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# Audi A4 1995 ➤

## TDI diesel injection and glow plug system (4-cyl.) 08.99 ➤

| Engine ID | AFF | AFN | AHH | AHU | AVG | | | | |
|---|---|---|---|---|---|---|---|---|---|

Edition 08.1999

# List of Workshop Manual Repair GroupsList of Workshop Manual Repair GroupsList of Workshop Manual Repair Groups

## Audi A4 1995 ➤

## TDI diesel injection and glow plug system (4-cyl.) 08.99 ➤

### 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

**Equipment**

- Fault memory: Non-volatile memory and volatile memory1)
- Rapid data transfer

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

**Selectable functions**

| Function | Ignition switched on | Engine idling |
|---|---|---|
| 01 Interrogating control unit version | x | x |
| 02 Interrogate fault memory | - | x |
| 03 Final control diagnosis | - | x |
| 04 Basic setting | - | x |
| 05 Erase fault memory | x | x |
| 06 End output | x | x |
| 07 Code control unit | x | x |
| 08 Read measured value block | x | x |

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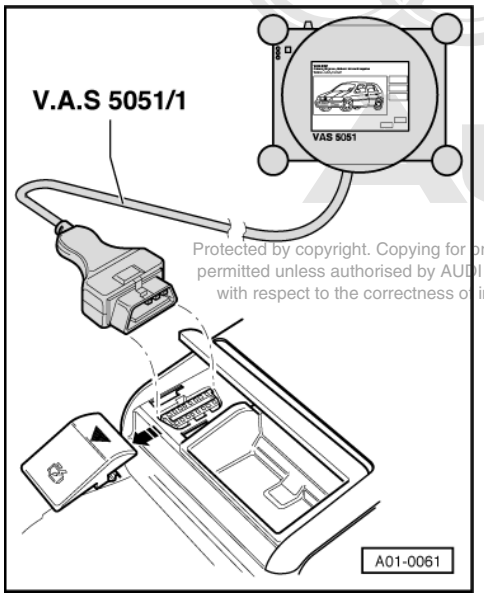
## 1.3 - Connecting vehicle diagnostic, testing and information system VAS 5051 or fault reader V.A.G 1551 and selecting functions

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**Test conditions**

- Battery voltage at least 11 V
- Fuse OK.

- -> Open rear ashtray (in centre console) and remove cover for diagnostic connector.
- -> Connect up vehicle diagnostic, testing and information system VAS 5051 with diagnostic cable VAS 5051/1. Alternatively, connect fault reader V.A.G 1551 using diagnostic cable V.A.G 1551/3A.

Warning:
- **When carrying out road tests using vehicle diagnostic, testing and information system VAS 5051 or fault reader V.A.G**

***Note:***

*The following description only covers the procedure for performing self-diagnosis with fault reader V.A.G 1551.*

*If using vehicle diagnostic, testing and information system VAS 5051, follow the operating instructions supplied with the equipment.*

-> Indicated on display:

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

* Appears alternately

***Note:***

*If the display remains blank:*

=> Fault reader operating instructions

Depending on the function required:

- Switch on ignition

or
Start engine => Page 1 , Table "Selectable functions".

- Switch on printer with the Print button (Warning lamp in button lights up).
- Press key 1 for "Rapid data transfer".

-> Indicated on display:

```
Rapid data transfer      HELP
Enter address word XX
```

```
Rapid data transfer      Q
01 - Engine electronics
```

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

*-> If the display shows one of the messages reproduced here, run through the fault-finding procedure as described in the Fault-Finding Programme for diagnosis wiring.*

```
Rapid data transfer      HELP
Control unit does not answer
```

=> Current Flow Diagrams, Electrical Fault-Finding and Fitting Locations

```
Rapid data transfer      HELP
Fault in communication build up
```

```
Rapid data transfer      HELP
K wire not switching to earth
```

```
Rapid data transfer      HELP
K wire not switching to positive
```

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

```
038906018..      1.9l      R4      EDC
G00SG      0203 " Coding 00002      WSC
12345
```

| | |
|---|---|
| - 038906018.. | Control unit number (see also Parts List) |
| - 1.9 ltr. | Engine capacity |
| - R4 | In-line engine, 4 cylinders |
| - EDC | Electronic Diesel Control |
| - G<br>- or no display | Vehicle with or without cruise control |
| - 00 | Control unit maps |
| - AG<br>- SG | Automatic gearbox<br>Manual gearbox |
| - 0203 | Software version of control unit |
| - Coding 00002 | Control unit coding |
| - WSC 12345 | 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
```

## 1.4 - Interrogating and erasing fault memory

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 ).
  When doing this the engine must be running at idling speed.

*Only when engine does not start:*

- Interrogate fault memory with ignition switched on.

-> Indicated on display:

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

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

-> The display will show either the number of faults stored or the message "No fault recognised!".

```
X Faults recognised!
```

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*If no fault is stored:*

- Press ⇒key.

If one or more faults are stored:

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

-> Then the display will show:

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

- Locate and eliminate faults printed out as per fault table => Page 4 .
- Press keys 0 and 5 for the function "Erase fault memory" and confirm entry with Q key.

-> Indicated on display:

```
Rapid data transfer
Fault memory is erased!
```

***Note:***

*If the ignition is switched off between interrogating fault memory and erasing fault memory, the fault memory will not be erased.*

- Press ⇒key.

-> Indicated on display:

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

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

## 1.5 - Fault table

***Notes:***

- If faults occur in the sensors and components being monitored, they will be stored in the fault memory together with an indication of the type of fault.
- The fault table is arranged according to the 5-digit fault codes in the left-hand column.
- Sporadically occurring faults (temporary faults) will be indicated on the V.A.G 1551 display as "SP".
- If a fault is stored in the fault memory and then does not occur again during the next 50 engine warm-up phases, the fault code will be automatically erased.

- Before renewing components indicated as being faulty, check the wiring and connectors to these components as well as the earth connections using the current flow diagrams.

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 16485 P0101<br>Air mass meter -G70<br>Implausible signal | - Air mass meter defective<br><br>- Engine has been stalled (within the last 50 starts) | - Loss of power, jolting | - Test air mass meter => Page 81<br>- Erase fault memory and continue to monitor vehicle |
| | - Battery low | - Loss of power<br>- 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<br>- Fault reading: Needle lift sender open circuit/short to positive might be displayed | - Test needle lift sender => Page 83 |
| | - Air cleaner blocked<br>- Vacuum hose system for exhaust gas recirculation incorrectly connected, or mechanical exhaust gas recirculation valve constantly open | - Rough idling, loss of power | - Test intake system<br>Check vacuum hoses => 4-Cyl. Diesel direct injection engine (TDI), Mechanics; Repair group 26 |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 16705 P0321<br>Engine speed sender -G28<br>Implausible signal | - Sender disc bent or loose | - Engine stops | - Remove sump and check sender disc |
| | - -G28 defective<br><br>- Open circuit in screening | - Engine stops | - Test engine speed sender => Page 80 |
| 16706P0322<br>Engine speed sender -G28<br>No signal | - -G28 defective<br>- Open circuit or short | | - Check engine speed sender => Page 80 |

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| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 16885 P0501<br>Road speed signal<br>Implausible signal | - Open circuit between speedometer sender -G22 and dash panel insert<br>- -G22 defective<br>- Speedometer -G21 defective<br>- Open circuit between dash panel insert and engine control unit | - Cruise control not working<br>- Air conditioner not working<br>- Load change jolts | - Test speed signal => Page 91<br>Test speedometer sender => Electrical System; Repair Group 90 |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 16955 P0571<br>Brake light switch -F | | | |

| | | | |
|---|---|---|---|
| Implausible signal | - Switch incorrectly set<br>- Open circuit<br>- -F or -F47 defective<br>- Fuse defective<br>- Both brake lights defective | - No throttle response at times, complete loss of power<br>- Glow period warning lamp flashes | - Test and adjust -F and -F47<br>Check brake lights<br>=> Electrical system; Repair group 94 |
| 16989 P0605<br>Control unit defective | - Internal fault in control unit | - Engine running problems<br>- Engine will not run | - Fit a new control unit<br>=> Page 71 |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 17552 P1144<br>Air mass meter -G70<br>Open/short circuit to earth | - -G70 defective<br>- Open circuit or short to earth | - Loss of power<br>- Black exhaust smoke possible when accelerating from low engine speeds | - Test air mass meter<br>=> Page 81 |
| 17553 P1145<br>Air mass meter -G70<br>Short circuit to positive | - -G70 defective<br>- Short circuit to positive | - Loss of power<br>- Black exhaust smoke possible when accelerating from low engine speeds | - Test air mass meter<br>=> Page 81 |
| 17554 P1146<br>Air mass meter -G70<br>Voltage supply | - Open circuit or short circuit | - Loss of power<br>- Black exhaust smoke possible when accelerating from low engine speeds | - Test air mass meter<br>=> Page 81 |

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| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 17563 P1155<br>Intake manifold pressure sender - G71<br>Short circuit to positive | - Open circuit or short<br>- -G71 defective | - Loss of power | - Test intake manifold pressure sender<br>=> 4-Cyl. Diesel direct injection engine (TDI), Mechanics; Repair group 21 |
| 17564 P1156<br>Intake manifold pressure sender - G71<br>Open/short circuit to earth | - Open circuit<br>- -G71 defective | - Loss of power | - Test intake manifold pressure sender<br>=> 4-Cyl. Diesel direct injection engine (TDI), Mechanics; Repair group 21 |
| 17565 P1157<br>Intake manifold pressure sender - G71<br>Voltage supply | - Open circuit or short | - Loss of power | - Test intake manifold pressure sender<br>=>4-Cyl. Diesel direct injection engine (TDI), Mechanics; Repair group 21 |

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

| | | | |
|---|---|---|---|
| 17568P1160<br>Intake manifold temperature sender -G72<br>Short circuit to earth | - -G72 defective<br>- Short to earth | - Engine pre-heating not working | - Test intake manifold temperature sender<br>=>Page 85 |
| 17569 P1161<br>Intake manifold temperature sender -G72<br>Open/short circuit to positive | - -G72 defective<br>- Open circuit or short to positive | - Engine pre-heating not working | - Test intake manifold temperature sender<br>=>Page 85 |

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| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 17570 P1162<br>Fuel temperature sender -G81<br>Short circuit to earth | - -G81 defective<br>- Short circuit to earth | - Reduced power | - Test fuel temperature sender<br>=> Page 75 |
| 17571 P1163<br>Fuel temperature sender -G81<br>Open/short circuit to positive | - -G81 defective<br>- Open circuit or short to positive | - Reduced power | - Test fuel temperature sender<br>=> Page 75 |
| | - Plug for injection pump disconnected | - Several faults recorded<br>- Engine stops | - Check injection pump connection |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 17653 P1245<br>Needle lift sender -G80<br>Short circuit to earth | - -G80 defective<br>- Short circuit | - Glow period warning lamp lights up<br>- Engine running rough<br>- Reduced power | - Test needle lift sender<br>=> Page 83 |
| 17654 P1246<br>Needle lift sender -G80<br>Implausible signal | - Fuel feed interrupted (intermittently); tank was run dry, supply pipe or filter blocked, air entering fuel system | - Fault 17656 (Commencement of injection control; Control difference) may be recorded<br>- Misfiring, jolting | - Check fuel system |
| | - (Sporadic) open circuit in wiring to fuel cut-off valve | - Engine stops<br>- Misfiring | - Check wiring and plug connections to injection pump |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 17654 P1246<br>Needle lift sender -G80<br>Implausible signal | - Sender disc of engine speed sender is bent or loose | - Misfiring at exactly 3000 rpm | - Remove sump and check sender disc |
| | - -G80 defective | - Misfiring, jolting (especially at high engine speeds) | - Fit a new needle lift sender |

| | | | |
|---|---|---|---|
| | - Injection pump defective | - Fault 17969 recorded (Quantity adjuster; Control difference)<br>- Engine running rough, misfiring<br>- No throttle response after overrun | - Fit a new injection pump |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 17655 P1247<br>Needle lift sender -G80<br>Open/short circuit to positive | - -G80 defective<br>- Open circuit or short circuit | - Glow period warning lamp lights up<br>- Engine running rough<br>- Reduced power | - Test needle lift sender => Page 83 |
| | - Sporadic open circuit (break in wiring) | - Misfiring, jolting | |
| 17656 P1248<br>Injection commencement regulation<br>Regulating difference | - Start of delivery not OK | - Loss of power at high engine speeds<br>- Engine difficult to start | - Check and adjust commencement of injection =>Page 59 |
| | - Control range of injection pump blocked (dirt, metal particles) | - Loss of power at high engine speeds | - Check control range of injection timing control => Page 72 |
| | - Engine has been stalled (within the last 50 starts) | | - Erase fault memory and continue to monitor vehicle |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 17656 P1248<br>Injection commencement regulation<br>Control difference | - Fuel feed interrupted (intermittently); tank was run dry, supply pipe or filter blocked, air entering fuel system | - Fault 17654 (implausible signal for needle lift sender) may be have been recorded | - 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 => Page 72 |
| | | - Several faults may have been recorded | - Test fuse |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 17659 P1251<br>Commencement of injection valve -N108<br>Short circuit to positive | - Short circuit to positive | - Engine knocks when idling because commencement of injection is constantly advanced | - Test commencement of injection valve => Page 72 |
| 17660 P1252 | | | |

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| | | | |
|---|---|---|---|
| Commencement of injection valve -N108<br>Open/short circuit to earth | - Open circuit (fuse)<br>- Valve defective | - Engine knocks when idling because commencement of injection is constantly advanced | - Test commencement of injection valve => Page 72 |
| | | - 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 72 |

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| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 17663 P1255<br>Coolant temperature sender -G62<br>Short circuit to earth | - -G62 defective<br>- Short to earth | - Black exhaust smoke when starting<br>- Engine pre-heating not functioning<br>- Glow period always approx. 20 seconds | - Test coolant temperature sender =>Page 84 |
| 17664 P1256<br>Coolant temperature sender -G62<br>Open/short circuit to positive | - -G62 defective<br>- Open circuit or short to positive | - Black exhaust smoke when starting<br>- Engine pre-heating not functioning<br>- Glow period always approx. 20 seconds | - Test coolant temperature sender =>Page 84 |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 17762 P1354<br>Modulating piston movement sender -G149 | - Connector for injection pump disconnected | - Several faults recorded<br>- Engine will not run | - Check connector for injection pump |
| | - Injection pump defective<br>- Open circuit or short circuit | - Engine running problems<br>- Engine will not run | - Test modulating piston movement sender => Page 86 |
| 17795 P1387<br>Control unit defective | - Internal fault in control unit | - Engine running problems<br>- Engine will not run | - Fit a new control unit => Page 71 |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 17810 P1402<br>Exhaust gas recirculation valve -N18- | | | |

| | | | |
|---|---|---|---|
| Short circuit to positive | - Short circuit to positive | - No exhaust gas recirculation | - Test exhaust gas recirculation valve<br>=> 4-Cyl. Diesel direct injection engine (TDI), Mechanics; Repair group 26 |
| 17849 P1441<br>Exhaust gas recirculation valve -N18-<br>Open/short circuit to earth | - Open circuit<br>- Solenoid defective | - No exhaust gas recirculation | - Test exhaust gas recirculation valve<br>=> 4-Cyl. Diesel direct injection engine (TDI), Mechanics; Repair group 26 |
| | - Short circuit to earth | - Too much exhaust gas recirculation<br>- Reduced power, black exhaust smoke | |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 17911 P1503<br>Load signal for alternator terminal DF<br>Implausible signal | - Open circuit or short circuit | - Engine pre-heating not working | - Check wiring<br>=> Current flow diagrams, Electrical fault-finding and Fitting locations binder |
| 17931 P1523<br>Crash signal from airbag CU<br>Implausible signal | - Open circuit or short circuit | | - Test crash signal =>Carry out final control diagnosis in airbag control unit<br>Check wiring<br>=> Current flow diagrams, Electrical fault-finding and Fitting locations binder |

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| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 17945 P1537<br>Fuel cut-off valve -N109<br>Mechanical fault | - N109 defective, leaking or sticking | - Reduced output<br>- Engine will not start | - Check N109<br>=>Page 16 , Final control diagnosis |
| 17946 P1538<br>Fuel cut-off valve -N109<br>Open/short circuit to earth | - -N109 defective<br>- Open circuit in wiring or short circuit to earth | - Engine stops | - Check wiring<br>=> Current flow diagrams, Electrical fault-finding and Fitting locations |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 17948 P1540<br>Road speed signal | | | |

| | | | |
|---|---|---|---|
| Signal too high | - -G22 defective<br>- Speedometer -G21 defective | - Cruise control not working<br>- Air conditioner not working<br>- Load change jolts | - Test speed signal => Page 91<br>Test speedometer sender => Electrical system; Repair group 90 |
| 17954 P1546 | | | |
| Charge pressure control solenoid valve -N75<br>Short circuit to positive | - Short circuit to positive | - Reduced power<br>- Boost pressure too low | - Test charge pressure control solenoid valve => 4-Cyl. Diesel direct injection engine (TDI), Mechanics; Repair group 21 |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 17957 P1549 | | | |
| Charge pressure control solenoid valve -N75<br>Open/short circuit to earth | - Open circuit<br>- Solenoid defective | - Reduced power<br>- Boost pressure too low | - Test charge pressure control solenoid valve => 4-Cyl. Diesel direct injection engine (TDI), Mechanics; Repair group 21 |
| | - Short circuit to earth | - Reduced power<br>- Boost pressure too high | |
| 17964 P1556<br>Charge pressure control<br>Regulating limit not reached | - Hoses wrongly connected, disconnected, blocked or leaking<br>- Pressure unit for turbocharger defective<br>- Solenoid valve for charge pressure control -N75 defective | - Sudden complete loss of power<br>- Reduced power | - Test charge pressure<br>Check charge pressure hose connections => 4-Cyl. Diesel direct injection engine (TDI), Mechanics; Repair group 21 |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 17965 P1557<br>Charge pressure control<br>Regulating limit surpassed | - Hoses wrongly connected, disconnected, blocked or leaking<br>- Pressure unit for turbocharger defective<br>- Solenoid valve for charge pressure control -N75 defective | - Sudden complete loss of power<br>- Reduced power | - Test charge pressure<br>Check charge pressure hose connections => 4-Cyl. Diesel direct injection engine (TDI), Mechanics; Repair group 21 |
| 17969 P1561<br>Metering device -N146<br>Regulating difference | - Injection pump defective<br>- Open circuit or short circuit | - Engine running problems<br>- Engine stops | - Test quantity adjuster =>Page 86<br>Fit a new injection pump |

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| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 17970 P1562<br>Metering device -N146<br>Upper stop value | - Quantity adjuster incorrectly set | - Engine stops (safety cut-out) | - Test quantity adjuster =>Page 86<br>Replace injection pump |
| 17971 P1563<br>Metering device -N146<br>Lower stop value | - Quantity adjuster incorrectly set | - Engine stops (safety cut-out) | - Test quantity adjuster =>Page 86<br>Replace injection pump |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 17977 P1569<br>CCS Switch -E45<br>Implausible signal | - Cruise control system switch -E45 defective<br>- Open circuit or short in wiring | - Cruise control system switched off | - Test cruise control system<br>=> Electrical system; Repair group 27 |
| 17978<br>Engine control unit blocked | - Attempted tampering<br>- Short in the communication wire | - Engine starts but cuts out again immediately | - Adapt control unit for engine electronics to electronic immobilizer<br>- Check electronic immobilizer:<br>=> Repair group 96; Servicing electronic immobilizer |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 18008 P1600<br>Voltage supply, terminal 15<br>Voltage too low | - Control unit was connected while ignition was switched on | | - Erase fault memory and continue to monitor vehicle |
| | - Open circuit or short | - Engine will not start<br>- Engine stops | - Test power supply to diesel direct injection system =>Page 76 |
| 18009 P1601<br>Vehicle voltage terminal 30<br>Implausible signal | - Relay for diesel direct injection system -J322 sticking | - Engine will not start (safety cut-out) | - Check power supply to diesel direct injection system =>Page 76 |

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| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 18020 P1612<br>Engine control unit<br>Wrong coding | - Invalid control unit coding | - Glow period warning lamp flashes | - Code control unit<br>=> Page 22 |
| 18026 P1618 | | | |

| | | | |
|---|---|---|---|
| Glow plug relay -J52 | | | |
| Short circuit to positive | - Short circuit to positive | - Glow plug system not working | - Test wiring<br>=> Current flow diagrams, Electrical fault-finding and Fitting locations |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 18027 P1619<br>Glow plug relay -J52<br>Open/short circuit to earth | - Open circuit<br>- Relay defective | - Glow plug system not working | - Check wiring<br>=> Current flow diagrams, Electrical fault-finding and Fitting locations |
| | - Short circuit to earth | - Glow plug system remains on constantly | |
| 18034 P1626<br>Drive train data bus<br>No message from gearbox CU | - Open circuit in wiring to gearbox CU | - Gearbox in emergency running mode | - Check wiring<br>=> Current flow diagrams, Electrical fault-finding and Fitting locations |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 18039 P1631<br>Accelerator position sender -G79<br>Signal too high | - Open circuit or short circuit to positive<br>- -G79 defective | - Safety governing at approx. 1100 rpm<br>- No throttle response | - Test accelerator position sender<br>=> 4-Cyl. Diesel direct injection engine (TDI), Mechanics; Repair group 20 |
| 18040 P1632<br>Accelerator position sender -G79<br>Voltage supply | - Open circuit or short circuit | - Safety governing at approx. 1100 rpm<br>- No throttle response | - Test accelerator position sender<br>=> 4-Cyl. Diesel direct injection engine (TDI), Mechanics; Repair group 20 |

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| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 18044 P1636 | | | |
| Drive train data bus<br>No message from airbag CU | - Open circuit in wiring to airbag CU | | - Check wiring<br>=> Current flow diagrams, Electrical fault-finding and Fitting locations binder |
| 18047 P1639<br>Accelerator position sender -G79 + G185 | | | |

| | | | |
|---|---|---|---|
| Implausible signal | - Open circuit<br>- -G79 defective (idling speed switch) | - Safety governing at approx. 1100 rpm<br>- No throttle response | - Test accelerator position sender<br>=> 4-Cyl. Diesel direct injection engine (TDI), Mechanics; Repair group 20 |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 18048 P1640<br>Control unit defective | - Internal fault in control unit | - Engine running problems<br>- Engine will not run | - Fit a new control unit<br>=> Page 71 |
| 18050 P1642<br>Please interrogate fault memory of airbag CU | - Fault in airbag system | | - Investigate and eliminate cause of fault in airbag system |
| 18056 P1648<br>Drive train data bus<br>Hardware defective | - Open circuit or short circuit to earth/positive | - Engine running problems | - Check wiring<br>=> Current flow diagrams, Electrical fault-finding and Fitting locations binder |

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| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 18057 P1649<br>Drive train data bus<br>Message from ABS control unit missing | - Open circuit in wiring to ABS control unit | - ASR warning lamp (traction control system) lights up<br>- Traction control system (ASR) not working | - Check wiring<br>=> Current flow diagrams, Electrical fault-finding and Fitting locations binder |
| 18058 P1650<br>Drive train data bus<br>Message from combi-instrument missing | - Open circuit in wiring to combi-instrument (dash panel insert) | | - Check wiring<br>=> Current flow diagrams, Electrical fault-finding and Fitting locations binder |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 18062 P1654<br>Please interrogate fault memory of combi-instrument | - Fault in combi-instrument (dash panel insert) | | - Investigate and eliminate cause of fault in combi-instrument (dash panel insert) |
| 18067 P1659<br>Activation 1 for radiator fan | | | |

| | | | |
|---|---|---|---|
| Short to positive | - Short to positive | - Fan run-on not working | - Test radiator fan run-on control unit -J138 => Current flow diagrams, Electrical fault-finding and Fitting locations binder |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 18080 P1672<br>Activation 1 for radiator fan<br>Open /short circuit to earth | - Open circuit<br>- Relay defective | - Fan run-on not working | - Test radiator fan run-on control unit -J138<br>=> Current flow diagrams, Electrical fault-finding and Fitting locations binder |
| | - Short circuit to earth | - Radiator fan remains on constantly | |
| 18090 P1682<br>Drive train data bus<br>Implausible signal from ABS CU | - Signal malfunction | - ASR warning lamp (traction control system) glows<br>- Traction control system (ASR) not working | - Check wiring<br>=> Current flow diagrams, Electrical fault-finding and Fitting locations binder |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 19458 P3002<br>Kick-down switch -F8<br>Implausible signal | - Open circuit<br>- -G79 defective (kick-down switch) | | - Test accelerator position sender<br>=> 4-Cyl. Diesel direct injection engine (TDI), Mechanics; Repair group 20 |
| 19459 P3003<br>Low heating output relay -J359<br>Short circuit to positive | - Short circuit to positive | - Engine pre-heating not working | - Check wiring<br>=> Current flow diagrams, Electrical fault-finding and Fitting locations binder |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 19460 P3004<br>Low heating output relay -J359<br>Open/short circuit to earth | - Open circuit in wiring<br>- Low heating output relay -J359 defective | - Engine pre-heating not working | - Check wiring<br>=> Current flow diagrams, Electrical fault-finding and Fitting locations |
| | - Short circuit to earth | - Engine pre-heating remains on constantly | |
| 19461 P3005<br>High heating output relay -J360 | | | |

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| | | | |
|---|---|---|---|
| Short circuit to positive | - Short circuit to positive | - Engine pre-heating not working | - Check wiring<br>=> Current flow diagrams, Electrical fault-finding and Fitting locations |

| V.A.G 1551 print-out | Possible causes of fault | Possible effects | Fault remedy |
|---|---|---|---|
| 19462 P3006<br>High heating output relay - J360<br>Open/short circuit to earth | - Open circuit<br>- High heating output relay -J360 defective | - Engine pre-heating not working | - Check wiring<br>=> Current flow diagrams, Electrical fault-finding and Fitting locations |
| | - Short circuit to earth | - Engine pre-heating remains on constantly | |

# 2 - Final control diagnosis

## 2.1 - Final control diagnosis

**Test requirements for vehicles with air conditioning system**

- Vehicle at room temperature (warmer than + 15 °C)
- Air conditioning system switched on
- Select lowest temperature and highest blower speed

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

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1. Commencement of injection valve (N108)
2. Exhaust gas recirculation valve (N18)
3. Conditioner compressor interruption
4. Fuel cut-off valve (N109)
5. Solenoid valve for boost pressure control (N75)
6. Glow plug relay (J52)
7. Glow period warning lamp (K29)
8. Low heating output relay (J359)

   (only on vehicles with manual gearbox)
9. High heating output relay (J360)

   (only on vehicles with manual gearbox)
10. Fan relay (J323)

    (engine code AFN and AVG only)

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 ).
  When doing this the engine must be running at idling speed.

-> Indicated on display:

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

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

-> Indicated on display:

