

Audi 100 1991 ➤

Diesel direct injecton and glow plug system (TDI 4-cyl.)

Engine ID	1Z	AHU							
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List of Workshop Manual Repair GroupsList of Workshop Manual Repair GroupsList of Workshop Manual Repair Groups Audi 100 1991 ➤

Diesel direct injecton and glow plug system (TDI 4-cyl.)

Repair Group

01 - Self diagnosis

23 - Mixture preparation, Injection

28 - Glow plug system

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

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01 - Self diagnosis

1 - Self-diagnosis

1.1 - Self-diagnosis

1.2 - Technical data of self-diagnosis

Equipped with

- ◆ Fault memory: Non-volatile memory (maximum of 5 different faults) 1)
 - 1) Will be cancelled after 50th engine start if fault has not occurred again.
- ◆ Rapid data transfer

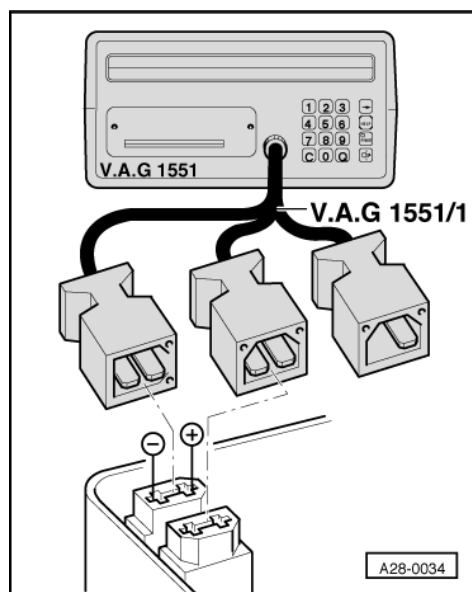
1.3 - Safety notes

Note the following points if test equipment has to be used during a road test:
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Warning

- ◆ Test equipment must always be secured on the rear seat and operated by a second person.
- ◆ If test equipment is operated from the front passenger seat, the occupant could be injured by the passenger's airbag in an accident.

1.4 - Connecting fault reader V.A.G 1551 and selecting engine electronics control unit





Requirements for test:

- Supply voltage of electrical system OK
- Fuses OK

=> Current flow diagrams, Electrical fault-finding and Fitting locations

- Remove cover from relay panel with fuse holder in plenum chamber.
- -> Connect fault reader V.A.G 1551 or vehicle system tester V.A.G 1552 to diagnostic connectors on relay panel as follows using cable V.A.G 1551/1:
- Fit black cable connector to black diagnostic connector.

-> Indicated in display

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

- 1) appears alternately

Note:

If the display remains blank, test the voltage supply and wiring using the current flow diagram.

- Fit white cable connector to white diagnostic connector. (The blue connector is not used.)

Depending on the function required, see table of selectable functions => Page 3 .

- Switch on ignition.

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- Start the engine.
- Press PRINT key to switch on printer (indicator lamp in key lights up).
- Press key 1 for "Rapid data transfer".

-> Indicated on display:

Rapid data transfer	HELP
Enter address word XX	

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

-> The display on fault reader V.A.G 1551 will show the control unit identification. For example:

028906021A	1.9l	R4	EDC
SG	D ..		
Coding 00000	WSC 00000		

Note:

The control unit identification can be printed out by pressing the PRINT key on fault reader V.A.G 1551.

Control unit identification (example)

- | | |
|-----------------|----------------------------------|
| - 028 906 021 A | Part No. |
| | (see also Parts List) |
| - 1.9 ltr. | Engine capacity |
| - R4 | In-line engine, 4 cylinders |
| - EDC | Electronic Diesel Control |
| - AG | Automatic gearbox |
| - SG | Manual gearbox |
| - D .. | Software version of control unit |
| - Coding 00000 | Control unit coding |

- WSC 00000 Workshop Code of V.A.G 1551 which was used to perform the last coding

- Press ⇒key.

-> Indicated on display:

Rapid data transfer HELP
Select function XX

Notes:

-> If the following message appears on the display:

Rapid data transfer HELP
Control unit does not answer!

- ◆ Open circuit in K-wire at immobilizer control unit
- ◆ Open circuit in diagnostic wiring
- ◆ Fault in voltage supply to control unit
- ◆ Diesel direct injection system control unit defective

-> If the following message appears on the display:

Rapid data transfer
Fault in communication build up

or

Rapid data transfer HELP
K wire not switching to earth

or

Rapid data transfer HELP
K wire not switching to positive

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- ◆ Fault in diagnostic wiring (including wiring to other control units)
- ◆ Fault in voltage supply to control unit
- ◆ Diesel direct injection system control unit or other control unit defective

Selectable functions

Fault reader V.A.G 1551 or V.A.G 1552	Ignition on, engine not running	Engine idling	Vehicle being driven	Page
Address words				
01 Engine electronics	Yes	Yes	Yes	
00 Automatic test sequence	Yes	Yes	Yes	
Functions				
01 Interrogate control unit version	Yes	Yes	Yes	2
02 Interrogate fault memory	No	Yes	Yes	4
03 Final control diagnosis	No	Yes	No	15
04 Basic setting	No	Yes	Yes	18
05 Erase fault memory	Yes	Yes	Yes	4
06 End output	Yes	Yes	Yes	4
07 Code control unit	Yes	No	No	20



08 Read measured value block	Yes	Yes	Yes	22
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2 - Interrogating and erasing fault memory

2.1 - Interrogating and erasing fault memory

- 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 2.)

Note:

If the engine does not start, turn the engine over for at least 5 seconds using the starter. After doing this, do not switch off the ignition.

-> Indicated on display:

Rapid data transfer Select function XX	HELP
---	------

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

-> Indicated on display:

No fault recognised

- Press =>key.

Note:

If problems have been reported but no faults are detected by the self-diagnosis:

- Perform self-diagnosis => Page 52

or

-> Indicated on display:

X faults recognised

If the printer on the fault reader is switched on the stored faults will be displayed and printed out in sequence.

Note:

If the printer is switched off, press the => key to display the next fault.

- After the last fault has been displayed and printed out, rectify the faults as described in the fault table => from Page 5.
- Press =>key.

-> Indicated on display:

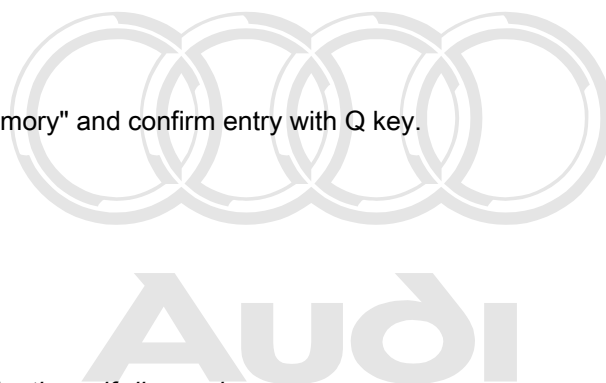
Rapid data transfer Select function XX	HELP
---	------

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

Notes:

-> Indicated on display:

Attention! Fault memory is not interrogated
--



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This means that the proper sequence of steps was not followed.

- Interrogate fault memory.

In the following cases the fault memory is not erased:

- ◆ If the ignition was switched off after interrogating the fault memory
- ◆ If the engine speed exceeded 2000 rpm
- ◆ If an existing static fault was not rectified

-> Indicated on display:

Rapid data transfer
Fault memory is erased!

- Press ➡key.

-> Indicated on display:

Rapid data transfer HELP
Select function XX

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

-> Indicated on display:

Rapid data transfer HELP
Insert address word XX

- Switch off ignition and unplug the diagnostic connector.

2.2 - Fault table

Notes:

- ◆ The table below lists all the possible faults that can be detected by diesel direct injection system control unit -J248, and which may appear on fault reader V.A.G 1551 or vehicle system tester V.A.G 1552 when the fault memory is interrogated. The fault table lists the faults in order according to fault code.
- ◆ Before renewing a component indicated as being faulty, test the wiring and connectors for the component and also the earth connections using the current flow diagram. This is particularly important in the case of sporadic faults (indicated by the letters "/SP").
- ◆ If the engine is switched off after the test drive and before interrogating the fault memory, all existing faults will be displayed as sporadic faults. If there are faults which only occur sporadically, or if the fault memory is not erased once the faults have been rectified, these faults will also be displayed as sporadic faults, i.e. with the letters "/SP" on the right of the V.A.G 1551 display.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00513 Engine speed sender -G28 Implausible signal 1)	- Sender disc bent or loose	- Poor starting - Engine runs rough, - misfiring	- Remove sump and check sender disc
	- -G28 defective	- Poor starting - Increased idling speed	- Test engine speed sender -G28 => Page 84
	- Open circuit in screening	- Glow plug warning lamp flashes - Reduced power - No display on rev counter	- Test wiring to engine speed sender =>Page 84
No signal 1)	- Open circuit or short circuit		



	- G28 defective		- Test engine speed sender => Page 84
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1) One of these displays will appear in addition to the name of the component.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00519 Intake manifold pressure sender -G71 Short circuit to positive 1)	- Charge pressure (boost pressure) too high	- Sudden loss of power - during acceleration and - reduced power	- Test charge pressure system =>Page 60
	- -G71 defective	- Loss of power	- Test intake manifold pressure sender -G71 =>Page 66
Open/short circuit to earth 1)			
Implausible signal 1)	- Hoses wrongly connected or detached - Control unit defective		- Check hose connections Renew control unit =>Page 58

1) One of these displays will appear in addition to the name of the component.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00522 Coolant temperature sender -G62 Short circuit to earth 1)	- Short to earth in wiring - -G62 defective	- Poor starting below -20 °C - Black exhaust smoke when starting above +10 °C	- Test coolant temperature sender -G62 =>Page 86
Open/short circuit to positive 1)	- Open circuit or short to positive in wiring - -G62 defective	- Additional heater not working	

1) One of these displays will appear in addition to the name of the component.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00527 Intake manifold temperature sender -G72 Short circuit to earth 1)	- Short to earth in wiring - -G72 defective	- Additional heater not working	- Test intake manifold temperature sender -G72 =>Page 65
Open/short circuit to positive 1)	- Open circuit or short to positive - -G72 defective		

1) One of these displays will appear in addition to the name of the component.

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V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00532			

Supply voltage Implausible signal	- Control unit was - connected while ignition was switched on		- Erase fault memory and continue to monitor vehicle
	- Open circuit or short circuit - Diesel direct injection - system relay -J322 - defective (sticking)	- Engine cuts out - (safety cut-out)	- Test voltage supply to diesel direct injection system=>Page 80
	- Diesel direct injection - control unit -J248 defective		- Fit a new control unit => Page 58

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00539 Fuel temperature sender - G81 Short circuit to earth 1)	- Fuel overheating - -G81 defective - Short circuit to earth in - wiring - Fuel pre-heating not - working, or non-return valve in return hose - between filter and fuel tank is installed the wrong way round	- Reduced power - Uneven idling	- Test fuel temperature sender -G81 => Page 72
Open/short circuit to posi- tive 1)	- Open circuit or short to positive in wiring - -G81 defective		
	- 8-pin connector for - injection pump - disconnected	- Several faults stored - Engine cuts out	- Check injection pump connector

1) One of these displays will appear in addition to the name of the component.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00542 Needle lift sender -G80 Output open 1) Short circuit to earth 1) Open/short circuit to posi- tive 1)	- Open circuit or short circuit - -G80 defective	- Glow plug warning lamp flashes - Reduced power - Engine running rough	- Test needle lift sender -G80 => Page 85
Implausible signal 1)	- Fuel feed was interrupted; tank run dry, supply hose or filter blocked, air - entering fuel system	- Misfiring, jolting - Fault 00550 ("Injection commencement regula- tion; Regulating differ- ence") may be stored	- Check fuel system
	(Sporadic) open circuit in wiring to fuel cut-off valve	- Engine cuts out - Misfiring	- Check wiring and 3-pin connector on injection pump
Continued ▼			

1) One of these displays will appear in addition to the name of the component.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00542	(Fault code 00542 continued)		



Needle lift sender -G80 Implausible signal 1)	- Sender disc of engine speed sender -G28 is bent or loose	- Misfiring at exactly 3000 rpm	- Remove sump and check sender disc
	- Injection pump defective	- Fault 01268 ("Metering control; Regulating difference") is stored - Engine running rough, misfiring - No throttle response after overrun	- Fit a new injection pump =>Page 47 . Do not fit a new needle lift sender -G80
	- -G80 defective	- Misfiring, jolting (especially at high engine speeds)	- Fit a new needle lift sender -G80

1) One of these displays will appear in addition to the name of the component.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00545 Engine/gearbox electrical connection	- Open circuit or short circuit	- Gearshift harsher than normal	- Check signals to and from automatic gearbox; A - gearshift signal =>Page 93
00550 Injection commencement regulation Regulating difference	- Commencement of injection (injection timing) not OK	- Loss of power at high engine speeds - Engine difficult to start	- Check and adjust commencement of injection =>Page 52
	- Control range of injection pump blocked (dirt, metal particles)	- Loss of power at high engine speeds	- Check control range of injection timing control => Page 69
	- Engine has been stalled (within the last 50 starts)		- Erase fault memory and continue to monitor vehicle
	Continued ▼		

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00550 Injection commencement regulation Regulating difference	(Fault code 00550 continued) - Fuel feed was interrupted; tank run dry, supply hose or filter blocked, air entering fuel system	- Fault 00542 ("Needle lift sender; Implausible signal") may be stored	- Check fuel system
	- Open circuit in wiring to commencement of injection valve -N108	- Engine knocks when idling because commencement of injection is constantly advanced	- Test commencement of injection valve -N108 => Page 70
		- Fault 00741 ("Brake pedal monitoring; Implausible signal") may be stored	- Test fuse

	- Commencement of injection valve -N108 - is worn	- Commencement of injection cannot be made constant during "Basic setting" (value in display zone 2 fluctuates by more than 10 units) - Engine running unevenly, loss of power	- Fit a new commencement of injection valve -N108 => Page 70
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V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00553 Air mass meter -G70 Implausible signal 1)	- Engine has been stalled (within the last 50 starts)		- Erase fault memory and continue to monitor vehicle
	- Battery low	- Loss of power - Constant air mass readout in measured value block	- Test battery
	- Sporadic open circuit in wiring to needle lift sender -G80 (break in wiring)	- Misfiring, jolting - Fault 00542 ("Needle lift sender; Input open" or "Implausible signal") may be stored	- Test needle lift sender => Page 85
	Continued ▼		

1) One of these displays will appear in addition to the name of the component.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00553 Air mass meter -G70 Implausible signal 1)	(Fault code 00553 continued) - Air cleaner blocked - Vacuum hose system for exhaust gas recirculation wrongly connected, or mechanical exhaust gas recirculation valve constantly open	- Uneven idling, loss of power	- Check intake system Check vacuum hoses => Page 79
	- Implausible signal for brake pedal monitoring	- Fault 00741 ("Brake pedal monitoring; Implausible signal") is also stored - No throttle response at times, complete loss of power - Glow period warning lamp flashes	- Do not fit a new air mass meter -G70 Test and adjust brake light switch -F and brake pedal switch -F47 => Page 87
	- -G70 defective	- Loss of power, jolting	- Test air mass meter -G70 => Page 76
	Continued ▼		

1) One of these displays will appear in addition to the name of the component.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00553 Air mass meter -G70	(Fault code 00553 continued)		



Open/short circuit to earth 1)	- -G70 defective - Open circuit or short to earth in wiring	- Reduced power - Black exhaust smoke - possible when accelerating from low engine speeds	- Test air mass meter - G70 => Page 76
Short circuit to positive 1)	- Open circuit or short to positive in wiring - -G70 defective		
Power supply 1)	- Open circuit or short circuit in wiring		

1) One of these displays will appear in addition to the name of the component.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00575 Intake manifold pressure Regulating difference	- Hoses wrongly connected, disconnected, blocked or leaking - Fault in hose connection to intake manifold pressure sender -G71	- Sudden loss of power - Reduced power	- Check charge pressure hose connections => Page 68
	- Pressure unit for turbocharger defective - Solenoid valve for charge pressure control -N75 defective		- Test charge pressure => Page 64

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00625 Speed signal Implausible signal	- Open circuit between speedometer sender -G22 and dash panel insert - -G22 defective - Speedometer -G21 defective - Open circuit between dash panel insert and engine control unit	- Cruise control not working - Air conditioner not working - Load change jolts	- Test speed signal => Page 96 Test speedometer sender -G22 => Electrical system; Repair group 90; Dash panel insert; Testing speedometer sender Dash panel insert; Testing speedometer sender

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00626 Glow period warning lamp - K29 Open/short circuit to earth 1)	- Open circuit in wiring - Bulb defective	- Glow period warning system not working	- Test glow period warning lamp => Page 104
	- Short circuit to earth	- Glow period warning lamp permanently lit	
Short circuit to positive 1)	- Short circuit to positive	- Glow period warning system not working	
00668 Vehicle voltage terminal 30			

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Signal too small	- Diesel direct injection system relay -J322 sticking - Open circuit in wiring	- Engine will not start (safety cut-out)	- Check voltage supply to diesel direct injection system =>Page 80
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1) One of these displays will appear in addition to the name of the component.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00671 CCS Switch -E45 Undefined switch position	- Open circuit or short circuit - Cruise control system switch -E45 defective	- Cruise control not working	- Test cruise control system =>Page 98
00741 Brake pedal monitoring Implausible signal	- Switch incorrectly set - Connectors for -F and -F47 interchanged - Open circuit - -F or -F47 defective - Fuse defective - Both brake lights defective	- No throttle response at times, complete loss of power - Glow period warning lamp flashes - Cruise control not working	- Test and adjust -F and -F47 => Page 87 Test brake lights

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00765 Modulating piston movement sender -G149 Implausible signal			
	- Open circuit or short circuit - -G149 defective	- Engine running problems - Engine cuts out	- Test modulating piston movement sender - G149 => Page 88
	- 8-pin connector for injection pump disconnected	- Several faults stored - Engine cuts out	- Check injection pump connector
	- Metering control mechanism out of position - Needle lift sender - G80 defective. Fault 00542 ("Needle lift sender; Implausible signal") is usually stored as well.	- Engine jolting on overrun - Brief misfiring while driving	- Fit a new injection pump => Page 47 - Fit a new needle lift sender -G80

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
00777 Accelerator position sender - G79 Short circuit to positive 1)	- Open circuit - -G79 defective	- Engine speed governed to approx. 1100 rpm (safety function)	- Test accelerator position sender -G79 => Page 91
Implausible signal 1)	- Open circuit or short circuit - -G79 defective		



Power supply 1)	- Open circuit or short circuit		
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1) One of these displays will appear in addition to the name of the component.

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 flashes	- Code control unit => Page 20
01117 Load signal for alternator terminal DF Implausible signal	- Open circuit or short circuit	- Additional heater not working	- Check wiring => Current flow diagrams, Electrical fault-finding and Fitting locations binder
01180 Engine / ACC electrical connection Short circuit to positive	- Short circuit in wiring	- Slower acceleration when air conditioner is on	- Test air conditioner compressor shut-off => Page 95

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01193 Low heating output relay 01194 High heating output relay Open/short circuit to earth 1)	- Open circuit in wiring - Low heating output relay -J359 or high heating output relay -J360 defective - Short circuit to earth	- Additional heater not working - Additional heater remains on constantly	- Check wiring => Current Flow Diagrams, Electrical Fault-Finding and Fitting Locations
Short circuit to positive 1)	- Short circuit to positive	- Additional heater not working	

1) One of these displays will appear in addition to the name of the component.

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V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01237 Fuel cut-off valve -N109 Mechanical fault 1)	- -N109 defective, leaking or sticking	- Reduced power - Engine cuts out	- Perform final control diagnosis => Page 15
Open/short circuit to earth 1)	- Open circuit or short circuit to earth - -N109 defective	- Engine cuts out	- Check wiring => Current flow diagrams, Electrical fault-finding and Fitting locations binder

1) One of these displays will appear in addition to the name of the component.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
----------------------	--------------------------	------------------	--------------

01242 Output stage in control unit Open/short circuit to positive	- Commencement of injection valve -N108 defective	- Fault 00550 ("Injection commencement regulation; Regulating difference") is stored	- Perform final control diagnosis => Page 15
	- Charge pressure control valve -N75 defective	- Reduced charge pressure (boost pressure)	
	- Short to positive in wiring to glow period warning lamp -K29	- Glow period warning lamp does not work	- Perform final control diagnosis => Page 104
	- Glow plug relay -J52 defective	- Poor starting at low ambient temperatures	- Perform final control diagnosis => Page 103
Continued ▼			

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V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01242 Output stage in control unit Open/short circuit to positive	(Fault code 01242 continued) - Exhaust gas recirculation valve -N18 defective - Low heating output relay -J359 or high heating output relay -J360 defective ¹⁾	- Poor cold starting at low ambient temperatures - Additional heater not working	- Perform final control diagnosis => Page 15

1) Only applies to vehicles with manual gearbox.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01262 Boost pressure control solenoid -N75 Open/short circuit to earth 1)	- Open circuit - Boost pressure (charge pressure) control solenoid valve -N75 defective - Short circuit to earth	- Reduced power - Boost pressure too low - Reduced power - Boost pressure too high	- Test boost pressure (charge pressure) control solenoid valve => Page 64
Short circuit to positive 1)	- Short circuit to positive	- Reduced power - Boost pressure too low	

1) One of these displays will appear in addition to the name of the component.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01265 Exhaust gas recirculation valve -N18 Open/short circuit to earth 1)	- Open circuit - Exhaust gas recirculation valve -N18 defective - Short circuit to earth	- No exhaust gas recirculation - Too much exhaust gas recirculation - Reduced power, black exhaust smoke	- Test exhaust gas recirculation valve => Page 74



Short circuit to positive 1)	- Short circuit to positive	- No exhaust gas - recirculation	
------------------------------	-----------------------------	-------------------------------------	--

1) One of these displays will appear in addition to the name of the component.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01266 Glow plug relay -J52 Open/short circuit to earth 1)	- Open circuit - Relay -J52 defective	- Glow plug system not working	- Check wiring => Current flow diagrams, Electrical fault-finding and Fitting locations binder
	- Short circuit to earth	- Glow plug system remains on constantly	
Short circuit to positive 1)	- Short circuit to positive	- Glow plug system not working	

1) One of these displays will appear in addition to the name of the component.

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V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01268 Metering control -N146 Regulating difference 1)	- Open circuit or short circuit	- Engine jolting, misfiring	- Test quantity adjuster -N146 (metering control) => Page 88 - Fit a new injection pump => Page 47
	- Implausible signal from modulating piston movement sender -G149	- No throttle response after overrun	
	- Quantity adjuster (metering control) stiff or jamming	- Engine jolting, misfiring	
Lower stop value 1)	- Quantity adjuster out of position - Open circuit	- Engine will not start - (safety cut-out)	
Upper stop value 1)	- Quantity adjuster out of position		

1) One of these displays will appear in addition to the name of the component.

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
01269 Commencement of injection valve -N108 Open/short circuit to earth 1)	- Open circuit (fuse) - Commencement of injection valve -N108 defective	- Engine knocks when idling because commencement of injection is constantly advanced	- Test commencement of injection valve => Page 70
		- Several faults may be recorded	- Test fuse
	- Short circuit to earth	- Loss of power because commencement of injection is constantly retarded	- Test commencement of injection valve => Page 70

Short circuit to positive 1)	- Short circuit to positive	- Engine knocks when idling because commencement of injection is constantly advanced	
------------------------------	-----------------------------	--	--

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
17978 Engine control unit blocked	- Attempted tampering - Short circuit in signal wire - Immobilizer control unit defective/missing	- Engine starts but cuts out again immediately	- Perform adaption of engine electronics control unit to immobilizer control unit => Electrical system; Repair group 01; Self-diagnosis; Adaption procedure after renewing engine control unit Self-diagnosis; Adaption procedure after renewing engine control unit - Check electronic immobilizer: => Repair group 96; Servicing electronic immobilizer

V.A.G 1551 print-out	Possible causes of fault	Possible effects	Fault remedy
65535 Control unit defective	- Internal fault in control unit - Signal communication problems between fault reader and engine control unit	- Engine running problems - Engine cuts out - None	- Renew control unit => Page 58 - Erase fault memory and continue to monitor the vehicle

3 - Final control diagnosis

3.1 - Final control diagnosis

Requirements for test on vehicles with air conditioner:

- Vehicle at room temperature (above +15 °C)
- Air conditioner switched on
- Lowest temperature setting and maximum blower speed selected

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

Activation sequence
1 Commencement of injection valve -N108
2 Exhaust gas recirculation valve -N18
3 Air conditioner compressor cut-in (shut-off)
4 Fuel cut-off valve -N109
5 Charge pressure control valve -N75
6 Glow plug relay -J52



Activation sequence
7 Glow period warning lamp -K29
8 Low heating output relay -J359
9 High heating output relay -J360

Notes:

- ♦ When performing final control diagnosis, the procedure must be carried out in full once the ignition has been switched on.
- ♦ During the final control diagnosis, the individual control elements are only activated for 30 seconds each.
- 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 2.)

-> Indicated on display:

Rapid data transfer
Select function XX

HELP

- Press keys 0 and 3 for the function "Final control diagnosis" and confirm entry with Q key.

-> Indicated on display:

Final control diagnosis
Commencement of injection valve -N108

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

If no changes in the combustion noises are heard:

- Check injection timing control range=>Page 69.
- Press =>key.

-> Indicated on display:

Final control diagnosis
Exhaust gas recirculation valve -N18

The valve must click.

Notes:

- ♦ Because of engine noises the clicking of the valve cannot be heard and therefore must be felt to detect its operation.
- ♦ The piston movement of the mechanical exhaust gas recirculation valve is visible in the side slot.

Valve does not click:

- Test exhaust gas recirculation valve -N18 => Page 74 .
- Press =>key.

-> Indicated on display:

Final control diagnosis
Air conditioner compressor cut-in

Conditioner compressor shut-off is checked.

The test step is also recalled on vehicles without air conditioner system.

The "cut-in" or "shut-off" function should cause the air conditioner compressor to switch itself off within 5 seconds (check visually), then start and stop again at 5-second intervals.

If the conditioner compressor is not switched off:

- Check air conditioner compressor shut-off=>Page 95 .
- Press =>key.

-> Indicated on display:

Final control diagnosis
Fuel cut-off valve -N109

The engine must stop.

If the engine does not stop:

- Switch off ignition.
- Unscrew fuel cut-off valve and remove any metal particles or dirt.
- Repeat final control diagnosis and if the engine will not stop replace fuel cut-off valve.

Continue the final control diagnosis with the ignition switched on and the engine not running.

- Press =>key.

-> Indicated on display:

Final control diagnosis
Charge pressure control solenoid valve - N75

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:

- Test solenoid valve for charge (boost) pressure control -N75
=> Page 64 .
- Press =>key.

-> Indicated on display:

Final control diagnosis
Glow plug relay -J52

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:

- Test glow plug system => Page 103 .
- Press =>key.

-> Indicated on display:

Final control diagnosis
Glow period warning lamp -K29

The control lamp must blink.

Control lamp does not blink:

- Test glow period warning lamp -K29 => Page 104 .
- Press =>key.

-> Indicated on display:

Final control diagnosis
Low heating output relay -J359

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The test step is only carried out on vehicles with manual gearbox.
The relay must click.

