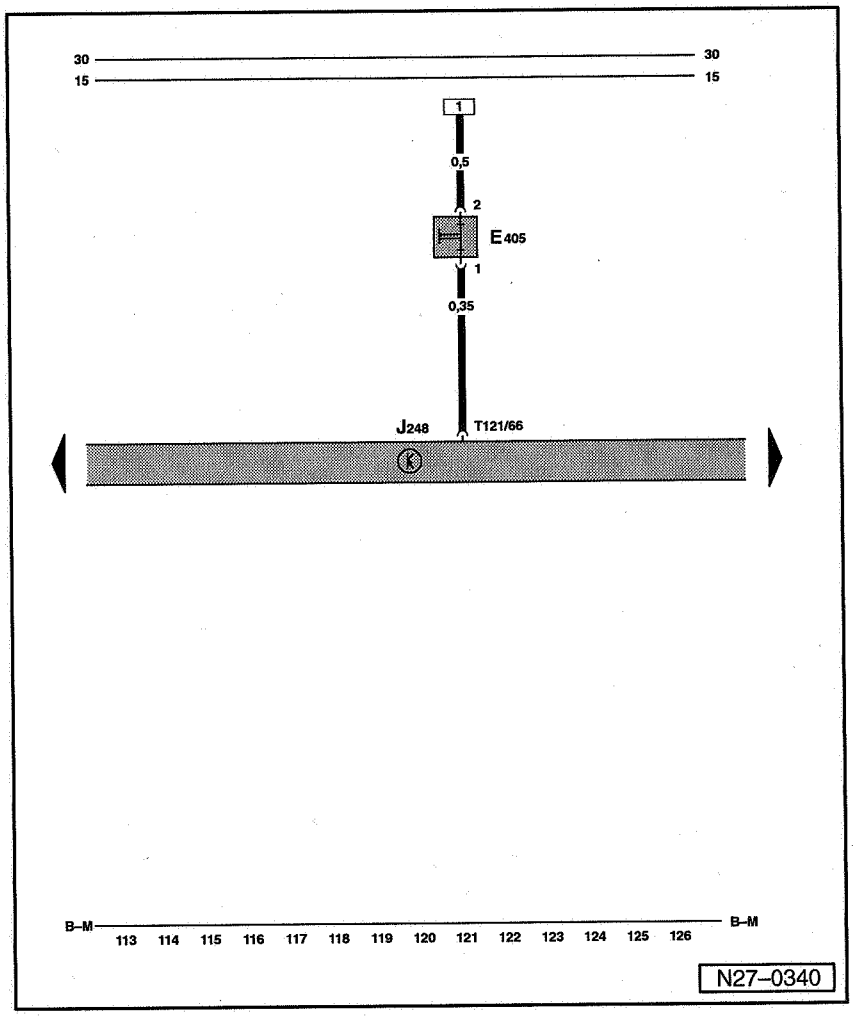
J35 - Speed relay



J248 - Diesel direct injection system control unit

T121 - Connector, 121-pin

B-M - Battery earth/engine earth



Additional circuit diagram: Working speed governor (WSG), part 2

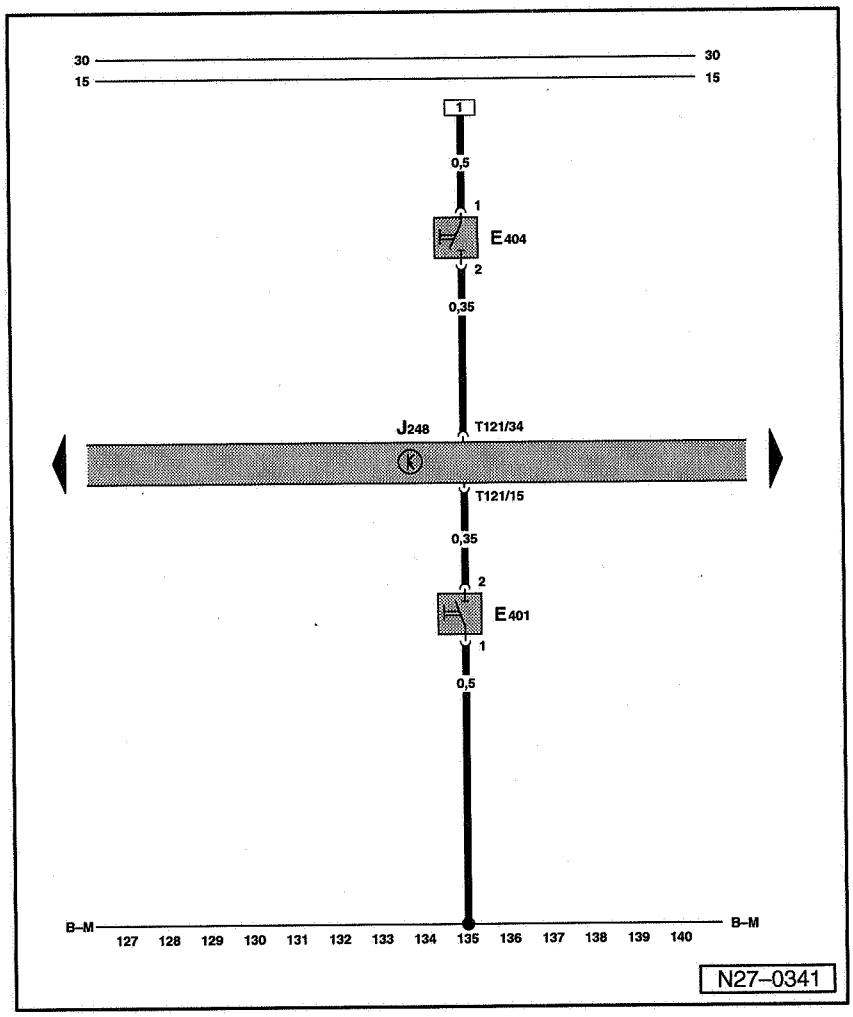
Swicthes

E405 - Idling switch
"harder"/"softer"
♦ E405 shut:
"harder" idling activated
♦ E405 open:
"softer" idling activated

J248 - Diesel direct injection system control unit

T121 - Connector, 121-pin