```
Rapid data transfer      Q
03 Final control diagnosis
```

- Confirm input with Q key.

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-> Indicated on display:

```
Final control diagnosis
Commencement of injection valve -N108
```

Activating the valve has a noticeable effect on the noise of combustion (pre-ignition).

If no changes in the combustion noises are heard:

- Check injection adjuster control range
  => Page 72
- 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.

If the valve does not click:

- Test exhaust gas recirculation valve

=> 4-Cyl. Diesel Direct Injection (TDI), Mechanics; Repair Group 26; Testing exhaust gas recirculation system; Testing exhaust gas recirculation valve Testing exhaust gas recirculation system Testing exhaust gas recirculation valve

- Press ⇒key.

-> Indicated on display:

```
Final control diagnosis
Air conditioner compressor cut-out
```

Air conditioner compressor switch-off is checked.
The test step is also recalled on vehicles without air conditioner system.
The conditioner compressor must stop within 5 seconds (visual check) then start approx. every 5 seconds and then stop.

If the conditioner compressor is not switched off:

- Check conditioner compressor shut-off
  => Page 90
- 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.
- 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:

- Check boost (charge) pressure control solenoid valve

=> 4-Cyl. Diesel Direct Injection (TDI), Mechanics; Repair Group 21; Testing charge pressure system; Testing charge pressure control solenoid valve Testing charge pressure system Testing charge pressure control solenoid valve

- Press ⇒key.

-> Indicated on display:

```
Final control diagnosis
Glow plug relay -J52
```

The relay must click.
Fitting location: Relay position 4 of central electrics

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

If the relay does not click:

- Check glow plug relay:

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

- Press ⇒key.

-> Indicated on display:

```
Final control diagnosis
Glow period warning lamp -K29
```

The control lamp must flash.

Control lamp does not flash:

- Check glow period warning lamp

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

- Press ⇒key.

-> Indicated on display:

```
Final control diagnosis
Low heating output relay -J359
```

(only on vehicles with manual gearbox)
The relay must click.
Fitting location: electronics box in plenum chamber

If the relay does not click:

- Test low heating output relay

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

- Press ⇒key.

-> Indicated on display:

```
Final control diagnosis
High heating output relay -J360
```

(only on vehicles with manual gearbox)
The relay must click.
Fitting location: electronics box in plenum chamber

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If the relay does not click:

- Test high heating output relay

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

- Press ⇒key.

-> Indicated on display:

```
Final control diagnosis
Blower relay -J323
```

The radiator fan should come on and switch off again.
(engine code AFN and AVG only)

***Note:***

*The radiator fan can also be activated by the temperature level at the thermoswitch, the automatic gearbox or the air conditioner. When performing the final control diagnosis, make sure that the fan has not been activated for this reason.*

- If necessary, allow engine to cool down.

If the radiator fan is not activated:

- Test radiator fan run-on control unit -J138

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

-> Indicated on display:

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

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

# 3 - Basic setting

## 3.1 - Basic setting

### Test conditions

- Coolant temperature must be at least 80 °C.
- All electrical consumers like e.g. rear window heating must be switched off.
- If the vehicle is equipped with an air conditioner, this must be switched off.
- On vehicles with an automatic gearbox the selector lever must be in P or N.

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 ).
  When doing this the engine must be running at idling speed.

-> Indicated on display:

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

- Press keys 0 and 4 for function "Basic setting" and confirm entry by pressing Q.

-> Indicated on display:

```
Basic setting      Q
Enter display group number      XXX
```

- Press key 0 three times to select display group "00" and confirm entry by pressing key Q.

-> Indicated on display:

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

### Specifications for display group 00

*This display group is used for the dynamic test of the commencement of injection. The commencement of injection valve -N108 is activated constantly so that the injection timing control will move to the retarded position.*

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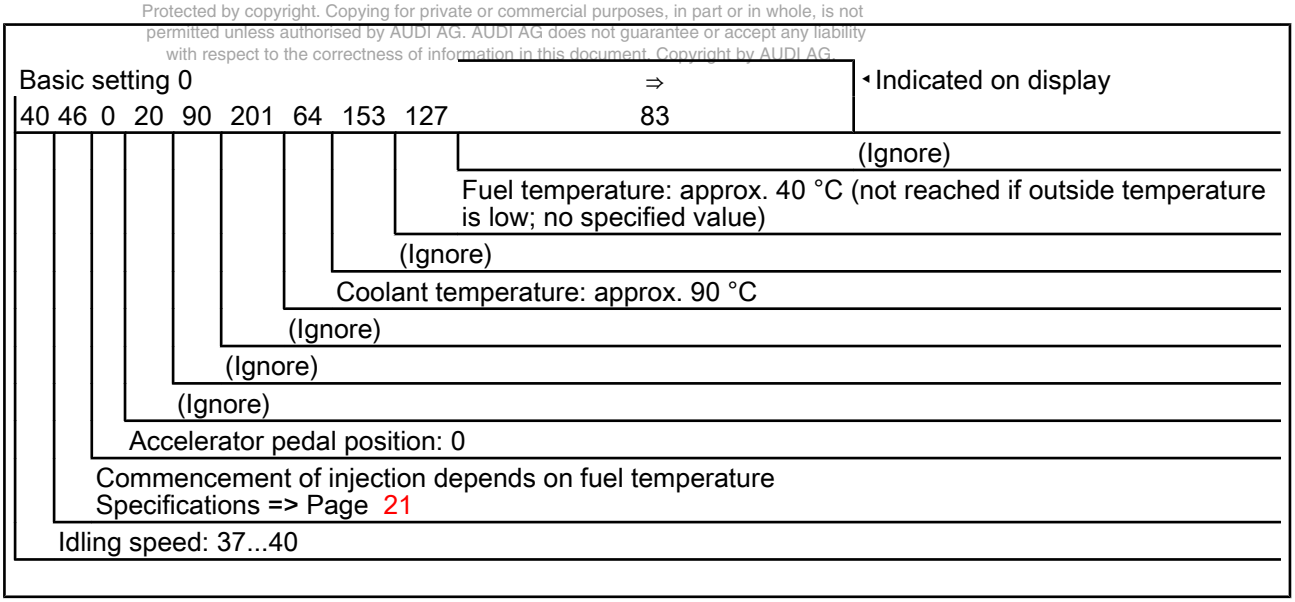

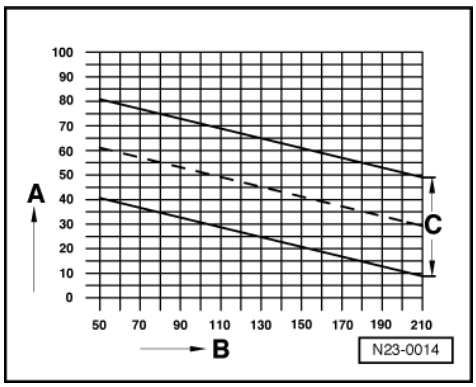


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- -> The commencement of injection value in display zone 2 varies in accordance with the fuel temperature value in display zone 9.

  Specification: => range C in illustration
  A - Zone 2 commencement of injection
  B - Zone 9 fuel temperature

***Notes:***

- If the commencement of injection is advanced turn injection pump in engine direction of rotation, if the commencement of injection is retarded turn against direction of rotation.
- If when checking the commencement of injection the specifications are within zone -C- then no adjustment is required. After repairs e.g. removing and installing injection pump, adjusting timing then the commencement of injection is to be set to the mean valve (dashed line) of specification zone -C-.

If the specifications within zone C are not met:

- Adjust commencement of injection => Page 59 .

**Display Group 03 at idling speed**

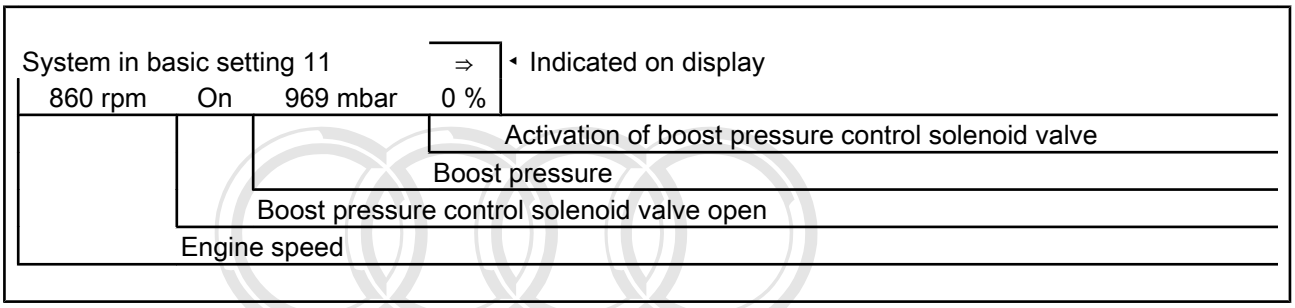
*This display group is used for testing the exhaust gas recirculation. The exhaust gas recirculation valve -N18 opens and closes alternately for periods of 10 seconds.*

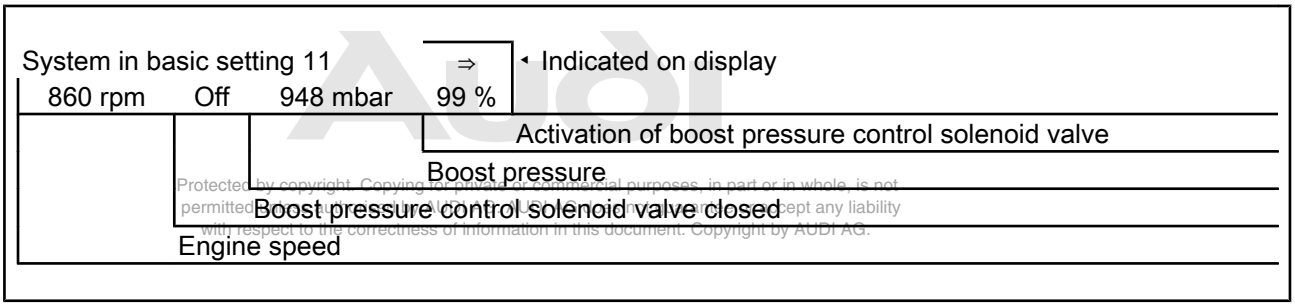
| System in basic setting 3 | | | ⇒ | ◂ Indicated on display |
|---|---|---|---|---|
| 860 rpm | EGR active | 200 mg/H | 99 % | |
| | | | | Duty cycle (activation) of exhaust gas recirculation valve |
| | | | | Intake air mass |
| | | | | Exhaust gas recirculation valve -N18 open |
| | | | | Engine speed |

| System in basic setting 3 | | | ⇒ | ◂ Indicated on display |
|---|---|---|---|---|
| 860 rpm | EGRn.active | 420 mg/H | 0 % | |
| | | | | Duty cycle (activation) of exhaust gas recirculation valve |
| | | | | Intake air mass |
| | | | | Exhaust gas recirculation valve -N18 closed |
| | | | | Engine speed |

**Display Group 11 at idling speed**

*This display group is used for testing the boost (charge) pressure control. The boost pressure control solenoid valve -N75 opens and closes alternately for periods of 10 seconds.*

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# 4 - Coding control unit

## 4.1 - Coding control unit

If the appropriate code for the vehicle is not displayed or if the control unit has been renewed, the control unit must be coded as follows.

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" ( => Page 2 .)
  When doing this the ignition must be switched on.

-> 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.

-> Indicated on display:

```
Code control unit      Q
Enter code number xxxxx (0-32000)
```

- Enter the appropriate code number for this vehicle and confirm with Q key.

| Coding | For vehicles with |
|---|---|
| 00001 | Automatic gearbox<br>with and without ESP |
| 00002 | Manual gearbox (front-wheel drive)<br>without ESP |

| Coding | For vehicles with |
|---|---|
| 00003 | Manual gearbox (four-wheel drive) without ESP |
| 00005 | Manual gearbox (front-wheel drive) with ESP |
| 00006 | Manual gearbox (four-wheel drive) with ESP |

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