If the relay does not click:

- Test low heating output relay

=> Current flow diagrams, Electrical fault-finding and Fitting locations

- Press =>key.

-> Indicated on display:

Final control diagnosis
High heating output relay -J360

The test step is only carried out on vehicles with manual gearbox, although not with all control unit versions.
The relay must click.

If the relay does not click:

- Test high heating output relay

=> Current flow diagrams, Electrical fault-finding and Fitting locations

- Press =>key.

-> Indicated on display:

Rapid data transfer
Select function XX

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

4 - Basic setting

4.1 - Basic setting

Note:

The basic setting procedure is used as a dynamic check of the injection timing (commencement of injection). Commencement of injection valve -N108 is activated continuously, causing the injection adjuster to move to the "retarded" setting.

Requirements for test:

- Coolant temperature at least 80 °C
- Electrical consumers switched off (radiator fan must not run during the test)
- Air conditioner switched off
- Gear selector lever in position P or N
- Connect fault reader V.A.G 1551 (or V.A.G 1552) and interrogate fault memory => Page 4 . After interrogating the fault memory, run the engine at idling speed.

-> Indicated on display:

Rapid data transfer
Select function XX

HELP

- Press keys 0 and 4 for the function "Basic setting" and confirm entry with Q key.

-> Indicated on display:

Basic setting Q
Enter display group number XXX

- Press key 0 three times to select Display Group 000 and confirm entry with Q key.

Display group overview

System in basic setting 0										⇒	◀ Indicated on display
1	2	3	4	5	6	7	8	9	10		
											Intake air mass
											Fuel temperature
											Intake manifold temperature
											Coolant temperature
											Atmospheric pressure (ambient air pressure)
											Intake manifold pressure (charge pressure)
											Injection quantity
											Accelerator pedal position
											Commencement of injection
											Engine speed

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

System in basic setting 0										⇒	◀ Indicated on display
40	46	0	20	90	201	64	153	127	83		
											Intake air mass: 70 ... 110. If the specification is not obtained, test exhaust gas recirculation => Page 73 . After 10 minutes at idling speed the exhaust gas recirculation is switched off. The display will show 125 ... 145.
											Fuel temperature: approx. 40 °C (not reached if outside temperature is low; no specified value)
											Intake manifold temperature: approx. 30 °C (dependent on ambient temperature - no specified value)
											Coolant temperature: approx. 90 °C
											Atmospheric pressure (ambient air pressure): no specified value - ignore
											Intake manifold pressure (charge pressure): no specified value - ignore
											Injection quantity: 10 ... 45 (idling)
											Accelerator pedal position: 0 (pedal not depressed)
											Commencement of injection depends on fuel temperature => Page 20
											Engine speed: 37 ... 42 (idling speed)

- Press ⇒key.

→ Indicated on display:

Rapid data transfer HELP
Select function XX

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

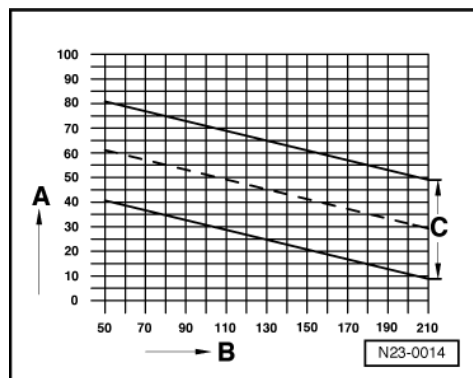
→ Indicated on display:



Rapid data transfer HELP
Insert address word XX

- Switch off ignition and unplug diagnostic connector.

Commencement of injection (injection timing)



-> The commencement of injection value in display zone 2 is dependent on the fuel temperature value in display zone 9.

- A - Display zone 2 - commencement of injection
- B - Display zone 9 - fuel temperature

- ♦ Specification: => area C on graph

5 - Coding control unit

5.1 - Coding control unit

- ♦ There are some control units that must not be coded (engine control unit MSA 12) and some that must be coded (engine control unit MSA 15).
- ♦ An MSA 15 control unit needs to be coded if the control unit coding which appears on the fault reader display does not correspond to the vehicle equipment, or if the control unit has been newly fitted.

Caution:

- ♦ Always start by calling up (and if necessary printing out) the control unit identification code on the fault reader display => Page 2 .
- ♦ An incorrect coding can affect the performance of the engine, gearbox and exhaust system.

Procedure

- 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 2 .)
- Control units that must not be coded (MSA 12)

-> Indicated on display (control unit identification):

028906021XX 1.9L R4 EDC SG
DXX
Coding 00000 WSC 00000

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Distinguishing points:

- ◆ No zeros before the gearbox type (SG or AG).
- ◆ Software version code has 3 characters and starts with the letter "D"
- ◆ Control unit has a plastic housing

• Control units that must be coded (MSA 15)

-> Indicated on display (control unit identification):

```
028906021XX 1.9l R4 EDC G00SG XXXX
Coding XXXXX WSC XXXXX
```

Distinguishing points:

- ◆ Two zeros before the gearbox type (SG or AG), and an extra letter "G" for vehicles with cruise control.
- ◆ Software version code has 4 characters (either 4 digits or the letters "KD" and 2 digits)
- ◆ The code sequence "KDxx" indicates that the control unit is a replacement part. To find out what coding needs to be entered, check the printout obtained previously for the original control unit.
- ◆ Control unit has an aluminium housing.

- Press =>key.

-> Indicated on display:

```
Rapid data transfer HELP
Select function XX
```

- Press keys 0 and 7 for the function "Code control unit" and confirm entry with Q key.

-> If the following readout appears on the display:

```
Code control unit
Feed in code number 00000 (0 - 00127)
```

- Enter the correct coding for the vehicle and confirm entry with Q key.

Codings to be entered when replacing an MSA 12 control unit with an MSA 15 control unit

Control unit MSA 12	Replacement control unit MSA 15	Coding for replacement control unit MSA 15
028 906 021 K	028 906 021 FD	00013
028 906 021 CD	028 906 021 GC	00001
028 906 021 J	028 906 021 GC	00002

-> The fault reader V.A.G 1551 display will show the control unit coding, as in this example.

```
028906021XX 1.9l R4 EDC G00SG
KD09 □
Coding 00012 WSC 12345
```

- Switch ignition off and then on again.

Notes:

- ◆ The newly entered code will be activated the next time the ignition is switched on.
 - ◆ If the ignition is not switched off and then on again after entering the correct coding, it will not be possible to erase fault code 01044 ("Control unit incorrectly coded") from the fault memory.
- Erase fault memory => Page 4 .



6 - Reading measured value block

6.1 - Reading measured value block

Requirements for test:

- Electrical consumers switched off (radiator fan must not run during the test)
- Air conditioner switched off
- Connect fault reader V.A.G 1551 (or V.A.G 1552) and select engine electronics control unit with the "Address word" 01. If necessary, start the engine.
(Connecting fault reader and selecting engine electronics control unit => Page 2.)

-> Indicated on display:

```
Rapid data transfer      HELP
Select function XX
```

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

-> Indicated on display:

```
Read measured value block  Q
Enter display group number XXX
```

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- Enter the Display Group number.
=>Overview of Display Group numbers to be selected, Page 22.

-> Indicated on display for Display Group 000:

```
Read measured value block  0
 1      2      3      4      5      6
7      8      9     10
```

-> Indicated on display (example) for Display Group 001:

```
Read measured value block  1
1      2      3      4
```

Overview of Display Group numbers to be selected

Display Gr. number	Indicated on display	Meaning
000 General vehicle inspection	Read measured value block 0 1 2 3 4 5 6 7 8 9 10	1 = Engine speed 2 = Commencement of injection 3 = Accelerator pedal position 4 = Injection quantity 5 = Intake manifold pressure (charge/boost pressure) 6 = Atmospheric pressure (ambient air pressure) 7 = Coolant temperature 8 = Intake manifold temperature 9 = Fuel temperature 10 = Intake air mass

Display Gr. number	Indicated on display	Meaning
001 Injection quantity	Read measured value block 1 1 2 3 4	1 = Engine speed 2 = Injection quantity 3 = Voltage from modulating piston movement sender - G149

		4 = Coolant temperature
002 Idling speed	Read measured value block 2 1 2 3 4	1 = Engine speed 2 = Accelerator pedal position 3 = Operating status: X X 1 Air conditioner "ON" signal X 1 X Idling speed switch closed 1 X X Increased idling speed: ▪ because required by air conditioner 1) ▪ because acceleration and braking de- tected ▪ because glow plug additional heater is on 4 = Coolant temperature

1) The idling speed is not increased with all control units. However, a "1" will appear if this condition is required by the air conditioner.

Display Gr. num- ber	Indicated on dis- play	Meaning
003 Exhaust gas recirculation	Read measured value block 3 1 2 3 4	1 = Engine speed 2 = Intake air mass (specified) 3 = Intake air mass (actual) 4 = Duty cycle (activation) of exhaust gas recirculation valve -N18
004 Start of injection	Read measured value block 4 1 2 3 4	1 = Engine speed 2 = Commencement of injection (specified) 3 = Commencement of injection (actual) 4 = Duty cycle (activation) of commencement of injection valve -N108
005 Start conditions	Read measured value block 5 1 2 3 4	1 = Engine speed 2 = Injection quantity for starting (recorded from last start) 3 = Commencement of injection 4 = Coolant temperature

Display Gr. number	Indicated on display	Meaning
006 Switch positions	Read measured value block 6 1 2 3 4 Continued ▼	1 = Road speed 2 = Brake pedal monitoring: X X 1 Brake light switch -F closed X 1 X Brake pedal switch -F47 open 1 X X Clutch pedal switch -F36 open 3 = Cruise control system (CCS) controls: X X X X X 1 CCS on X X X X 1 X CCS off with memory X X X 1 X X Speed reduction X X 1 X X X Resume/accelerate X 1 X X X X Brake pedal depressed 1 X X X X X Clutch pedal depressed

Display Gr. number	Indicated on display	Meaning
006	Read measured value block 6	4 = Operating status of cruise control system (CCS):



Switch positions	1 2 3 4	0 Control unit with CCS function 1 CCS switched off 2 Accelerate 4 Decelerate 8 Resume 1 6 Brake depressed 3 2 Maintain speed 6 4 (Ignore) 1 2 8 (Ignore) 2 5 5 Control unit without CCS function
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Display Gr. number	Indicated on display	Meaning
007 Temperatures	Read measured value block 7 1 2 3 4	1 = Fuel temperature 2 = No display 3 = Intake manifold temperature 4 = Coolant temperature
008 Injection quantity limitation	Read measured value block 8 1 2 3 4	1 = Engine speed 2 = Desired injection quantity (driver's requirement via accelerator pedal) 3 = Injection quantity limitation via engine speed (torque limitation) 4 = Injection quantity limitation based on intake air mass (avoidance of exhaust smoke)
009 Injection quantity limitation	Read measured value block 9 1 2 3 4	1 = Engine speed 2 = Injection quantity (cruise control system activated) 3 = Injection quantity limitation by automatic gearbox during gear change 4 = Emergency quantity (voltage from modulating piston movement sender - G149)

Display Gr. number	Indicated on display	Meaning
010 Air quantities	Read measured value block 10 1 2 3 4	1 = Intake air mass 2 = Atmospheric pressure (ambient pressure) 3 = Intake manifold pressure (charge pressure) 4 = Accelerator pedal position
011 Charge pressure control	Read measured value block 11 1 2 3 4	1 = Engine speed 2 = Charge pressure (specified) 3 = Charge pressure (actual) 4 = Duty cycle (activation) of charge pressure control solenoid -N75
012 Glow plug system	Read measured value block 12 1 2 3 4	1 = (Ignore) 2 = Glow period (in seconds) 3 = Supply voltage from control unit

	4 = Coolant temperature
--	-------------------------

Display Gr. number	Indicated on display	Meaning
013 Smooth idling control	Read measured value block 13 1 2 3 4	1 = Difference between injection quantities for cylinders 4 and 3 2 = Difference between injection quantities for cylinders 2 and 3 3 = Difference between injection quantities for cylinders 1 and 3 4 = No display
014 (Unallocated)	Read measured value block 14	No display
015 Fuel consumption	Read measured value block 15 1 2 3 4	1 = Engine speed 2 = Injection quantity (actual) 3 = Fuel consumption 4 = Desired injection quantity (driver's requirement via accelerator pedal)

Display Gr. number	Indicated on display	Meaning
016 1) Additional heater	Read measured value block 16 1 2 3 4	1 = Alternator load 2 = Additional heater switched off because: X X X X X X 1 Coolant temperature above 70 °C... 80 °C 2) or intake air temperature above 5 °C X X X X X X 1 X Alternator defective X X X X X 1 X X Battery voltage less than 9 V X X X X 1 X X X Engine speed less than 800 rpm X X X 1 X X X X Engine started within the last 10 seconds X X 1 X X X X X Coolant temperature sender -G62 or intake manifold temperature sender -G72 defective X 1 X X X X X X (Ignore) 1 X X X X X X X (Ignore)
	Continued ▼	

1) Does not appear with all control units.

1) If the intake air temperature is 5 °C when the engine is started, the additional heater will switch off when the coolant temperature reaches 70 °C. If the air temperature is -10°C, the additional heater will not switch off until the coolant temperature reaches 80 °C.

Display Gr. number	Indicated on display	Meaning
016 1) Additional heater		3 = Heater element activation X 1 Low heating output relay - J359 activated 1 X High heating output relay - J360 activated 4 = Supply voltage from control unit



Display Gr. number	Indicated on display	Meaning
017 1) (Unallocated)	Read measured value block 17	No display
018 1)	Read measured value block 18 1 2 3 4	(Ignore)
019 1) Quantity adjuster	Read measured value block 19 1 2 3 4	1 = Lower stop value (voltage from modulating piston movement sender) 2 = Upper stop value (voltage from modulating piston movement sender) 3 = No display 4 = No display

1) Does not appear with all control units.

6.2 - Readout specifications for general vehicle inspection

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Display group 000 at idling speed (engine warm, coolant temperature not below +85°C)

Read measured value block 0										⇒	Indicated on display
40	50	0	20	90	201	64	153	127	83		
											Intake air mass: 70...110 okay ▪ If outside tolerance => Display Group 003, Page 30
											Fuel temperature: no specification
											Intake manifold temperature: no specification
											Coolant temperature: approx. 90 °C
											Ambient air pressure: no specification
											Charge pressure: ignore
											Injection quantity: 10...45 okay ▪ If outside tolerance => Display Group 001, Page 27
											Accelerator pedal position: 0 (pedal not depressed)
											Commencement of injection: 20...60 okay ▪ If outside tolerance => Display Group 004, Page 28
											Idling speed: 37...42 okay ▪ If outside tolerance => Display Group 002, Page 29

Display Group 000 at full throttle (test drive in 3rd or 4th gear, coolant temperature not below 85 °C)

Important: Always observe safety precautions => Page 1.

Read measured value block 0										⇒	Indicated on display
186	225	255	186	186	201	64	138	175	233		
											Intake air mass: > 210 okay ▪ < 210: => Display Group 010, Page 31
											Fuel temperature: ignore
											Intake air temperature: ignore

					Coolant temperature: ignore
					Ambient air pressure: ignore
					Charge pressure: 171...191 okay
					▪ If outside tolerance => Display Group 011, Page 32
					Injection quantity: 160...176 (at full throttle)
					▪ 125 (emergency quantity - system fault detected)
					Accelerator pedal position: 255 (fully depressed)
					Commencement of injection: 180...245 (depending on engine speed)
					▪ If outside tolerance => Display Group 004, Page 28
					Engine speed: 160...190 (display value of 190 = 4000 rpm; do not exceed - engine speed is governed)

6.3 - Readout specifications for injection pump

Display Group 001 at idling speed (engine warm, coolant temperature not below 85 °C)

Read measured value block 1			⇒	▪ Indicated on display
840 rpm	6.5 mg/H	1.480 V	87.3 °C	
				Coolant temperature
				▪ 85...100 °C okay
				▪ < 85 °C: => run engine till warm
				Voltage from modulating piston movement sender -G149
				▪ 1.250...1.700 V okay
				▪ < 1.250 V: injection pump too rich => fit a new injection pump
				▪ > 1.700 V: engine load => switch off consumers
				▪ Injection pump too lean => fit a new injection pump
				Injection quantity
				▪ 2.0...9.0 mg/H (mg/stroke) okay
				▪ < 2.0 mg/H: injection pump too rich => fit a new injection pump
				▪ > 9.0 mg/H: engine load => switch off consumers
				▪ Injection pump too lean => fit a new injection pump
				Engine speed
				▪ 780...860 rpm okay for vehicles with automatic gearbox
				▪ 820...900 rpm okay for vehicles with manual gearbox

Display Group 001 with attempted start (if engine does not start) 1)

Read measured value block 1			⇒	▪ Indicated on display
230 rpm	37.4 mg/H	2.780 V	14.3 °C	
				Coolant temperature
				Voltage from modulating piston movement sender -G149
				(quantity adjuster informs control unit of position of modulating piston)
				▪ Voltage increases periodically: okay (pump is injecting)
				▪ < 1.000 V: quantity adjuster closed => monitor display zone 2.
				▪ Only fit a new injection pump if injection quantity is as specified.



Engine speed	Specified injection quantity (control unit activating quantity adjuster in injection pump)
	▪ Injection quantity increases periodically: okay (pump is being activated) ▪ 0.0 mg/H (mg/stroke): system fault => interrogate fault memory, Page 4

1) If the voltage of the electrical system falls below 10.8 V during the attempted start, fault reader V.A.G 1551 will terminate the diagnosis.

Display Group 019 with ignition on

Read measured value block 19		⇒	◀ Indicated on display
0.780 V	4.150 V		
		No display	No display
		Voltage from modulating piston movement sender at maximum stop of quantity adjuster	
		▪ 3.800...4.400 V okay ▪ If outside tolerance: contact resistance in wiring => test, Page 89 ▪ Quantity adjuster in injection pump out of position => fit a new injection pump	
		Voltage from modulating piston movement sender at minimum stop of quantity adjuster	
		▪ 0.600...0.900 V okay ▪ If outside tolerance: contact resistance in wiring => test, Page 89 ▪ Quantity adjuster in injection pump out of position => fit a new injection pump	

Display Group 004 at idling speed (engine warm, coolant temperature not below 85 °C)

Read measured value block 4		⇒	◀ Indicated on display
840 rpm	0.9 °BTDC	0.9 °BTDC	3 %
		Duty cycle (activation) of commencement of injection valve	
		▪ No specification	
		Current commencement of injection	
		▪ 2° ATDC...4° BTDC okay ▪ Later than 2° ATDC: injection timing control jammed ▪ Commencement of injection valve defective ▪ Injection pump set at extreme retard position ▪ => check injection timing control range, Page 69	
		Commencement of injection specified by control unit	
		▪ 2° ATDC...4° BTDC okay	
Engine speed			
		▪ 780...860 rpm okay for vehicles with automatic gearbox ▪ 820...900 rpm okay for vehicles with manual gearbox	

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6.4 - Readout specifications for engine idling speed

Display Group 002 at idling speed (engine warm, coolant temperature not below 85 °C)

Read measured value block 2			⇒	• Indicated on display
840 rpm	0.0 %	0 1 0	88.4 °C	
				Coolant temperature ▪ 85...100 °C okay ▪ < 85 °C: => run engine till warm
				Operating status ▪ 0 1 0: okay (idling speed switch closed) ▪ 1 1 0: Idling speed increased because: ▪ - Signal from air conditioner 1) ▪ - Throttle and brake detected ▪ - Additional heater is switched on ▪ 1 1 1: "ON" signal from air conditioner
				Accelerator pedal position ▪ 0.0 % okay ▪ > 0.0 %: accelerator pedal position sender incorrectly set or defective => adjust
				Engine speed ▪ 780...860 rpm okay for vehicles with automatic gearbox ▪ 820...900 rpm okay for vehicles with manual gearbox

1) The increase in idling speed does not occur with all control unit versions. However, a "1" will still appear if a signal is received from the air conditioner.

Display Group 013 at idling speed (engine warm, coolant temperature not below 85 °C)

The injection system is equipped with an idling speed smooth running control. There may be power differences between the individual cylinders (component tolerances, jet drillings, 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.

The measured value block displays the injected quantity differences of the individual cylinders compared with No. 3 cylinder that is required to ensure an even engine idling speed.

+... mg/H: The relevant cylinder is less powerful than No. 3 cylinder and is therefore supplied with more fuel.

-... mg/H: The relevant cylinder is more powerful than No. 3 cylinder and is therefore supplied with less fuel.

Read measured value block 13			⇒	• Indicated on display
0.82mg/H1)	-0.12mg/H1)	0.49mg/H1)		
				No display
				Difference between injection quantities for cylinder 1 and cylinder 3 ▪ -1.5 mg/H...+1.5 mg/H (mg/stroke) okay ▪ > +1.5 mg/H: cylinder 1 weak ▪ < -1.5 mg/H: cylinder 1 strong
				Difference between injection quantities for cylinder 2 and cylinder 3 ▪ -1.5 mg/H...+1.5 mg/H (mg/stroke) okay ▪ > +1.5 mg/H: cylinder 2 weak ▪ < -1.5 mg/H: cylinder 2 strong



- Difference between injection quantities for cylinder 4 and cylinder 3
- -1.5 mg/H...+1.5 mg/H (mg/stroke) okay
 - > +1.5 mg/H: cylinder 4 weak
 - < -1.5 mg/H: cylinder 4 strong

1) Difference between injection quantities for cylinders 4/2/1 and cylinder 3:

- -1.5 mg/H ... +1.5 mg/H: okay
- Values in all display zones too high: cylinder 3 strong
- Values in all display zones too low: cylinder 3 weak

6.5 - Readout specifications for exhaust gas recirculation

Display Group 003 at idling speed (engine warm, coolant temperature not below 85 °C)

Read measured value block 3		⇒	Indicated on display
840 rpm	290 mg/H	308 mg/H	54 %
Duty cycle (activation) of exhaust gas recirculation valve			
Intake air mass			
▪ If as specified in display zone 2 (tolerance ± 20 mg/H (mg/stroke)): okay ▪ Air mass too small: unmetered air in intake tract ▪ Excessive exhaust gas recirculation => test, Page 73 ▪ Press accelerator briefly if engine has been idling for 10 minutes or more. ▪ Constant 425 mg/H: substitute value => interrogate fault memory			
Air mass specified by control unit			
▪ 230...370 mg/H (mg/stroke) okay ▪ > 370 mg/H: engine too cold => run engine till warm ▪ Injection quantity too great => readout specifications for injection pump ▪ Intake manifold temperature very high => correction not possible			
Engine speed			
▪ 780...860 rpm okay for vehicles with automatic gearbox ▪ 820...900 rpm okay for vehicles with manual gearbox			

6.6 - Readout specifications for temperature senders

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

Read measured value block 7		⇒	Indicated on display
15.4 °C	15.9 °C	16.7 °C	
Coolant temperature (at coolant temperature sender -G62)			
▪ If the wiring has an open circuit the approximate fuel temperature will be displayed as a substitute value.			

		Intake manifold temperature (at intake manifold temperature sender -G72) ▪ If the wiring has an open circuit, a constant temperature of 18.9 °C will be displayed as a substitute value.
	No display	
	Fuel temperature (at fuel temperature sender -G81) ▪ If the wiring has an open circuit, a constant temperature of -5.4 °C will be displayed as a substitute value.	

Notes:

- ♦ No specifications can be given for temperature values.
- ♦ When the engine is cold, the temperatures of the fuel, intake manifold and coolant should be approximately the same as the ambient temperature. If one of the temperature readings differs noticeably, test the relevant sender.

6.7 - Readout specifications for engine power output

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Display Group 008 at full throttle (test drive in 3rd or 4th gear, coolant temperature not below 85 °C)

Important: Always observe safety precautions => Page 1 .

Read measured value block 8	⇒	◀ Indicated on display
3290 rpm 38.4 mg/H 35.2 mg/H 35.7 mg/H		
		Injection quantity limitation according to detected air mass 35...38 mg/H (mg/stroke) okay ▪ < 35 mg/H: detected air mass too small ▪ => test air mass meter, Page 73
		Injection quantity according to engine speed (torque limitation) 34.2...35.2 mg/H (mg/stroke) okay ▪ < 34.2 mg/H: engine speed too high or too low ▪ > 35.2 mg/H: injection quantity increased as a result of tuning
		Desired injection quantity (accelerator pedal position) 36...42 mg/H (mg/stroke) okay ▪ < 36 mg/H: accelerator pedal not fully depressed, incorrectly adjusted or defective ▪ => test, Page 91
Engine speed 2800...4000 rpm okay		

Display Group 010 at full throttle (test drive in 3rd or 4th gear, coolant temperature not below 85 °C)

Important: Always observe safety precautions => Page 1 .

Read measured value block 10	⇒	◀ Indicated on display
830 mg/H 1030 mbar 1850 mbar 100 %		
		Accelerator pedal position: 100 % okay ▪ < 100 %: accelerator pedal not fully depressed ▪ Accelerator pedal position sender -G79 incorrectly adjusted or defective => test, Page 91



		Current charge pressure: 1800...2050 mbar okay If outside tolerance: charge pressure control defective => Display Group 011, Page 32
		Current air pressure: no specification
		Intake air mass: 750...850 mg/H (mg/stroke) okay ▪ < 750 mg/H: Engine speed below 2000 rpm or above 4000 rpm ▪ Charge pressure too low => monitor display zone 3 ▪ Unmetered air between air mass meter and turbocharger ▪ Air mass meter defective

6.8 - Readout specifications for charge pressure control

Display Group 011 at full throttle (test drive in 3rd and 4th gear, coolant temperature not below 85 °C)

Important: Always observe safety precautions => Page 1.

Read measured value block 11	⇒	▪ Indicated on display
3340 rpm 1830 mbar 1850 mbar 68 %		
		Duty cycle (activation) of charge pressure control solenoid valve - N75
		Current charge pressure ▪ If as specified in display zone 2 (tolerance ±100mbar): okay ▪ Charge pressure too low: no charge pressure control => test, Page 60
		Charge pressure specified by control unit ▪ 1800...2050 mbar okay ▪ > 2050 mbar: charge pressure increased as a result of tuning
		Engine speed 2900...4000 rpm okay

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23 - Mixture preparation, Injection

1 - Servicing Diesel direct injection system

1.1 - Servicing Diesel direct injection system

1.2 - Safety precautions

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 the engine is to be turned at starter speed without starting (e.g. when checking compression), detach the 3-pin connector from the injection pump.
- ♦ Before disconnecting battery, obtain radio code for radios fitted with anti-theft coding.
- ♦ 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.
- ♦ When connecting test equipment (voltage tester V.A.G 1527 B, hand-held multimeter V.A.G 1526 etc.), always use adapter set V.A.G 1594 A.