B-M - Battery earth/engine earth



Additional circuit diagram: Working speed governor (WSG), part 3

Swicthes

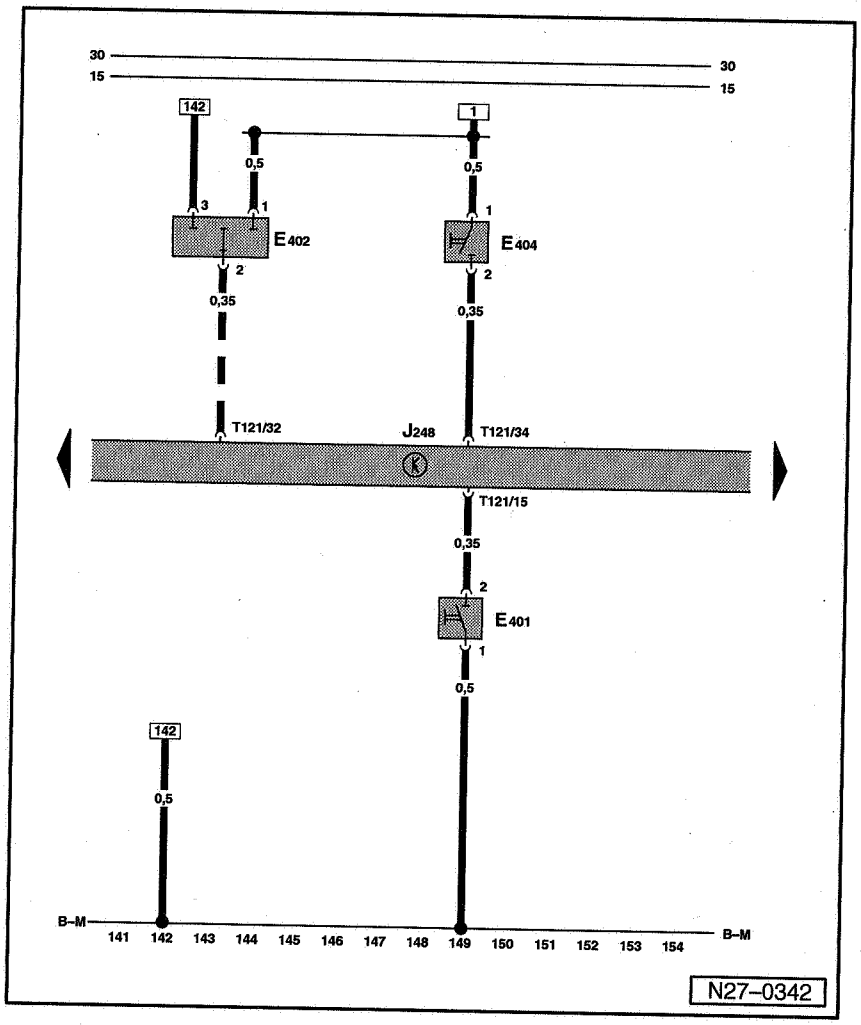
E401 - Increased idling speed switch
♦ 1100 rpm

E404 - Increased idling speed
♦ 1900 rpm

J248 - Diesel direct injection system control unit

T121 - Connector, 121-pin

B-M - Battery earth/engine earth



Additional circuit diagram: Data set 7, stationary operation

Note:

Data set 1...6 (stationary operation) ⇒ page 27-53, Base equipment: Components, part 4.