```
038906018..     1.9l     R4     EDC
G00SG     0203     "
Coding 00002     WSC 12345
```

- Switch ignition off and then on again.

***Note:***

*The next time the ignition is switched on the newly entered coding will be activated.*

*If the ignition is not switched off and then on again after the correct coding has been entered, it will not be possible to erase fault 18020 ("Control unit incorrectly coded").*

- 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 the Q key.

# 5 - Reading measured value block

## 5.1 - Reading measured value block

### Safety precautions

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

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

  If test and measuring instruments are operated from front passenger's seat and the vehicle is involved in an accident, there is a possibility that the person sitting in this seat may receive serious injuries when the airbag is triggered.

### Procedure

- Connect vehicle diagnostic, testing and information system VAS 5051 (or fault reader V.A.G 1551) and select engine electronics control unit by entering address word "01" (=> Page 2 ).
  When doing this the engine must be running at idling speed.

-> 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.

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-> Indicated on display:

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

- Enter relevant display group number and confirm entry with Q key.

-> Indicated on display:

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

## Display group overview

| Display Gr. number | Indicated on display | Meaning |
|---|---|---|
| 00<br><br>General vehicle inspection | Read measured value block 0<br><br>1 2 3 4 5 6 7 8 9 10 | 1 = Engine speed<br>2 = Commencement of injection<br>3 = Accelerator pedal position<br>4 = Injection quantity<br>5 = Intake manifold pressure (charge/boost pressure)<br>6 = Atmospheric pressure (ambient air pressure)<br>7 = Coolant temperature<br>8 = Intake manifold temperature<br>9 = Fuel temperature<br>10 = Intake air mass |
| 01<br><br>Injection quantity | Read measured value block 1<br><br>1 2 3 4 | 1 = Engine speed<br>2 = Injection quantity<br>3 = Voltage from modulating piston movement sender -G149<br>4 = Coolant temperature |

| Display Gr. number | Indicated on display | Meaning |
|---|---|---|
| 02<br>Idling speed | Read measured value block 2<br>1 2 3 4 | 1 = Engine speed<br>2 = Accelerator pedal position<br>3 = Operating status:<br>X X 1 Air conditioner signal on<br>X 1 X Idling speed switch closed<br>1 X X Increased idling speed:<br>▪ because required by air conditioner 1)<br>▪ because acceleration and braking detected<br>▪ because additional heater is on<br>4 = Coolant temperature |
| 03<br>Exhaust gas recirculation | Read measured value block 3<br>1 2 3 4 | 1 = Engine speed<br>2 = Intake air mass (specified)<br>3 = Intake air mass (actual)<br>4 = Duty cycle (activation) of exhaust gas recirculation valve -N18 |

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.

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| Display Gr. number | Indicated on display | Meaning |
|---|---|---|
| 04<br>Start of injection | Read measured value block 4<br>1 2 3 4 | 1 = Engine speed<br>2 = Commencement of injection (specified)<br>3 = Commencement of injection (actual)<br>4 = Duty cycle (activation) of commencement of injection valve -N108 |
| 05<br>Start conditions | Read measured value block 5<br>1 2 3 4 | 1 = Engine speed<br>2 = Injection quantity for starting (recorded from last start)<br>3 = Commencement of injection<br>4 = Coolant temperature |
| 06<br>Switch positions | Read measured value block 6<br>1 2 3 4 | 1 = Road speed<br>2 = Brake pedal monitoring:<br>Brake light switch and brake pedal switch are a combined component<br>X X 1 Brake light switch -F closed<br>X 1 X Brake pedal switch open<br>1 X X Clutch pedal switch - F36 open |

| Display Gr. number | Indicated on display | Meaning |
|---|---|---|
| 06<br>Switch positions | Read measured value block 6<br>1 2 3 4 | 3 = Cruise control system (CCS) operating inputs:<br>X X X X X 1 CCS on<br>X X X X 1 X CCS off with memory<br>X X X 1 X X Speed reduction<br>X X 1 X X X Resume/accelerate<br>X 1 X X X X Brake pedal depressed<br>1 X X X X X Clutch pedal depressed<br>4 = Operating status of cruise control system:<br>0 Control unit with CCS function<br>1 CCS off<br>2 Accelerate<br>4 Decelerate<br>8 Resume<br>1 6 Brake depressed<br>3 2 Maintain speed<br>6 4 (Ignore)<br>1 2 8 (Ignore)<br>2 5 5 Control unit without CCS function |

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| Display Gr. number | Indicated on display | Meaning |
|---|---|---|
| 07<br>Temperatures | Read measured value block 7<br>1 2 3 4 | 1 = Fuel temperature<br>2 = No display<br>3 = Intake manifold temperature<br>4 = Coolant temperature |

| | | |
|---|---|---|
| 08<br><br>Injection quantity limitation | Read measured value block 8<br>1 2 3 4 | 1 = Engine speed<br>2 = Desired injection quantity (driver's requirement via accelerator pedal)<br>3 = Injection quantity limitation via engine speed (torque limitation)<br>4 = Injection quantity limitation based on intake air mass (avoidance of exhaust smoke) |
| 09<br><br>Injection quantity limitation | Read measured value block 9<br>1 2 3 4 | 1 = Engine speed<br>2 = Injection quantity (cruise control system activated)<br>3 = Injection quantity limitation by automatic gearbox during gear change<br>4 = Voltage from modulating piston movement sender |

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

| Display Gr. number | Indicated on display | Meaning |
|---|---|---|
| 13<br><br>Smooth idling control | Read measured value block 13<br>1 2 3 4 | 1 = Difference between injection quantities for cylinders 4 and 3<br>2 = Difference between injection quantities for cylinders 2 and 3<br>3 = Difference between injection quantities for cylinders 1 and 3<br>4 = No display |
| 14<br><br>(Unallocated) | Read measured value block 14 | No display |
| 15<br><br>Fuel consumption | Read measured value block 15<br>1 2 3 4 | 1 = Engine speed<br>2 = Injection quantity (actual)<br>3 = Fuel consumption |

| | | |
|---|---|---|
| | | 4 = Desired injection quantity (driver's requirement via accelerator pedal) |

| Display Gr. number | Indicated on display | Meaning |
|---|---|---|
| 16<br>Additional heater | Read measured value block 16<br>1 2 3 4 | 1 = Alternator load<br>2 = Additional heater switched off because:<br>X X X X X X X 1 Coolant temperature above 70 °C... 80 °C1)<br>or intake air temperature above 5 °C<br>X X X X X X 1 X Alternator defective<br>X X X X X 1 X X Battery voltage less than 9 V<br>X X X X 1 X X X Engine speed less than 800 rpm<br>X X X 1 X X X X Engine started within the last 10 seconds<br>X X 1 X X X X X Coolant temperature sender (G62) or intake manifold temperature sender (G72) defective<br>X 1 X X X X X X (Ignore)<br>1 X X X X X X X (Ignore)<br>3 = Heater element activation<br>X 1 Low heating output relay (J359) on<br>1 X High heating output relay (J360) on<br>4 = Supply voltage from control unit |

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 |
|---|---|---|
| 17<br>(Unallocated) | Read measured value block 17 | No display |
| 18 | Read measured value block 18<br>1 2 3 4 | (Ignore) |
| 19<br>Quantity adjuster | Read measured value block 19<br>1 2 3 4 | 1 = Lower stop value (voltage from modulating piston movement sender)<br>2 = Upper stop value (voltage from modulating piston movement sender)<br>3 = No display<br>4 = No display |

## 5.2 - Readout specifications for general vehicle inspection

**Display group 00 at idling speed (engine warm, coolant temperature not below +85 °C)**

**Engine code: AFF, AHU, AHH, AFN, AVG**

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| 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 03, Page 33
Fuel temperature: no specification
Intake manifold temperature: no specification
Coolant temperature: 80...51 okay
▪ > 80: run engine till warm
Ambient air pressure: no specification
Charge pressure: ignore
Injection quantity: 10...30 okay
▪ If outside tolerance => Display Group 01, Page 29
Accelerator pedal position: 0
Commencement of injection: 20...60 okay
▪ If outside tolerance => Display Group 04, Page 31
Idling speed: 37...42 okay
▪ If outside tolerance => Display Group 02, Page 32

**Display group 00 at full throttle (test drive in 3rd or 4th gear, coolant temperature not below +85 °C)**

**- Engine code AFF**

**Note: the fault reader must be secured on the rear seat and operated from this position. Always follow the safety precautions relating to test drives =>Page 39 .**

| Read measured value block 0 | | | | | | | | | ⇒ | Indicated on display |
|---|---|---|---|---|---|---|---|---|---|---|
| 186 | 225 | 255 | 154 | 186 | 201 | 64 | 138 | 175 | 233 | |

Intake air mass: > 210 okay
▪ < 210: => Display Group 10, Page 36
Fuel temperature: no specification
Intake manifold temperature: no specification
Coolant temperature: 80...51 okay
▪ > 80: run engine till warm
Ambient air pressure: ignore
Charge pressure: 171...191 okay
▪ If outside tolerance => Display Group 11, Page 37
Injection quantity:145...158 (injection quantity at full throttle) okay
▪ 125: emergency quantity - system fault detected => interrogate fault memory, Page 4
Accelerator pedal: 255 (fully depressed)
Commencement of injection: 170...245 (depending on engine speed)
▪ If outside tolerance => Display Group 04, Page 31
Engine speed: 160...190 (do not exceed 4000 rpm; engine speed is governed)

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**Display group 00 at full throttle (test drive in 3rd or 4th gear, coolant temperature not below +85 °C)**

**- Engine code AHU, AHH**

**Note: the fault reader must be secured on the rear seat and operated from this position. Always follow the safety precautions relating to test drives =>Page 39 .**

| Read measured value block 0 | | | | | | | | | ⇒ | Indicated on display |
|---|---|---|---|---|---|---|---|---|---|---|
| 186 | 225 | 255 | 199 | 190 | 201 | 64 | 138 | 175 | 255 | |

Intake air mass: > 210 okay