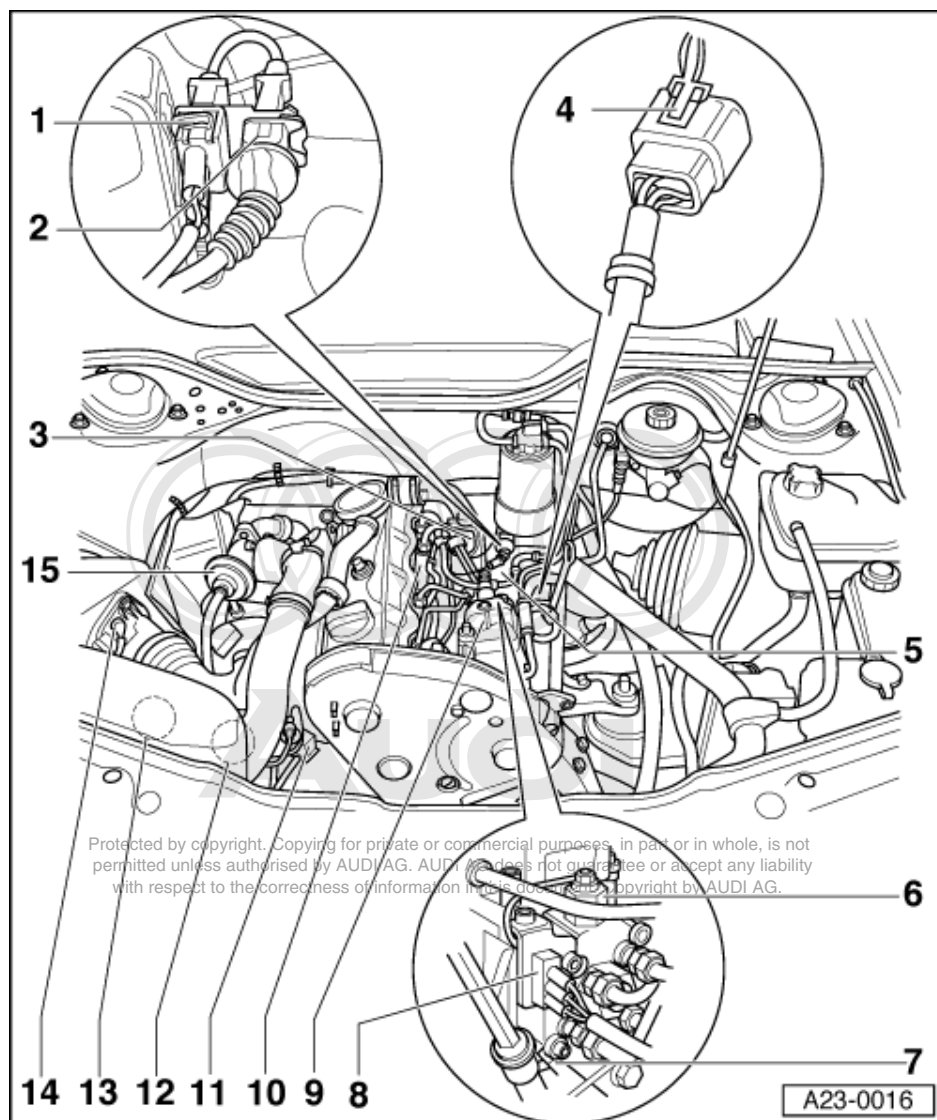
1.3 - Rules for cleanliness

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

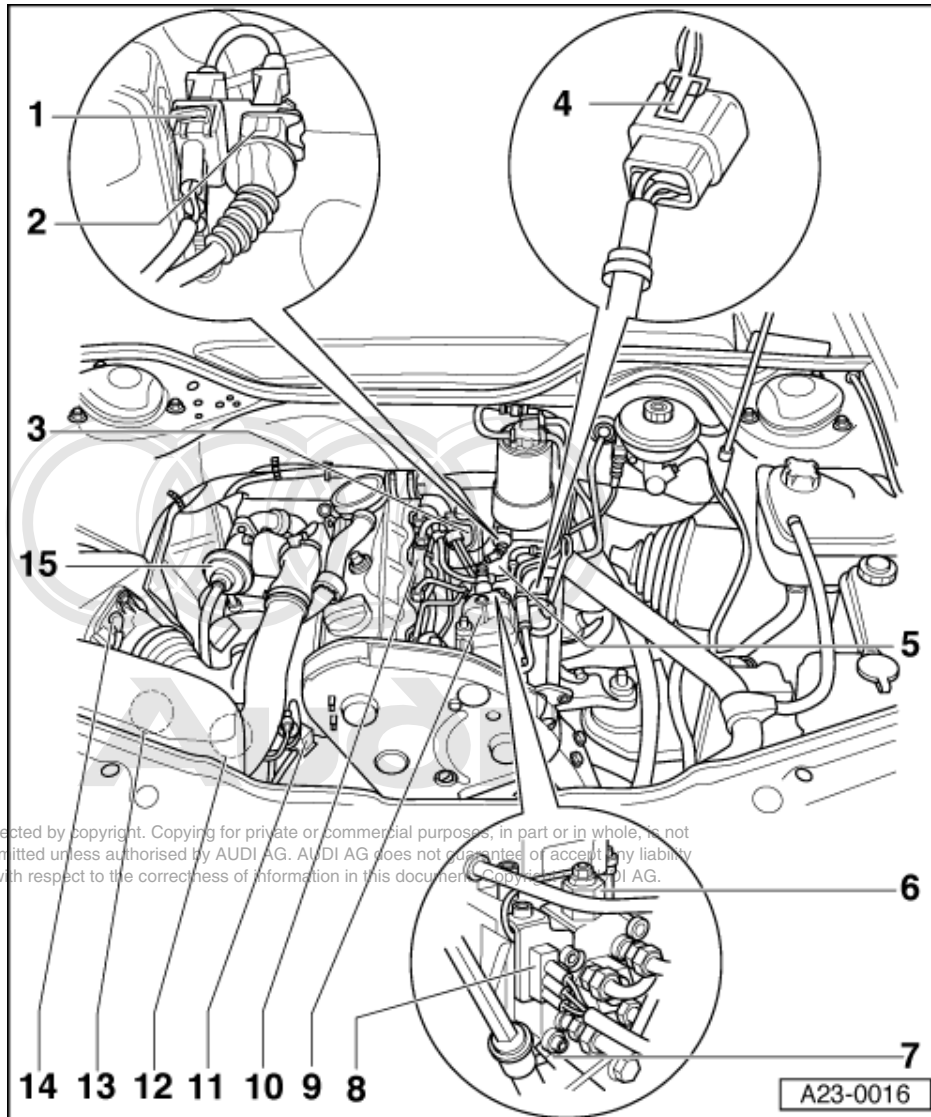
- ♦ Thoroughly clean all unions and the adjacent areas before disconnecting.
- ♦ Place parts that have been removed on a clean surface and cover with plastic sheeting or paper. Do not use fluffy cloths.
- ♦ Carefully cover opened components or seal, if the repair cannot be carried out immediately.
- ♦ 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. If necessary hoses must be cleaned immediately. Affected hoses must be replaced.



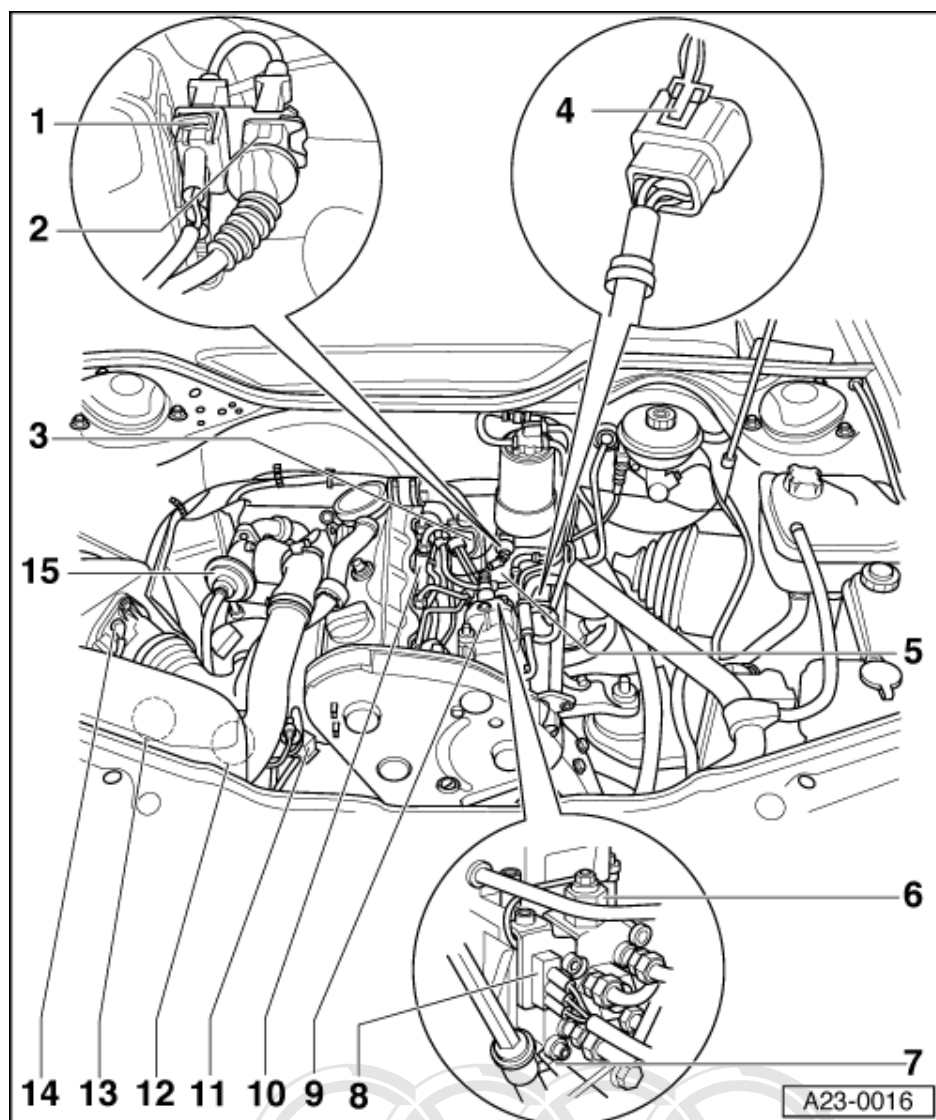
1.4 - Fitting locations overview



- 1 Connector
 - ◆ 3 pin
 - ◆ For engine speed sender -G28
- 2 Connector
 - ◆ 2 pin
 - ◆ For needle lift sender -G80
- 3 Coolant temperature sender -G62
- 4 Connector
 - ◆ 8 pin
 - ◆ For injection pump
- 5 Engine speed sender -G28
- 6 Fuel cut-off valve -N109



- 7 Commencement of injection valve -N108**
- 8 Connector**
- ♦ 3 pin
 - ♦ For injection pump
- 9 Metering control for injection pump**
- ♦ With quantity adjuster -N146
 - ♦ With fuel temperature sender -G81
 - ♦ With modulating piston movement sender -G149
- 10 Injector**
- ♦ For cylinder 3 with needle lift sender -G80
- 11 Charge pressure control valve -N75 (solenoid valve)**



12 Intake manifold temperature sender -G72

13 Exhaust gas recirculation valve -N18

14 Air mass meter -G70

15 Mechanical exhaust gas
recirculation valve

Fitting locations not shown in illustration

Diesel direct injection system control unit -J248

(altitude sender -F96 and intake manifold pressure sender -G71 are integrated in the control unit)

- ◆ In electronics box in front passenger's footwell

Diesel direct injection system relay -J322

- ◆ In auxiliary relay carrier III (relay position 5) behind right-hand A-pillar trim

Accelerator position sender -G79

- ◆ On accelerator pedal in footwell

Glow plug strip fuse -S39

- ◆ In electronics box in front passenger's footwell

Glow plug relay -J52

- ◆ In central electrics

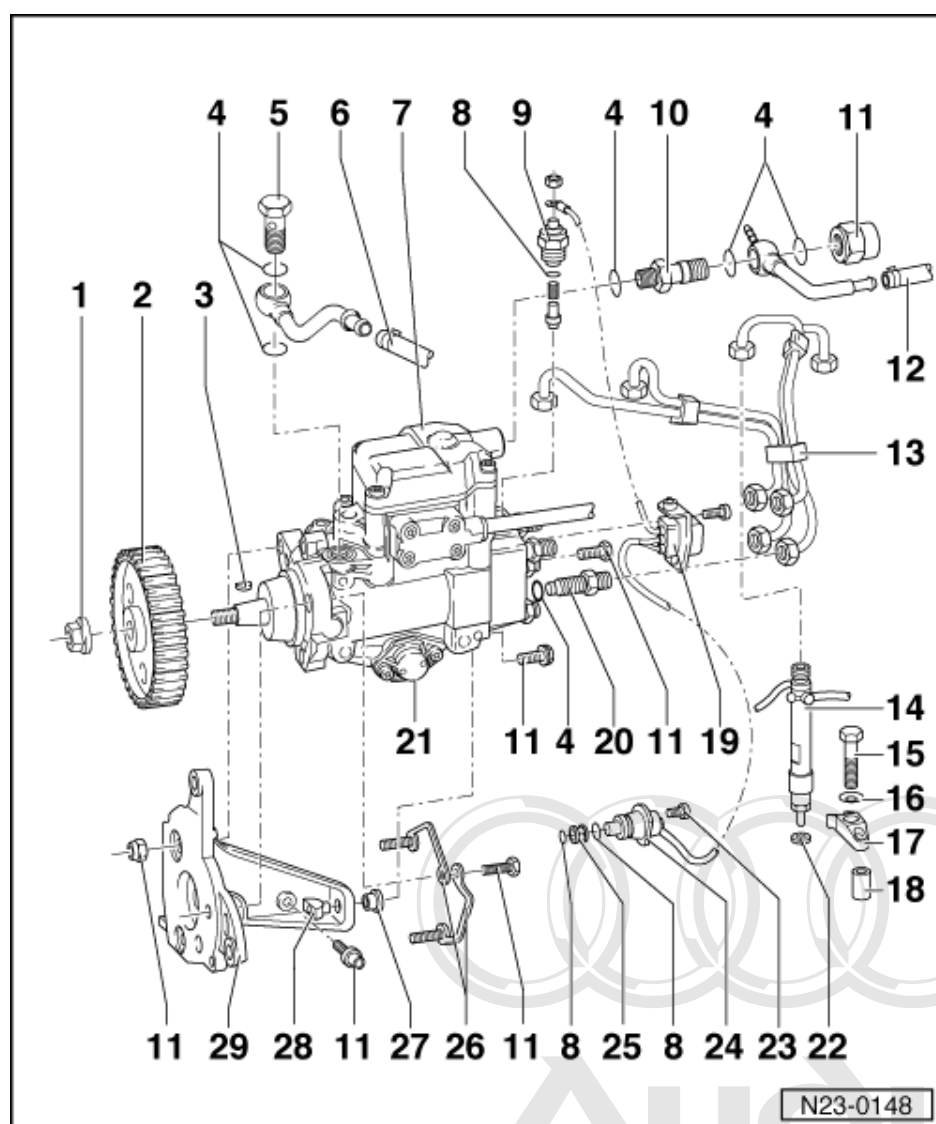
Clutch pedal switch -F36

- ◆ On clutch pedal in footwell

Brake light switch -F and brake pedal switch -F47

- ◆ On brake pedal in footwell

1.5 - Servicing fuel injection system



Notes:

- ◆ Observe safety precautions
=>Page 33 .

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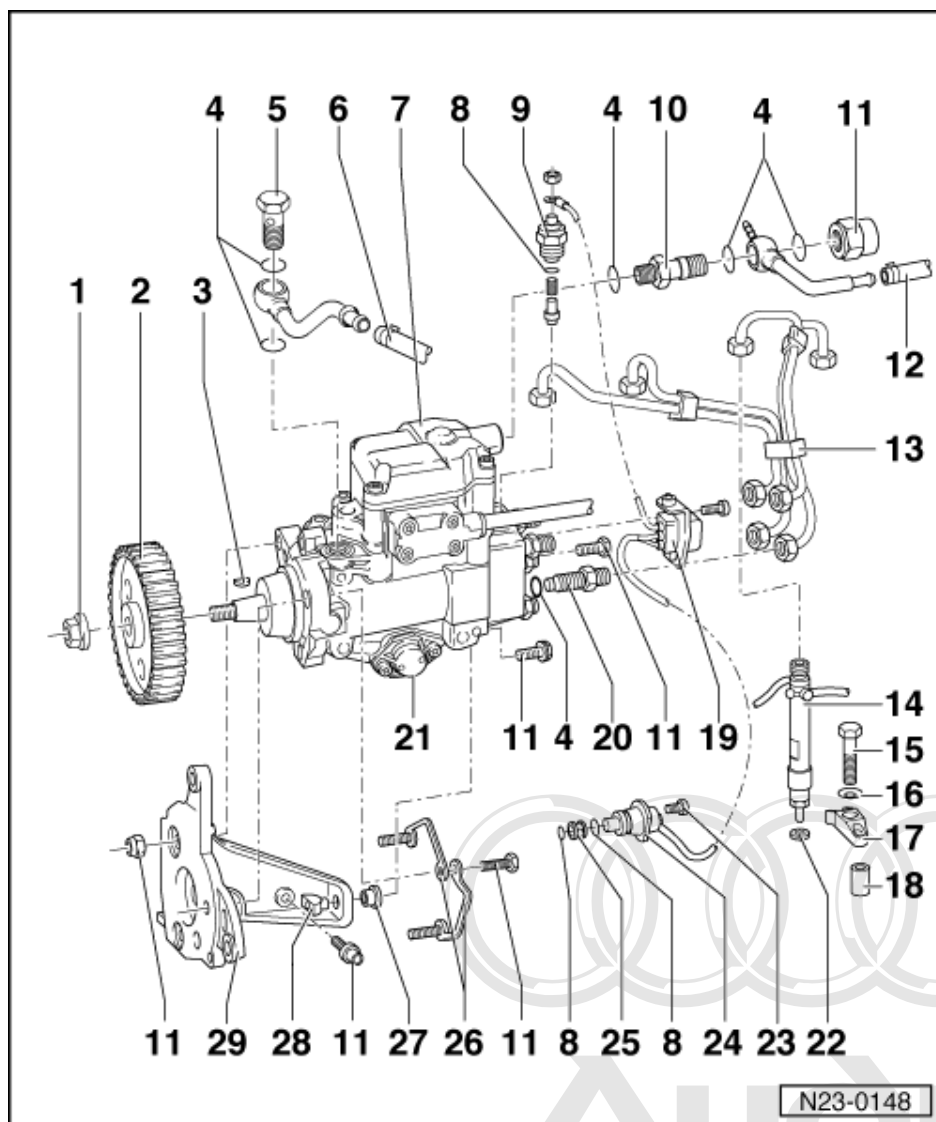
- ♦ Observe rules for cleanliness
=>Page **33**.
- ♦ Always renew seals and gaskets.
- ♦ Tensioning toothed belt:

=> 4-cyl. Diesel engine (turbo), Mechanics; Repair group 13; Crankshaft group; Removing and installing toothed belt Crankshaft group Removing and installing toothed belt

1 45 Nm

2 Injection pump sprocket

- ♦ Removing and installing
=>Removing, installing and adjusting injection pump, Page **47**



3 Woodruff key

- ♦ Check position before fitting injection pump sprocket

4 Seal

- ♦ Renew

5 Banjo bolt - 25 Nm

- ♦ For supply pipe

6 Supply hose

- ♦ From fuel filter

7 Injection pump

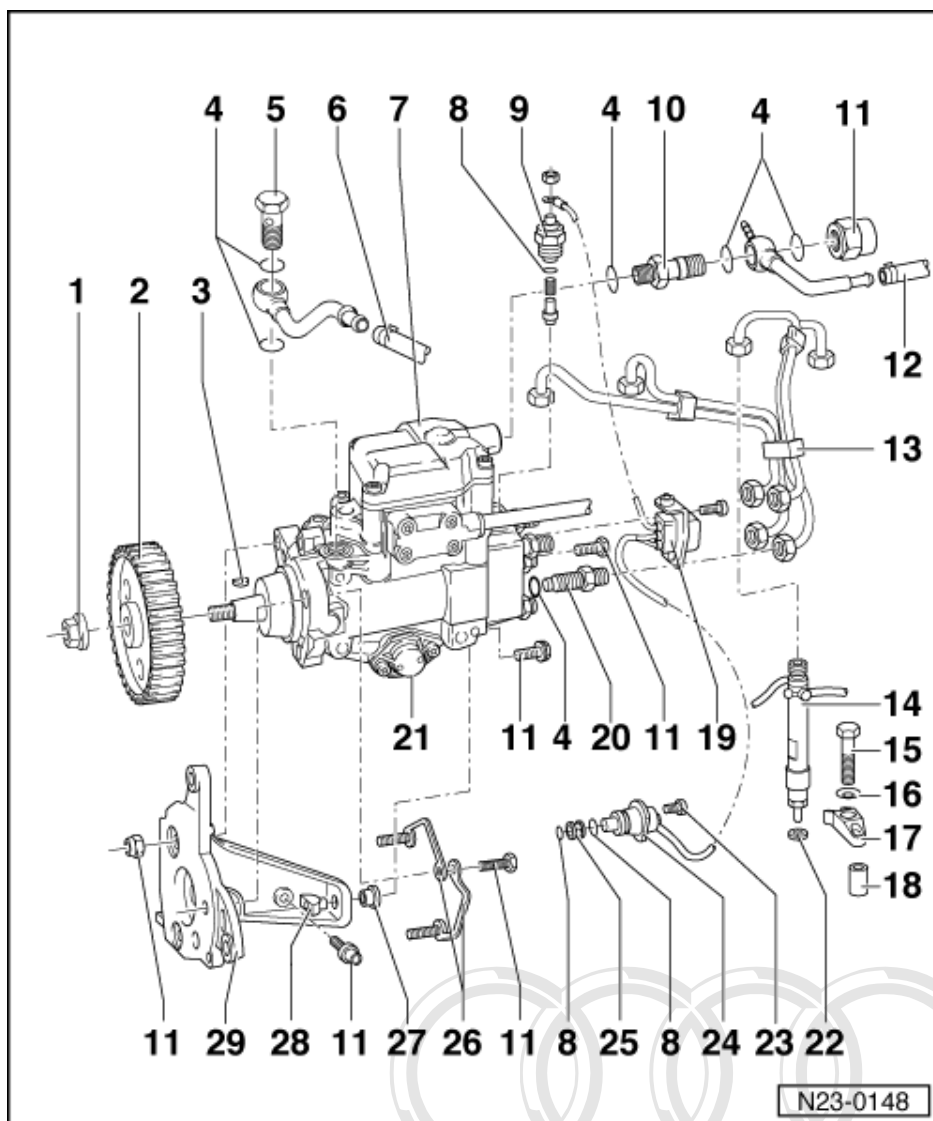
- ♦ With quantity adjuster -N146

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- ♦ With fuel temperature sender -G81
- ♦ With modulating piston movement sender -G149

8 O-Ring

- ♦ Renew if damaged



9 Fuel cut-off valve -N109

- ♦ Tighten to 20 Nm
- ♦ Testing =>Final control diagnosis, Page 15

10 Connection

- ♦ For return pipe
- ♦ Tighten to 28 Nm

11 25 Nm

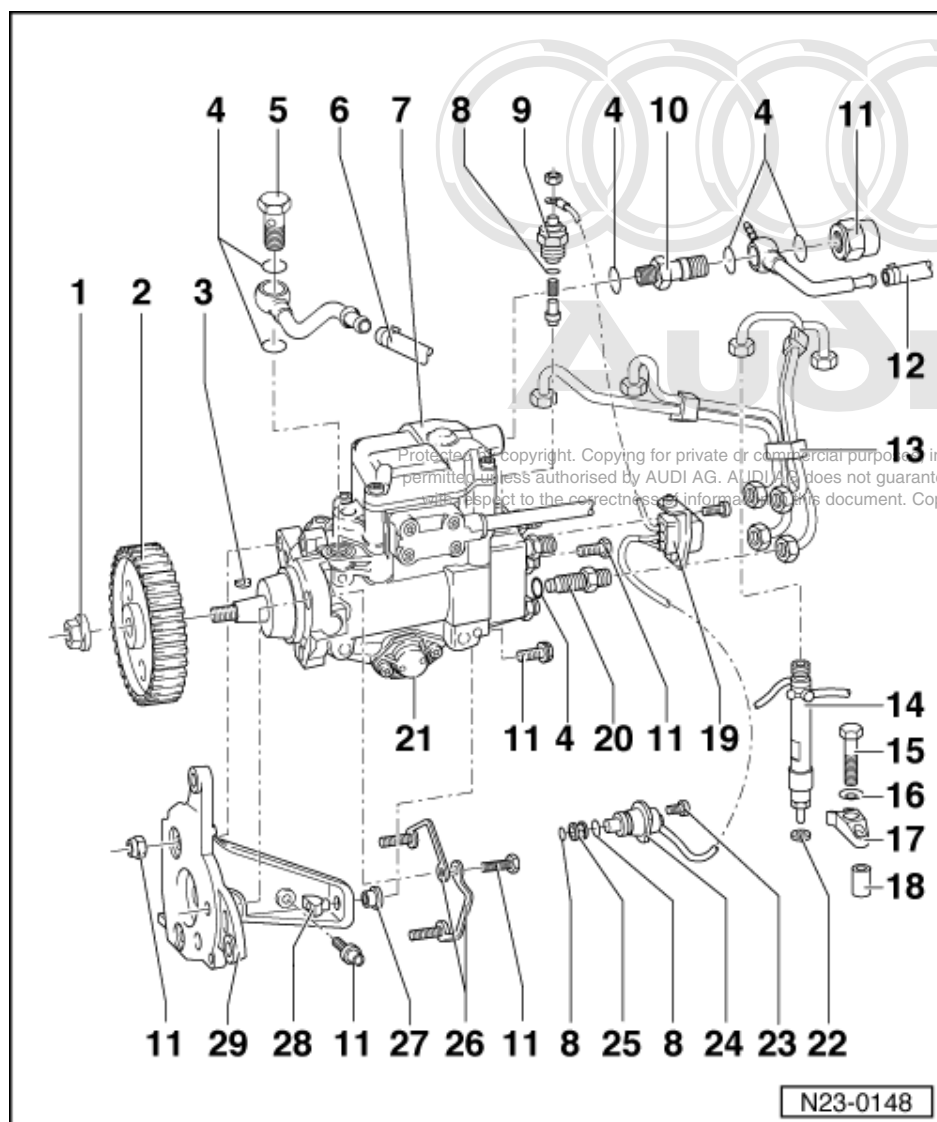
12 Return hose

- ♦ To fuel filter

13 Injector pipes

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

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14 Injector

- ♦ Removing and installing
=> Page **55**
- ♦ Testing => Page **56**
- ♦ For cylinder 3 with needle lift sender -G80. Testing => Page **85**.