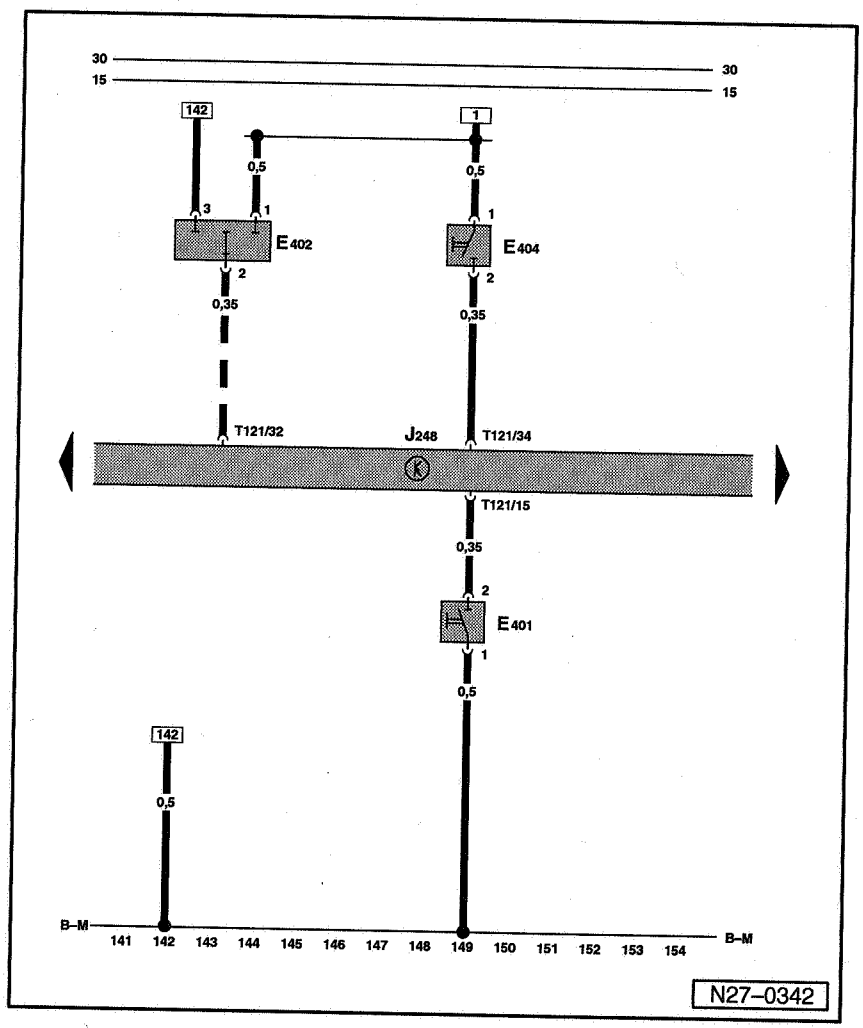
Swicthes

E401 - Idling speed switch
♦ 1500 rpm

E402 - Idling speed switch
♦ 1200 rpm

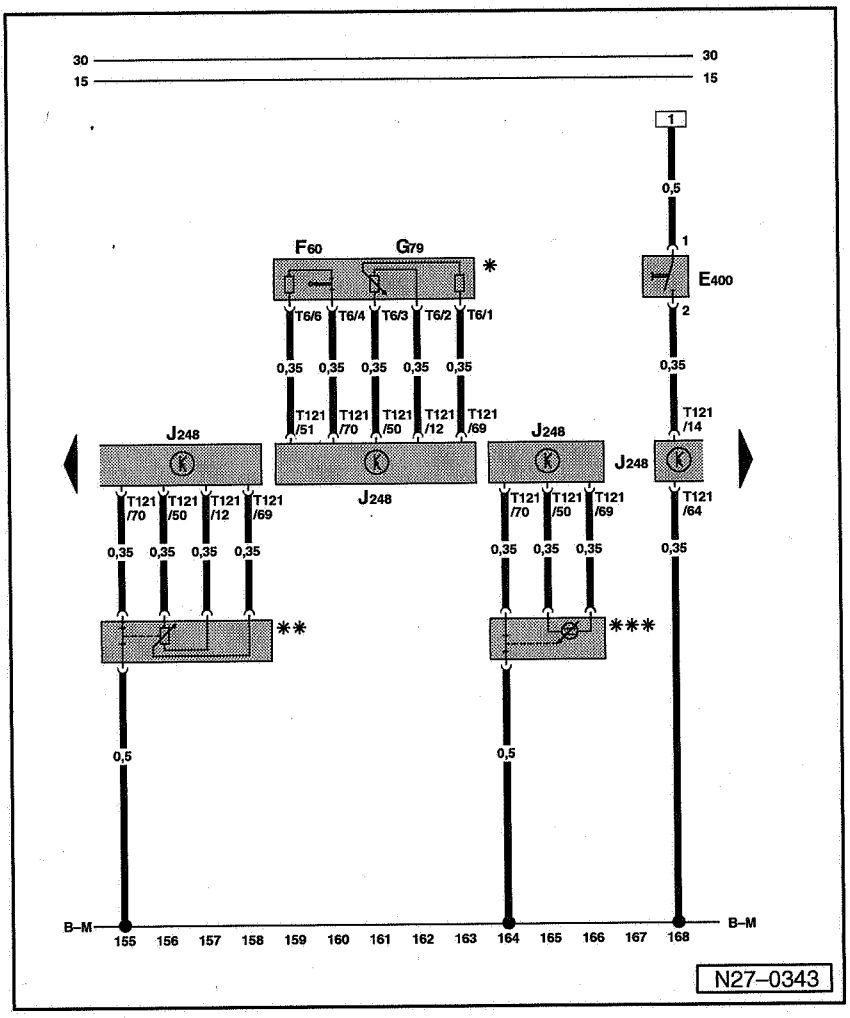
E404 - Idling speed switch
♦ 1800 rpm