▪ < 210: => Display Group 10, Page 36
Fuel temperature: no specification
Intake manifold temperature: no specification
Coolant temperature: 80...51 okay
▪ > 80: run engine till warm
Ambient air pressure: ignore
Charge pressure: 171...191 okay
▪ If outside tolerance => Display Group 11, Page 37
Injection quantity:160...180 (injection quantity at full throttle) okay
▪ 125: emergency quantity - system fault detected => interrogate fault memory, Page 4
Accelerator pedal: 255 (fully depressed)
Commencement of injection: 180...245 (depending on engine speed)
▪ If outside tolerance => Display Group 04, Page 31
Engine speed: 160...190 (do not exceed 4000 rpm; engine speed is governed)

**Display group 00 at full throttle (test drive in 3rd or 4th gear, coolant temperature not below +85 °C)**

**- Engine code AFN, AVG**

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**Note: the fault reader must be secured on the rear seat and operated from this position. Always follow the safety precautions relating to test drives =>Page 39 .**

Read measured value block 0 ⇒ ◂ Indicated on display
186 225 255 199 190 201 64 138 175 255

Intake air mass: > 240 okay
▪ < 240: => Display Group 10, Page 36
Fuel temperature: no specification
Intake manifold temperature: no specification
Coolant temperature: 80...51 okay
▪ > 80: run engine till warm
Ambient air pressure: ignore
Charge pressure: 180...200 okay
▪ If outside tolerance => Display Group 11, Page 37
Injection quantity:190...210 (injection quantity at full throttle) okay
▪ 125: emergency quantity - system fault detected => interrogate fault memory, Page 4
Accelerator pedal: 255 (fully depressed)
Commencement of injection: 180...245 (depending on engine speed)
▪ If outside tolerance => Display Group 04, Page 31
Engine speed: 160...190 (do not exceed 4000 rpm; engine speed is governed)

## 5.3 - Readout specifications for injection pump

**Display group 01 at idling speed (engine warm, coolant temperature not below +85 °C)**

**Engine code: AFF, AHU, AHH, AFN, AVG**

Read measured value block 1 ⇒ ◂ Indicated on display
860 rpm 5.6 mg/H 1.680 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...1.750 V okay
- < 1.250 V: injection pump too rich => fit a new injection pump
- > 1.750 V: engine load => switch off consumers

Engine too cold => run engine till warm (see display zone 4)
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

Engine too cold => run engine till warm (see display zone 4)
Injection pump too lean => fit a new injection pump

Engine speed
- 780...900 rpm okay

**Display group 01 with attempted start (if engine does not start)1)**

**Engine code: AFF, AHU, AHH, AFN, AVG**

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.

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

Engine speed

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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 19 with ignition on**

**Engine code: AFF, AHU, AHH, AFN, AVG**

Read measured value block 19 ⇒ ◂ Indicated on display

0.780 V 4.350 V

No display

No display

Voltage at modulating piston movement sender with quantity adjuster at maximum stop
- 4.150...4.720 V okay
- If outside tolerance: contact resistance in wiring => test, Page 87

Quantity adjuster in injection pump incorrectly set => fit a new injection pump

Voltage at modulating piston movement sender with quantity adjuster at minimum stop
- 0.500...0.970 V okay
- If outside tolerance: contact resistance in wiring => test, Page 87

Quantity adjuster in injection pump incorrectly set => fit a new injection pump

**Display group 04 at idling speed (engine warm, coolant temperature not below +85 °C)**

**Engine code: AFF, AHU, AHH, AFN, AVG**

Read measured value block 4 ⇒ ◂ Indicated on display

860 rpm 0.9 ° BTDC 0.9 ° BTDC 23 %

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 72

Commencement of injection specified by control unit
- 2° ATDC...4° BTDC okay

Engine speed
- 780...900 rpm okay

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**Display group 04 at full throttle (test drive in 3rd or 4th gear, coolant temperature not below +85 °C)**

**Engine code: AFF, AHU, AHH, AFN, AVG**

**Note: the fault reader must be secured on the rear seat and operated from this position. Always follow the safety precautions relating to test drives =>Page 39 .**

Read measured value block 4 ⇒ ◂ Indicated on display

4060 rpm 16.3°BTDC 16.1°BTDC 84 %

Duty cycle (activation) of commencement of injection valve
- No specification

Current commencement of injection
- If as specified in display zone 2 (tolerance ±2°): okay
- If outside tolerance: commencement of injection incorrect

=> test commencement of injection, Page 72

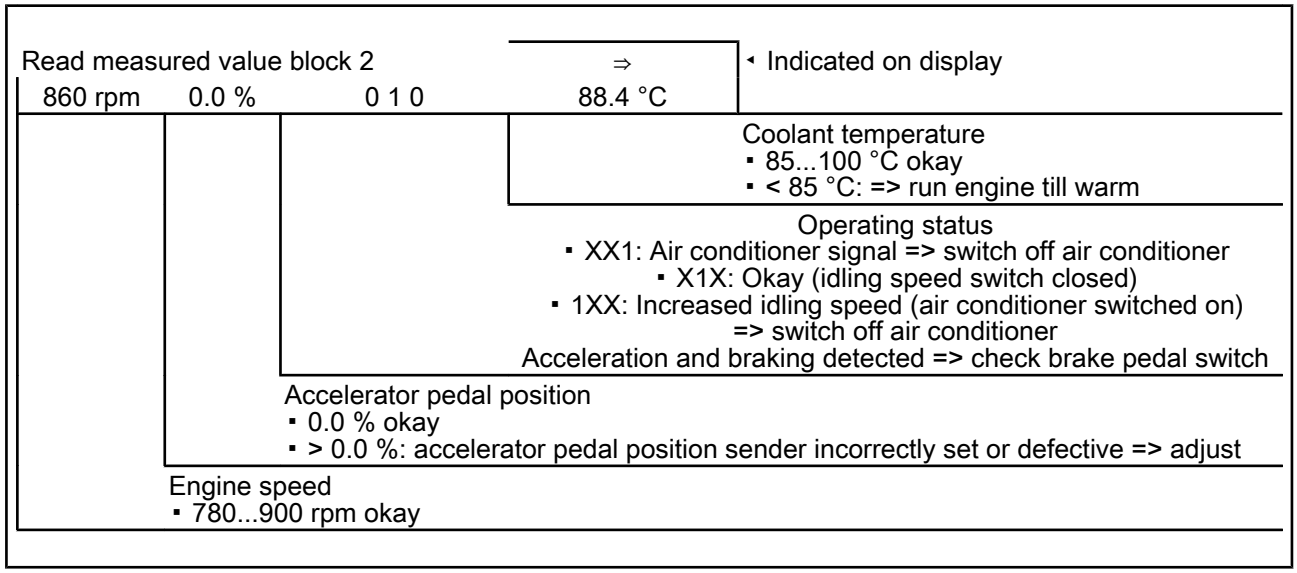
Commencement of injection specified by control unit
- 14...18 ° BTDC okay

Engine speed
- 3800...4200 rpm okay

## 5.4 - Readout specifications for engine idling speed

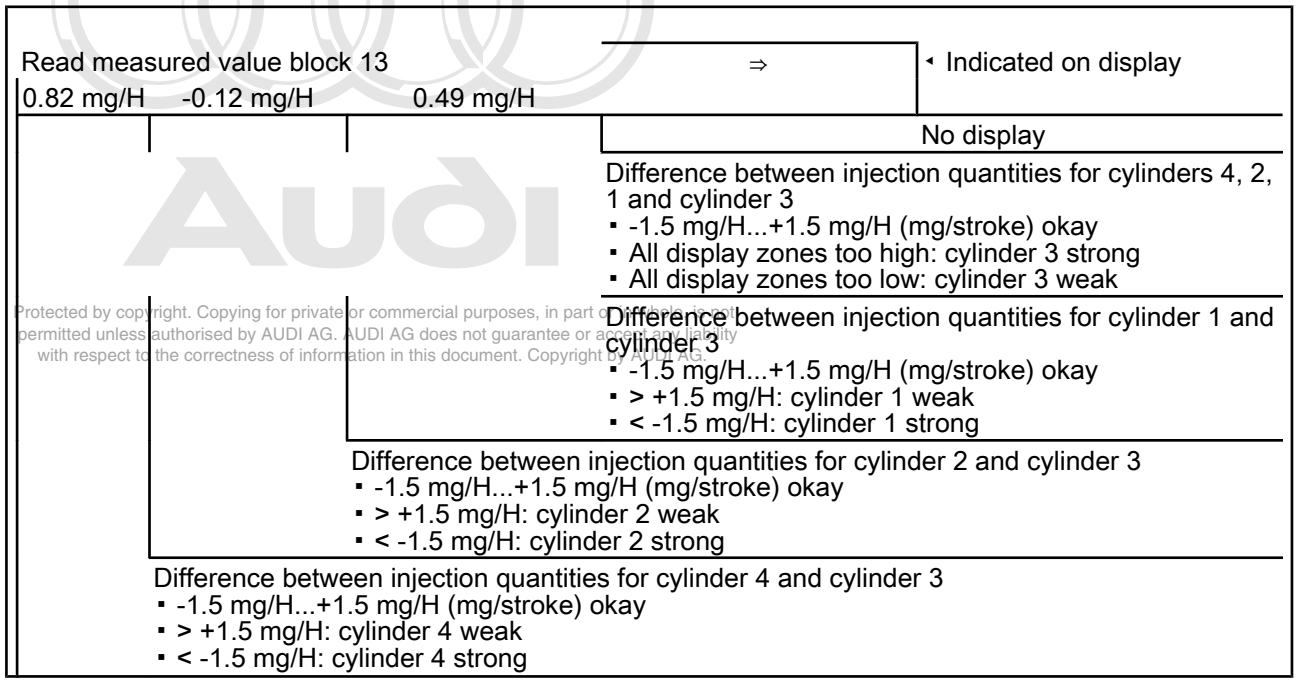
**Display group 02 at idling speed (engine warm, coolant temperature not below +85 °C)**

**Engine code: AFF, AHU, AHH, AFN, AVG**




**Display group 13 at idling speed (engine warm, coolant temperature not below +85 °C)**

**Engine code: AFF, AHU, AHH, AFN, AVG**

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*Notes on display group 13:*

- The injection system is equipped with an idling speed smooth running control. There may be power differences between the individual cylinders (component tolerances, injector delivery, compressions etc.) which are recognised and equalized via selective injected quantities at idling speed.
- 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 amounts by which the quantity of fuel injected at the individual cylinders is varied as compared with No. 3 cylinder to achieve 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.

## 5.5 - Readout specifications for exhaust gas recirculation

**Display group 03 at idling speed (engine warm, coolant temperature not below +85 °C)**

**Engine code: AFF, AHU, AHH, AFN, AVG**

Read measured value block 3 ⇒ ◂ Indicated on display

860 rpm 290 mg/H 308 mg/H 54 %

Duty cycle (activation) of exhaust gas recirculation valve
- No specification

Intake air mass (actual value)
- If as specified in display zone 2 (tolerance ±20mg/H (mg/stroke)): okay
- Air mass too small: unmetered air in intake tract

Excessive exhaust gas recirculation => test
- Air mass too great: too little exhaust gas recirculation => test

If engine has been idling for 10 minutes or more => press accelerator briefly
- Constant 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...900 rpm okay

## 5.6 - Readout specifications for temperature senders

**Display group 07 with ignition switched on (engine cold and not running)**

**Engine code: AFF, AHU, AHH, AFN, AVG**

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| Read measured value block 7 ⇒ | ◂ Indicated on display |
|---|---|
| 15.4 °C | Coolant temperature (at coolant temperature sender -G62)<br>▪ If the wiring has an open circuit the approximate fuel temperature (display zone 1) will be displayed as a substitute value, test sender =>Page 84 |
| 15.9 °C | Intake manifold temperature (at intake manifold temperature sender -G72)<br>▪ If the wiring has an open circuit, a constant temperature of 136.8 °C will be displayed as a substitute value, test sender =>Page 85 |
| 16.7 °C | No display |
| | Fuel temperature (at fuel temperature sender -G81)<br>▪ If the wiring has an open circuit, a constant temperature of -5.4 °C will be displayed as a substitute value, test sender =>Page 75 |

*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.

## 5.7 - Readout specifications for engine power output

**Display group 08 at full throttle (test drive in 3rd or 4th gear, coolant temperature not below +85 °C)**

**-Engine code AFF**

**Note: the fault reader must be secured on the rear seat and operated from this position. Always follow the safety precautions relating to test drives =>Page 39 .**

| Read measured value block 8 ⇒ | ◂ Indicated on display |
|---|---|
| 3990 rpm 38.4 mg/H | Engine speed 2800...4000 rpm okay |
| 31.0 mg/H | Desired injection quantity (accelerator pedal position) > 36 mg/H (mg/stroke) okay<br>▪ < 36 mg/H: accelerator pedal not fully depressed, incorrectly adjusted or defective, test<br>=> 4-Cylinder diesel direct injection engine (TDI), Mechanics; Repair group 20; Testing accelerator pedal position sender -G79; Vehicles with 4-cylinder engine Testing accelerator pedal position sender -G79; Vehicles with 4-cylinder engine |
| 35.7 mg/H | Injection quantity limitation according to engine speed (torque limitation)<br>29.0...31.5 mg/H (mg/stroke) okay<br>▪ < 29.0 mg/H: engine speed too high or too low<br>▪ > 31.5 mg/H: injection quantity has been increased by engine tuning |
| | Injection quantity limitation according to recognised air mass<br>> 35 mg/H (mg/stroke) okay<br>▪ < 35 mg/H: recognised air mass too small<br>=> test air mass meter, Page 81<br>Exhaust gas recirculation at full throttle => test |

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**Display group 08 at full throttle (test drive in 3rd or 4th gear, coolant temperature not below +85 °C)**

**-Engine code AHU, AHH**

**Note: the fault reader must be secured on the rear seat and operated from this position. Always follow the safety precautions relating to test drives =>Page 39 .**

| Read measured value block 8 | | ⇒ | ◂ Indicated on display |
|---|---|---|---|
| 3990 rpm 38.4 mg/H | 35.0 mg/H | 35.7 mg/H | |
| | | | Injection quantity limitation according to recognised air mass<br>> 35 mg/H (mg/stroke) okay<br>▪ < 35 mg/H: recognised air mass too small<br>=> test air mass meter, Page 81<br>Exhaust gas recirculation at full throttle => test |
| | | Injection quantity limitation according to engine speed (torque limitation)<br>34.2...36.5 mg/H (mg/stroke) okay<br>▪ < 34.2 mg/H: engine speed too high or too low<br>▪ > 36.5 mg/H: injection quantity has been increased by engine tuning | |