15 20 Nm

16 Spherical washer

17 Retainer

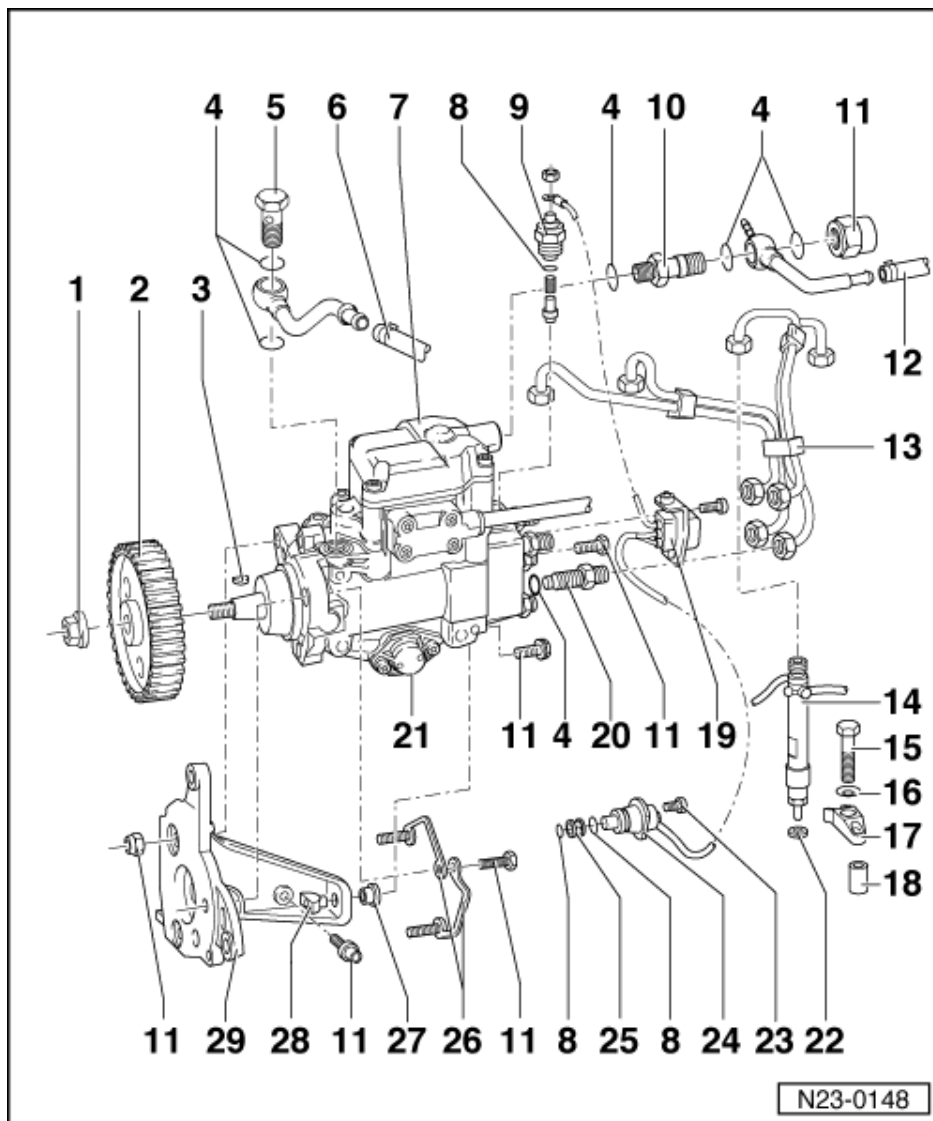
18 Mounting

19 Connector

- ♦ For fuel cut-off valve -N109 and commencement of injection valve -N108

20 Constant pressure valve

- ♦ Tighten to 45 Nm



21 Timing control cover

- ♦ If leaking, replace O-ring
=>Page 57

22 Copper seal

- ♦ Renew

23 12 Nm

**24 Commencement of injection valve
-N108**

25 Strainer

26 Retainer bar

27 Bush

- ♦ Tapered

28 Nut - 25 Nm

- ♦ Conical

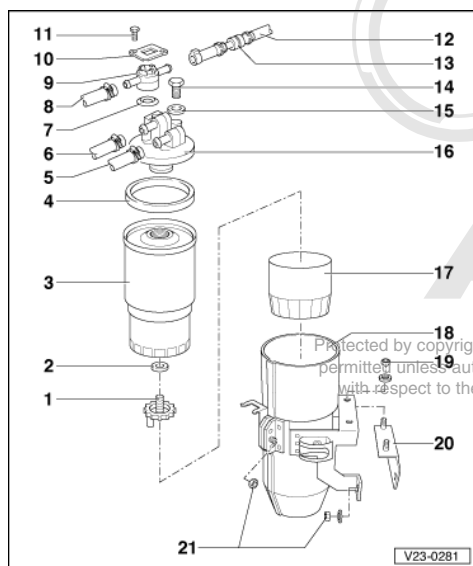
29 Console



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1.6 - Servicing fuel filter



Notes:

- ♦ All hose connections must be secured with hose clips (same as original parts).

=> Parts List

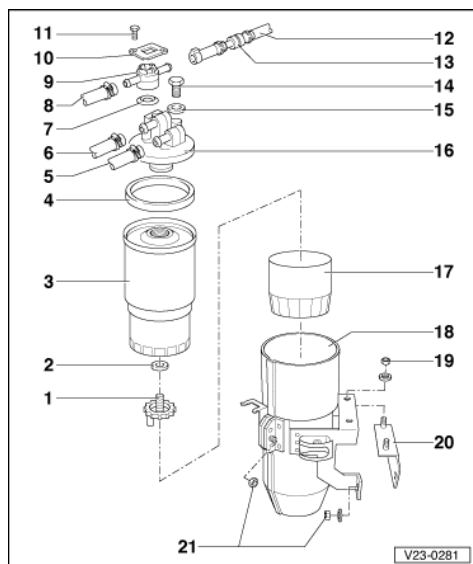
- ♦ Always renew seals and gaskets.

1 Water drain plug

- ♦ Loosen and allow approx. 100 cm³ fluid to drain
- ♦ Loosen vent screw in order to drain water

2 Seal

- ♦ Renew if damaged



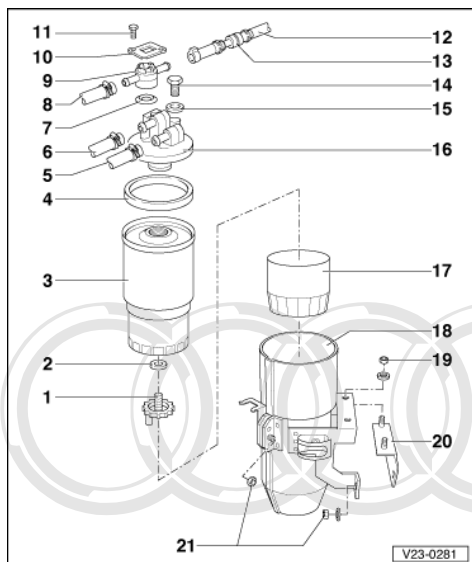
3 Fuel filter

- ♦ Loosen with strap wrench
- ♦ Lightly lubricate seals with diesel before installing
- ♦ Fill with clean fuel before installing
- ♦ Tighten by hand

4 Seal

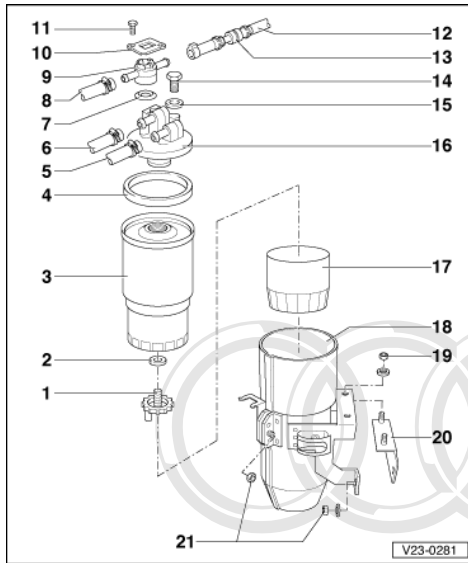
- ♦ Renew if damaged

- 5 Supply pipe**
 - ♦ From fuel tank
- 6 Supply pipe**
 - ♦ To injection pump
- 7 O-Ring**
 - ♦ Renew
- 8 Return pipe**
 - ♦ From injection pump



- 9 Control valve**
 - ♦ Installation position: arrow points towards fuel tank
- 10 Retainer plate**
- 11 5 Nm**
- 12 Return pipe**
 - ♦ To fuel tank
- 13 Non-return valve**
 - ♦ Installation position: arrow points towards fuel tank
- 14 Vent screw - 10 Nm**
 - ♦ Loosen in order to drain water
- 15 Seal**
- 16 Fuel filter flange**

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17 Insert

18 Heat shield

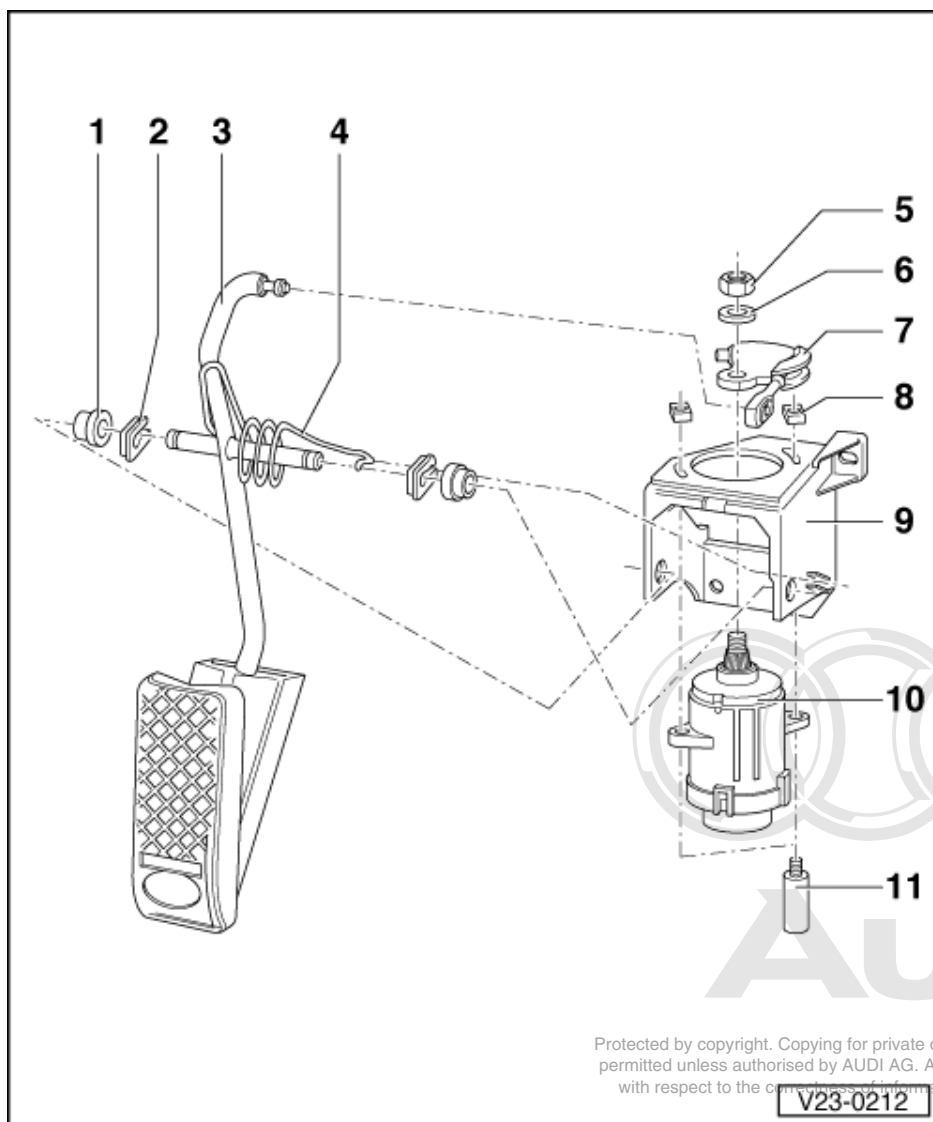
19 10 Nm

20 Bracket

21 10 Nm

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1.7 - Servicing accelerator linkage



- 1 Bush
- 2 Circlip
- 3 Accelerator pedal
- 4 Torsion spring
- 5 10 Nm
- 6 Spring washer
- 7 Cable cam
- 8 Square nut
- 9 Mounting
- 10 Accelerator position sender -G79
 - ♦ Installing and adjusting
=> Page 46
- 11 10 Nm

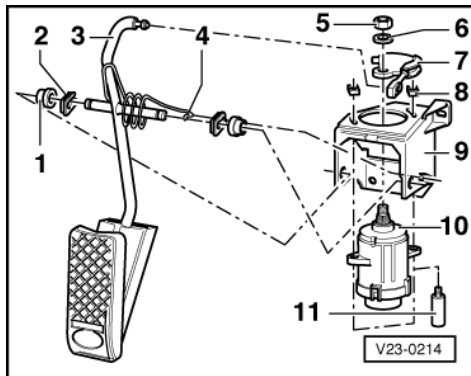
1.8 - Installing and adjusting accelerator position sender -G79

Note:

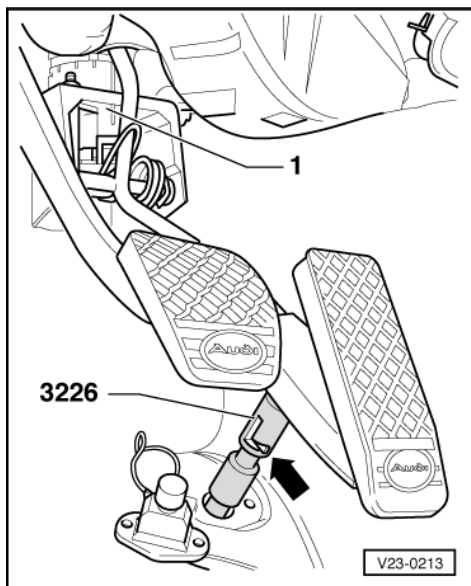
To renew accelerator position sender -G79, first remove the accelerator pedal.

Special tools, testers and auxiliary items

- ♦ Setting jig 3226



- -> Turn accelerator position sender -10- anticlockwise as far as possible in slots in bracket -9- and tighten bolts to secure in position.
- Fit eye from cable cam -7- onto stud on accelerator pedal -3- (pedal is already in position).
 - The eye must be properly seated in the slot on the cable cam.
 - The cable cam must be able to turn freely on the shaft of the accelerator position sender.
- Turn the cable cam anticlockwise slightly and pull the accelerator pedal until it touches the stop on the bracket.
- Secure the cable cam in its new position on accelerator position sender -10- by tightening the nut and counterholding with an open-ended spanner (AF 17) on the flats of the cable cam.
- Install the pre-assembled throttle mechanism in the vehicle and adjust as follows:
- Remove the full-throttle stop.



- -> Push together setting jig 3226 and screw it in the hole instead of the full-throttle stop.
 - The threaded section of the setting jig must be screwed in as far as it will go.
- Pull apart the setting jig and lock it in position with the pin -arrow-.
- Slacken bolts securing accelerator position sender and turn sender so that accelerator pedal rests against setting jig without exerting pressure.
- Tighten bolts to secure accelerator position sender in this position.



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- Remove setting jig and install full-throttle stop.

1.9 - Removing, installing and adjusting injection pump

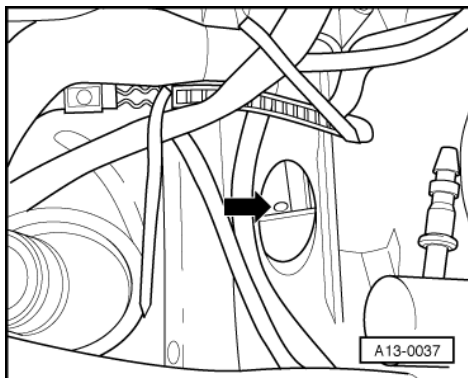
Special tools, testers and auxiliary items

- ◆ Mandrel 2064
- ◆ Setting bar 2065 A
- ◆ Adjustment bar 2068 A for top dead centre
- ◆ Puller 3032
- ◆ Ring spanner 3035
- ◆ Counter-hold tool 3036
- ◆ Adapter 3313
- ◆ Small dial gauge (measuring range from 0 to 3 mm)

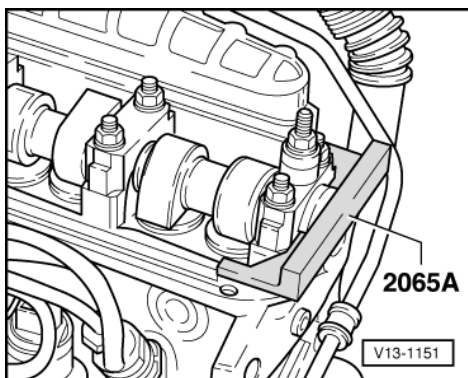
Removing

- Remove engine cover.
- Remove upper toothed belt guard.
- Unbolt cylinder head cover.
- Rotate crankshaft to TDC for cylinder 1.

Engine installed:



- -> Marking -O- on the flywheel must be below the edge which is visible through the inspection hole.



- -> It must also be possible to insert adjustment bar 2065 A in the slot on the back of the camshaft.

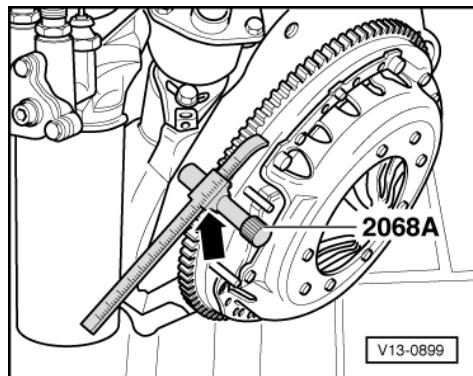
Notes:

- ◆ If the camshaft slot is covered by the upper edge of the cylinder head, rotate the crankshaft through one more revolution.



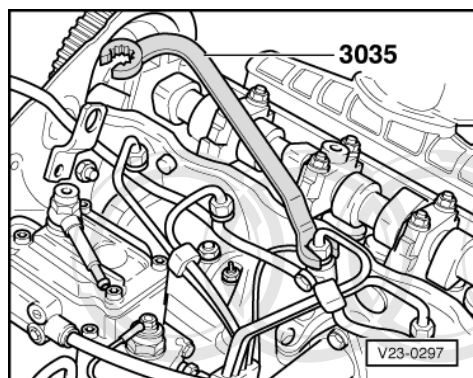
- ♦ If adjustment bar 2065 A cannot be inserted with the crankshaft in TDC position, adjust the basic mechanical setting when installing the injection pump.
- Lock camshaft with adjustment bar 2065 A.

Engine removed:



- Unscrew oil filter.
- -> Screw in adjustment bar 2068 A as shown in the illustration.
- Set adjustment bar to 107 mm -arrow-. The reference point is the left-hand notch of the vernier scale.
- Rotate crankshaft until TDC marking ("O") on flywheel is aligned with edge of adjustment bar.

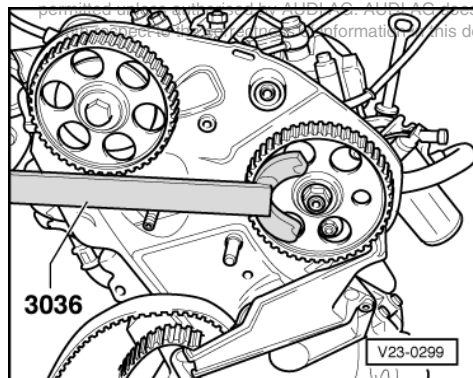
All models



- Unscrew fuel hoses from injection pump.
- Unplug electrical connectors.
- -> Unscrew injection pipes using open ring spanner 3035.

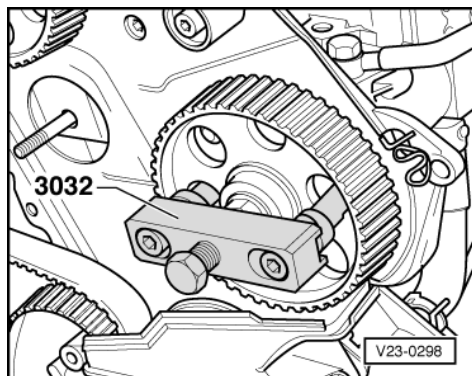
Note:

Always remove pipe set complete. Do not alter pipe shape.



- Remove tensioning roller nut.
- Slacken toothed belt and remove from toothed belt sprockets on camshaft and injection pump together with tensioning roller.

- -> Slacken securing nut for injection pump by about 1 turn, counterholding with retainer 3036.
- Unscrew arms of puller 3032 by about 2 turns.



- -> Fit the puller so that the slots in the arms engage in the holes on the injection pump sprocket.
- Use puller to detach injection pump sprocket.

Note:

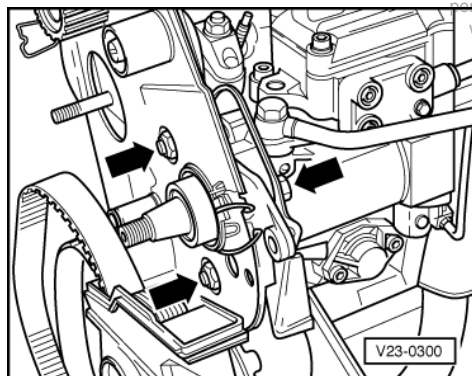
When removing the injection pump sprocket, do not strike the spindle.

- Unscrew nut.

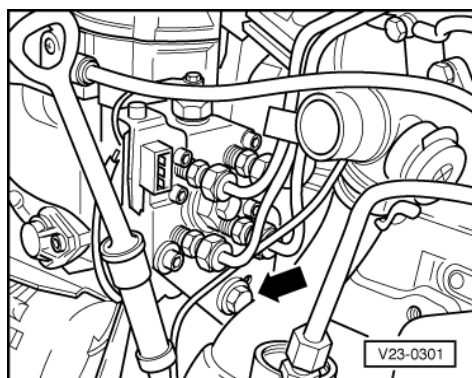
Note:

When removing the injection pump sprocket, make sure not to lose the Woodruff key.

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- -> Remove securing bolts -arrows- for injection pump on front of console.



- -> Remove securing bolt -arrow- on rear support.
- Take off injection pump.



Note:

Shown in illustration with coolant hose removed.

Installing

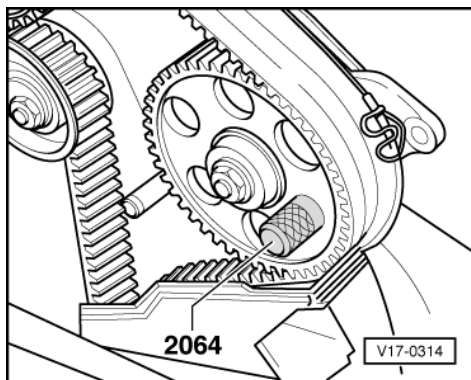
Notes:

- ♦ Do not interchange banjo bolts for supply and return pipes.
- ♦ The banjo bolt with non-return valve is fitted to the return pipe.
- Insert injection pump into console and then tighten securing bolt on rear support with conical nut first.
- Centre the injection pump in the slots in the console.
- Tighten securing bolts for injection pump on front of console by hand.
- Fit injection pump sprocket.

Note:

Make sure that the Woodruff key is properly seated.

- Tighten securing nut to 45 Nm, counterholding with retainer 3036.



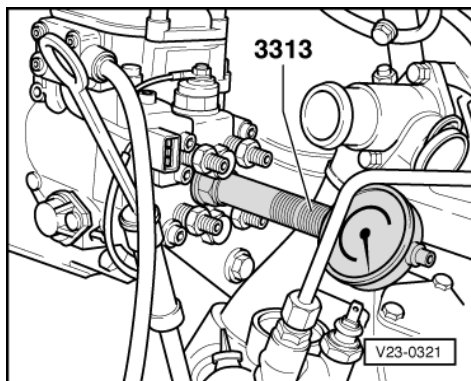
- -> Rotate the injection pump sprocket until it is possible to insert mandrel 2064 into the hole in the console via the small hole in the sprocket.
- Fit the toothed belt.

=> 4-cyl. diesel direct injection engine (TDI), Mechanics; Repair group 13; Dismantling and assembling engine; Removing, installing and tensioning toothed belt Dismantling and assembling engine Removing, installing and tensioning toothed belt

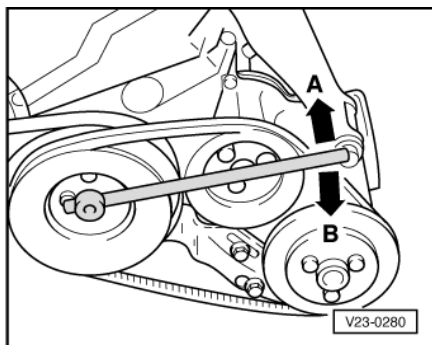
Adjusting

Requirements:

- Correct basic mechanical setting of engine
- Toothed belt correctly tensioned
- Engine at top dead centre



- Remove screw plug from injection pump.
- -> Screw in dial gauge adapter 3313 in place of screw plug.
- Screw threaded end of adapter plunger rod firmly into dial gauge (small version with measuring range from 0 to 3 mm).
- Insert plunger rod with dial gauge into adapter.
- Set dial gauge to pre-load of 2 mm and tighten tensioning nut on adapter.



- -> Rotate crankshaft slowly in direction of arrow -A- (against engine running direction) until needle on dial gauge stops moving.

Note:

Use a 12-point socket (AF 19) to rotate the crankshaft.

- Slacken dial gauge and tighten again with pre-load of about 1 mm.
- Set measuring scale to 0.
- Rotate crankshaft slowly in direction of arrow -B- (engine running direction) until marking -O- on flywheel aligns with reference marking or with edge of adjuster.

Note:

When aligning the TDC marking, the crankshaft must be rotated in the engine running direction. If the crankshaft is rotated too far by mistake

- Rotate crankshaft back until dial gauge returns to zero, then rotate forwards again to align TDC marking.
- Read off commencement of injection value on dial gauge:
 - Setting value: 0.7 ± 0.02 mm travel

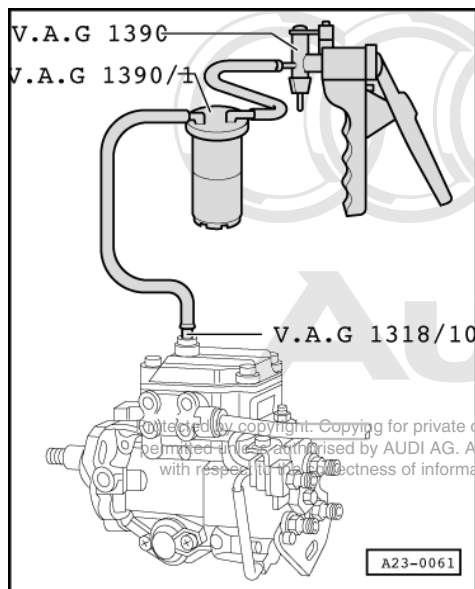
Notes:

- ◆ If the test value is within the specified tolerance, no new setting is required.
- ◆ If the test value is outside the tolerance, adjust to the setting value.
- Slacken securing bolts for injection pump on front of console and on rear support by about 1 turn each.
- Adjust commencement of injection by turning the injection pump.
- Tighten securing bolts to 25 Nm.
- Tighten screw plug to 25 Nm.
- Reconnect injection pipes, fuel supply pipe and electrical wiring.
- Bleed the fuel system => Page 52 .
- Fit toothed belt guard.
- Dynamically check and adjust commencement of injection
=>Page 52 .

1.10 - Bleeding fuel system

Special tools, testers and auxiliary items

- ♦ Adapter V.A.G 1318/10
- ♦ Hand-operated vacuum pump V.A.G 1390 with bleeder container V.A.G 1390/1.



- -> Fill the injection pump with clean diesel fuel as follows:
- Screw adapter V.A.G 1318/10 into return connection on injection pump.
- Connect hand vacuum pump V.A.G 1390 and bleeder container V.A.G 1390/1 to adapter.
- Operate hand vacuum pump until fuel flows free of bubbles.