J248 - Diesel direct injection system control unit



T121 - Connector, 121-pin

B-M - Battery earth/engine earth



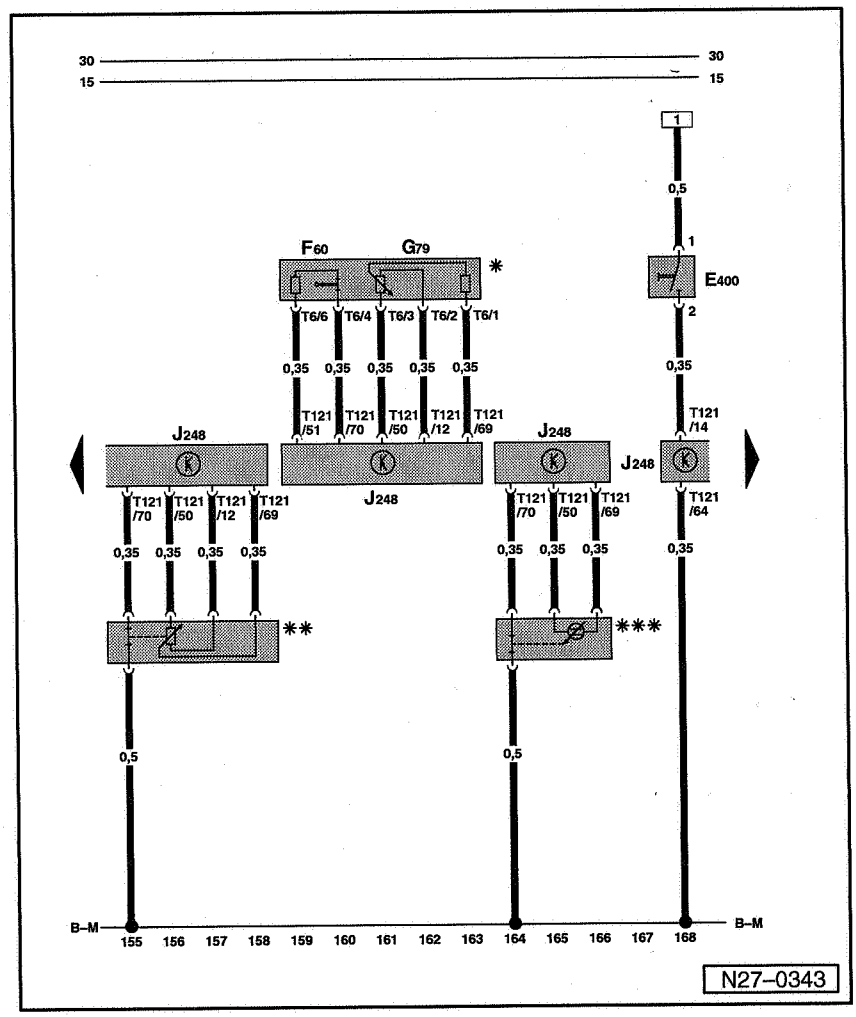
Additional circuit diagram: Data set 1, 2, 3 and 6, drive