| | Desired injection quantity (accelerator pedal position) > 36 mg/H (mg/stroke) okay<br>▪ < 36 mg/H: accelerator pedal not fully depressed, incorrectly adjusted or defective, test<br>=> 4-Cylinder diesel direct injection engine (TDI), Mechanics; Repair group 20; Testing accelerator pedal position sender -G79; Vehicles with 4-cylinder engine Testing accelerator pedal position sender -G79; Vehicles with 4-cylinder engine | | |
| Engine speed 2800...4000 rpm okay | | | |

**Display group 08 at full throttle (test drive in 3rd or 4th gear, coolant temperature not below +85 °C)**

**-Engine code AFN, AVG**

**Note: the fault reader must be secured on the rear seat and operated from this position. Always follow the safety precautions relating to test drives =>Page 39 .**

| Read measured value block 8 | | ⇒ | ◂ Indicated on display |
|---|---|---|---|
| 3990 rpm 43.4 mg/H | 40.4 mg/H | 42.0 mg/H | |
| | | | Injection quantity limitation according to recognised air mass<br>> 40 mg/H (mg/stroke) okay<br>▪ < 40 mg/H: recognised air mass too small<br>=> test air mass meter, Page 81<br>Exhaust gas recirculation at full throttle => test |

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Injection quantity limitation according to engine speed (torque limitation)
38.0...43.5 mg/H (mg/stroke) okay
- < 38.0 mg/H: engine speed too high or too low
- > 43.5 mg/H: injection quantity has been increased by engine tuning

Desired injection quantity (accelerator pedal position) > 42 mg/H (mg/stroke) okay
- < 42 mg/H: accelerator pedal not fully depressed, incorrectly adjusted or defective, test
=> 4-Cylinder diesel direct injection engine (TDI), Mechanics; Repair group 20; Testing accelerator pedal position sender -G79; Vehicles with 4-cylinder engine Testing accelerator pedal position sender -G79; Vehicles with 4-cylinder engine

Engine speed 2800...4000 rpm okay

**Display group10 at full throttle (test drive in 3rd or 4th gear, coolant temperature not below +85 °C)**

**-Engine code AFF, AHU, AHH**

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**Note: the fault reader must be secured on the rear seat and operated from this position. Always follow the safety precautions relating to test drives =>Page 39 .**

Read measured value block 10 ⇒ 830 mg/H 1030 mbar 1968 mbar 100 %

◂ Indicated on display

Accelerator pedal position: 100 % okay
- < 100 %: accelerator pedal not fully depressed
Accelerator pedal position sender -G79 incorrectly adjusted or defective => test
=> 4-Cylinder diesel direct injection engine (TDI), Mechanics; Repair group 20; Testing accelerator pedal position sender -G79; Vehicles with 4-cylinder engine Testing accelerator pedal position sender -G79; Vehicles with 4-cylinder engine

Current charge pressure: 1800...2050 mbar okay
If outside tolerance: charge pressure control defective
=> Display Group 11, Page 37

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 =>Page 33
Unmetered air between air mass meter and turbocharger
Air mass meter defective

**Display group10 at full throttle (test drive in 3rd or 4th gear, coolant temperature not below +85 °C)**

**-Engine code AFN, AVG**

**Note: the fault reader must be secured on the rear seat and operated from this position. Always follow the safety precautions relating to test drives =>Page 39 .**

Read measured value block 10 ⇒ 963 mg/H 1030 mbar 1968 mbar 100 %

◂ Indicated on display

Accelerator pedal position: 100 % okay
▪ < 100 %: accelerator pedal not fully depressed
Accelerator pedal position sender -G79 incorrectly adjusted or defective => test
=> 4-Cylinder diesel direct injection engine (TDI), Mechanics; Repair group 20; Testing accelerator pedal position sender -G79; Vehicles with 4-cylinder engine Testing accelerator pedal position sender -G79; Vehicles with 4-cylinder engine

Current charge pressure: 1800...2250 mbar okay
If outside tolerance: charge pressure control defective
=> Display Group 11 Page 37

Current air pressure: no specification

Intake air mass: 800...1100 mg/H (mg/stroke) okay
▪ < 800 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

## 5.8 - Readout specifications for charge pressure control

**Display group 11 at full throttle (test drive in 3rd and 4th gear, coolant temperature not below +85 °C)**

**-Engine code AFF, AHU, AHH**

**Note: the fault reader must be secured on the rear seat and operated from this position. Always follow the safety precautions relating to test drives =>Page 39 .**

| Read measured value block 11 | ⇒ | ◂ Indicated on display |
|---|---|---|
| 3340 rpm 1830 mbar 1850 mbar | 57 % | |

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
▪ Charge pressure too high: solenoid valve -N75 jamming
Pressure hose for charge pressure control detached or blocked
Vacuum unit defective => test charge pressure
=> 4-Cylinder diesel direct injection engine (TDI), Mechanics; Repair group 21; Testing charge air system; Testing solenoid valve for charge pressure control Testing charge air system; Testing solenoid valve for charge pressure control

Charge pressure required by control unit
▪ 1800...2050 mbar okay
▪ > 2050 mbar: charge pressure has been increased by engine tuning

Engine speed 2900...4000 rpm okay

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**Display group 11 at full throttle (test drive in 3rd and 4th gear, coolant temperature not below +85 °C)**

**-Engine code AFN, AVG**

**Note: the fault reader must be secured on the rear seat and operated from this position. Always follow the safety precautions relating to test drives =>Page 39 .**

Read measured value block 11 ⇒ ◂ Indicated on display
3340 rpm 1948 mbar 1917 mbar 57 %

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
- Charge pressure too high: solenoid valve -N75 jamming

Pressure hose for charge pressure control detached or blocked
Vacuum unit defective => test charge pressure
=> 4-Cylinder diesel direct injection engine (TDI), Mechanics; Repair group 21; Testing charge air system; Testing solenoid valve for charge pressure control Testing charge air system; Testing solenoid valve for charge pressure control

Charge pressure required by control unit
- 1800...2250 mbar okay
- > 2250 mbar: charge pressure has been increased by engine 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, note the following points:**

- 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 compressions, pull connector off 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.

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

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

  If test and measuring instruments are operated from front passenger's seat and the vehicle is involved in an accident, there is a possibility that the person sitting in this seat may receive serious injuries when the airbag is triggered.

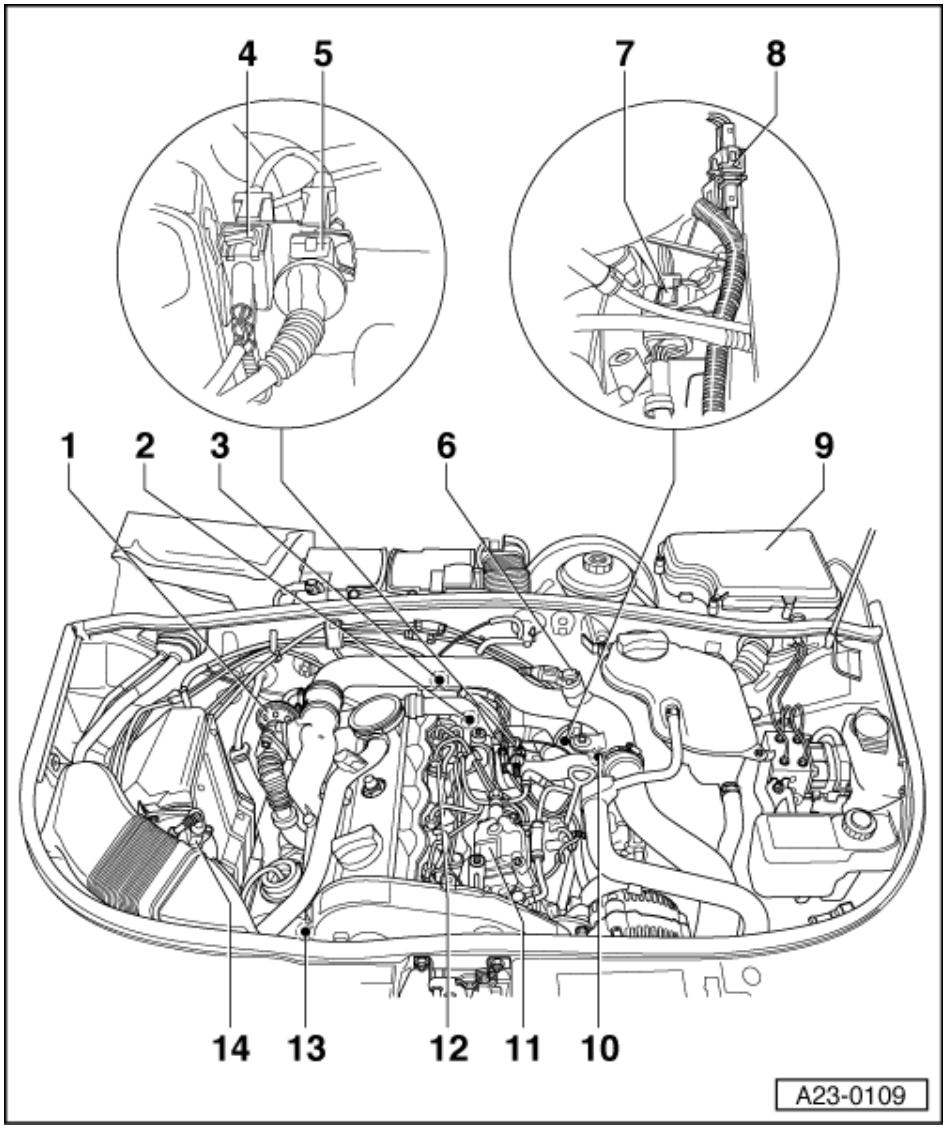
| |
|---|
| Warning!<br>Secure fault reader to rear seat and operate from this position. |

### 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 them over. Do not use fluffy cloths.
- Carefully cover over or seal opened components if the repair cannot be completed immediately.
- Only install clean components:
  Only unpack replacement parts immediately prior to installation.
  Do not use parts that have been stored loose (e.g. in tool boxes etc.).
- When the system is open:
  Do not work with compressed air if this can be avoided.
  Do not move vehicle unless absolutely necessary.
- Also ensure that no diesel fuel runs onto the coolant hoses. Hoses coming in contact with fuel must be cleaned immediately. Damaged hoses must be replaced.

## 1.4 - Fitting locations overview




Components A to E are not shown in the illustration.

**A - Glow plug relay (J52)**

- Central electrics, relay position 4

**B - Accelerator pedal position sender (G79)**

- In footwell on accelerator pedal

**C - Brake light switch (F) and brake pedal switch**

- In footwell on brake pedal
- Combined as one unit

**D - Clutch pedal switch (F36)**

- In footwell on clutch pedal

**E - Low/High heating output relay (Additional heater)**

- Electronics box in plenum chamber
- Only on vehicles with manual gearbox

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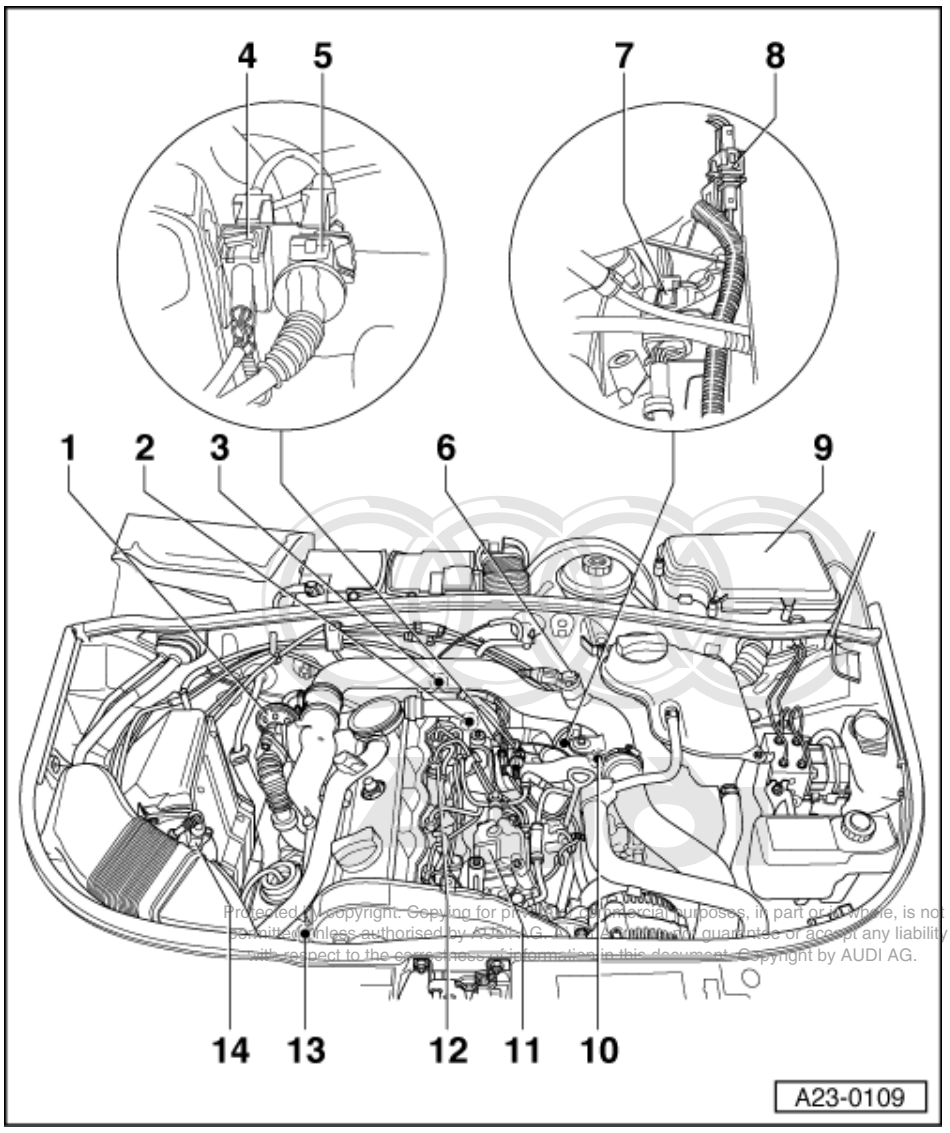


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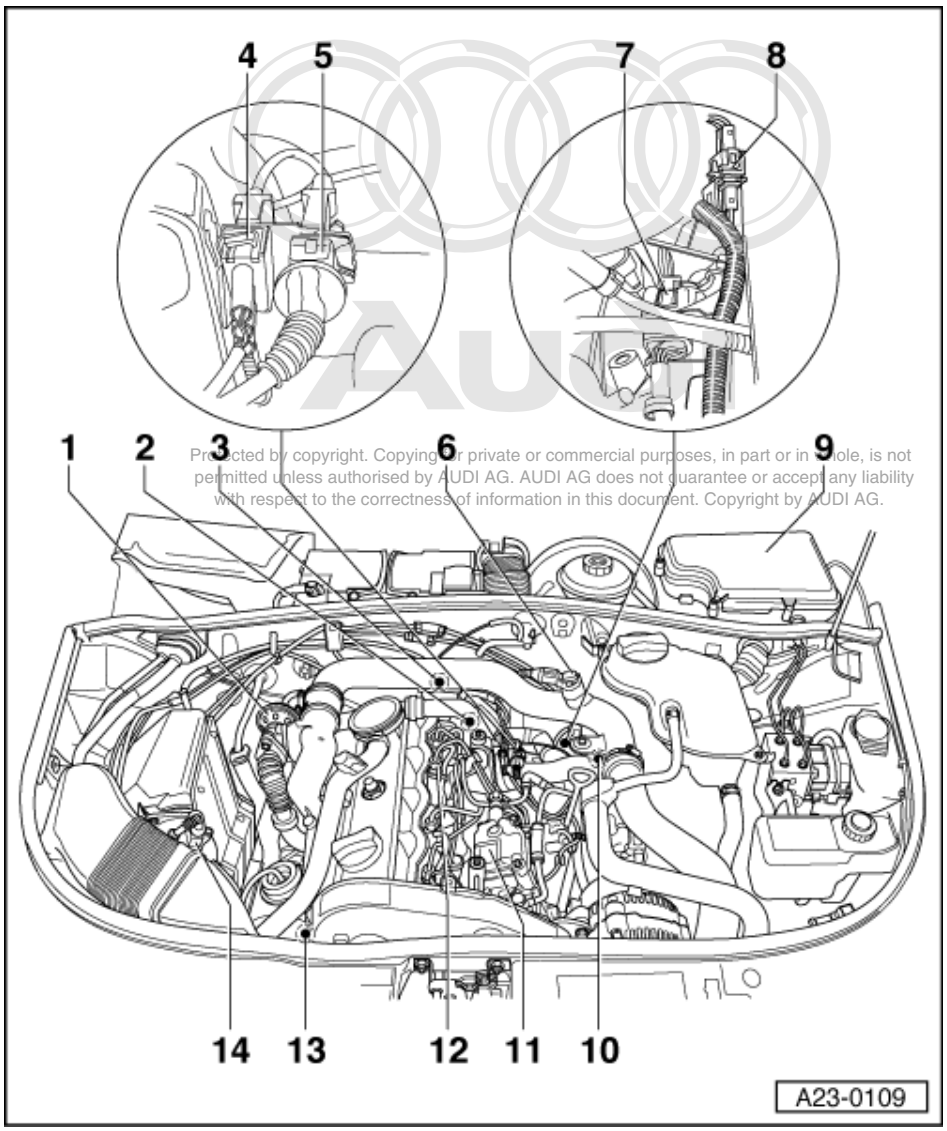
1 Mechanical exhaust gas recirculation valve
2 Coolant temperature sender (G62)
3 Exhaust gas recirculation valve (N18)
4 Connector
- 3 pin
- For engine speed sender (G28)

5 Connector
- 2 pin
- For needle lift sender (G80)

6 Intake manifold pressure sender (G71) and intake manifold temperature sender (G72)

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*Note:*

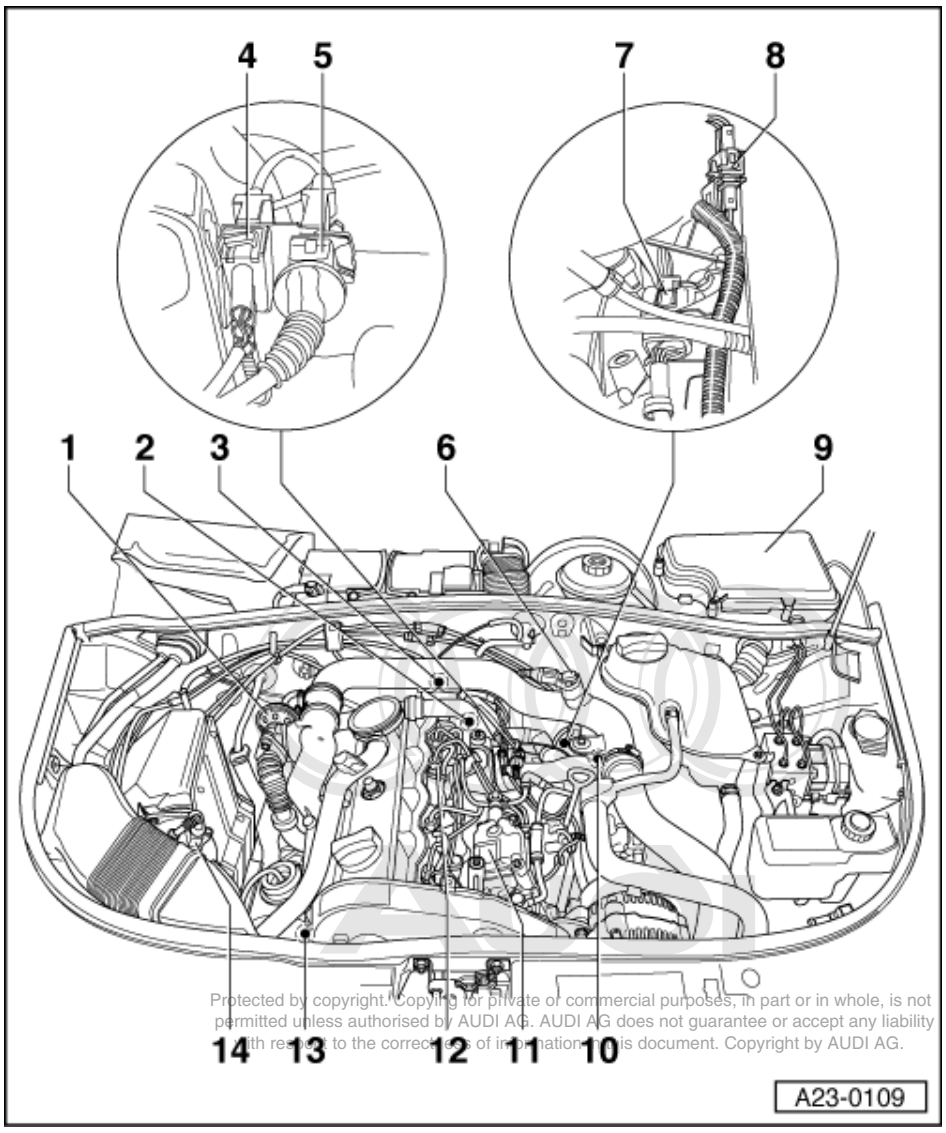
*Some vehicles are equipped with a 10-pin connector instead of an 8-pin and 3-pin connector (Item 7 and 8).*

**7 Connector**

- 8-pin
- For fuel temperature sender (G81)
- For quantity adjuster (N146)
- For modulating piston movement sender (G149)

**8 Connector**

- 3 pin
- For commencement of injection valve (N108)
- For fuel shut-off valve (N109)

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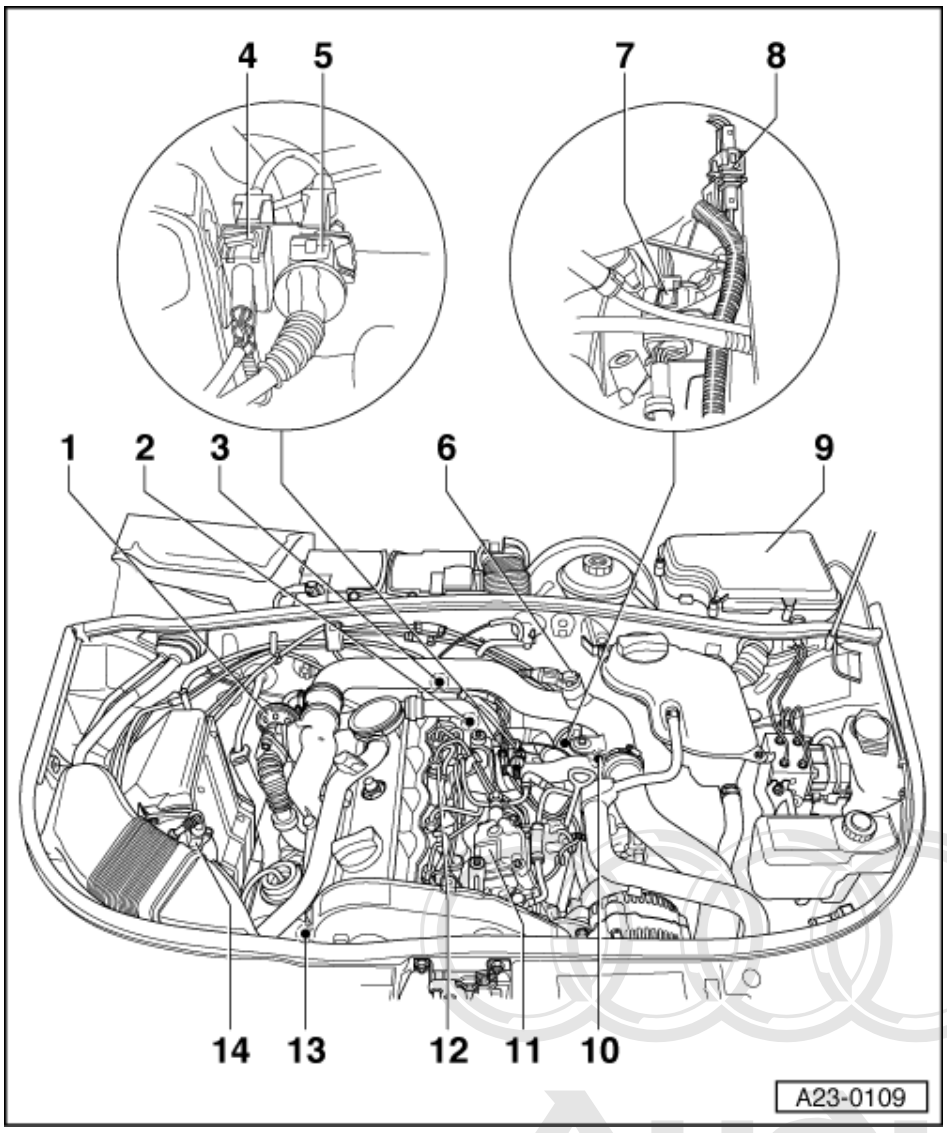
**9 Electronics box**

- Diesel direct injection system control unit (J248) with altitude sender (F96)
- Diesel direct injection system relay (J322)
- Fuse for glow plugs
- Low/High heating output relay
  (only on vehicles with manual gearbox)

**10 Engine speed sender (G28)**

**11 Injection pump**

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




12 Injector with needle lift sender (G80)
13 Charge pressure control solenoid valve (N75)
14 Air mass meter (G70)

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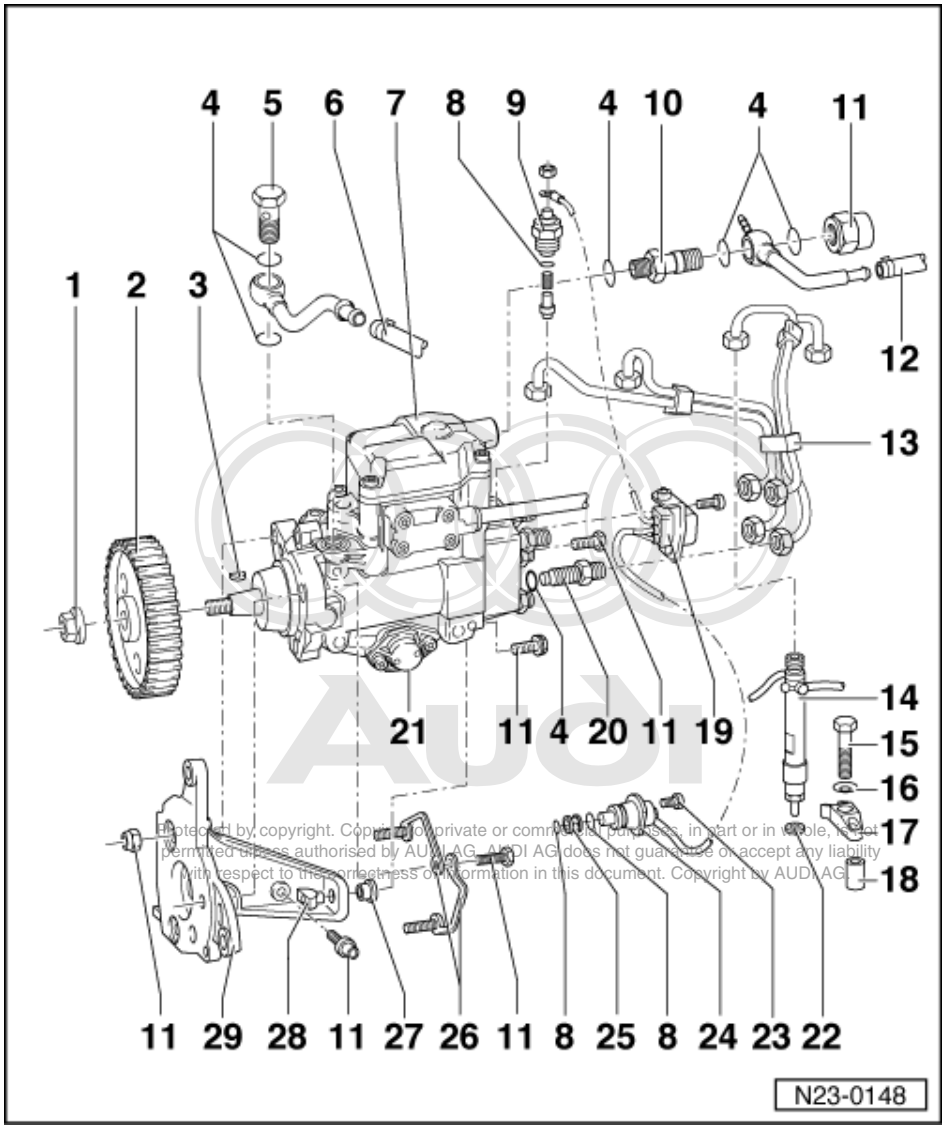
## 1.5 - Servicing injection pump: engine code AFF, AHU, AFN, AVG

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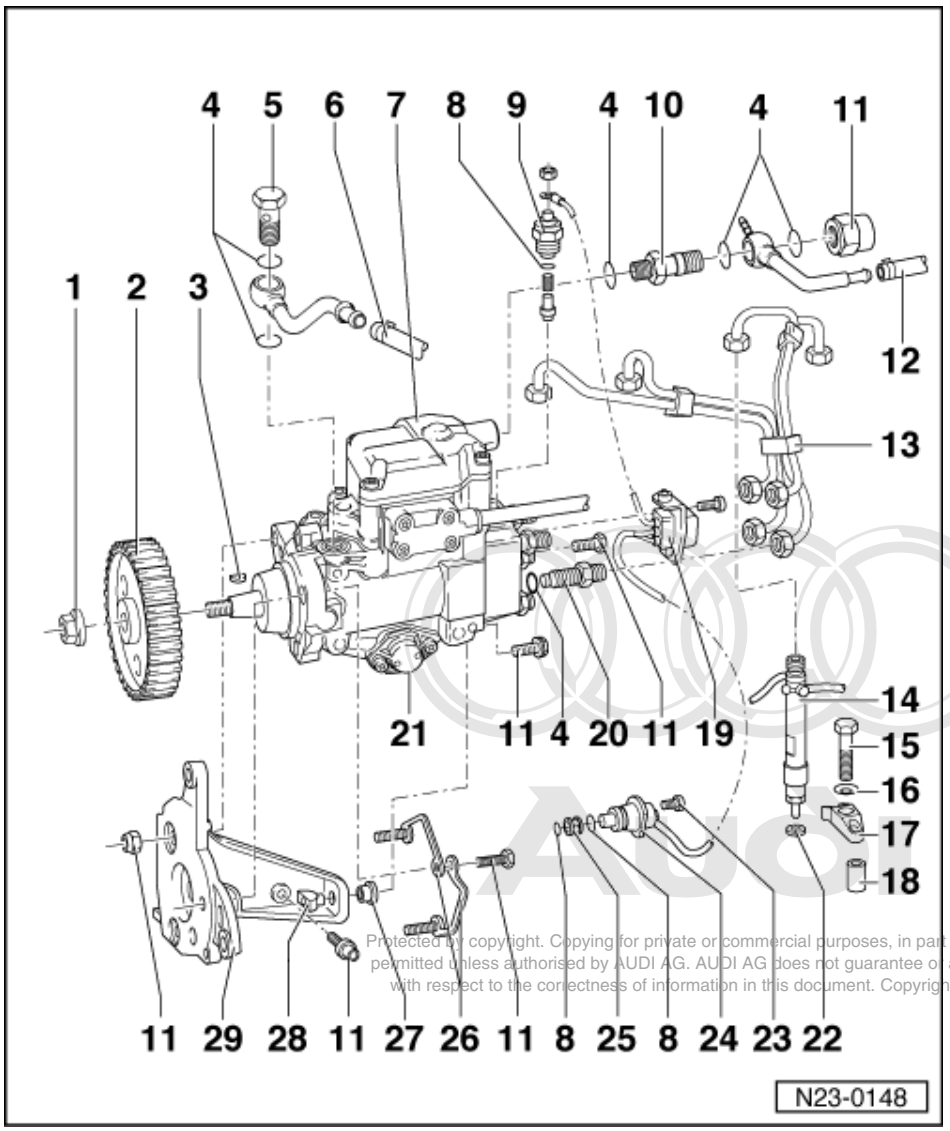
- Note safety precautions
  =>Page 39
- Observe rules for cleanliness
  =>Page 39
- Removing and installing injection pump
  =>Page 53
- Dynamically checking and adjusting injection pump =>Page 59

1 45 Nm
2 Injection pump sprocket
3 Woodruff key
4 Seal
- Renew

5 Banjo bolt, 25 Nm