Important:

Do not allow fuel to be drawn into the hand vacuum pump.

- Connect return pipe.
- Start the engine and check fuel system for leaks (visual check).

1.11 - Dynamically checking and adjusting commencement of injection

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/1

Notes:

- ♦ 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.
- ♦ The dynamic check of the commencement of injection is only possible with function 04 "Basic setting". This is because in the basic setting mode the commencement of injection valve is activated continuously and therefore the injection timing control is set to "late" (retarded).

Requirements for test:

- Correct basic mechanical setting of engine
- Toothed belt correctly tensioned
- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page 2.

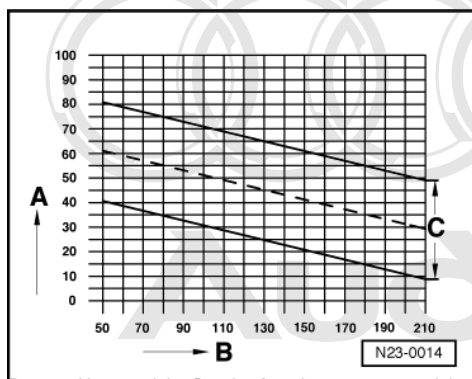
- Start the "Basic setting" function and select Display Group 000
=> Page 18.

-> Indicated on display

Basic setting 0						
1	2	3	4	5	6	7
8	9	10				

- Monitor the display in display zone 7 (coolant temperature).
 - Specification: less than 73 (equivalent to 85°C)
- Do not proceed with the test until the coolant temperature has reached the specified level.

The commencement of injection value in display zone 2 is dependent on the fuel temperature value in display zone 9.



→ A - Display zone 2 commencement of injection
B - Display zone 9 - fuel temperature

- ◆ Specification: => area C on graph

Note:

If the commencement of injection is within the specified range -C- when tested, no adjustment is required.

- If the commencement of injection is outside the tolerance range, adjust the injection pump as follows:
- Slacken securing bolts for injection pump by about 1 turn each. The most easily accessible bolt should be slackened last.
- Take hold of injection pump and apply manual turning force in direction of adjustment.
- Carefully slacken the last securing bolt far enough to allow the pump to turn slightly.
- If commencement of injection is too early, turn injection pump in engine running direction. If commencement of injection is too late, turn pump against engine running direction.
- Re-tighten securing bolt.

System in basic setting 0							
1	2	3	4	5	6	7	8
9	10						

- > Observe readout in display zone 2 and if necessary repeat the adjustment procedure until the readout remains within the specified range.
- Re-tighten securing bolts for injection pump to 25 Nm.

Note:

After performing the dynamic adjustment of the injection pump, always slacken the injection pipes on the injection pump and then re-tighten them to 25 Nm. This relieves the tension on the pipes and prevents fracturing caused by constant vibrational stress.

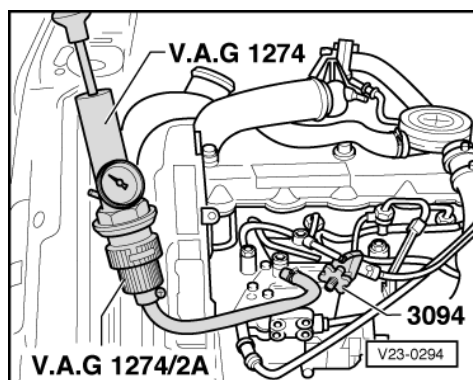
1.12 - Checking fuel system for leaks

Special tools, testers and auxiliary items

- ♦ Hose clamps 3093 or 3094
- ♦ Cooling system tester V.A.G 1274
- ♦ Adapter V.A.G 1274/2 A

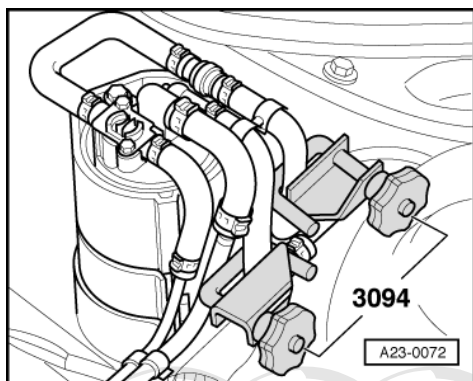
Leaks in the fuel system may result in the following:

- ♦ Foam build-up or air bubbles in the supply pipe
- ♦ Loss of power, misfiring



- ♦ Starting problems

- -> Attach adapter 1274/2 A to cooling system tester V.A.G 1274.
- Unscrew return pipe from injection pump and connect adapter hose in its place.



- -> Fit hose clamps 3093 or 3094 at the following points:
 - On supply hose downstream of fuel filter
 - On return hose downstream of fuel filter
 - On return hose from injection pump
- Use hand pump on tester to create a pressure of between 1.0 and 1.5 bar.
- If the pressure constantly drops, locate leak and eliminate fault.

Note:

By moving the hose clamps from the filter to the fuel tank connections it is also possible to test the fuel hoses.

1.13 - Removing, installing and testing injectors and constant pressure valves

Note:

Defective injectors cause the following faults:

- ◆ Loss of power
- ◆ Excessive black exhaust smoke
- ◆ Excessive blue smoke when starting from cold
- ◆ Higher fuel consumption
- ◆ Engine over-heating
- ◆ Knocking in one or more cylinders
- ◆ Misfiring

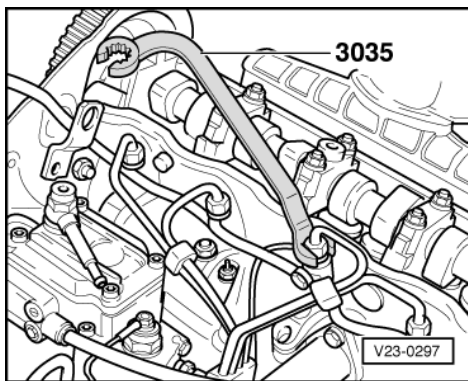
Defective constant pressure valves cause the following fault:

- ◆ Uneven idling, possibly at irregular intervals (sporadically)

Special tools, testers and auxiliary items

- ◆ Ring spanner 3035
- ◆ Injector tester V.A.G 1322
- ◆ Pressure pipe V.A.G 1322/2
- ◆ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/1

Removing



- -> Unscrew injection pipes using open ring spanner 3035.

Note:

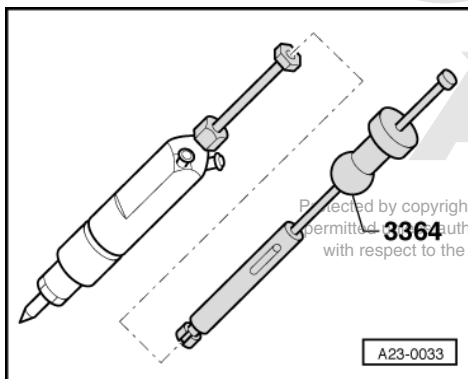
Always remove pipe set complete. Do not alter pipe shape.

- Remove securing nut, take off retainer and take out injector.

Note:

If the injectors are seized, construct the following auxiliary tool:

- Saw off an injection pipe about 5 cm away from the injector union nut.





- Braze an M6 nut onto the sawn-off end of the pipe section.
- Clean the auxiliary tool thoroughly. Any dirt will make the injector unusable.
- -> Screw the union nut end of the auxiliary tool onto the seized injector, then apply special tool 3364 to the end with the brazed-on nut.

Installing

Note:

Always renew copper seals between cylinder head and injectors.

- Insert injectors.
- Check mounting is seated correctly in cylinder head.
- Fit retainer.

Tightening torques

Component	Nm
Injection pipes	25
Nut for retainer	20

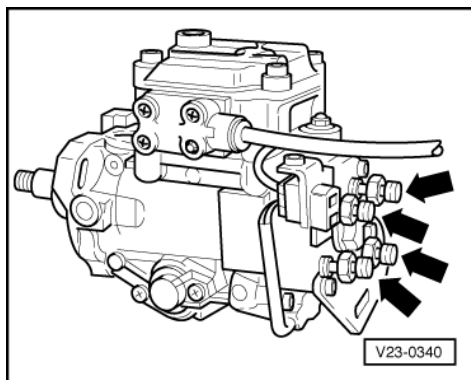
Testing

- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page 2 .
- ->

Read measured value block 13
0.82mg/H -0.12mg/H 0.49mg/H

Read measured value block, Display Group 013, engine at idling speed => Page 29 .

- Specification: -1,50 mg/H ... +1,50 mg/H (milligrams per stroke)
- If one or more of the values is outside the tolerance, swap round the injectors (except the injector for cylinder 3).
- If the fault moves along with the injector, fit a new injector.



- If the fault remains on the same cylinder, check the compression.

=> 4-cyl. diesel direct injection engine (TDI), Mechanics; Repair group 15; Removing and installing cylinder head; Testing compression Removing and installing cylinder head Testing compression

- -> If the compression is OK, renew the relevant constant pressure valve -arrow- together with sealing ring.
- Tightening torque: 45 Nm

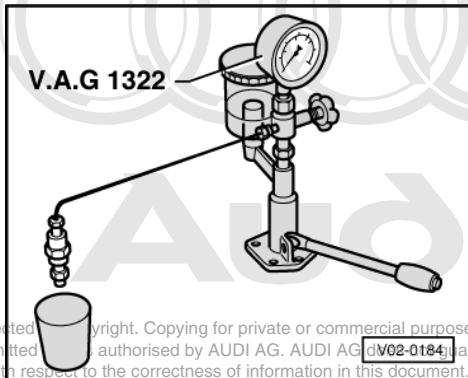
Notes:

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- ♦ When removing the sealing ring from the pump, always use a soft object (plastic or wood) in order not to scratch the sealing surface.
- ♦ After 15,000 km the constant pressure valves must always be renewed as a complete set if one or more of them is defective.

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.



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-> Test injectors using V.A.G 1322 and pressure pipe V.A.G 1322/2.

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.

Testing spray pressure

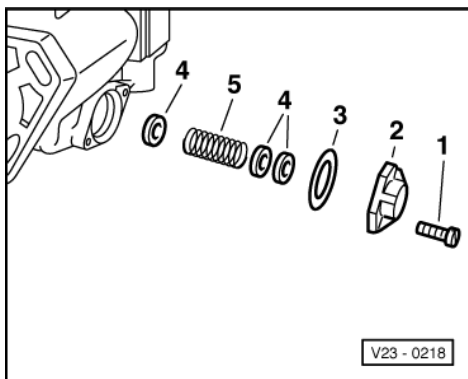
- Pressure gauge on
- Move pump lever down slowly. When injection begins, read off spray pressure. If the pressure does not match the specification, fit a new injector.

Specification	
New injectors	190...200 bar
Wear limit	170 bar

Checking for leaks

- Pressure gauge on
- 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.

1.14 - Renewing injection timing device cover O-ring



- Place a clean cloth beneath 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.
- Renew O-ring -3- and install cover with existing shim -4-.

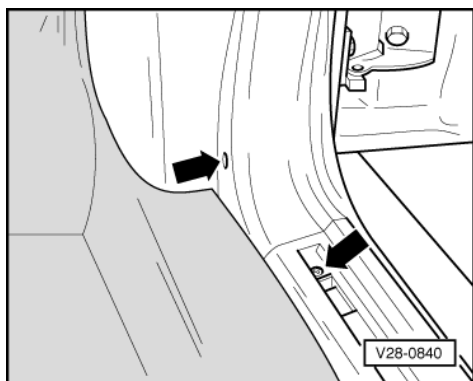
1.15 - Renewing engine electronics control unit

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 with cable V.A.G 1551/1

Removing

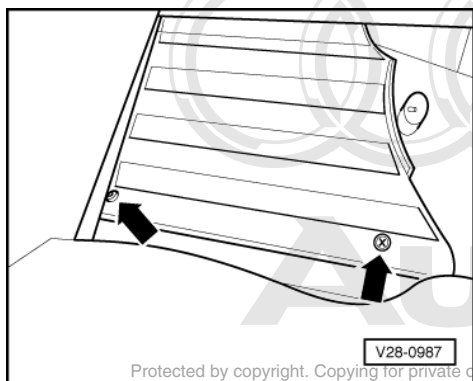
- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page 2.
- Always start by calling up and printing out the control unit identification => Page 2.
- Switch off ignition.



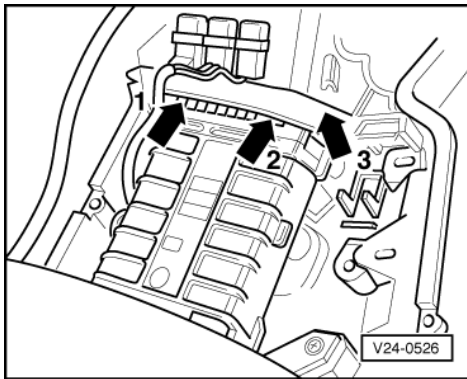
- -> Remove lower section of right-hand A-pillar trim and also right-hand sill panel trim around front door.

=> General body repairs; Repair group 70; Trims; Removing and installing A-pillar trim and Removing and installing inner sill panel trim Trims Removing and installing A-pillar trim and Removing and installing inner sill panel trim

- Pull back floor covering at front of right-hand footwell. (If necessary, cut open the perforated seam on the left with a knife.)



- -> Remove screws on cover for electronics box -arrows-.
- Carefully detach upper and lower sections of cover.



- -> Pull out cross-piece (arrow -3-) together with attached components.
- Remove screws (arrows -1- and -2-).
- Disengage retainer clip and unplug control unit connector.

Note:

Always make sure that the ignition is switched off before unplugging or fitting the connector for the diesel direct injection system control unit.

Installing

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

Note:

Always make sure that the ignition is switched off before unplugging or fitting the connector for the diesel direct injection system control unit.

- Check whether there is water in the electronics box and seal any cracks or openings.
- Check wiring.
- If necessary, code the control unit => Page 20 .
- Adapt engine electronics control unit to immobilizer control unit.

=> Electrical system; Repair group 01; Self-diagnosis; Adaption procedure after renewing engine control unit
 Self-diagnosis Adaption procedure after renewing engine control unit

Vehicles with cruise control system:

- Activate cruise control system
 => Page 100 .

1.16 - Wiring and component check with test box V.A.G 1598/18

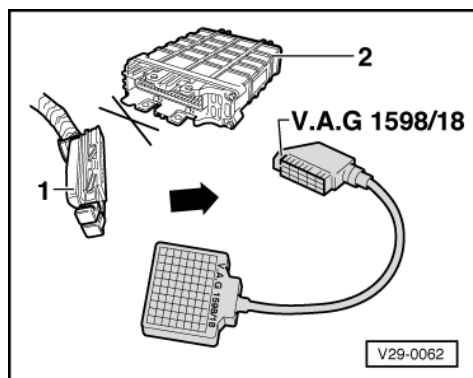
Notes:

- ◆ Always make sure that the ignition is switched off before detaching or fitting the connector for the Diesel direct injection system control unit.
- ◆ Test box V.A.G 1598/18 must be disconnected when performing the diagnosis with fault reader V.A.G 1551.
- ◆ Use hand-held multimeter V.A.G 1526 or multimeter V.A.G 1715 and voltage tester V.A.G 1527 B for the tests.
- ◆ To connect the test equipment to the test box, use auxiliary cables from adapter set V.A.G 1594 A.
- ◆ The contact numbers of the plugs and the socket numbers in the test box are identical.

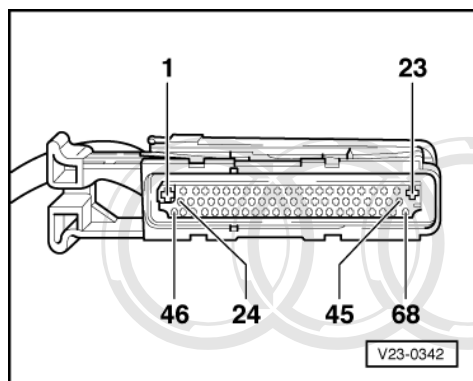
To avoid damaging the electronic components, always set the tester to the correct measuring range before connecting the test leads.



- Switch off ignition.



- Remove diesel direct injection system control unit=>Page 58 .
- -> With the ignition switched off, connect test box V.A.G 1598/18 to connector -1- (the control unit -2- remains disconnected).



Notes:

- ♦ -> Layout of contacts for repair work on connector for Diesel direct injection system control unit -J248.
- ♦ The contact layout is identical to the socket layout on test box V.A.G 1598/18.

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2 - Testing charge pressure system

2.1 - Testing charge pressure system

2.2 - Checking charge pressure

Safety notes

Note the following points if test equipment has to be used during a road test:

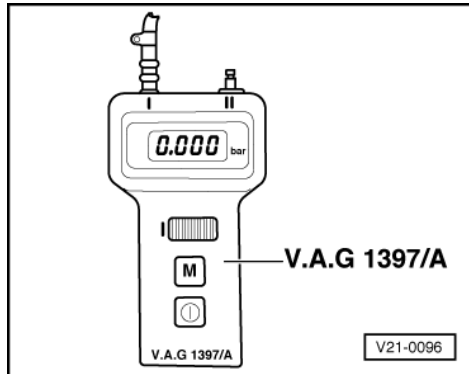
Warning

- ♦ **Test equipment must always be secured on the rear seat and operated by a second person.**
- ♦ **If test equipment is operated from the front passenger seat, the occupant could be injured by the passenger's airbag in an accident.**

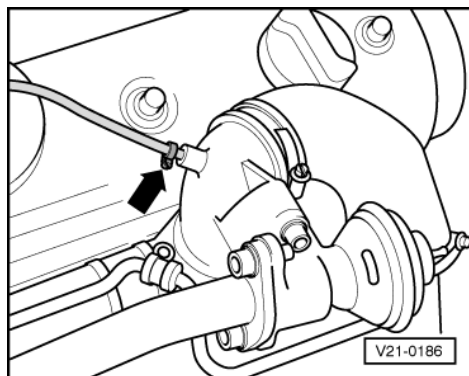
Special tools, testers and auxiliary items

- ◆ Turbocharger tester V.A.G 1397 A
- ◆ Fault reader V.A.G 1551 with cable V.A.G 1551/1

Requirements for test:

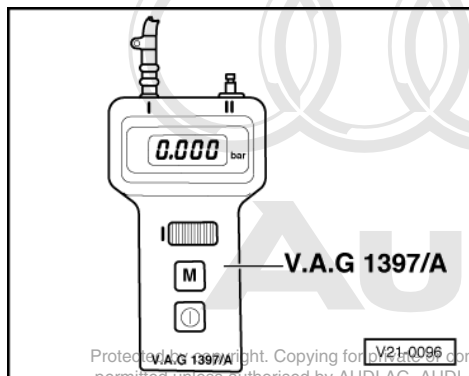


- No leaks in intake or exhaust systems
- Compression, hydraulic tappets and injectors must be OK
- -> The charge pressure is measured with turbocharger tester V.A.G 1397/A and fault reader V.A.G 1551 during a test drive.
- Pull cap off connecting pipe for intake manifold.
- Check for obstructions in connecting pipe, if necessary piercing soot layer with a piece of wire.



- -> Connect measuring hose from turbocharger tester V.A.G 1397/A to connecting pipe and secure with a hose clamp -arrow-.
- Route measuring hose under rear edge of bonnet and into passenger compartment via right-hand window.

Notes:



- ◆ Hose connections must be completely airtight, otherwise measurements will not be correct.
- ◆ Ensure that measuring hose is not pinched at bonnet or side window.
- ◆ A second mechanic is required to note the readings on the tester when the vehicle is moving.

♦ Observe safety notes => Page 60 .

- -> Switch on turbocharger tester and set measuring range selector switch to position -I- (absolute pressure).
- Connect measuring hose to connection -I-.
- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page 2 .
- Read measured value block, Display Group 011, engine at idling speed => Page 32 .

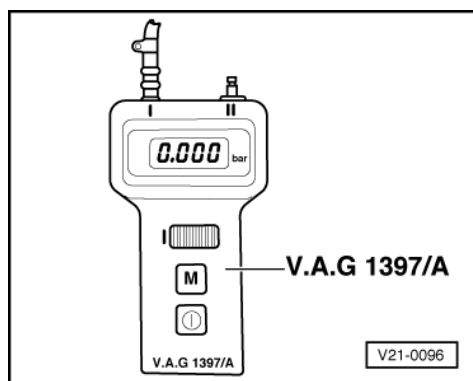
-> Indicated on display:

Read measured value block 11			
840 rpm	938 mbar	978 mbar	
92 %			

To determine the exact cause of the fault, first test the turbocharger without charge pressure control, and then test the charge pressure with charge pressure control.

Testing charge pressure without charge pressure control:

- Unplug connector from charge pressure control solenoid valve -N75 => Fitting locations overview, Page 34 .
- Accelerate vehicle in 3rd gear from about 1500 rpm using full throttle.
- At about 3000 rpm, press memory key M on V.A.G 1397/A and at the same time press the PRINT key on V.A.G 1551.



-> Specification for V.A.G 1397/A:

- ♦ 1.550 ... 1.750 bar

-> Specification for display zone 3 on V.A.G 1551:

Read measured value block 11			
3040 rpm	1846 mbar	1693	
mbar	39 %		

- ♦ 1550 ... 1750 mbar

Note:

The charge pressure level is measured with turbocharger tester V.A.G 1397/A. Fault reader V.A.G 1551 is used to check whether the charge pressure is being registered by the control unit.

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Charge pressure too low - causes:

- ♦ Leak between turbocharger and intake manifold
- ♦ Turbocharger defective (turbine jammed by foreign body)
- ♦ Actuation (linkage, shaft) for by-pass valve stiff or jammed (by-pass valve permanently open)

Charge pressure too high - causes:

- ♦ Charge pressure control hose disconnected, leaking or blocked
- ♦ Charge pressure control solenoid valve -N75 blocked
- ♦ Actuation (linkage, shaft) for by-pass valve stiff or jammed (by-pass valve permanently closed)

- ♦ Leak in pressure unit

Testing charge pressure with charge pressure control:

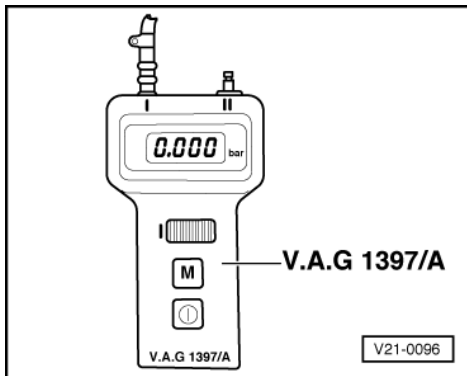
If the charge pressure level without charge pressure control is okay, repeat the test, this time with charge pressure control:

- Fit connector to charge pressure control solenoid valve -N75.

Note:

The charge pressure is determined by the control unit and is dependent on the intake manifold temperature and ambient air pressure.

- Accelerate vehicle in 3rd gear from about 1500 rpm using full throttle.



- At about 3000 rpm, press memory key M on V.A.G 1397/A and at the same time press the PRINT key on V.A.G 1551.

-> Specification for V.A.G 1397/A:

- ♦ 1.800 ... 2.050 bar

-> Specification for display zone 3 on V.A.G 1551:

Read measured value block 11			
3090 rpm	1866 mbar	1917	
mbar	62 %		

- ♦ 1800 ... 2050 mbar

Note:

The charge pressure level is measured with turbocharger tester V.A.G 1397/A. Fault reader V.A.G 1551 is used to check whether the charge pressure is being registered by the control unit.

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Charge pressure too low causes:

- ♦ Electrical fault in charge pressure control solenoid valve -N75
- ♦ Charge pressure control solenoid valve -N75 is jammed in the open position

Charge pressure too high - causes:

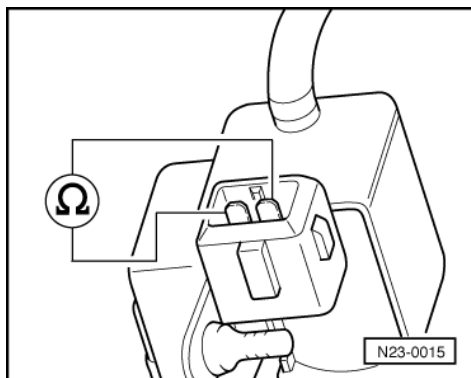
- ♦ Charge pressure control solenoid valve -N75 is jamming at times in the closed position
- ♦ Charge pressure has been increased as a result of tuning

2.3 - Testing charge pressure control solenoid valve -N75

Special tools, testers and auxiliary items

- ♦ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ♦ Adapter set V.A.G 1594 A
- Switch off ignition.
- Pull connector off charge pressure valve -N75
=>Fitting locations overview, Page 35 , Item 11 .

Testing internal resistance

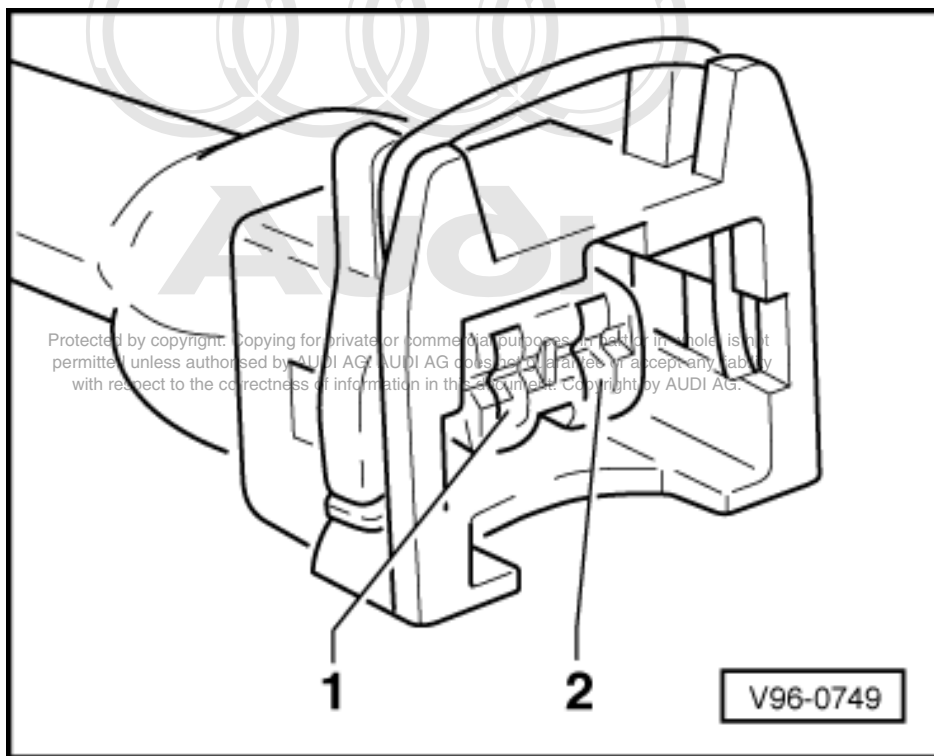


- -> Set hand-held multimeter V.A.G 1526 to resistance measuring range and connect to valve contacts using test leads from V.A.G 1594 A.
- Specification: 25 ... 45 ω

If the specification is not attained:

- Renew charge pressure control solenoid valve -N75.