Activation of PI control switch, idling speed switch, accelerator pedal position sender

E400 - Activation of PI control switch
- ♦ E400 closed: PI control active
- ♦ E400 open: Dependent on engine control unit coding, PI control or automotive drive active

F60 - Idling speed switch

G79 - Accelerator pedal position sender



J248 - Diesel direct injection system control unit

T6 - Connector, 6-pin

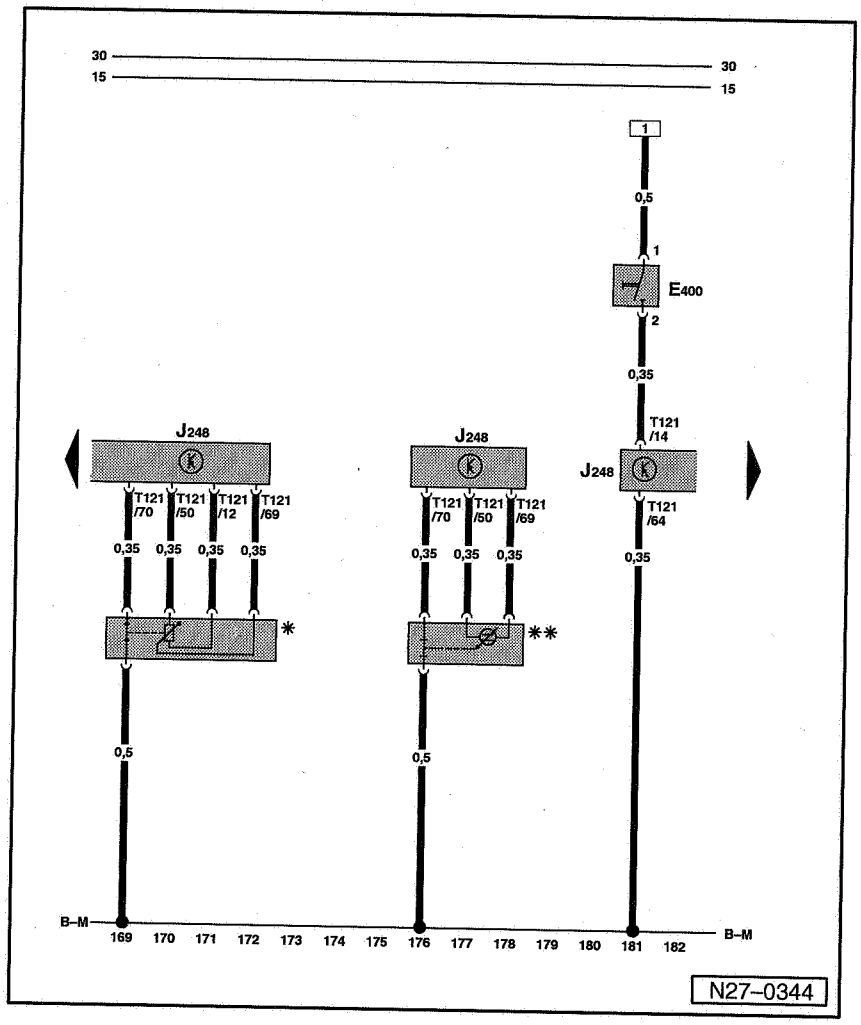