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**6 Supply hose**
- From fuel filter

**7 Injection pump**
- With quantity adjuster (N146)
- With modulating piston movement sender (G149)
- With fuel temperature sender

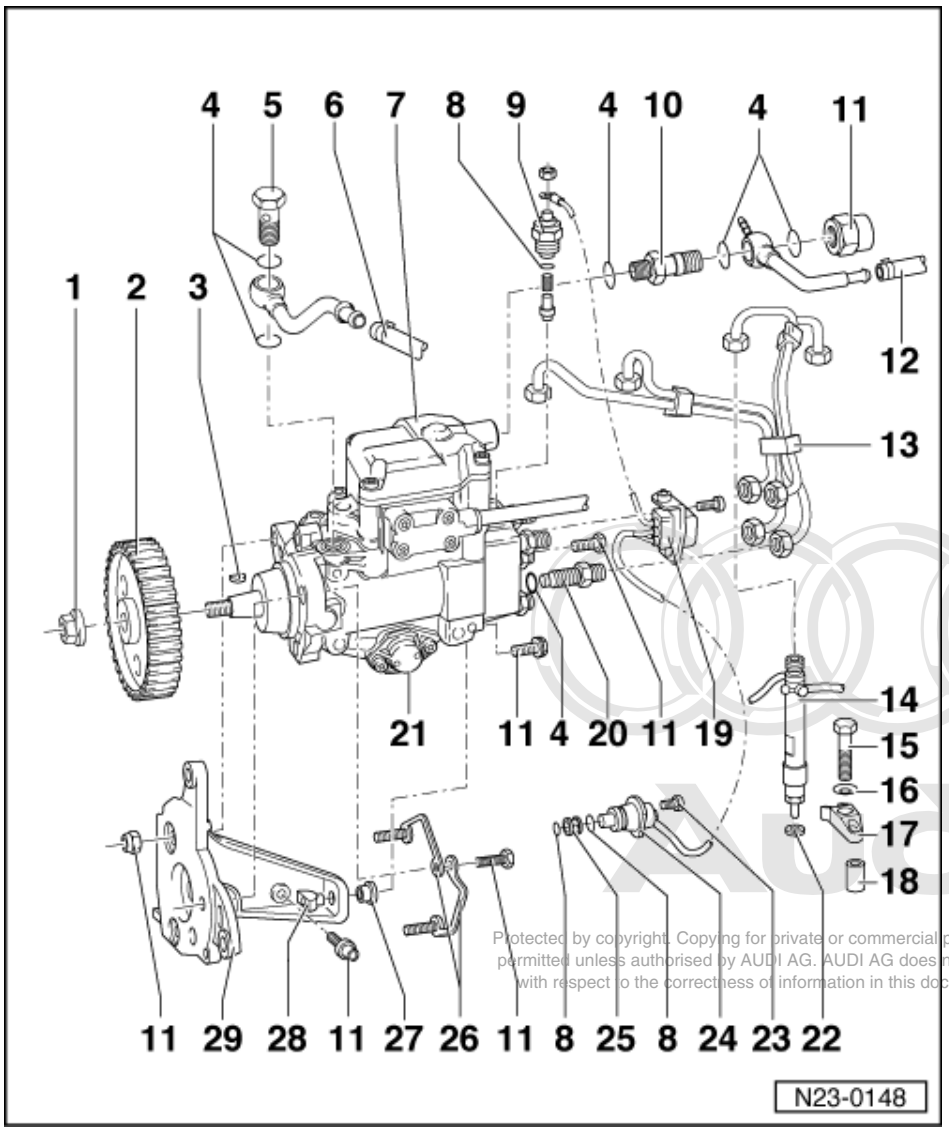
**8 O-Ring**
- Renew if damaged

**9 Fuel shut off valve**
- 20 Nm

**10 Pipe union**
- For return pipe
- 28 Nm

**11 25 Nm**

**12 Return hose**
- To control valve/fuel filter

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**13 Injector pipes**

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

**14 Injector**

- For 3rd cylinder with needle lift sender
- Removing, installing and testing
  => Page 67

**15 20 Nm**

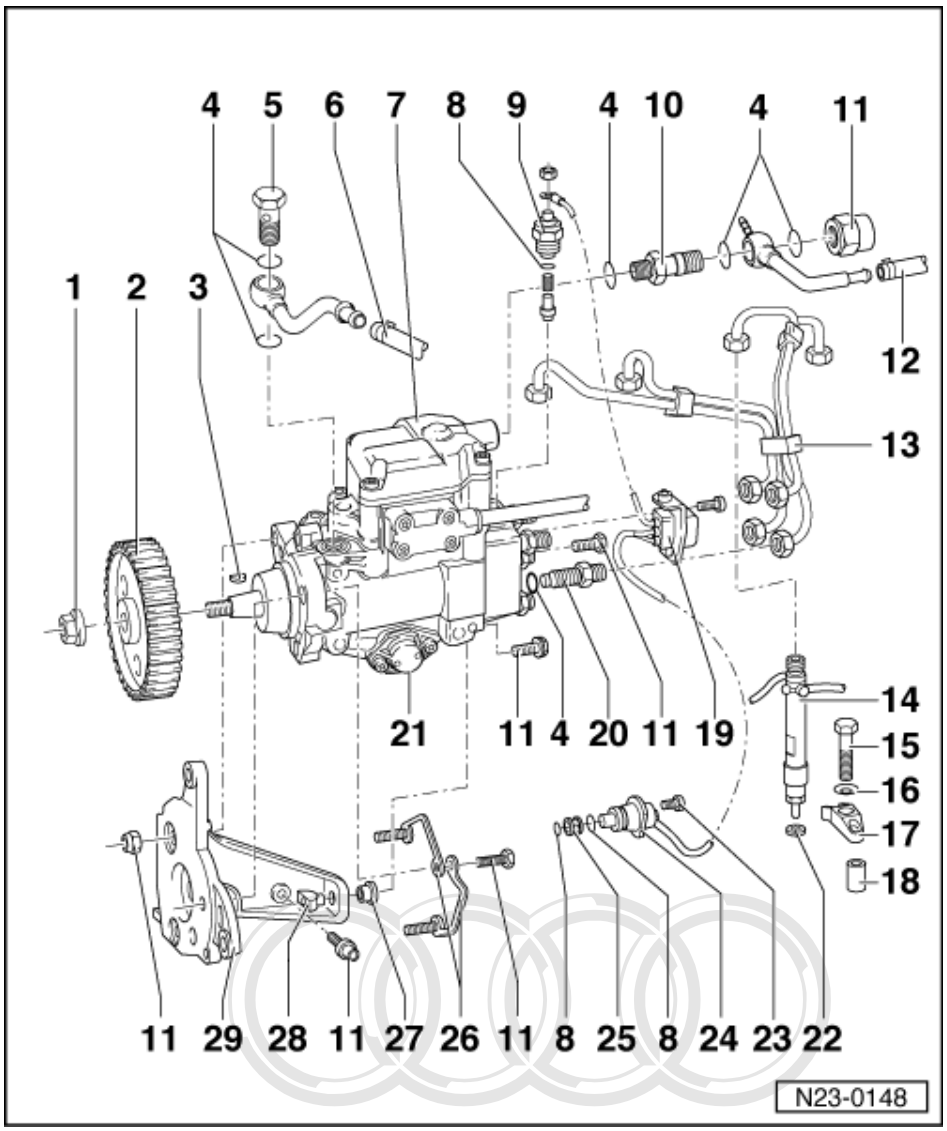
**16 Dished washer**

**17 Retainer**

**18 Mounting**

**19 Connector**

- 3 pin
- For commencement of injection valve (N108)
- For fuel shut-off valve (N109)




**20 Constant pressure valve**

- 45 Nm

**21 Timing control cover**

- If leaking, replace O-ring =>Page 69

**22 Copper seal**

- Renew

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**23 12 Nm**

**24 Commencement of injection valve (N108)**

**25 Strainer**

**26 Retainer**

**27 Sleeve**

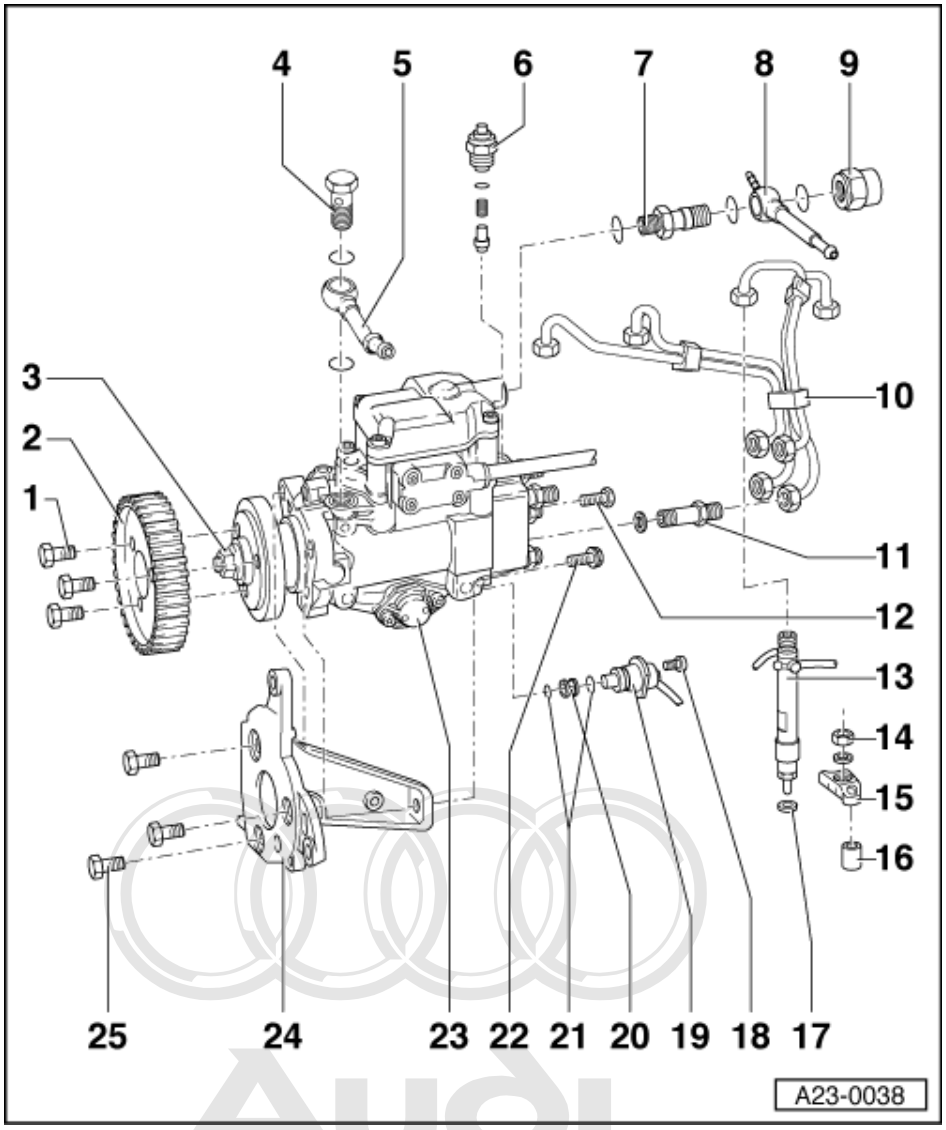
- Tapered

**28 25 Nm**

- Nut with taper

**29 Console**

## 1.6 - Servicing injection pump: engine code AHH




- Note safety precautions
  =>Page 39
- Observe rules for cleanliness
  =>Page 39
- Removing and installing injection pump
  =>Page 53
- Dynamically checking and adjusting injection pump =>Page 59

**1 Stretch bolt**
- Always renew
- 20 Nm + 1/4 turn (90°)

**2 Injection pump sprocket**

**3 Hub nut**
- Never slacken

**4 25 Nm**

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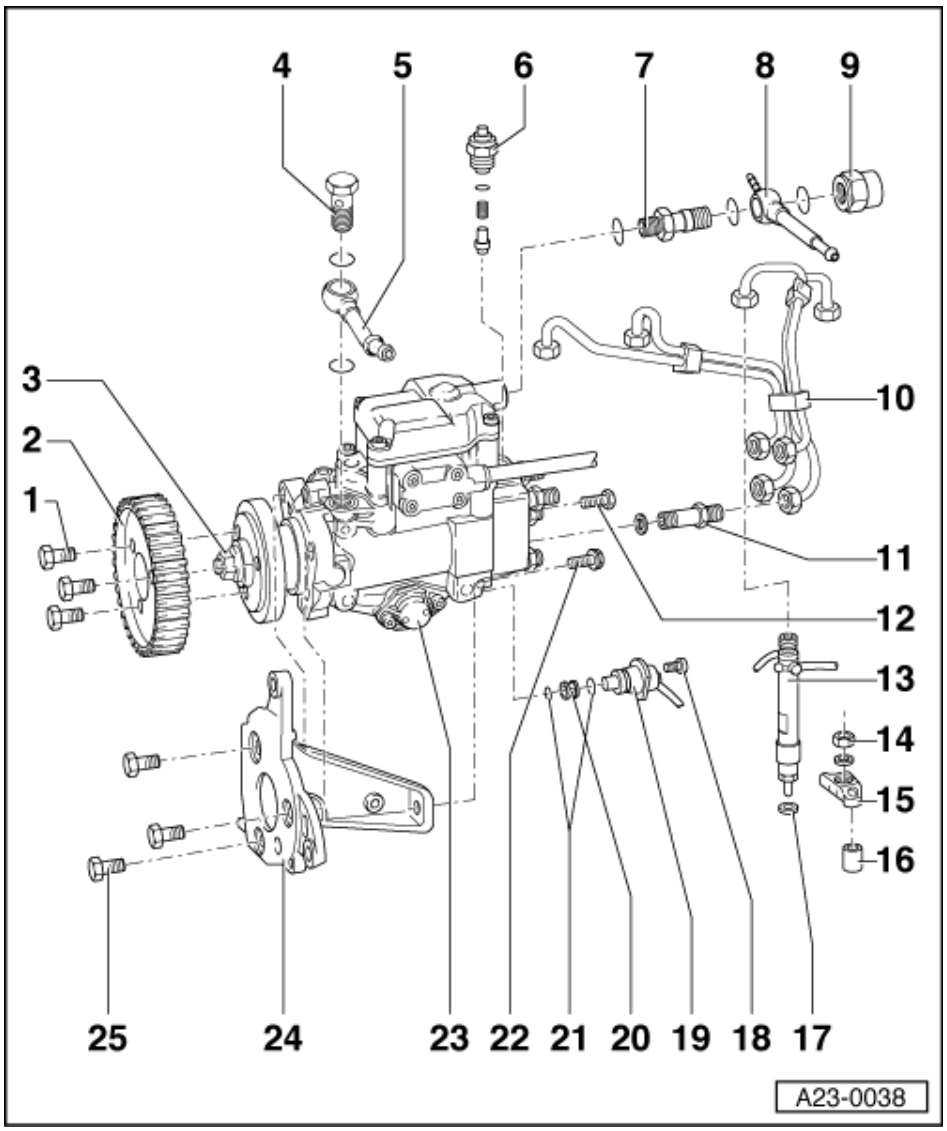


5 Supply pipe
- From fuel filter

6 Fuel shut off valve
- 20 Nm

7 Pipe union
- For return pipe
- 28 Nm

8 Return pipe
- To control valve/fuel filter

9 25 Nm

10 Injector pipes
- Tighten to 25 Nm
- Remove with 3035
- Always remove pipework complete
- Do not alter shape

11 Pressure valve
- 45 Nm

12 25 Nm

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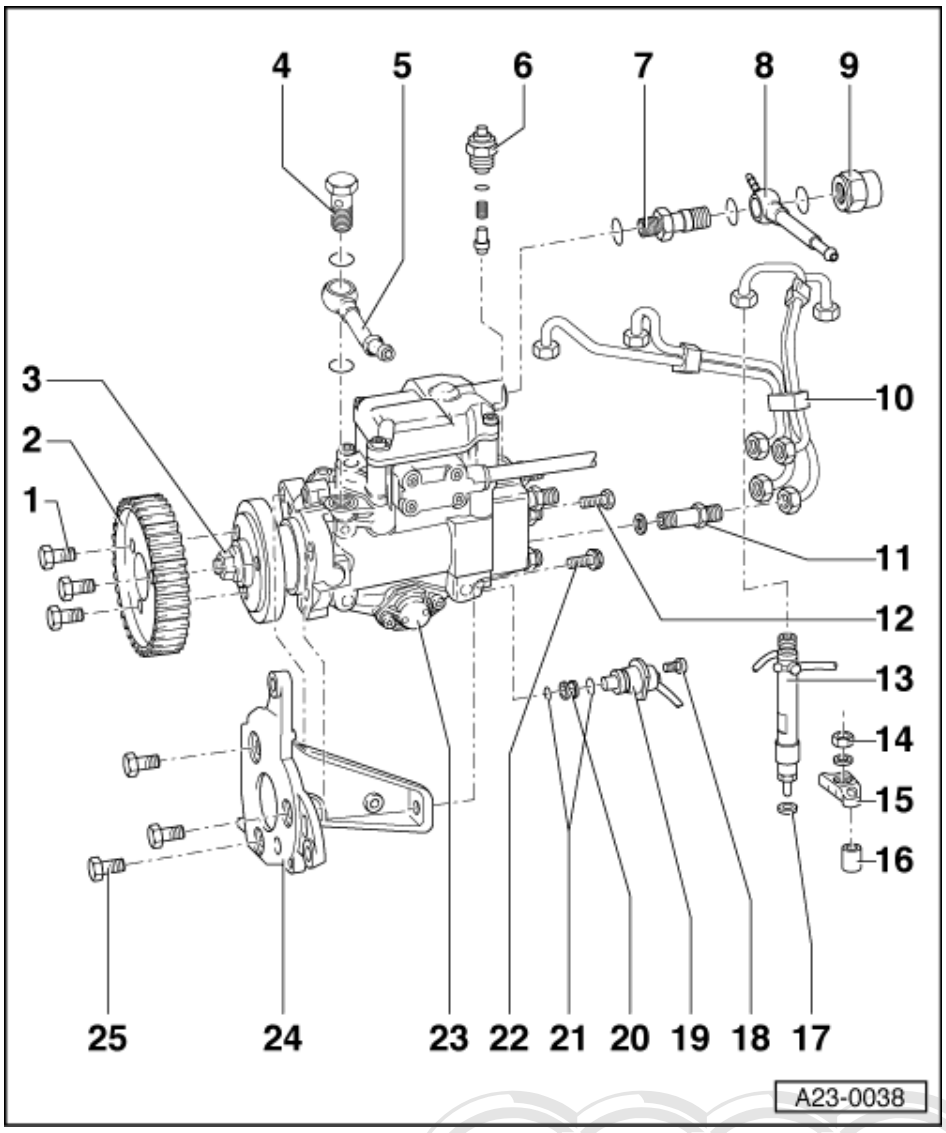


**13 Injector**

- For 3rd cylinder with needle lift sender
- Removing, installing and testing
  => Page 67

**14 20 Nm**

**15 Retainer**

**16 Mounting**

**17 Copper seal**

**18 12 Nm**

**19 Commencement of injection valve (N108)**

**20 Strainer**

**21 O-Ring**

**22 25 Nm**

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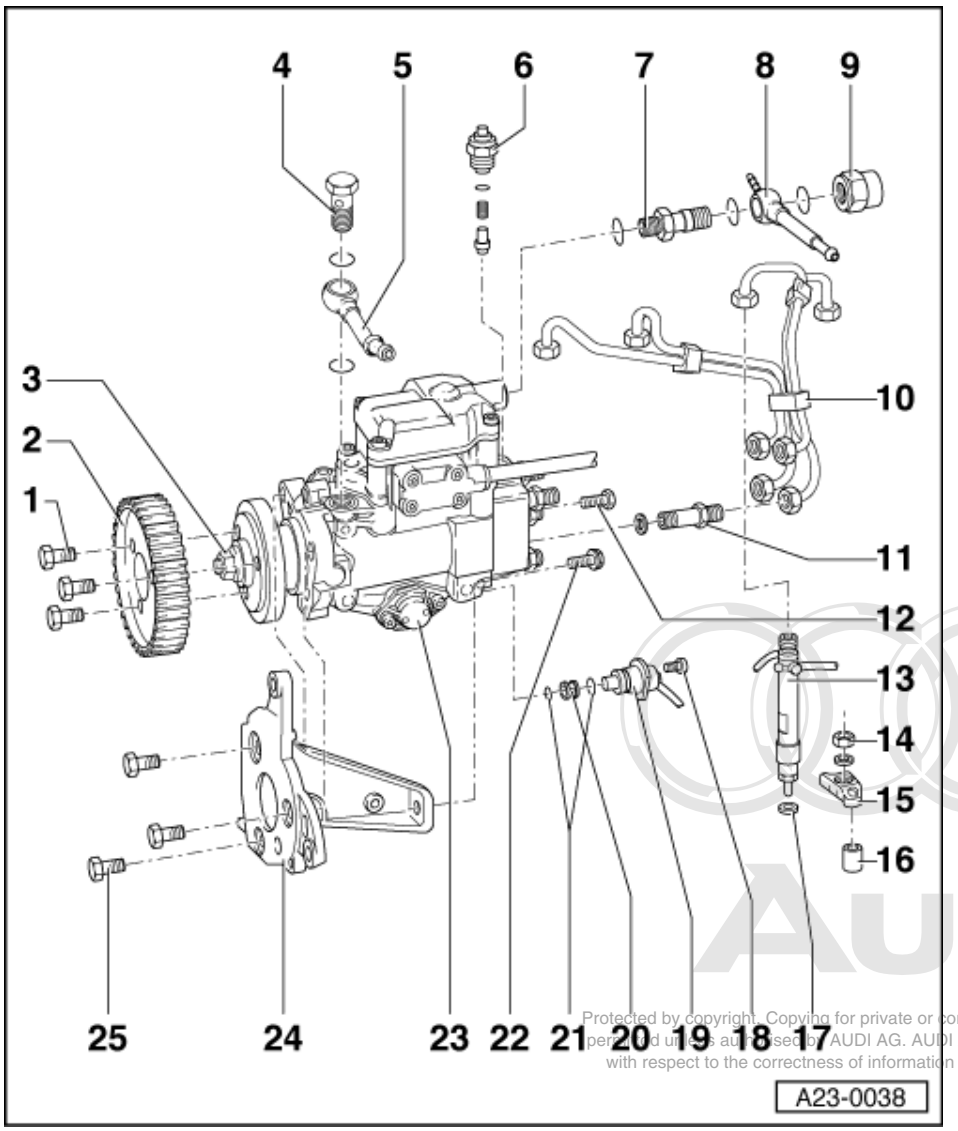


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**23 Timing control cover**

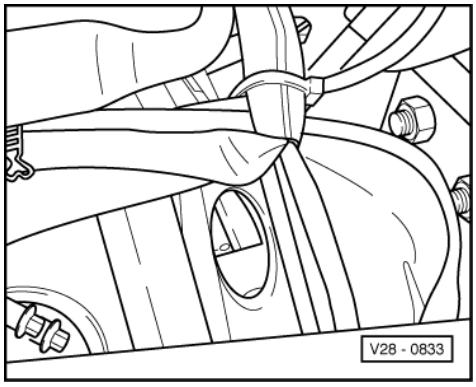
- If leaking, replace O-ring =>Page 69

**24 Console**

**25 25 Nm**

# 1.7 - Removing and installing injection pump: engine codeAFF, AHU, AFN,AVG

## Removing injection pump

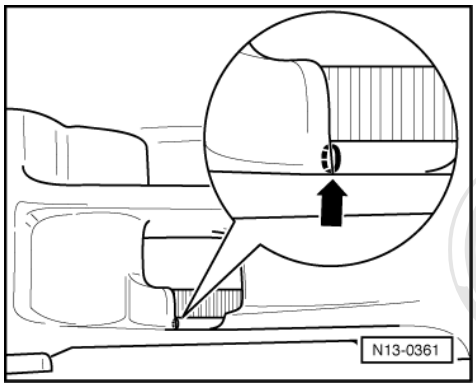



- Move lock carrier to service position

=> General body repairs, Exterior; Repair group 50; Body, front; Lock carrier - service position Body, front Lock carrier - service position

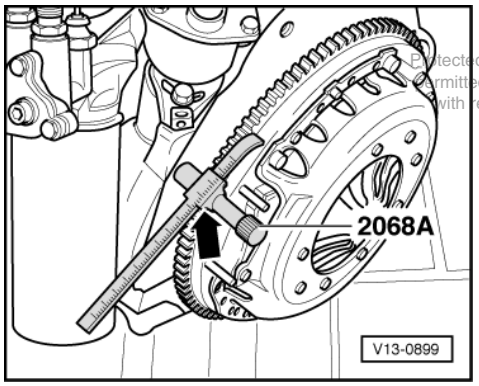
- Remove upper toothed belt guard and cylinder head cover.
- Turn crankshaft to TDC No. 1 cylinder.

  -> TDC on vehicles with manual gearbox




-> TDC on vehicles with automatic gearbox

*Engine removed - vehicles with manual gearbox:*

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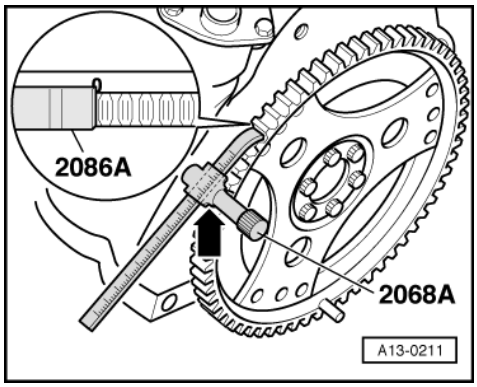
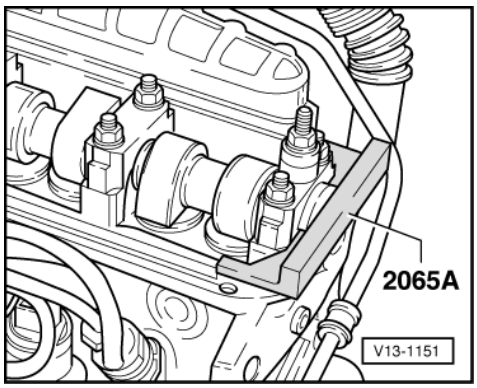
- -> Install adjustment device 2068 A as shown.
- Set adjustment device to 107 mm -arrow -. The left-hand mark on the scale is the reference point.

- Turn crankshaft until TDC marking on flywheel aligns with point of setting device.

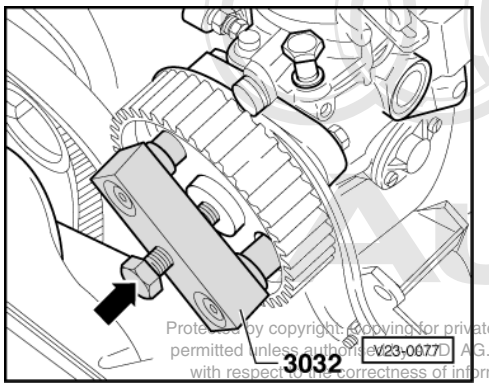
*Engine removed - vehicles with automatic gearbox:*




- -> Install adjustment device 2068 A as shown.
- Set adjustment device to 99 mm -arrow-. The left-hand mark on the scale is the reference point.
- Turn crankshaft until TDC marking on flywheel aligns with point of setting device.




- -> Lock camshaft with setting bar.
- Centralize setting bar as follows:
  Turn arrested camshaft so that one end of setting bar contacts the cylinder head. Using feeler gauge establish the gap at the other end of the setting bar. Place a feeler gauge corresponding to half the gap between setting bar and cylinder head. Turn camshaft until the setting bar contacts the feeler gauge. Place a 2nd feeler gauge, of same thickness, at the other end between setting bar and cylinder head.
- Remove idler roller.
- Remove tensioning roller nut.

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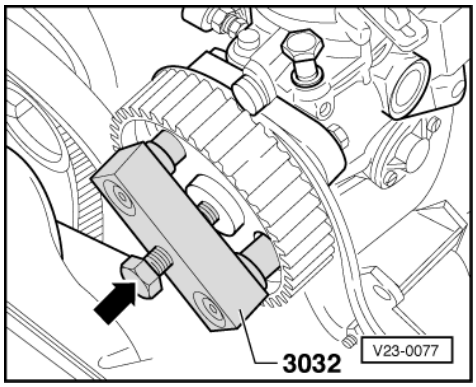
- Relieve tooth belt tension and take off camshaft and injection pump sprockets.
- Lock injection pump sprocket with pin 2064.
- Remove injection pump sprocket securing nut.

- -> Loosen puller arms and offer up.

- Locate puller arms through holes in injection pump sprocket and tighten.
- Place injection pump sprocket under tension with puller.




- -> Release injection pump sprocket from injection pump taper by tapping lightly on puller spindle -arrow- (when doing this hold sprocket so that it does not fall off).
- Unbolt all fuel lines at fuel pump.
- Cover openings with a clean cloth.

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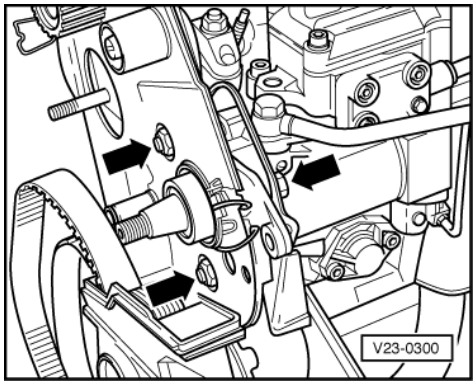
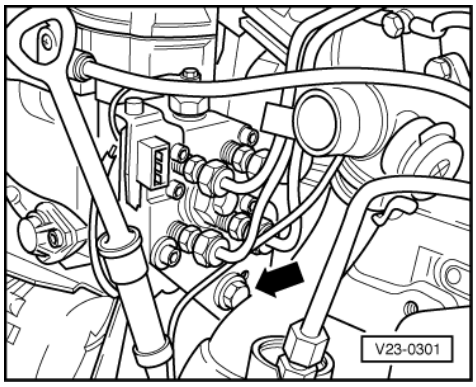
***Note:***

*Use slotted ring spanner 3035 to remove high pressure fuel pipes.*



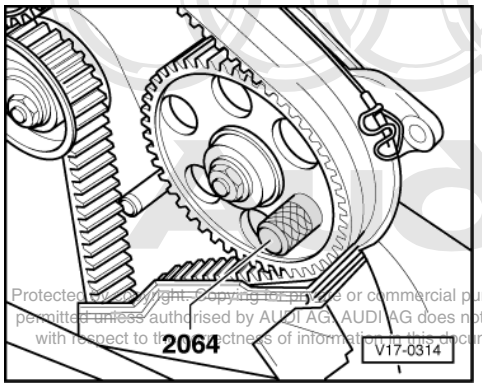

- Unplug connector for fuel cut-off valve/commencement of injection valve.
- Disconnect quantity adjuster connector and unclip connector from retainer.
- -> Remove securing bolts from console -arrows-.




- -> Then remove bolt from rear support -arrow-.
- Take off injection pump.

### Installing injection pump

- Insert injection pump into console and then tighten securing bolt on rear support with conical nut first.
- Align injection pump to central position in console elongated holes and secure hand tight.

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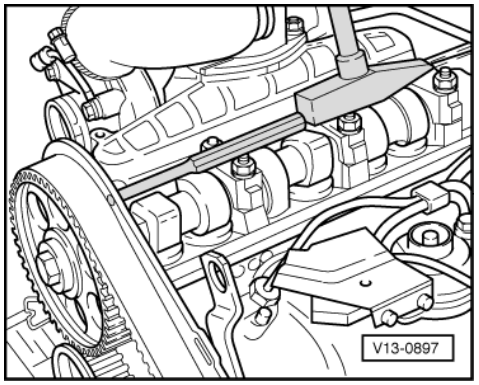
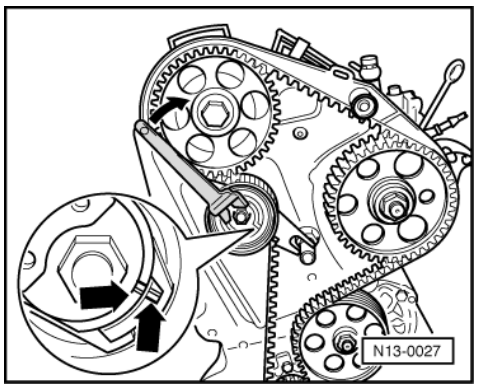
- -> Install injection pump sprocket and lock in position with pin 2064. When installing observe spring washer seating.
- Tighten securing nut to 45 Nm.
- Loosen camshaft sprocket securing bolt a half turn.




- -> Place a drift through hole in the rear of the toothed belt guard and release the camshaft sprocket from camshaft taper with a blow from a hammer.
- Take camshaft sprocket off.
- Check whether TDC mark on flywheel and reference mark are aligned.
- Place tooth belt on injection pump sprocket and tensioning roller.
- Fit camshaft sprocket into toothed belt and secure sprocket so that the camshaft can still turn.

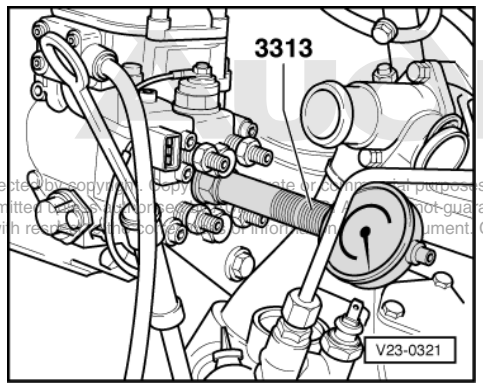



- Install idler roller.
- Remove locking pin from injection pump sprocket.
- -> Tension toothed belt. Using pin wrench (e.g. Matra V159) on eccentric turn clockwise until the notch and the raised mark -arrows- align.
- Tighten securing nut to 20 Nm.

- Check TDC mark on flywheel again.

- Tighten camshaft sprocket securing bolt to 45 Nm.
- Remove setting bar 2065A from camshaft.
- Turn crankshaft two rotations in engine D.O.R. until crankshaft is set to TDC No. 1 cylinder again.

### Adjusting injection pump

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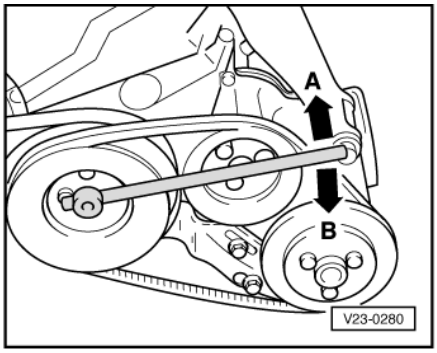
### Checking and adjustment conditions

- Mechanical engine basic setting OK.
- Toothed belt tension OK.
- Engine at TDC.

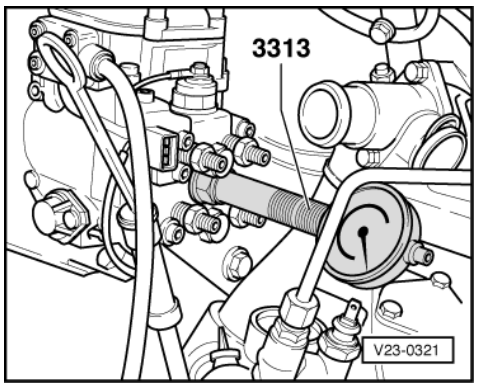
- -> Remove screw plug on injection pump and screw in adapter 3313 for dial gauge.
- Insert dial gauge with needle plunger into adapter.
- Pre-load dial gauge to about 2 mm and tighten adjusting nut on adapter.




- -> Rotate crankshaft slowly in direction -A- (against direction of engine revolution) until needle on dial gauge stops moving.
- Slacken dial gauge, then re-tighten with a pre-load of about 1 mm.
- Set measuring scale to 0.
- -> Rotate crankshaft slowly in direction -B- (direction of engine revolution) until marking -0- on flywheel aligns with reference mark or edge of setting bar.

***Note:***

*Alignment with the TDC mark is achieved by rotating the crankshaft in the direction of engine revolution. If the crankshaft is rotated too far by mistake (i.e. beyond the TDC mark), adjust as follows:*




- Rotate crankshaft in opposite direction until dial gauge reads 0 again, then rotate again until TDC mark is reached.

- -> Read off commencement of delivery on dial gauge.

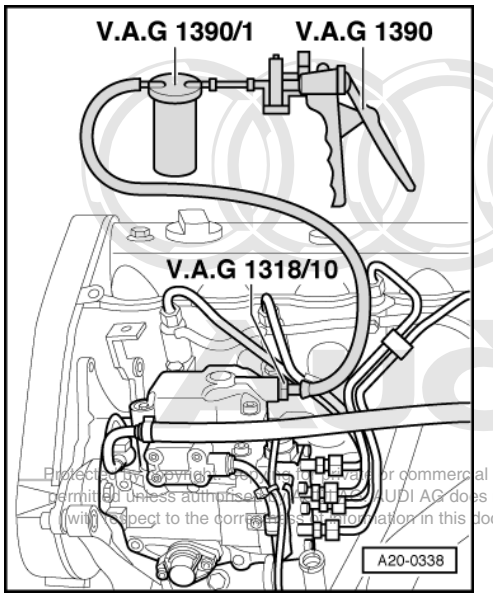
  Specification: 0.7 ±0.02 mm stroke

- Adjust commencement of delivery by turning injection pump.

Tightening torques:

Securing bolts for injection pump: 25 Nm
Screw plug: 20 Nm

- Reconnect injection pipes, fuel supply pipe and electrical wiring.

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-> Fill injection pump with clean diesel fuel as follows:

- Screw adapter V.A.G 1318/10 into return pipe connection on injection pump.
- Connect vacuum hand pump V.A.G 1390 to return pipe connection together with bleeder container V.A.G 1390.
- Operate vacuum hand pump until bubble-free fuel comes out of return pipe connection. Do not allow the fuel to enter the vacuum pump.

Reconnect return pipe to injection pump (with tightening torque of 25 Nm).
Install toothed belt guard and cylinder head cover.
Dynamically check and adjust commencement of injection
=>Page 59 .

## 1.8 - Dynamically checking and adjusting commencement of injection: engine code AFF, AHU, AFN, AVG

*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.
- Dynamically checking and correcting commencement of injection is only possible in function 04 "Engine basic setting". This is because in function 04 the commencement of injection valve is activated continuously and therefore the injection timing control is set to "late" (retarded).

- Initiate basic setting, Display Group 00, engine at idling speed
  => Page 20 .

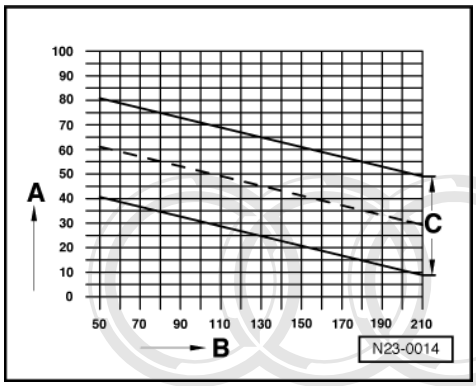
-> Indicated on display:

```
System in 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 (corresponds to 85°C)

Do not continue with the test until the coolant has reached the specified temperature.




- -> The commencement of injection value in display zone 2 varies in accordance with the fuel temperature value in display zone 9.

  Specification: => range C in illustration
  A - Zone 2 commencement of injection
  B - Zone 9 fuel temperature

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*Notes:*

- If the commencement of injection is advanced turn injection pump in engine direction of rotation, if the commencement of injection is retarded turn against direction of rotation.
- If when checking the commencement of injection the specifications are within zone -C- then no adjustment is required. After repairs e.g. removing and installing injection pump, adjusting timing then the commencement of injection is to be set to the mean valve (dashed line) of specification zone -C-.

If the commencement of injection (timing) is outside the specification tolerances, adjust commencement of injection as follows:

### Adjusting commencement of injection

- Remove upper toothed belt guard, if it has not already been removed.
- Loosen injection pump securing bolts approx. one turn, leaving the easiest bolt to reach till last.

- Hold injection pump by hand under tension in direction to be adjusted.
- Carefully loosen last securing bolt until the pump can be turned slightly and then retighten securing bolt.

- Check setting in function "Basic setting 04".

-> Indicated on display:

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

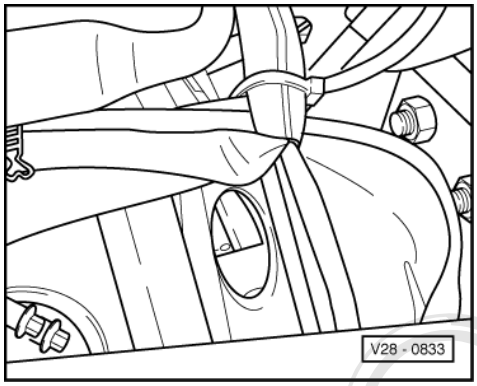
- Observe readout in display zone 2 and if necessary adjust again until the readout settles on the mean value shown in specification range -C-=>Page 59 .
- Tighten injection pump securing bolts to 25 Nm.
- Check commencement of injection again.

***Note:***

*Loosen and re-tighten (25 Nm) the injection pipes on the injection pump after dynamically adjusting the injection pump. This relieves the strain on pipes and prevents vibration breakages.*

## 1.9 - Removing and installing injection pump: engine code AHH

### Removinginjection pump

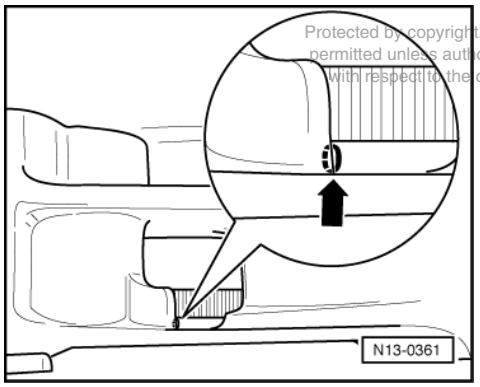



- Move lock carrier to service position

=> General body repairs, Exterior; Repair group 50; Body, front; Lock carrier - service position Body, front Lock carrier - service position

- Remove upper toothed belt guard and cylinder head cover.
- Turn crankshaft to TDC of No. 1 cylinder.

  -> TDC on vehicles with manual gearbox

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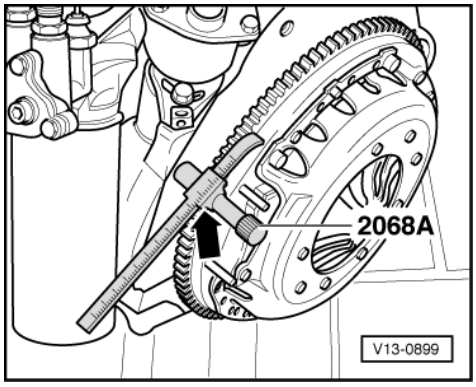
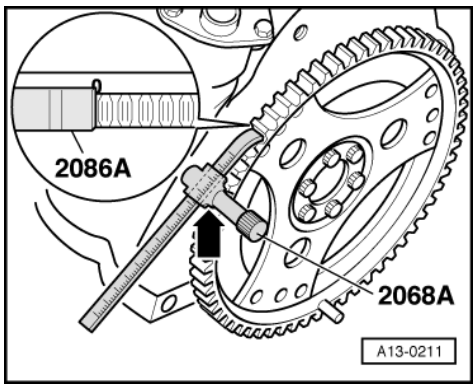
  -> TDC on vehicles with automatic gearbox

*Engine removed - vehicles with manual gearbox:*




- -> Install adjustment device 2068 A as shown.
- Set adjustment device to 107 mm -arrow-. The left-hand mark on the scale is the reference point.
- Turn crankshaft until TDC marking on flywheel aligns with point of setting device.