Testing voltage supply



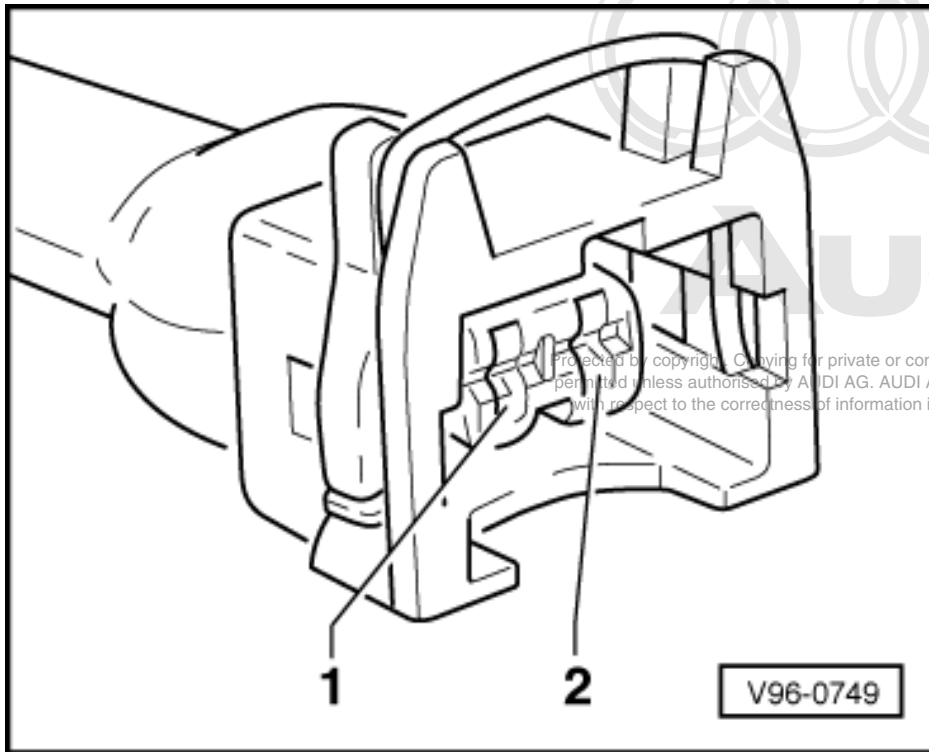
- -> Set hand-held multimeter V.A.G 1526 to voltage measuring range (20 V direct current) and connect to earth and contact 2 of connector using test leads from V.A.G 1594 A.
- Switch on ignition.
 - Specification: approx. battery voltage

If the specification is not attained:

- Test wiring for open circuit and short to positive or earth.

Testing wiring

- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page 59.



- -> Test for open circuit and short to positive or earth in the following wiring connections:

Connector for -N75 Contact	Test box V.A.G 1598/18 Socket
1	47
2	68

- Rectify any open/short circuit as necessary.

2.4 - Testing intake manifold temperature sender -G72

Special tools, testers and auxiliary items

- ◆ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ◆ Fault reader V.A.G 1551 with cable V.A.G 1551/1
- ◆ Adapter set V.A.G 1594 A
- ◆ Test box V.A.G 1598/18

- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page 2.

- Read measured value block, Display Group 007, engine cold and not running => Page 30 .

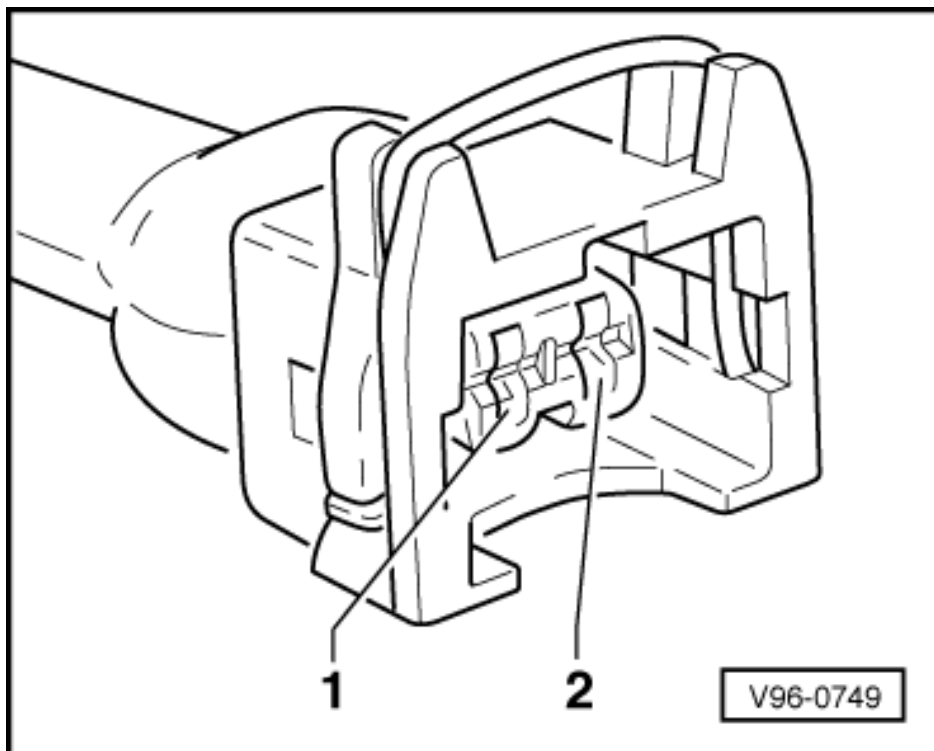
Read measured value block 7
15.4 5C 15.9 5C 16.7 5C

-> Observe display in display zone 3.

If the wiring to the sender has an open circuit, a substitute value of 18.9 °C will be displayed.

If an implausible value or a substitute value of 18.9 °C is displayed:

- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page 59 .
- Pull connector off intake manifold temperature sender -G72
=>Fitting locations overview, Page 36 , Item 12 .



- -> Test for open circuit and short to positive or earth in the following wiring connections:

Connector for -G72 Contact	Test box V.A.G 1598/18 Socket
1	64
2	33

- Rectify any open/short circuit as necessary.

2.5 - Testing intake manifold pressure sender -G71 and altitude sender -F96

Both senders are located in the diesel direct injection system control unit.

Special tools, testers and auxiliary items

- ♦ Turbocharger tester V.A.G 1397 A
- ♦ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/1

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- ♦ Adapter set V.A.G 1594 A
- ♦ Test box V.A.G 1598/18

Test requirement:

- Engine not running
- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page **2** .

Read measured value block 10
 0 mg/H 1027 mbar 1013 mbar 0.0
 %

- > Read measured value block, Display Group 010, engine not running => Page **31** .
- Observe the readouts in display zone 2 (altitude sender -F96) and display zone 3 (intake manifold pressure sender -G71).
 - Specification: The pressures should be the same.
 Tolerance: ± 30 mbar

If the specification is not attained:

- Compare displayed pressures with pressure according to a barometer (e.g. turbocharger tester V.A.G 1397/A).
 Tolerance: ± 30 mbar.

If the value in display zone 3 does not agree:

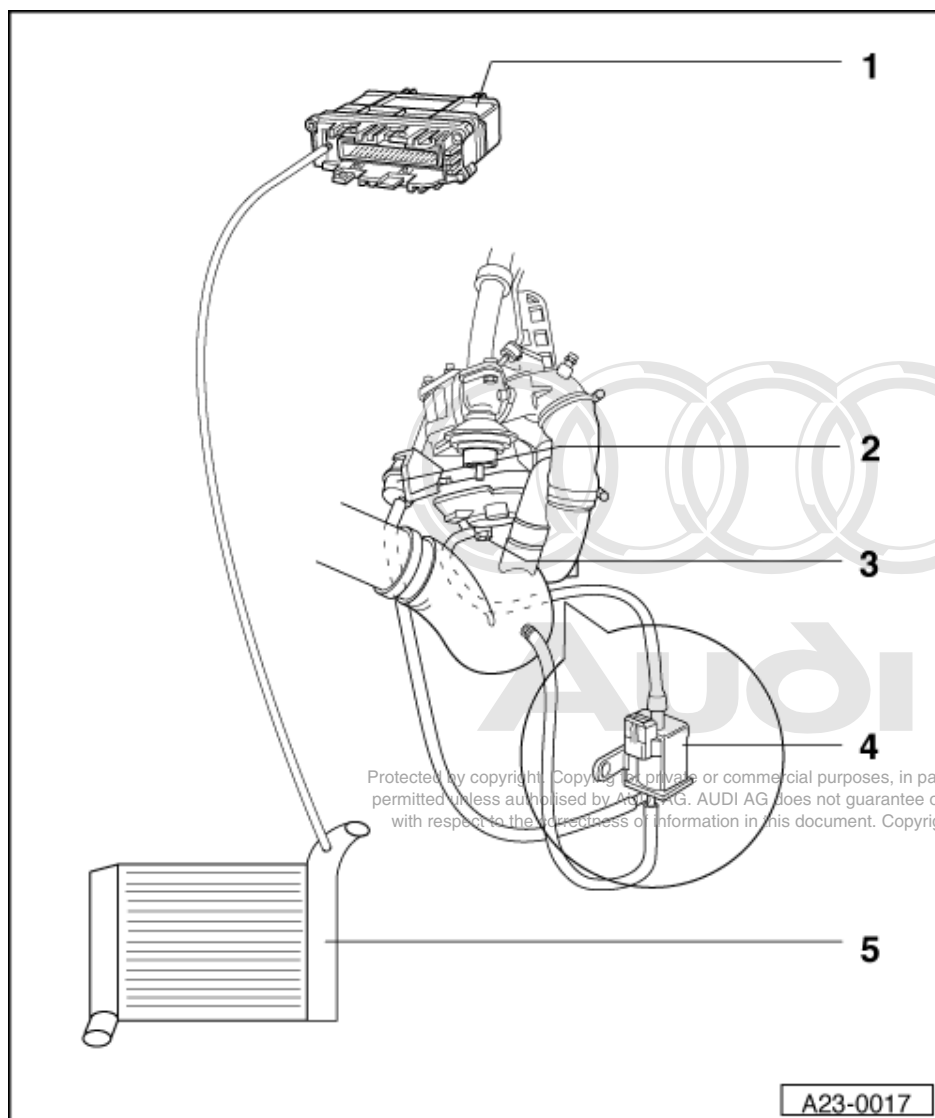
- Detach pressure hose from control unit.

If the value in display zone 3 still does not agree:

- Fit a new Diesel direct injection system control unit -J248
 => Page **58**

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2.6 - Hose routing diagram for charge pressure control system



- 1 Control unit with intake manifold pressure sender -G71
- 2 Pressure unit for charge pressure control
- 3 Pressure connection on turbocharger
 - ♦ Pressure supply for charge pressure control system
- 4 Solenoid valve for charge pressure control -N75
- 5 Charge air cooler

3 - Testing injection control

3.1 - Testing injection control

3.2 - Checking injection timing control range

Special tools, testers and auxiliary items

- ◆ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/1
- ◆ Adapter set V.A.G 1594 A

- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page 2.
- Start final control diagnosis and activate commencement of injection valve => Page 15.

-> Indicated on display:

Final control diagnosis
 Commencement of injection valve -N108

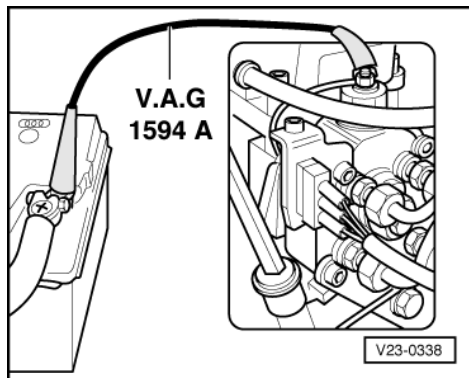
Activating the valve will affect the combustion noise considerably (pre-ignition).

- Start the "Basic setting" function and select Display Group 000
 => Page 18.

-> Indicated on display (example):

System in basic setting 0
 42 55 0 20 116 117
 62 97 127 83

- If necessary, correct the commencement of injection
 => Page 52.



- -> Use auxiliary cables from adapter set V.A.G 1594 A to connect battery positive terminal to fuel cut-off valve -N109, then unplug 3-pin connector on injection pump.

or

- Pull out fuse 64 in electronics box in front passenger's footwell.

Note:

Fault 00550 (and possibly also fault 00741) will be stored in the fault memory.

- Observe readout in display zone 2.



System in basic setting 0					
42	255	0	20	116	117
62	97	127	83		

-> The readout should increase to 255.

Note:

The break in the power supply will cause the commencement of injection valve to close. The interior pressure in the pump cannot be reduced further, and therefore the full pressure is applied to the injection timing control piston. This moves the injection timing control to the "early" (fully advanced) stop position.

If the specification is not attained:

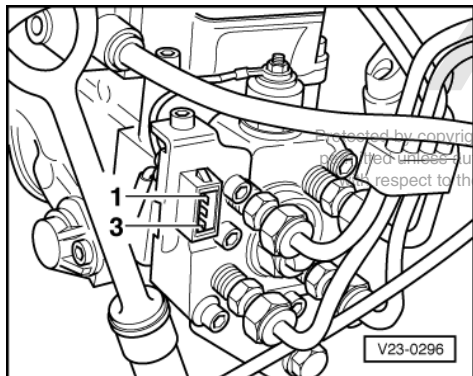
- Fit a new injection pump => Page 47 .
- Interrogate fault memory, then erase => Page 4 .

3.3 - Testing commencement of injection valve -N108

Special tools, testers and auxiliary items

- ♦ Hand multimeter V.A.G 1526 or V.A.G 1526 A
 - ♦ Voltage tester V.A.G 1527 B
 - ♦ Adapter set V.A.G 1594 A
 - ♦ Test box V.A.G 1598/18
- Switch off ignition.
 - Unplug connector on injection pump
=>Fitting locations overview, Page 35 , Item 8 .

Testing internal resistance

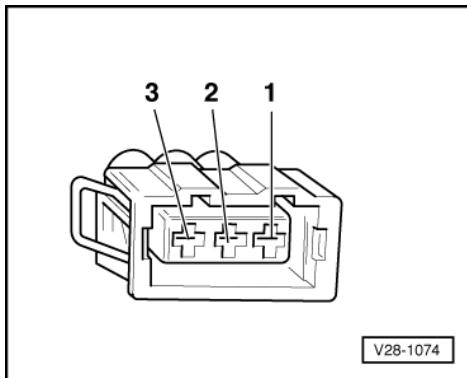


- -> Set hand-held multimeter V.A.G 1526 to resistance measuring range and connect to valve contacts 2 and 3 using test leads from V.A.G 1594 A.
- Specification: 12 ... 20Ω

If the specification is not attained:

- Fit a new commencement of injection valve -N108
=> Fitting locations overview, Page 35 , Item 7 .

Testing voltage supply

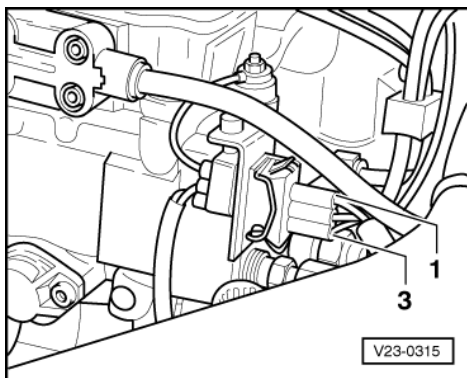


- -> Set hand-held multimeter V.A.G 1526 to voltage measuring range (20 V direct current) and connect to engine earth and contact 3 on connector using test leads from V.A.G 1594 A.
- Switch on ignition.
 - Specification: approx. battery voltage

If the specification is not attained:

- Eliminate open circuit or short circuit using the current flow diagram.

Testing activation



- -> Connect voltage tester V.A.G 1527 B to contacts 2 and 3 on injection pump connector using test leads from V.A.G 1594 A.
- Start final control diagnosis and activate commencement of injection valve => Page 15 .

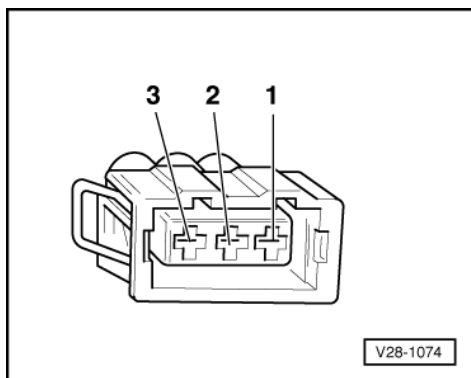
-> Indicated on display:

Final control diagnosis
Commencement of injection valve -N108

- The LED lamp on the voltage tester should flash.

If the LED lamp does not flash or lights up continuously:

- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page 59 .



- -> Test for open circuit and short to positive or earth in the following wiring connections:

Connector for -N108 Contact	Test box V.A.G 1598/18 Socket
2	51

- Rectify any open/short circuit as necessary.
- If the wiring is OK, fit a new Diesel direct injection system control unit -J248 => Page 58 .

3.4 - Testing fuel temperature sender -G81

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/1
- ♦ Test box V.A.G 1598/18

- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page 2 .
- Read measured value block, Display Group 007, engine cold and not running => Page 30 .

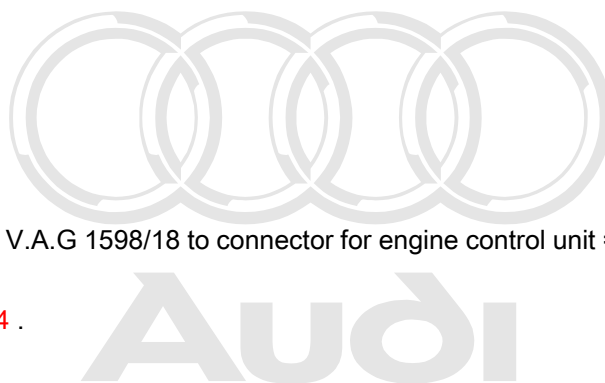
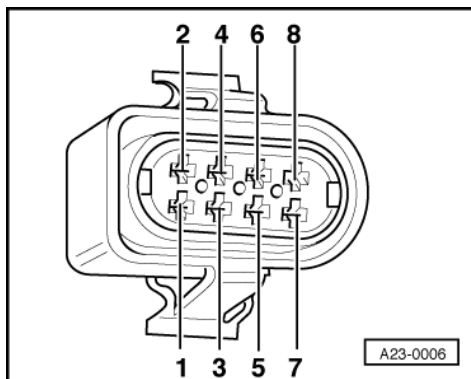
-> Indicated on display:

Read measured value block 7		
15.4 5C	15.9 5C	16.7 5C

- Observe display in display zone 1.

If an implausible value is displayed:

- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page 59 .
- Unplug connector on injection pump
=>Fitting locations overview, Page 35 , Item 4 .



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- -> Test for open circuit and short to positive or earth in the following wiring connections:

Connector for injection pump Contact	Test box V.A.G 1598/18 Socket
4	33
7	63

- Rectify any open/short circuit as necessary.
- If the wiring is OK, fit a new injection pump
=> Page 47 .

4 - Testing exhaust gas recirculation (EGR)

4.1 - Testing exhaust gas recirculation (EGR)

4.2 - Testing operation

The operation of the exhaust gas recirculation system is tested by measuring the intake air mass. If the exhaust gas is being recirculated the proportion of fresh air detected by the air mass meter will be smaller. The larger the quantity of recirculated exhaust gas, the weaker the signal from the air mass meter.

Special tools, testers and auxiliary items

- ◆ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/1
- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page 2 .
- Read measured value block, Display Group 001, engine at idling speed => Page 27 .

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-> Indicated on display:

Read measured value block 1		
840 rpm	6.5 mg/H	1.480 V
87.3	5C	

- Check display in display zone 4 (coolant temperature).
 - Specification: at least 85 °C
- Wait until the coolant has reached the specified temperature before continuing with the test.
- Press C key.
- Read measured value block, Display Group 003
=> Page 30 .

-> Indicated on display

Read measured value block 3		
840 rpm	272 mg/H	268 mg/H
54 %		

- Briefly depress the accelerator pedal, then allow the engine to continue running at idling speed.
- Observe displays in display zones 2 and 3.

Display zone		Possible cause of fault
2 (spec.)	3 (actual)	
230...370 mg/H	230...370 mg/H	Okay



Display zone		Possible cause of fault
2 (spec.)	3 (actual)	
> 370 mg/H	> 370 mg/H	Engine too cold Electrical equipment on Injection pump too lean
230...370 mg/H	< 230 mg/H	Unmetered air Too much EGR
230...370 mg/H	> 370 mg/H	Too little EGR or none at all
	Constant 425 mg/H	Fixed substitute value caused by open circuit in wiring to air mass meter or implausible air mass signal

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If the specifications are not obtained:

- Start final control diagnosis and activate EGR valve -N18
=> Page 15 .

-> Indicated on display:

Final control diagnosis
Exhaust gas recirculation valve -N18

The valve must click.

Valve does not click:

- Test exhaust gas recirculation valve -N18 => Page 74 .

If the valve clicks:

- Check vacuum hoses => Page 79 .

If vacuum hoses are OK:

- Test mechanical exhaust gas recirculation valve

=> 4-cyl. diesel direct injection engine (TDI), Mechanics; Repair group 26; Removing and installing parts of exhaust gas recirculation system; Removing and installing mechanical exhaust gas recirculation valve Removing and installing parts of exhaust gas recirculation system Removing and installing mechanical exhaust gas recirculation valve

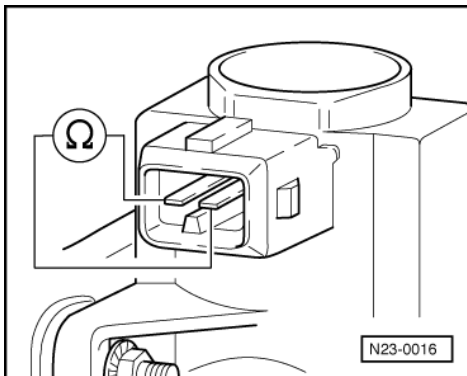
4.3 - Testing exhaust gas recirculation valve -N18

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/1
- ♦ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ♦ Adapter set V.A.G 1594 A
- ♦ Test box V.A.G 1598/18
- Switch off ignition.
- Pull connector off EGR valve -N18

=>Fitting locations overview, Page 34 .

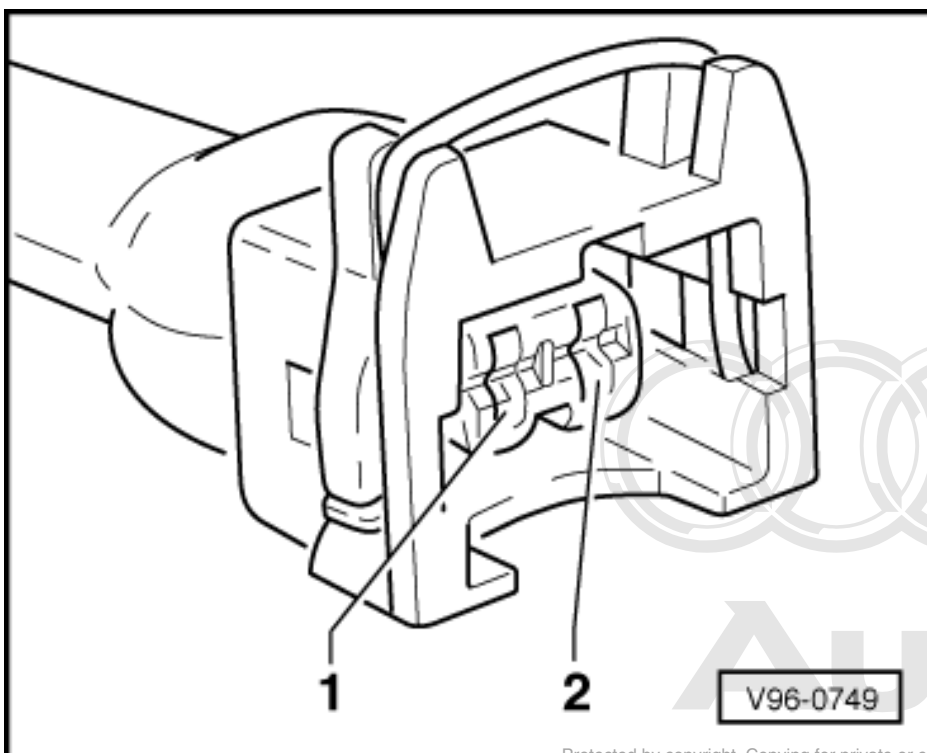
Testing internal resistance



- -> Set hand-held multimeter V.A.G 1526 to resistance measuring range and connect to valve contacts using test leads from V.A.G 1594 A.
 - Specification: 14 ... 20 ω
- If the specification is not attained, renew EGR valve -N18.

Testing voltage supply

- Pull connector off EGR valve -N18
=>Fitting locations overview, Page 34 .



- -> Set hand-held multimeter V.A.G 1526 to voltage measuring range (20 V direct current) and connect to engine earth and contact 2 of connector using test leads from V.A.G 1594 A.
- Switch on ignition.
 - Specification: approx. battery voltage

If the specification is not attained:

- Eliminate open circuit or short circuit using the current flow diagram.



Testing activation

- Fit connector for EGR valve -N18.
- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page **2**.
- Start final control diagnosis and activate EGR valve -N18
=> Page **15**.

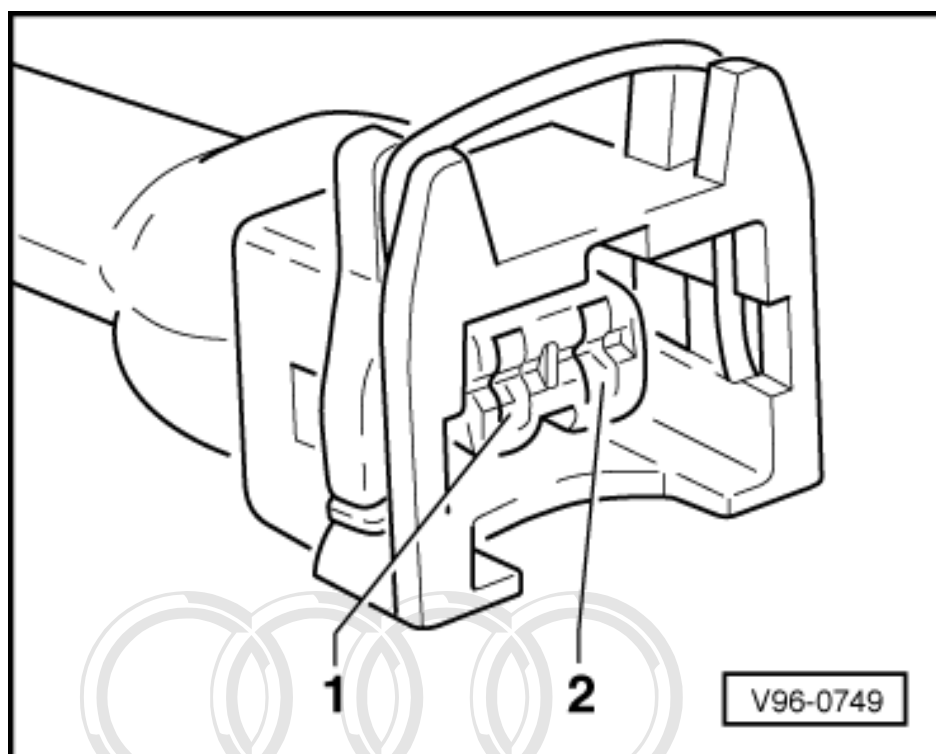
-> Indicated on display:

Final control diagnosis
Exhaust gas recirculation valve -N18

The valve must click.