T121 - Connector, 121-pin

B-M - Battery earth/engine earth

* - Selection 1: Accelerator pedal

** - Selection 2: Potentiometer

*** - Selection 3: External voltage source



Additional circuit diagram: Data set 4, 0...5 V interface

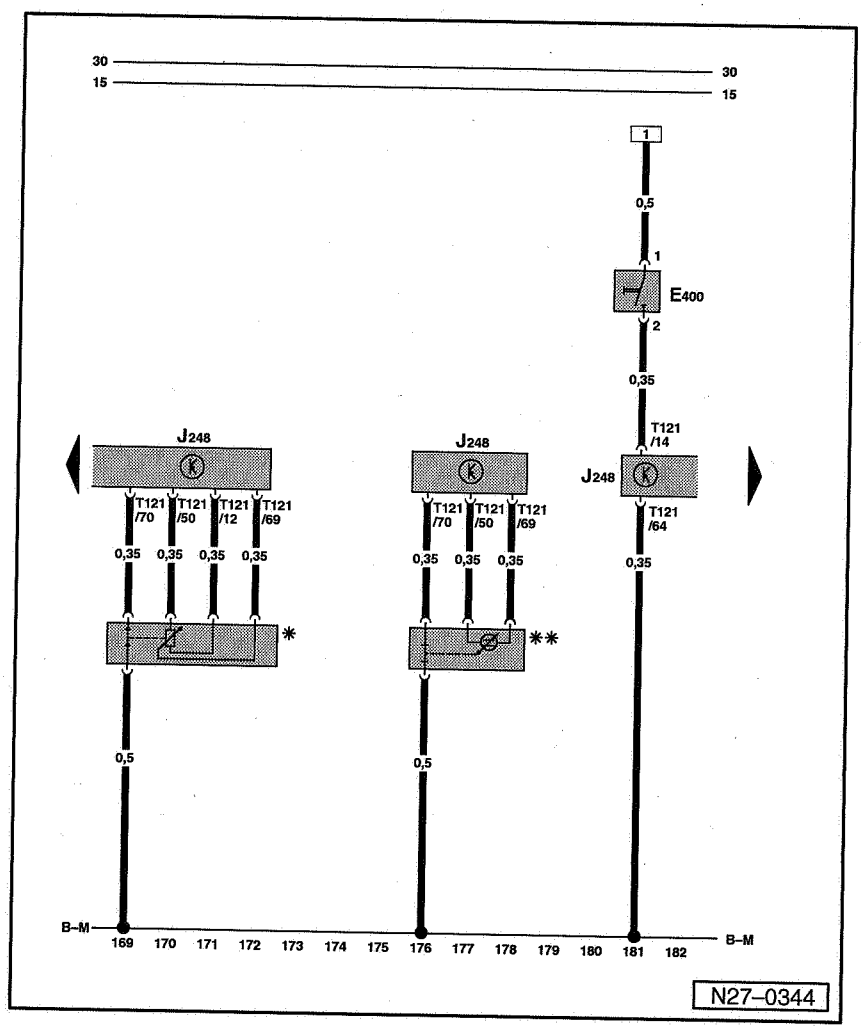
Activation of PI control switch

E400 - Activation of PI control switch
- ♦ E400 closed: PI control with safety concept active
- ♦ E400 open: Dependent on engine control unit coding, active

J248 - Diesel direct injection system control unit

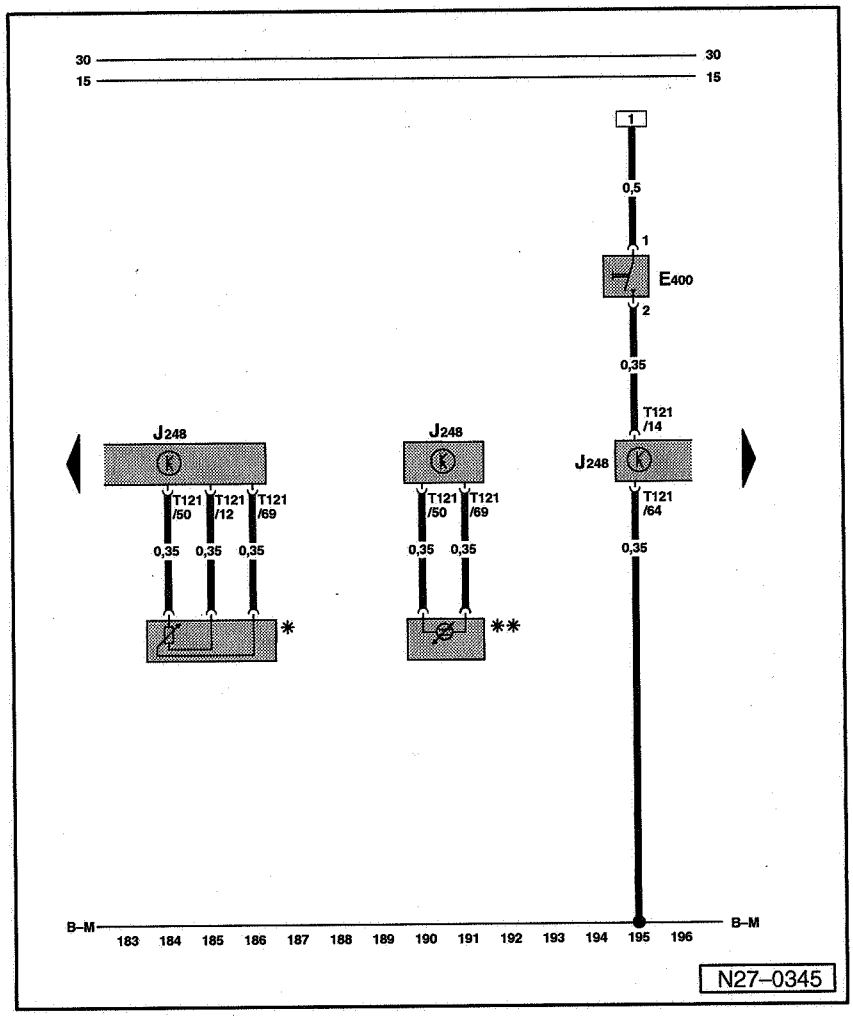
T121 - Connector, 121-pin

B-M - Battery earth/engine earth



* - Selection 1: Potentiometer

** - Selection 2: External voltage source



Additional circuit diagram: Data set 5 and 7

Activation of PI control switch

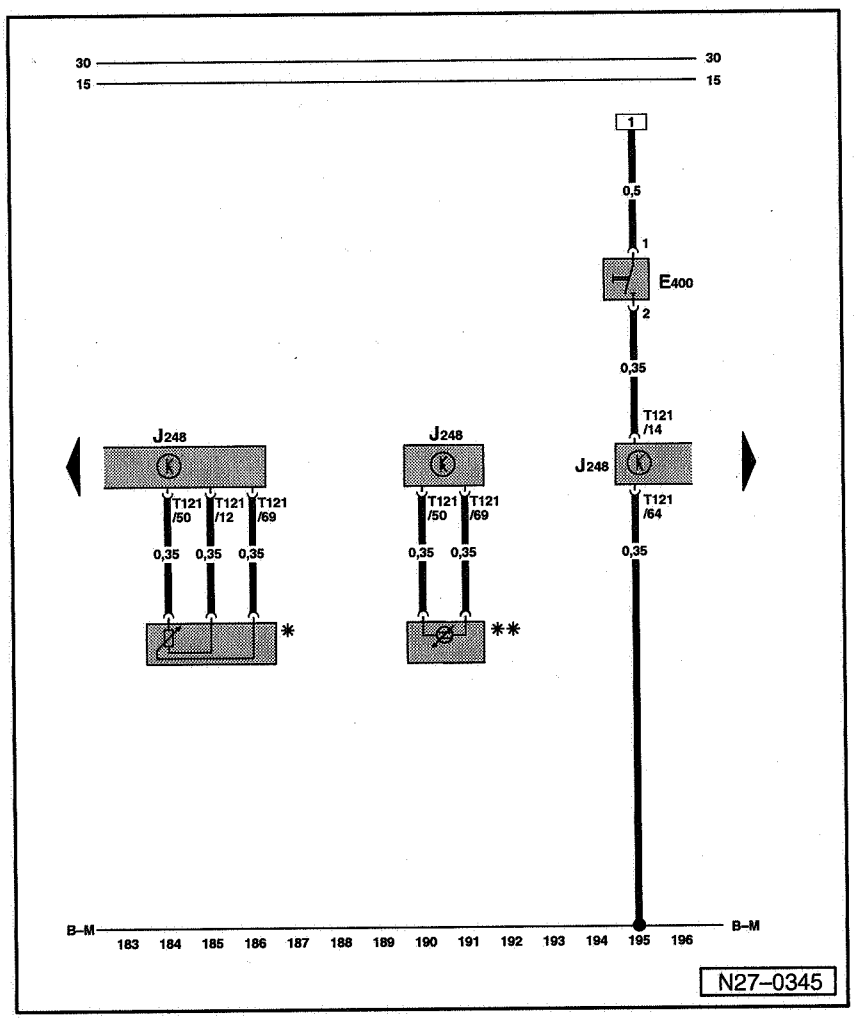
E400 - Activation of PI control switch

Data set 5

- ♦ E400 closed: PI control without safety concept
- ♦ E400 open: Dependent on engine control unit coding, active