Valve does not click:

- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page **59**.



- -> Test for open circuit and short to earth or positive in the following wiring connections:

Connector for -N18 Contact	Test box V.A.G 1598/18 Socket
1	25

- Rectify any open/short circuit as necessary.

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4.4 - Testing air mass meter -G70

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/1
- ♦ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ♦ Adapter set V.A.G 1594 A

- ♦ Test box V.A.G 1598/18

Testing operation

Notes:

- ♦ A second mechanic is required to note the readings on the tester when the vehicle is moving.
- ♦ Observe safety notes => Page 60 .
- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page 2 .
- Read measured value block, Display Group 010, engine at idling speed => Page 31 .

-> Indicated on display:

Read measured value block 10			
309 mg/H	1030 mbar	1011	
mbar	0.0 %		

- Observe display in display zone 1.
 - Specification: 230 ... 370 mg/H (mg/stroke)
- If the specification is not attained, test exhaust gas recirculation => Page 73 .
- Accelerate vehicle in 3rd gear from about 1500 rpm using full throttle.
- Press PRINT key on V.A.G 1551 at about 3000 rpm.

-> Specification for display zone 4:

Read measured value block 10			
830 mg/H	1030 mbar	1850	
mbar	100 %		

- 100 % (accelerator position)

If the specification is not attained:

- Repeat test and accelerate vehicle at full throttle.

-> Specification for display zone 3:

Read measured value block 10			
830 mg/H	1030 mbar	1850	
mbar	100 %		

- 1800 ... 2050 mbar (charge pressure)

If the specification is not attained:

- Test charge pressure => Page 60 .

-> Specification for display zone 1:

Read measured value block 10			
830 mg/H	1030 mbar	1850	
mbar	100 %		

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- > 750 mg/H (intake air mass)

If the specification is not attained:

- Fit a new air mass meter -G70.

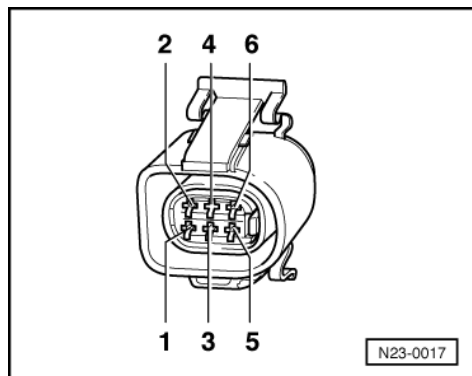
If display zone 1 shows a constant reading of 425 mg/stroke (fixed substitute value):

- Test voltage supply.



Testing voltage supply

- Switch off ignition.
- Unplug connector for air mass meter -G70
=>Fitting locations overview, Page 36 , Item 14 .



- -> Set hand-held multimeter V.A.G 1526 to voltage measuring range (20 V direct current) and connect to contacts on connector using test leads from V.A.G 1594 A.
- Switch on ignition.

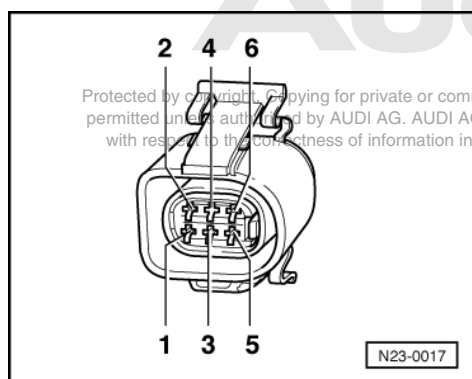
Connector for -G70 Contact	Test box V.A.G 1598/18 Socket
3 + earth	Battery voltage
3 + 5	Battery voltage
1 + earth	approx. 5 V
1 + 5	approx. 5 V

If the specifications are not obtained:

- Check the wiring.

Testing wiring

- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page 59 .



- -> Test for open circuit and short to positive or earth in the following wiring connections:

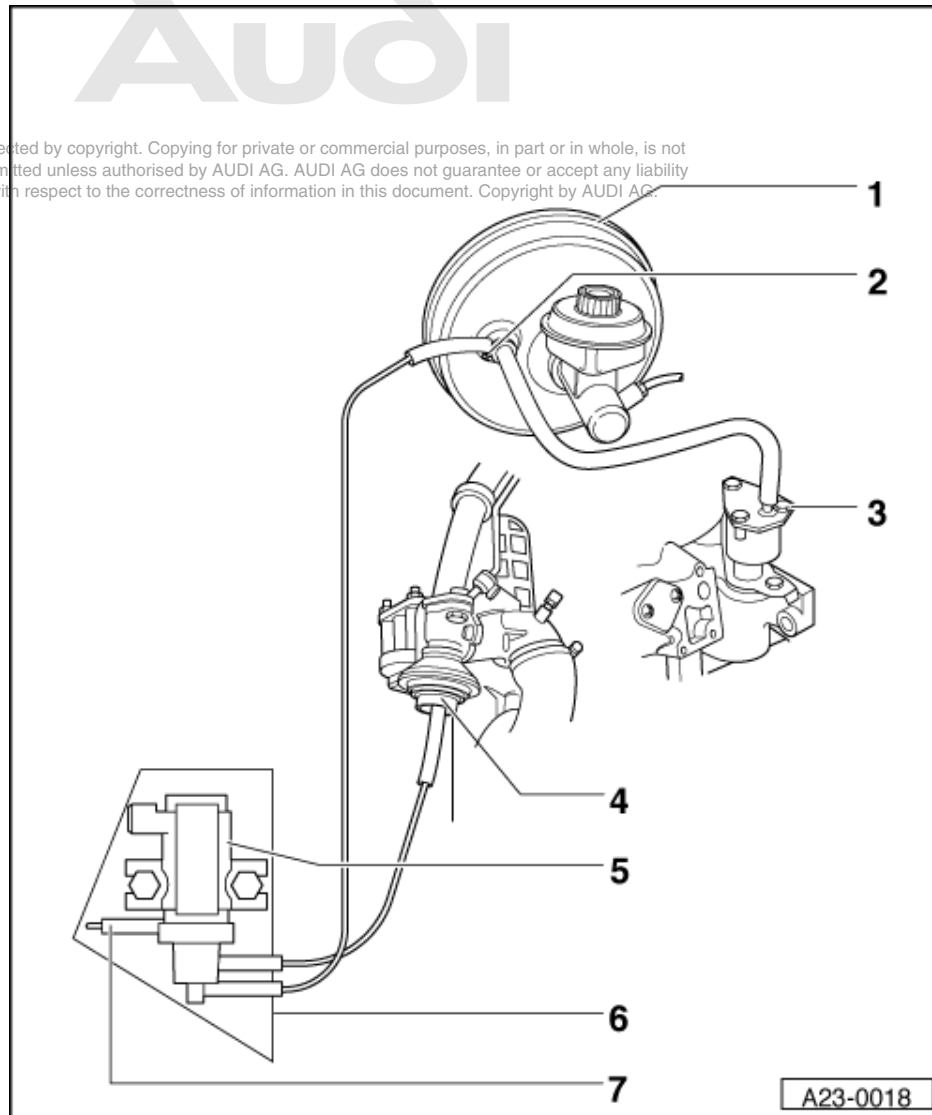
Connector for -G70 Contact	Test box V.A.G 1598/18 Socket
1	19

2	33
3	23, 45, 68
4	-
5	1, 24, 46
6	13

- Rectify any open/short circuit as necessary.

4.5 - Hose routing diagram for exhaust gas recirculation

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- 1 Brake servo
- 2 Vacuum connection
 - ♦ For air conditioner
- 3 Vacuum pump
- 4 Mechanical exhaust gas recirculation valve
- 5 Exhaust gas recirculation valve -N18
- 6 Air cleaner
- 7 Vent connection



- ♦ On air cleaner

5 - Checking control unit input values

5.1 - Checking control unit input values

5.2 - Checking Diesel direct injection system voltage supply

When the ignition is switched on, the injection system receives its voltage supply via Diesel direct injection system relay -J322.

In order for relay -J322 to close, a voltage must be applied to the Diesel direct injection system control unit via terminal 15. This means that relay -J322 is only earthed (via the Diesel direct injection system control unit) if a voltage is applied to the control unit via terminal 15.

Note:

Diesel direct injection system relay -J322 is located on auxiliary relay carrier III (relay position 5) behind the A-pillar trim on the passenger's side.

Special tools, testers and auxiliary items

- ♦ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ♦ Adapter set V.A.G 1594 A
- ♦ Test box V.A.G 1598/18

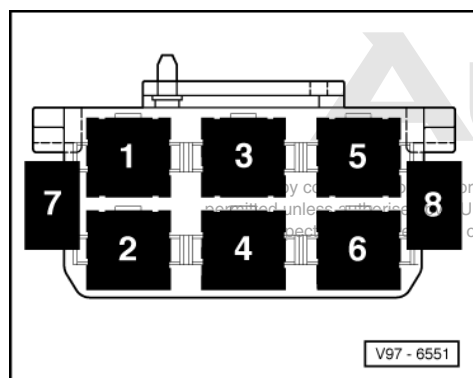
Testing voltage supply via terminal 15 for Diesel direct injection system control unit -J248 and excess voltage protection relay

-J249

Test requirement:

- Battery voltage not less than 12 V
- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page 59 .
- Remove A-pillar trim on passenger's side.

=> General body repairs; Repair group 70; Trims; Removing and installing A-pillar trim Trims Removing and installing A-pillar trim



- -> Remove relay from relay position 5 on auxiliary relay carrier III behind A-pillar trim on passenger's side.

- Switch on ignition.
- Set hand-held multimeter V.A.G 1526 to voltage measuring range (20 V direct current) and connect it as follows:

Test box V.A.G 1598/18 Socket	Specification
38 + earth	approx. battery voltage

Relay position 5 on auxiliary relay carrier III Contact	Specification
1 + earth	approx. battery voltage

If the specifications are not obtained:

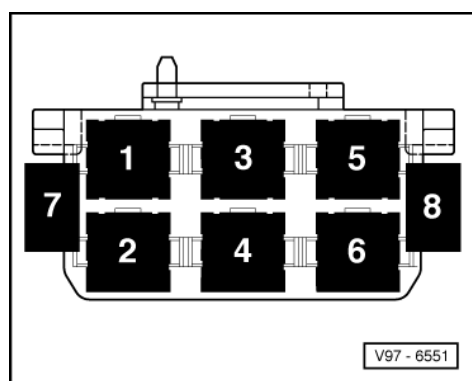
- Check wiring.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

Testing switched earth connection for Diesel direct injection system relay -J322

Requirements for test:

- Battery voltage not less than 12 V
- Voltage supply to terminal 15 okay
- Connector fitted to Diesel direct injection system control unit -J248
- Switch on ignition.



- -> Diesel direct injection system relay -J322 (position 5 on auxiliary relay carrier III) should "pull" (i.e. click).

Note:

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

If the relay does not pick up:

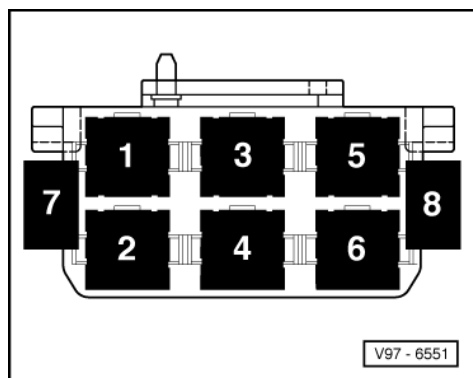
- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page 59.
- Connect together sockets 1 and 42 on the test box using a test lead from V.A.G 1594 A.
- Switch on ignition.
 - Diesel direct injection system relay -J322 (position 5 on auxiliary relay carrier III) should "pull" (i.e. click).

If the relay picks up now but not when the control unit is connected:

- Fit a new Diesel direct injection system control unit -J248

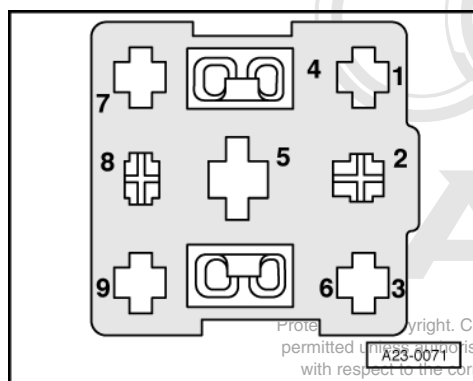


=> Page 58 .



If the relay does not pick up:

- Switch off ignition.
- -> Remove relay from position 5 on auxiliary relay carrier III behind A-pillar trim on passenger's side.



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- -> Test for open circuit and short to positive or earth in the following wiring connections:

Relay position 5 on auxiliary relay carrier III Contact	Test box V.A.G 1598/18 Socket
4	42

- Rectify any open/short circuit as necessary.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

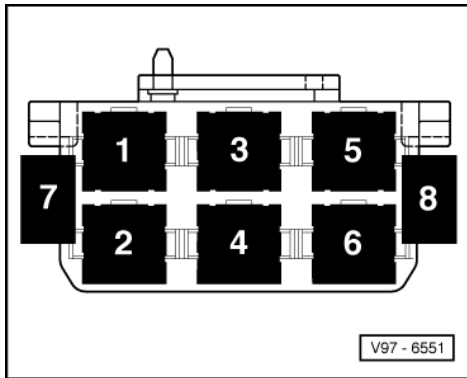
- If there are no open circuits or short circuits, fit a new Diesel direct injection system relay -J322.

Testing voltage supply at terminal 30 for Diesel direct injection system relay -J322

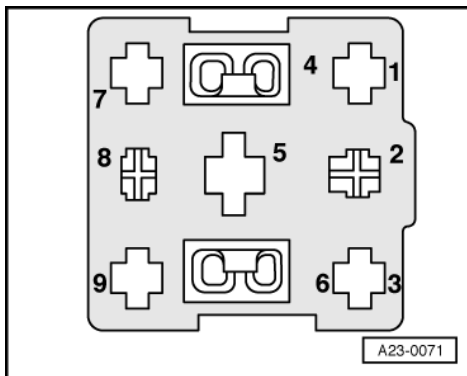
Requirements for test:

- Battery voltage not less than 12 V
- Switch off ignition.
- Remove A-pillar trim on passenger's side.

=> General body repairs; Repair group 70; Trims; Removing and installing A-pillar trim Trims Removing and installing A-pillar trim



- -> Remove relay from position 5 on auxiliary relay carrier III behind A-pillar trim on passenger's side.



- -> Set hand-held multimeter V.A.G 1526 to voltage measuring range (20 V direct current) and connect it as follows:

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Relay position 5 on auxiliary relay carrier III Contact	Specification
2 + earth	approx. battery voltage

If the specification is not attained:

- Check wiring.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

If the specification is attained:

- Re-fit the relay in position 5 on auxiliary relay carrier III behind A-pillar trim on passenger's side.
- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page 59.
- Connect together sockets 1 and 42 on the test box using a test lead from V.A.G 1594 A.
- Set hand-held multimeter V.A.G 1526 to voltage measuring range (20 V direct current) and connect it to the following sockets on the test box:

Test box V.A.G 1598/18 Socket	Specification
23 + earth	approx. battery voltage
45 + earth	approx. battery voltage
68 + earth	approx. battery voltage
1 + battery positive	approx. battery voltage
24 + battery positive	approx. battery voltage



Test box V.A.G 1598/18 Socket	Specification
46 + battery positive	approx. battery voltage

If the specifications are not obtained:

- Check wiring.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

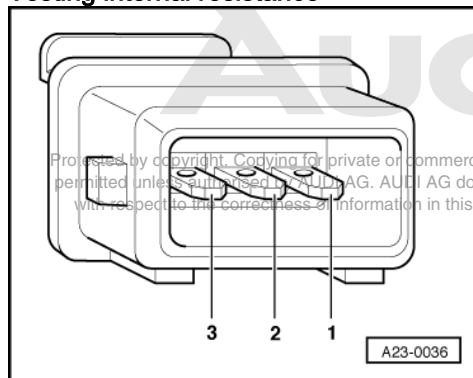
5.3 - Testing engine speed sender -G28

The engine speed sender is both a speed sender and a reference mark sender.

Special tools, testers and auxiliary items

- ♦ Hand multimeter V.A.G 1526 or V.A.G 1526 A
 - ♦ Adapter set V.A.G 1594 A
 - ♦ Test box V.A.G 1598/18
 - Switch off ignition.
 - Unplug connector for engine speed sender -G28
- =>Fitting locations overview, Page 34 , Item 5 .

Testing internal resistance



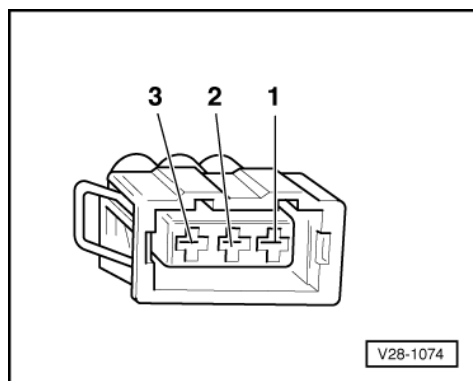
- -> Set hand-held multimeter V.A.G 1526 to resistance measuring range and connect to contacts 1 and 2 on the sender connector using test leads from V.A.G 1594 A.
- Specification: approx. 1 kw
- If the specification is not obtained, renew engine speed sender -G28.

Testing wiring

Note:

A test is only necessary if fault 00513 ("Engine speed sender; No signal") is stored in the fault memory. The fault message "Implausible signal" is stored if the wiring is okay but the signal is incomplete or unclear.

- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page 59 .



- -> Test for open circuit and short to positive or earth in the following wiring connections:

Connector for -G28 Contact	Test box V.A.G 1598/18 Socket
1	33
2	8
3	1, 24, 46

- Test all wires for short circuit to each other.
- Rectify any open/short circuit as necessary.

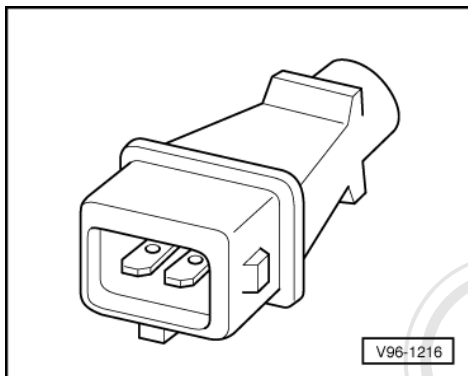
5.4 - Testing needle lift sender -G80

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, testers and auxiliary items

- ◆ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ◆ Adapter set V.A.G 1594 A
- ◆ Test box V.A.G 1598/18

- Switch off ignition.



- Unplug connector for needle lift sender -G80
=>Fitting locations overview, Page 34, Item 2.

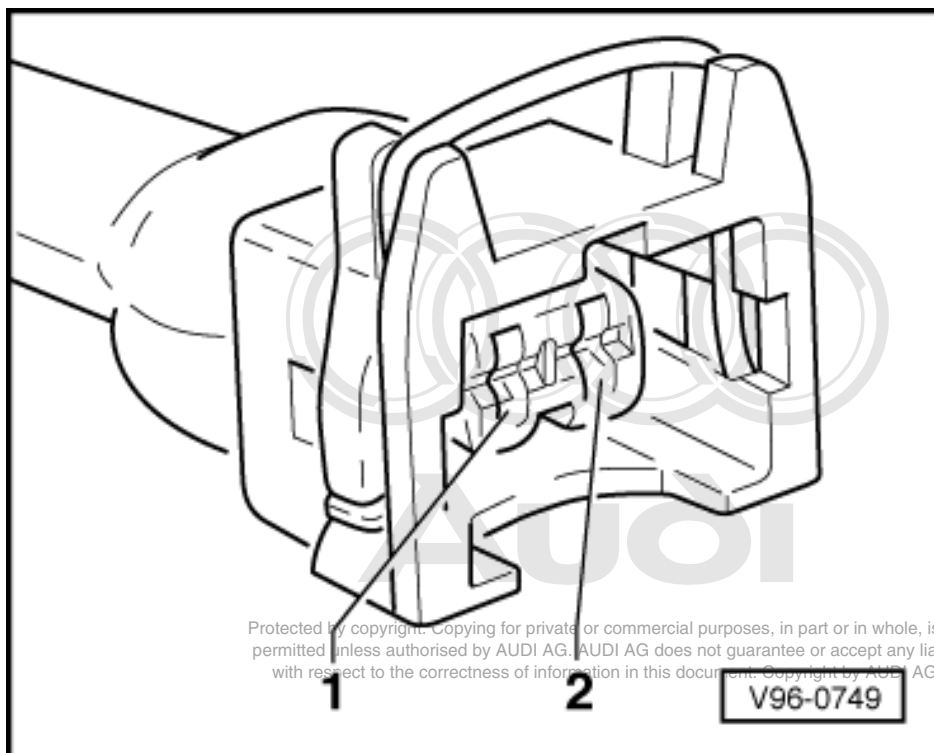
Testing internal resistance

- -> Set hand-held multimeter V.A.G 1526 to resistance measuring range and connect to sender contacts using test leads from V.A.G 1594 A.
 - Specification: 90 ... 120 ω
(If the engine is warm, the resistance may be up to 20 ω higher.)

- If the specification is not obtained, renew injector for cylinder 3 together with needle lift sender -G80.

Testing wiring

- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page 59.



- -> Test for open circuit and short to positive or earth in the following wiring connections:

Connector for -G80 Contact	Test box V.A.G 1598/18 Socket
1	12
2	11

- Test both wires for short circuit to each other.
- Rectify any open/short circuit as necessary.

5.5 - Testing coolant temperature sender -G62

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/1
- ♦ Adapter set V.A.G 1594 A
- ♦ Test box V.A.G 1598/18
- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page 2 .
- Read measured value block, Display Group 007, engine cold and running at idling speed => Page 30 .

-> Indicated on display:

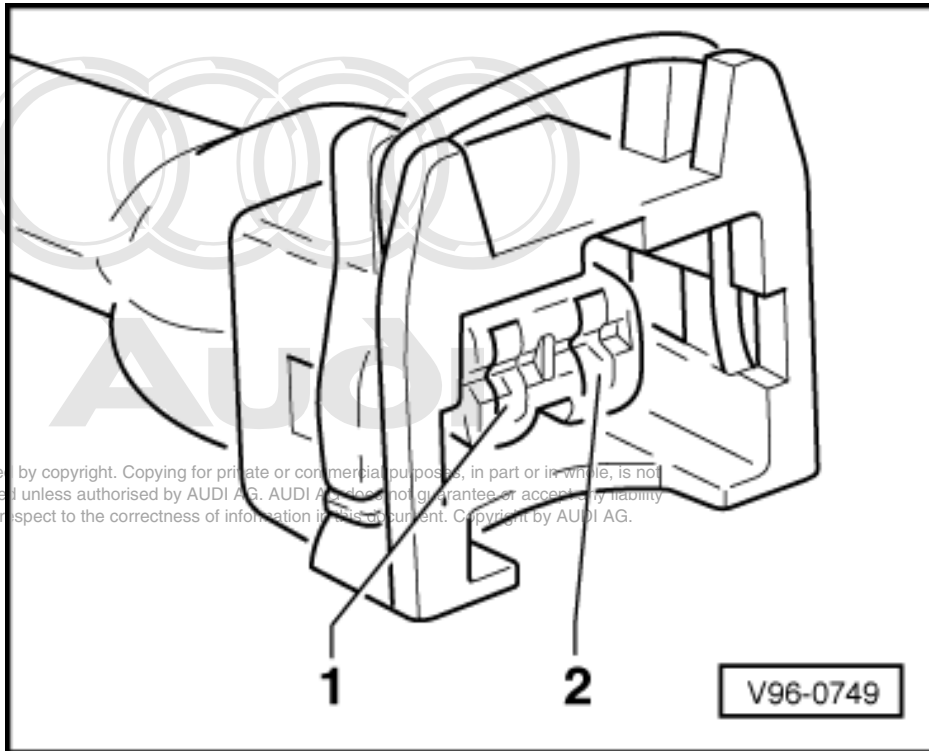
Read measured value block 7
15.4 5C 15.9 5C 16.7 5C

- Check display in display zone 4.
- Specification: The temperature value should increase steadily.

If an implausible value is displayed in display zone 4:

- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page 59 .

- Unplug connector for coolant temperature sender -G62
=>Fitting locations overview, Page 34 , Item 3 .



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- -> Test for open circuit and short to positive or earth in the following wiring connections:

Connector for -G62 Contact	Test box V.A.G 1598/18 Socket
1	14
2	33

- Test both wires for short circuit to each other.
- Rectify any open/short circuit as necessary.
- If the wiring is OK, renew coolant temperature sender -G62.

5.6 - Testing brake light switch -F and brake pedal switch -F47

Because the injection system operates with an accelerator position sender (potentiometer) which may be defective, the engine is regulated for safety reasons when the brakes are operated. To do this the control unit requires signals from the brake light switch and brake pedal switch. If the brakes are applied while the accelerator is being held in a constant position the engine is immediately regulated down to idling speed. Incorrectly adjusted switches may lead to unrequired regulating action.

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/1

Testing switches

- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page 2 .
- Read measured value block, Display Group 006, engine at idling speed => Page 22 .

-> Indicated on display:



Read measured value block 6
0 km/h 0 0 0 000000
255

- Check display in display zone 2.
 - Specification: 0 0 0
- Slowly depress brake pedal.

-> Indicated on display:

Read measured value block 6
0 km/h 0 1 1 000000
255

- Specification: 0 1 1
The two display values should change from 0 to 1.
Allow brake pedal to return slowly to its normal position.

-> Indicated on display:

Read measured value block 6
0 km/h 0 0 0 000000
255

- Specification: 0 0 0
The two display values should change back from 1 to 0.

If the display values do not change at the same time:

- Turn the switches until the switching points are aligned. If necessary, hold the retainer clip in position using long-nosed pliers.

Notes:

- ♦ When the engine is running the return force of the brake pedal is much weaker than when the engine is switched off (because the brakes are servo-assisted). The push rods in the switches should be pressed fully into the switches even when the engine is running and the brake is not depressed.
- ♦ If the engine speed is regulated down sporadically (engine speed governing function), screw the switches further into the pedal bracket and repeat the test.

If one or both of the displays does not change from 0 to 1:

- Check the wiring.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

5.7 - Testing modulating piston movement sender -G149 and quantity adjuster -N146

The quantity adjuster is an electro-magnetic 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 the modulating piston, thereby indicating the quantity of fuel injected.

Special tools, testers and auxiliary items

- ♦ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/1
- ♦ Adapter set V.A.G 1594 A
- ♦ Test box V.A.G 1598/18

Testing operation

- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page 2 .
- Read measured value block, Display Group 001, engine at idling speed => Page 27 .

-> Indicated on display:

Read measured value block 1			
840 rpm	5.6 mg/H	1.480 V	"
87.3 5C			

- Check display in display zone 4 (coolant temperature).
 - Specification: at least 85°C
- Do not proceed with the test until the coolant temperature has reached the specified level.
- Switch off any electrical consumers that may be on (air conditioner, rear window heater, lights etc.).

-> Indicated on display:

Read measured value block 1			
840 rpm	5.6 mg/H	1.480 V	"
87.3 5C			

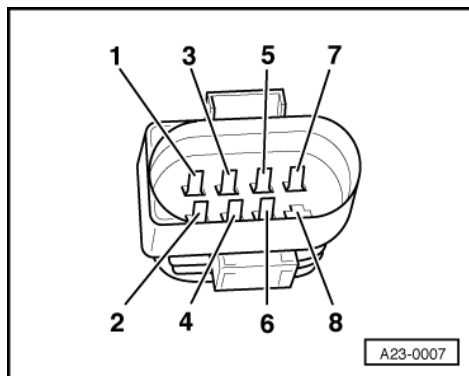
- Check display in display zone 3 (voltage supplied from modulating piston movement).
 - Specification: 1.250 ... 1.700 V

If the specification is not attained:

- Fit a new injection pump => Page 47 .

Testing internal resistance

- Switch off ignition.
- Unplug connector for injection pump
=>Fitting locations overview, Page 34 , Item 4 .



- -> Set hand-held multimeter V.A.G 1526 to resistance measuring range and connect it to the following contacts on the injection pump connector using test leads from V.A.G 1594 A:

Contact	To be tested	Specification
1 + 2	-G149	4,9 ... 7,5 ω
2 + 3	-G149	4.9 ... 7.5 ω
5 + 6	-N146	0.4 ... 1.1 ω

- If the specifications are not obtained, fit a new injection pump
=> Page 47 .

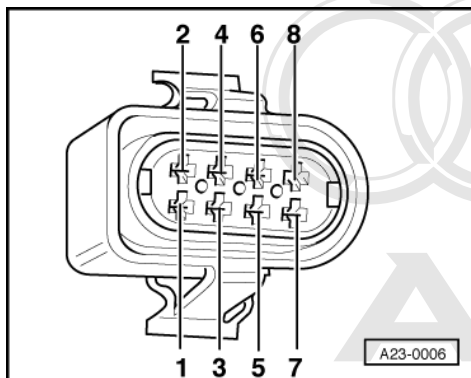
Testing voltage supply

- Switch off ignition.
- Disconnect connector on injection pump
=>Fitting locations overview, Page 34 .
- Set hand-held multimeter V.A.G 1526 to voltage measuring range (20 V direct current).

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- Switch on ignition.



- -> Connect hand-held multimeter to the following contacts on the wiring harness connector using test leads from V.A.G 1594 A:

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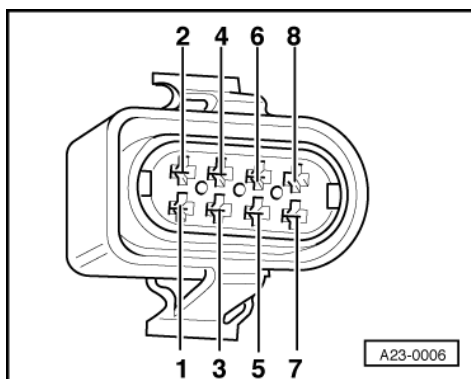
Contact	To be tested	Specification
1 + earth	-G149	approx. 2.5 V
3 + earth	-G149	approx. 2.5 V
5 + earth	-N146	approx. battery voltage

If the specifications are not obtained:

- Check the wiring.

Testing wiring

- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page 59 .



- -> Test for open circuit and short to positive or earth in the following wiring connections:

Wiring harness connector Contact	Test box V.A.G 1598/18 Socket
1	29
2	7
3	52
5	23, 45, 68
6	4, 5, 49

- Test all wires for short circuit to each other.
- Rectify any open/short circuit as necessary.

5.8 - Testing accelerator position sender -G79

Accelerator position sender -G79 is located on the accelerator pedal. Its function is to tell the control unit what position the pedal is in.

Special tools, testers and auxiliary items

- ◆ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ◆ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/1
- ◆ Adapter set V.A.G 1594 A
- ◆ Test box V.A.G 1598/18

- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page 2 .
- Read measured value block, Display Group 002, engine not running => Page 29 .

-> Indicated on display:

Read measured value block 2
0 rpm 0.0 % 0 1 0
18.4 5C

- Check display in display zone 2 (accelerator pedal position).
 - Specification: 0.0 % (accelerator not depressed)
- Check display in display zone 3.
 - Specification:
 - 0 1 0 (accelerator not depressed)
 - 0 0 0 (accelerator depressed)
- Press accelerator pedal down slowly.

-> Indicated on display:

Read measured value block 2
0 rpm 100 % 0 0 0
18.4 5C

- Specification: The value in display zone 2 should increase steadily to 100 % (accelerator fully depressed).

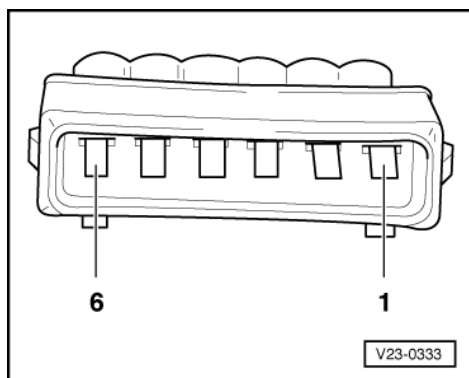
On vehicles with an automatic gearbox the kickdown switch pressure point must be distinctly felt before the full throttle stop position is reached.

- If the specifications for the initial and/or final readouts are not obtained, adjust accelerator position sender -G79 => Page 46 .

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If the display does not change or only changes irregularly:

- Switch off ignition.
- Disconnect connector for accelerator position sender -G79
 =>Fitting locations overview, Page 36 .





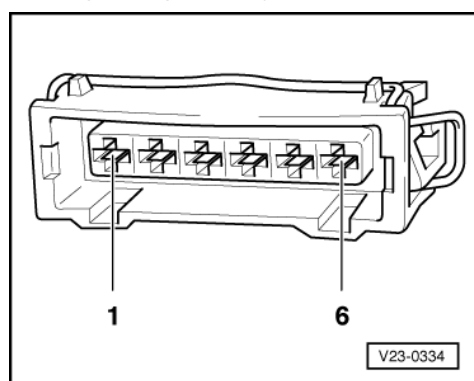
- -> Set hand-held multimeter V.A.G 1526 to resistance measuring range and connect to the following contacts on connector for accelerator position sender -G79 using test leads from V.A.G 1594 A:

Contacts	Accelerator	Specification
1 + 3	Not depressed	0.8 ... 1.4 k Ω
2 + 3	Not depressed	0.8 ... 1.4 k Ω
4 + 6	Not depressed	0.8 ... 1.2 k Ω
	Depressed	$\infty \Omega$
5 + 6 1)	Not depressed	$\infty \Omega$
	Fully depressed	0.8 ... 1.2 k Ω

1) Only on vehicles with automatic gearbox.

- If the specifications are not obtained, renew accelerator position sender -G79.

Testing voltage supply



- -> Set hand-held multimeter V.A.G 1526 to voltage measuring range (20 V direct current) and connect it to contacts 2 and 3 on connector.
- Switch on ignition.
 - Specification: approx. 5 V

If the specification is attained:

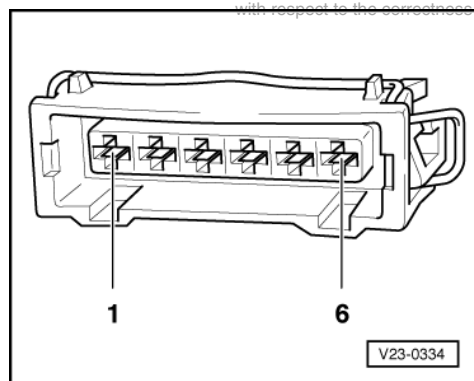
- Check the wiring.

Testing wiring

- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page 59.
- Remove storage compartment (shelf) on driver's side.

=> General body repairs; Repair group 70; Dash panel; Removing driver's side shelf Dash panel Removing driver's side shelf

- Unplug connector for accelerator position sender -G79 (located in footwell on accelerator pedal).



- -> Test for open circuit and short to positive or earth in the following wiring connections:

Connector for -G79 Contact	Test box V.A.G 1598/18 Socket
1	15
2	57
3	55
4	65
6	1, 24, 46
5 1)	62

1) Only on vehicles with automatic gearbox.

- Rectify any open/short circuit as necessary.

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6 - Testing auxiliary signals

6.1 - Testing auxiliary signals

6.2 - Testing signals from and to automatic gearbox

Special tools, testers and auxiliary items

- ◆ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/1
- ◆ Adapter set V.A.G 1594 A
- ◆ Test box V.A.G 1598/18

A - Gearshift signal

This signal causes the injection quantity to be briefly reduced (torque reduction) during gearshifts in order to smooth out the jolts experienced when changing gear.

Notes:

- ◆ A second mechanic is required to note the readings on the tester when the vehicle is moving.
- ◆ Observe safety notes => Page 60 .
- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page 2 .
- Read measured value block, Display Group 009, engine at idling speed => Page 22 .

-> Indicated on display:

Read measured value block 9			
1	2	3	4

- Check display in display zone 3.
 - Specification: 51 mg/H (mg/stroke)
- Accelerate the vehicle from a stationary position with full throttle, but without using kick-down.

Read measured value block 9			
1	2	3	4

-> Observe display zone 3 when vehicle changes into 2nd gear.



- Specification: The display value should briefly fall below 51 mg/H.

Note:

Because of the lag in data transfer there might be a delay before the display reaches the specified value.

If the specification is not attained:

- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page **59** .
- Test for open circuit and short to earth or positive in the following wiring connections:

Test box V.A.G 1598/18 Socket	Automatic gearbox control unit Contact
18	=> Current flow diagrams, Electrical fault-finding and Fitting locations binder

- Rectify any open/short circuit as necessary.

B - Accelerator pedal position signal

This signal is required for the calculation of gearshift points according to engine load.

The signal is monitored by the self-diagnosis function (fault memory, read measured value block) of the automatic gearbox control unit.

Testing signal

=> Automatic Gearbox 097; Repair group 01; Self-diagnosis of automatic gearbox 097 Self-diagnosis of automatic gearbox 097

=> Automatic Gearbox 01N; Repair group 01; Performing self-diagnosis Performing self-diagnosis

C - Engine speed signal

This signal is required for smoothing out the gearshifts.

Testing signal

=> Testing engine speed signal, Page **101** .

=> Automatic Gearbox 097; Repair group 01; Self-diagnosis of automatic gearbox 097 Self-diagnosis of automatic gearbox 097

=> Automatic Gearbox 01N; Repair group 01; Performing self-diagnosis Performing self-diagnosis

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D - Kick-down signal

The signal is monitored by the self-diagnosis function (fault memory, read measured value block) of the automatic gearbox control unit.

Testing signal

=> Automatic Gearbox 097; Repair group 01; Self-diagnosis of automatic gearbox 097 Self-diagnosis of automatic gearbox 097

=> Automatic Gearbox 01N; Repair group 01; Performing self-diagnosis Performing self-diagnosis

6.3 - Testing signals from and to air conditioner

Testing air conditioner compressor shut-off

The engine control unit will shut off the air conditioner compressor in the following cases:

- ◆ Heavy acceleration from low speeds (control unit detects angle change at accelerator position sender -G79 and receives road speed signal)
- ◆ In the emergency programme (emergency running mode)
- ◆ If the coolant temperature rises above 120 °C
- ◆ For about 6 seconds after every engine start

Special tools, testers and auxiliary items

- ◆ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/1
- ◆ Adapter set V.A.G 1594 A
- ◆ Test box V.A.G 1598/18

Requirements for test:

- Air conditioner okay
- Air conditioner switched on
- No faults stored in fault memory
- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page 2.
- Select the function "Final control diagnosis" and activate air conditioner compressor cut-in (shut-off) => Page 15.

-> Indicated on display:

Final control diagnosis
 Air conditioner compressor cut-in

The "cut-in" or "shut-off" function should cause the air conditioner compressor to switch itself off within 5 seconds (check visually), then start and stop again at 5-second intervals.

If the conditioner compressor is not switched off:

- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page 59.
- Test for open circuit and short to earth or positive in the following wiring connections:

Test box V.A.G 1598/18 Socket	Air conditioner operating and display unit Contact
28	=> Current flow diagrams, Electrical fault-finding and Fitting locations binder

- Rectify any open/short circuit as necessary.

Testing air conditioner signal

The air conditioner signal informs the engine control unit that the air conditioner needs a higher idling speed in order to provide the desired interior temperature (both when cooling and when heating).

The increase in idling speed resulting from the air conditioner signal depends on the control unit version and is not activated in all vehicles.

- Read measured value block, Display Group 002, engine running at idling speed=>Page 29

-> Indicated on display:



```
Read measured value block 2
860 rpm      0.0 %      0      1
0      18.4 5C
```

- Switch on air conditioner, press the "Auto" key and select the lowest temperature.
- Check display in display zone 3.

```
Read measured value block 2
860 rpm      0.0 %      1      1      1
18.4 5C
```

-> Specification: X X 1 (air conditioner signal)

If the specification is not attained:

- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page 59 .
- Test for open circuit and short to earth or positive in the following wiring connections:

Test box V.A.G 1598/18 Socket	Air conditioner operating and display unit Contact
37	=> Current flow diagrams, Electrical fault-finding and Fitting locations binder

- Rectify any open/short circuit as necessary.

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6.4 - Testing speed signal

The speed signal is required to ensure that the air conditioner compressor is switched off when accelerating. It is also required for the cruise control system and to ensure smoother driving (jolt damping).

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/1
- ♦ Adapter set V.A.G 1594 A
- ♦ Test box V.A.G 1598/18

Test requirement:

- Speedometer OK. Testing:

=> Electrical system; Repair group 90; Testing dash panel insert components; Testing speedometer sender signal at dash panel wiring harness Testing dash panel insert components Testing speedometer sender signal at dash panel wiring harness

Notes:

- ♦ A second mechanic is required to note the readings on the tester when the vehicle is moving.
- ♦ Observe safety notes => Page 60 .
- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page 2 .
- Read measured value block, Display Group 006, engine at idling speed => Page 22 .

-> Indicated on display:

```
Read measured value block 6
0 km/h      0      0      0      000000
255
```

- Take vehicle for a test drive.

Read measured value block 6
 45 km/h 0 0 0 000000
 255

-> Indicated on display:

- Check display in display zone 1.
 - Specification: The current road speed should be displayed (compare with speedometer).

If the specification is not attained:

- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page 59.
- Test for open circuit and short to earth or positive in the following wiring connections:

Test box V.A.G 1598/18 Socket	Dash panel insert Contact
43	=> Current flow diagrams, Electrical fault-finding and Fitting locations binder

- Rectify any open/short circuit as necessary.

If no fault in wire is detected:

- Establish which systems (e.g. radio, automatic gearbox, air conditioner etc.) are using the speed signal, disconnect them one by one from the dash panel insert, and keep repeating the test until the cause of the problem has been identified.

6.5 - Testing clutch pedal switch -F36

This signal prevents engine speed fluctuations and load change jolts when the clutch is disengaged. The signal is also required for the cruise control system.

Special tools, testers and auxiliary items

- ◆ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/1
- ◆ Adapter set V.A.G 1594
- ◆ Test box V.A.G 1598/18

- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page 2.
- Read measured value block, Display Group 006, engine not running => Page 22.

-> Indicated on display:

Read measured value block 6
 0 km/h 0 0 0 000000
 255

- Check display in display zone 2.
 - Specification: 0 0 0
- Depress clutch pedal.

Read measured value block 6
 0 km/h 1 0 0 000000
 255

-> Indicated on display:
 - Specification: 1 0 0



If the specification is not attained:

- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page 59 .
- Test for open circuit and short to earth or positive in the following wiring connections:

Test box V.A.G 1598/18 Socket	Clutch pedal switch Contact
17	=> Current flow diagrams, Electrical fault-finding and Fitting locations binder

- Remove storage compartment (shelf) on driver's side.

=> General body repairs; Repair group 70; Dash panel; Removing and installing storage compartment and glove box Dash panel Removing and installing storage compartment and glove box

- Remove footwell vent on driver's side.

=> Heating, air conditioner; Repair group 80; Servicing heater; Heater controls and air ducts Servicing heater Heater controls and air ducts

- Rectify any open/short circuit as necessary.
- If the specification is not obtained, fit a new clutch pedal switch -F36 (located in footwell on clutch pedal).

6.6 - Testing cruise control system (CCS)

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The CCS has no components of its own (except for the operating switch). All CCS functions are carried out by the Diesel direct injection system.

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/1
- ♦ Adapter set V.A.G 1594 A
- ♦ Test box V.A.G 1598/18

- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page 2 .
- Read measured value block, Display Group 006, engine at idling speed => Page 22 .

-> Indicated on display:

Read measured value block 6
0 km/h 0 0 0 000000
0

- Check display in display zone 4.
 - Specification: 0

Note:

-> Indicated on display:

Read measured value block 6
0 km/h 0 0 0 000000
255

If a value of 255 appears in display zone 4:

- Activate cruise control system => Page 100 .

Vehicles with automatic gearbox

- Take the vehicle for a test drive and accelerate beyond 30 km/h once. Then leave the engine running and engage the gear selector lever in position 2, 3 or D.
- Apply the handbrake.

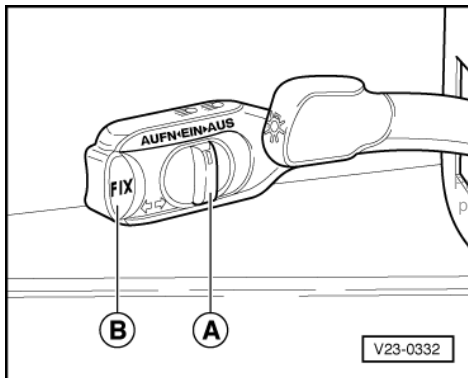
Note:

On vehicles with automatic gearbox the power supply for the CCS switch only cuts in when the road speed exceeds 30 km/h and when the selector lever is in position 2, 3 or D. The power supply is then maintained even during idling, as long as one of the drive positions (except 1 or R) is engaged.

All models

-> Indicated on display:

Read measured value block 6
 0 km/h 0 0 0 000000
 0



- -> Check display in display zone 3 for the various switch positions.

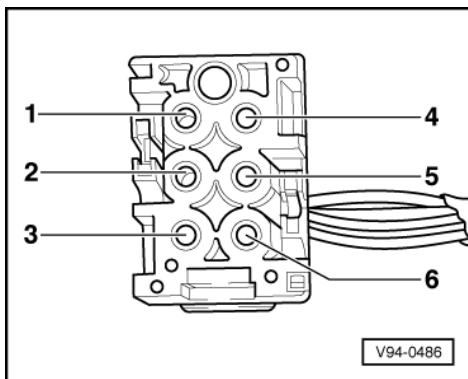
Test condition	Display zone 3
Switch A engaged in "AUS" position	000000
Switch A just before "AUS" position	000001
Switch A set to "EIN"	000011
Switch A set to "AUFN"	001011
Switch B pressed	000111
Brake depressed	010011
Clutch depressed	100011

If the specifications are not obtained:

- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page 59.

- Unplug connector from CCS switch

=> Electrical System; Repair Group 94; Servicing steering column switch Servicing steering column switch





- -> Test for open circuit and short to positive or earth in the following wiring connections:

Connector on -E45 Contact	Test box V.A.G 1598/18 Socket
1	58
2	34
3	35
4	66
5 1)	To fuse 14
5 2)	To fuse 36
5 3)	To fuse 20
5 4)	To fuse 64
6	66

- 1) Vehicles with manual gearbox, ä 1995
- 2) Vehicles with manual gearbox, 1996 ä (fuse in electronics box in front passenger's footwell)
- 3) Vehicles with automatic gearbox, ä 1995
- 4) Vehicles with automatic gearbox, 1996 ä (fuse in electronics box in front passenger's footwell)

- Rectify any open/short circuit as necessary.
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=> Current flow diagrams, Electrical fault-finding and Fitting locations

- If the wiring is okay, fit a new cruise control switch (CCS switch).

=> Electrical System; Repair Group 94; Servicing steering column switch Servicing steering column switch

Activating cruise control system

- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page **2**.

-> Indicated on display:

Rapid data transfer HELP
Select function XX

- Press key 1 twice for the function "Log-in procedure" and confirm entry with Q key.

-> Indicated on display:

Log-in procedure HELP
Feed in code number XXXXX

- Enter code number 11463 and confirm entry with Q key.

-> Indicated on display:

Rapid data transfer HELP
Select function XX

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

6.7 - Testing engine speed signal

The engine speed signal is required for the rev counter, air conditioner and automatic gearbox.

However, since the signal cannot be read in the form in which it is generated by engine speed sender -G28, it has to be processed by the engine control unit first.

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/1

- Check the engine speed signal as follows:

Dash panel insert

- Check reading on rev counter.
 - The rev counter should show the current engine speed.

Air conditioner

The signal is monitored by the self-diagnosis function (fault memory, read measured value block) of the air conditioner.

Testing signal

- The current engine speed should be displayed in the measured value block.

Automatic gearbox

The signal is monitored by the self-diagnosis (fault memory, read measured value block) of the automatic gearbox control unit.

Testing signal

=> Automatic gearbox 01N; Repair group 01; Self-diagnosis; Reading measured value block Self-diagnosis
Reading measured value block

- The current engine speed should be displayed in the measured value block.

If the engine speed signal is not as specified for all the "consumers" that use the signal, the following faults are possible:

- ♦ Open circuit or short in wiring between Diesel direct injection system control unit and wiring harness connector

=> Current flow diagrams, Electrical fault-finding and Fitting locations

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- ♦ Short circuit in wiring between wiring harness connector and "consumer"
- ♦ Diesel direct injection system control unit defective

If the engine speed signal is as specified for at least one of the "consumers", the following faults are possible:

- ♦ Open circuit in wiring between wiring harness connector and "consumer"
- ♦ "Consumer" defective



6.8 - Testing fuel consumption signal

This signal is required for the fuel consumption indicator in the dash panel insert.

Special tools, testers and auxiliary items

- ♦ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ♦ Adapter set V.A.G 1594 A
- ♦ Test box V.A.G 1598/18

- Remove dash panel insert.

=> Electrical system; Repair group 90; Dash panel insert; Removing and installing dash panel insert Dash panel insert Removing and installing dash panel insert

- Unplug the black 10-pin connector.
- Set hand-held multimeter V.A.G 1526 to voltage measuring range (20 V direct current) and connect between earth and contact 5 on the black connector.
- Start the engine and vary the engine speed continuously between 1000 and 4000 rpm.
 - Specification: 0.3 ... 7.0 V (depending on engine speed)

If the specification is attained:

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- Test on-board computer using the Fault-Finding Programme

=> Current flow diagrams, Electrical fault-finding and Fitting locations

If the specification is not attained:

- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page 59.
- Test for open circuit and short to positive or earth in the following wiring connections:

Test box V.A.G 1598/18 Socket	Black connector Contact
9	5

- Rectify any open/short circuit as necessary.

28 - Glow plug system

1 - Testing glow plug system

1.1 - Testing glow plug system

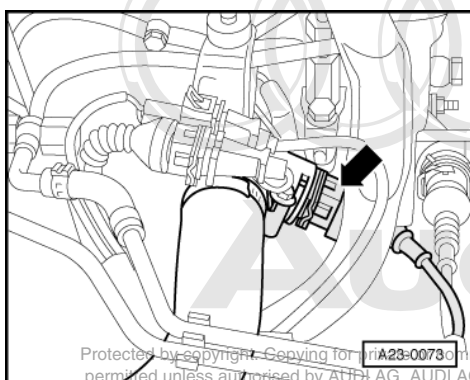
1.2 - Testing operation

Special tools, testers and auxiliary items

- ◆ Hand multimeter V.A.G 1526 or V.A.G 1526 A
- ◆ Adapter set V.A.G 1594 A

Requirements for test:

- Battery voltage at least 11.5 V
- Diesel direct injection system control unit -J248 okay
- Switch off ignition.



- -> Unplug connector for coolant temperature sender -G62 -arrow-.

Note:

Unplugging the connector for coolant temperature sender -G62 simulates the condition of the engine when cold. Therefore when the ignition is switched on, the glow plug system is activated.

- Pull glow plug connectors off glow plugs.
- Set hand-held multimeter V.A.G 1526 to voltage measuring range (20 V direct current) and connect between engine earth and one of the glow plugs.
- Switch on ignition.
 - Specification: approx. battery voltage for about 20 seconds
- If the specification is not obtained, test glow plug strip fuse -S39 in electronics box in front passenger's footwell.
- If glow plug strip fuse -S39 is okay, test for open circuits and short circuits in the wiring and rectify as necessary.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

Notes:

- ◆ Glow period warning lamp -K29 should light up during the simulated glow period.



- ♦ If the warning lamp does not light up, test glow period warning lamp -K29 => Page **104** .

1.3 - Checking glow plugs

Special tools, testers and auxiliary items

- ♦ Jointed spanner 3220
- ♦ 2 test leads with a diameter of at least 2.5 mm²

Test requirement:

- Battery voltage at least 11.5 V
- Switch off ignition.
- Remove glow plugs with jointed spanner 3220.
- Place the glow plug which is to be tested on a fireproof surface.
- Connect the connecting pin of the glow plug to the positive terminal of a fully charged 12 V battery.
- Connect the threaded section of the glow plug to the negative terminal of the battery.

Notes:

- ♦ Connect the glow plug using test leads which have a diameter of at least 2.5 mm².
- ♦ The connector clamps on the test leads must be robust and securely fitted.
- Check the glow plug as it is being activated.
- If the glow plug does not glow or if only part of the pin glows, renew the glow plug.

Tightening torque

Component	Nm
Glow plugs	15

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1.4 - Testing glow period warning lamp -K29

Special tools, testers and auxiliary items

- ♦ Fault reader V.A.G 1551 (or vehicle system tester V.A.G 1552) with cable V.A.G 1551/1
- ♦ Adapter set V.A.G 1594 A
- ♦ Test box V.A.G 1598/18

- Connect fault reader V.A.G 1551 and select engine electronics control unit => Page **2** .
- Perform final control diagnosis => Page **15** .

If the warning lamp does not light up during the final control diagnosis:

- Test bulb for glow period warning lamp -K29 in dash panel insert.

If bulb in dash panel insert is okay, test the wiring:

- With the ignition switched off, connect test box V.A.G 1598/18 to connector for engine control unit => Page **59** .
- Connect together the following sockets on the test box using a test lead from V.A.G 1594 A:

Test box V.A.G 1598/18	
Socket	Socket
48	46

- Switch on ignition.
 - Glow period warning lamp -K29 should light up.

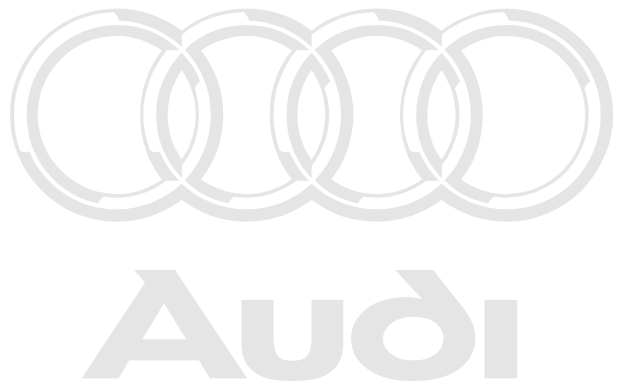
If the warning lamp does not light up:

- Test for open circuit and short to positive in wiring.

=> Current flow diagrams, Electrical fault-finding and Fitting locations

- Rectify any open/short circuit as necessary.
- If the wiring is okay, the fault must be in the dash panel insert.

=> Electrical system; Repair group 90; Dash panel insert Dash panel insert



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