Data set 7

- ♦ E400 closed: Speed 1900, 3000, 3100 or 3600 rpm
- ♦ E400 open: Idling speed



J248 - Diesel direct injection system control unit

T121 - Connector, 121-pin

B-M - Battery earth/engine earth

* - Selection 1: Potentiometer

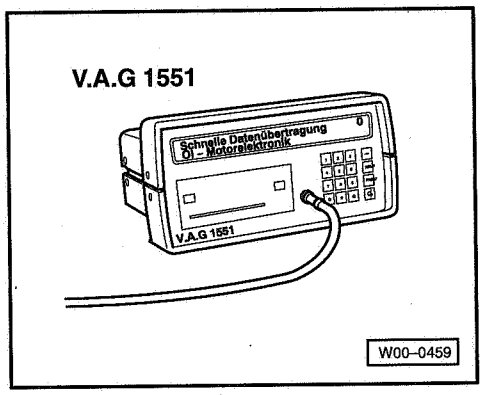
** - Selection 2: External voltage source

Current flow diagrams: Engine code BEQ

The relevant current flow diagrams will be released at a later date.

Checking glow plug system

Special tools, workshop equipment, testers, measuring instruments and auxiliary items required



♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/3

Note:

All functions which could previously be performed with V.A.G 1551/1552 can also be performed with the new tester VAS 5051.

♦ Hand multimeter V.A.G 1526 or multimeter V.A.G 1715

♦ Adapter set V.A.G 1594

♦ Current flow diagram

Check conditions

- The 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
  ⇒ Page 01-11, interrogating fault memory

Test sequence

- Pull glow plug connectors off glow plugs.

- Connect multimeter to measure voltage between a glow plug connector and battery/engine earth.

- Carry out final control diagnosis and activate the glow plug relay (J52) ⇒ page 01-53, Final control diagnosis.

Final control diagnosis Glow plug relay -J52	→	◄

Indicated on display:

The voltage must fluctuate between 0.0 V and approx. battery voltage.

- Proceed with final control diagnosis until completed.

- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.

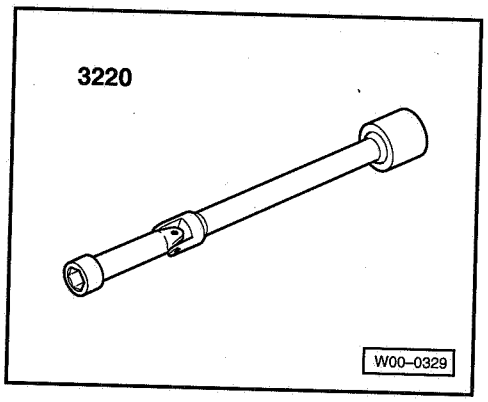
- Switch off ignition.

If the voltage values do not change as described:

- Repair the fault in the wiring to glow plug relay (J52) using current flow diagram ⇒ page 27-20, Current flow diagrams.

- Finally interrogate the fault memory of the new engine control unit and erase the fault memory if necessary ⇒ page 01-11, Interrogating fault memory.

Checking glow plugs



Special tools, workshop equipment, testers, measuring instruments and auxiliary items required

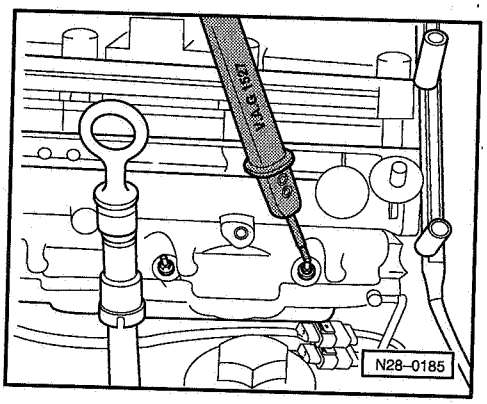
- ♦ 3220 Jointed socket
- ♦ V.A.G 1527 Diode test lamp
- ♦ V.A.G 1594 A Auxiliary test set

Test conditions

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

Test sequence

- Pull glow plug connectors off glow plugs.



◄ - Connect diode test lamp wire using auxiliary clips from auxiliary cable set to battery positive (+).

- Place diode test lamp probe on each glow plug one after the other.
  Diode lights up: glow plug OK.
  Diode does not light up: replace glow plug.
- Remove and install glow plugs with jointed spanner 3220.
  Tightening torque: 15 Nm.