*Engine removed - vehicles with automatic gearbox:*

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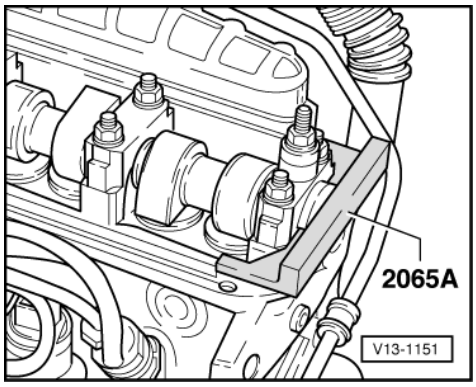
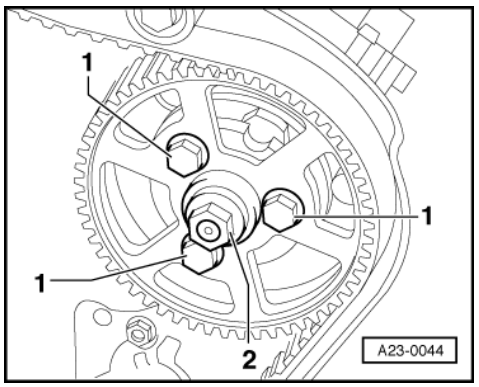
- -> Install adjustment device 2068 A as shown.
- Set adjustment device to 99 mm -arrow-. The left-hand mark on the scale is the reference point.
- Turn crankshaft until TDC marking on flywheel aligns with point of setting device.



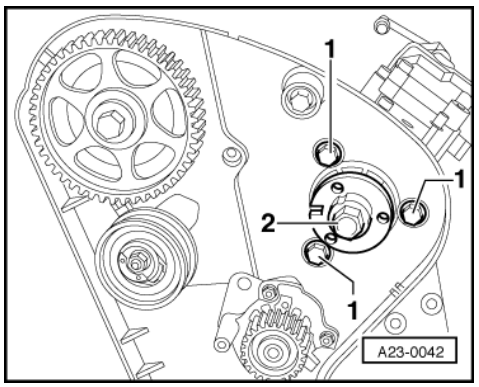

- -> Lock camshaft with setting bar.
- Centralize setting bar as follows:
  Turn arrested camshaft so that one end of setting bar contacts the cylinder head. Using feeler gauge establish the gap at the other end of the setting bar. Place a feeler gauge corresponding to half the gap between setting bar and cylinder head. Turn camshaft until the setting bar contacts the feeler gauge. Place a 2nd feeler gauge, of same thickness, at the other end between setting bar and cylinder head.




- -> Loosen securing bolts -1- for injection pump sprocket.
- Remove tensioning roller nut.
- Remove toothed belt from camshaft and injection pump sprockets.

=> Repair group 13; Dismantling and assembling engine; Removing and installing toothed belt and adjusting tension. Dismantling and assembling engine Removing and installing toothed belt and adjusting tension.

- Unscrew injection pipes from pump using open ring spanner 3035.
- Cover openings with a clean cloth.

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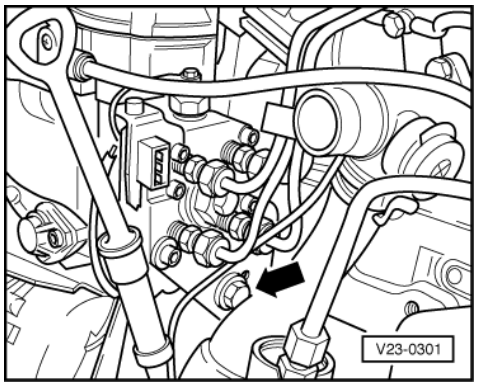
- -> Remove securing bolts -1- from console -arrows-.

***Note:***

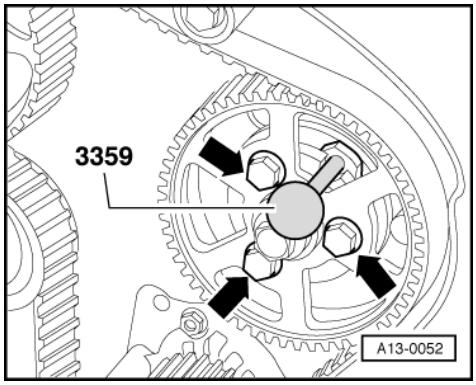
*On no account must hub nut -2- be loosened, otherwise the injection pump basic setting will be altered and this cannot be reset with normal workshop equipment.*



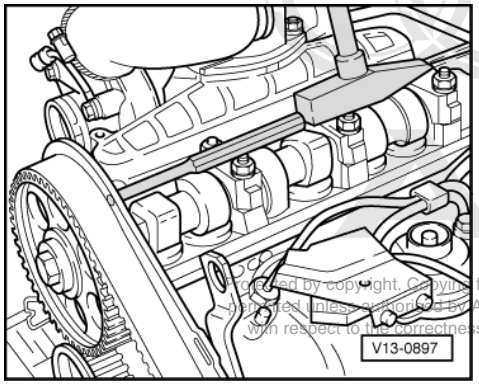

- -> Then remove bolt from rear support -arrow-.
- Take off injection pump.

### Installing injection pump

- Insert injection pump into console and then tighten securing bolt on rear support with conical nut first.




- Insert front securing bolts and tighten to 25 Nm.
- Fit injection pump sprocket to hub using new securing bolts but do not tighten the bolts.
- Align injection pump sprocket to central position in elongated holes.
- -> Lock injection pump sprocket with mandrel 3359.
- Loosen camshaft sprocket securing bolt a half turn.

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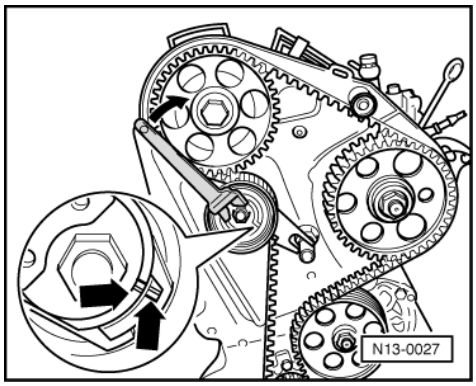
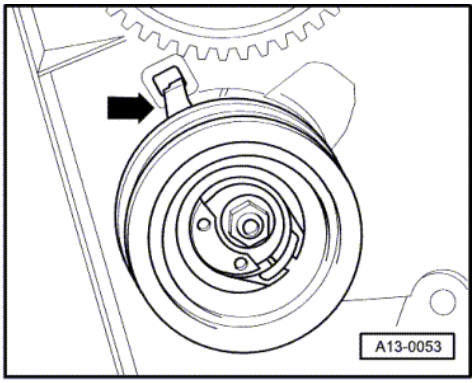
- -> Place a drift through hole in the rear of the toothed belt guard and release the camshaft sprocket from camshaft taper with a blow from a hammer.
- Check whether TDC mark on flywheel and reference mark are aligned.
- Place tooth belt on injection pump sprocket and tensioning roller.




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




*Note:*

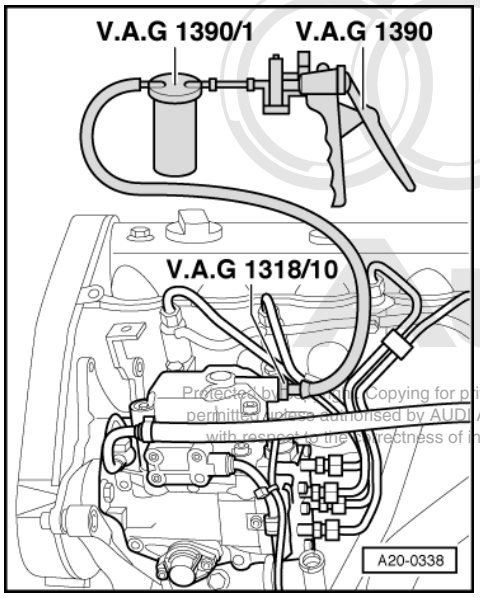
*-> Make sure that the holding claw is correctly positioned.*

- Tighten securing nut to 20 Nm.
- Check TDC mark on flywheel again.
- Tighten the new securing bolts for the injection pump sprocket to 20 Nm.

*Notes:*

- After the dynamic check of the commencement of injection, tighten the bolts by 1/4 turn (90°).
- The securing bolts are stretch bolts and can therefore only be used once.

- Tighten camshaft sprocket securing bolt to 45 Nm.
- Remove mandrel 3359.
- Remove setting bar 2065 A from camshaft.

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- Turn crankshaft two rotations in engine D.O.R. until crankshaft is set to TDC No. 1 cylinder again.
- Reconnect injection pipes, fuel supply pipe and electrical wiring.

-> Fill injection pump with clean diesel fuel as follows:

- Screw pipe union 1318/10 into return pipe connection on injection pump.
- Connect vacuum hand pump V.A.G 1390 with bleeder container V.A.G 1390/1 to return pipe connection.

- Operate vacuum hand pump until fuel comes out of return pipe connection. Do not allow the fuel to enter the vacuum pump.

- Connect return pipe.
- Install cylinder head cover.
- Dynamically check and adjust commencement of injection
  =>Page 65 .

## 1.10 - Dynamically checking and adjusting commencement of injection: engine code AHH

*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.
- Dynamically checking and correcting commencement of injection is only possible in function 04 "Engine basic setting". This is because in function 04 the commencement of injection valve is activated continuously and therefore the injection timing control is set to "late" (retarded).

- Initiate basic setting, Display Group 00, engine at idling speed
  => Page 20 .

-> Indicated on display:
(1...10 = Display zones)

```
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 (corresponds to 85°C)

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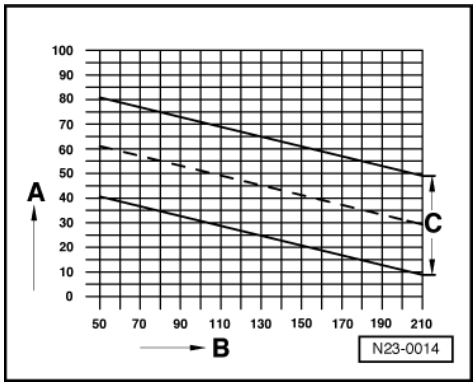
Do not continue with the test until the coolant has reached the specified temperature.




- -> The commencement of injection value in display zone 2 varies in accordance with the fuel temperature value in display zone 9.

  Specification: => range C in illustration
  A - Zone 2 commencement of injection
  B - Zone 9 fuel temperature

*Note:*

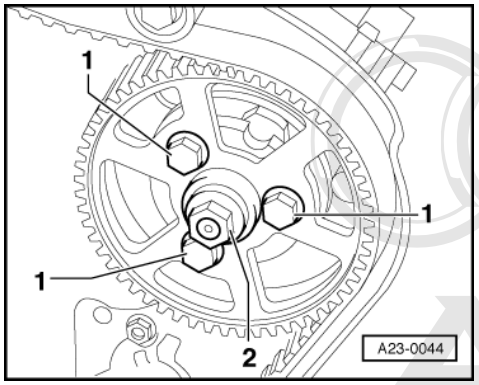
*If the commencement of injection is within the specified range -C- when tested, no adjustment is required.*

If the commencement of injection is outside the specified range, adjust the injection pump as follows:

- Switch off ignition.
- Remove upper toothed belt guard.

- Check toothed belt tension.

  The marks must be aligned.




If markings do not align:

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- Adjust toothed belt tension;

=> Repair group 13; Dismantling and assembling engine; Removing and installing toothed belt and adjusting tension. Dismantling and assembling engine Removing and installing toothed belt and adjusting tension.

- -> Slacken two of the injection pump sprocket securing bolts -1-.
- Apply a ring spanner (22 mm A/F) to hub nut -2- to hold the pump shaft in position.
- Slacken the third securing bolt on the injection pump sprocket and turn the pump shaft slightly:

  Anticlockwise => commencement of injection later (retarded)
  (display value in display zone 2 decreases)
  Clockwise => commencement of injection earlier (advanced)
  (display value in display zone 2 increases)

***Note:***

*On no account must hub nut -2- be slackened, otherwise the injection pump basic setting will be altered and this cannot be reset with normal workshop equipment.*

- Tighten the new securing bolts for the injection pump sprocket to 20 Nm.

***Note:***

*The securing bolts are stretch bolts and can therefore only be used once.*

- Again check whether commencement of injection is as specified.

*If commencement of injection is still outside tolerance range:*

- Correct the setting at the injection pump sprocket once again.

*If the commencement of injection is within the specified range:*

- Renew the three securing bolts (stretch bolts) one after the other and tighten them to 20 Nm.
- Then tighten the three securing bolts (stretch bolts) for injection pump sprocket by a further1/4turn (90°).
- Install toothed belt guard.

## 1.11 - Removing, installing and testing injectors

***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

### Removing injectors

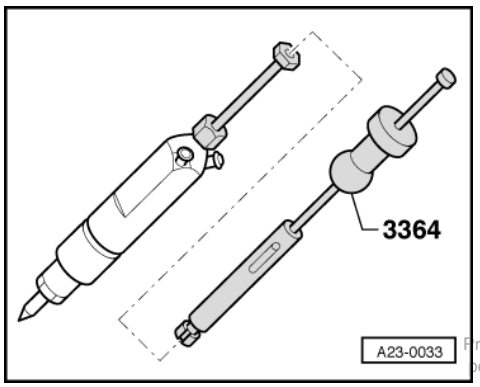
- Remove injection pipes with open ring spanner 3035.

***Note:***

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

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

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

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- 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 to the seized injector, then apply special tool 3364 to the end with the brazed-on nut.

### Installing injectors

***Note:***

*Always renew copper seals between cylinder head and injectors.*

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

Tightening torques:

Injection pipes: 25 Nm
Bolt for retainer: 20 Nm

### Testing injectors

- ->

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

Read measured value block, Display Group 13, engine at idling speed => Page 32

Specification: -1.50 mg/H...+1.50 mg/H (milligrams per stroke)

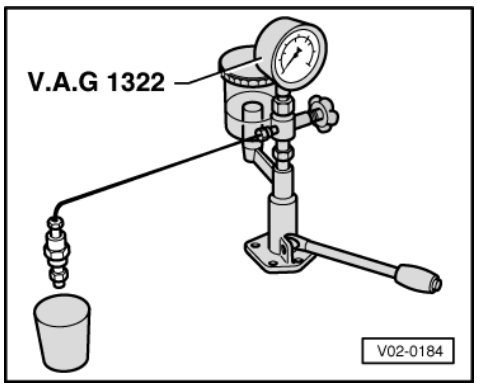
- If one or more of the values is outside the tolerance, swap round the injectors (except the injector for cylinder 3).
- If the fault moves along with the injector, fit a new injector.
- If the fault remains on the same cylinder, swap round the pressure valves.
- If the fault moves with the pressure valve, fit a new pressure valve with oil seal =>Servicing injection pump - Page 45 .

*Notes:*

- 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 pressure valves must always be renewed as a complete set.

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

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.




-> 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.

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- 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.

Engine code: AFF, AHU, AFN, AVG

| | |
|---|---|
| New injectors | 190...200 bar |
| Wear limit | 170 bar |

Engine code: AHH

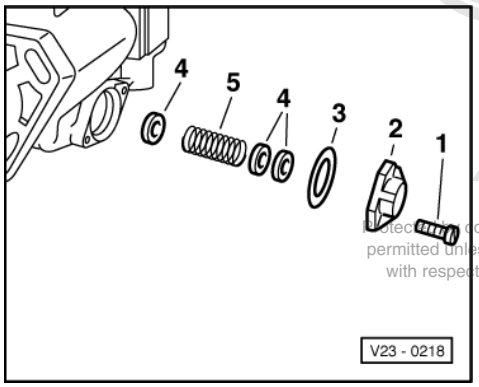
| | |
|---|---|
| New injectors | 220...230 bar |
| Wear limit | 200 bar |

**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.

## 1.12 - Renewing injection timing device cover O-ring

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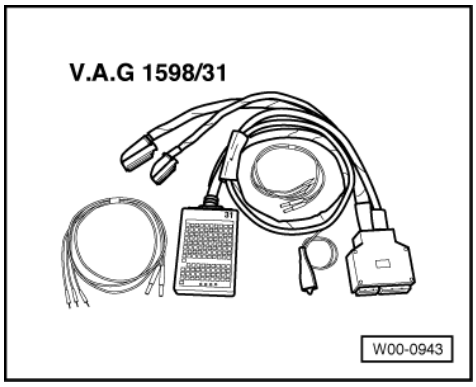
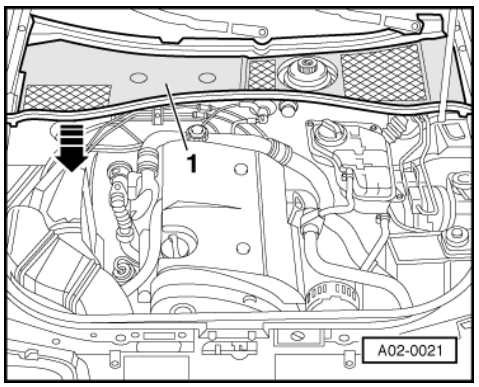
- Place a clean cloth under the injection pump.
- -> Remove cover screws -1- with commercially available key for Torx socket head screws, e.g. Hazet 2115-T30.
- Remove cover -2- and clean it.
- Renew O-ring -3- and install cover with existing shim -4-.

## 1.13 - Wiring and component check with test box V.A.G 1598/31



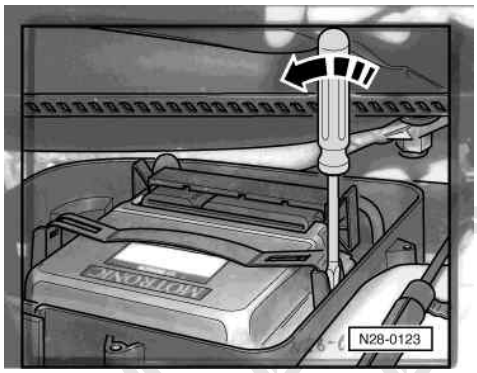

*Notes:*

- Test box V.A.G 1598/31 is designed so that it can be connected to the wiring harness for the engine control unit and to the engine control unit itself at the same time.
- This has the advantage of enabling the engine management system to remain fully operational even with the test box connected (for example, when testing signals while the engine is running).
- The instructions for performing the individual tests indicate whether or not the engine control unit itself also needs to be connected to the test box.




- Always use adapter set V.A.G 1594A to connect test equipment (e.g. voltage tester V.A.G 1527B, hand-held multimeter V.A.G 1526A etc.).

- Switch off ignition.
- -> Remove rubber seal from the front -arrow-.
- Remove plenum chamber cover -1- from the front.
- Remove cover for electronics box in plenum chamber.




- -> Carefully lever off the retainer bar with a screwdriver -arrow-.
- Release catches and unplug control unit connectors.

Warning!
To prevent damage to the electronic components, switch to the respective measuring range before connecting the measuring cable and observe the test prerequisites.

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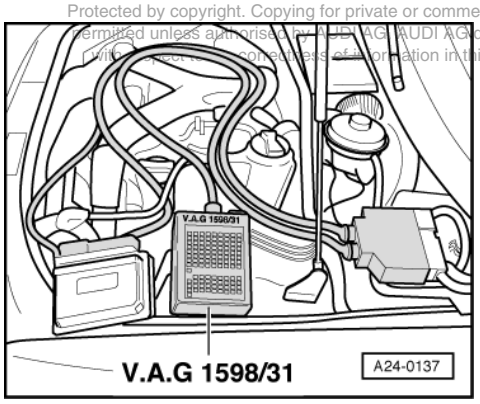
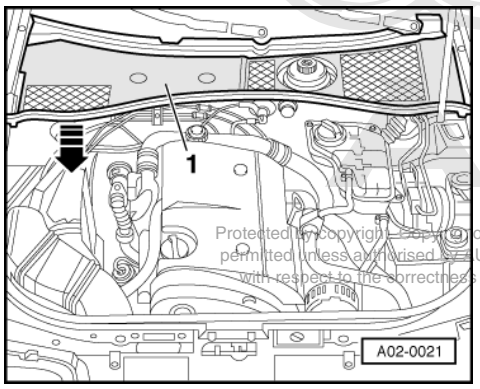



- -> Connect test box V.A.G 1598/31 to wiring harness connector. Also connect earth clamp on test box to battery negative terminal. The instructions for performing the individual tests indicate whether or not the engine control unit itself also needs to be connected to the test box.
- Carry out test as described in the repair instructions.

## 1.14 - Renewing engine electronics control unit

### Removing engine control unit

- Switch off ignition.

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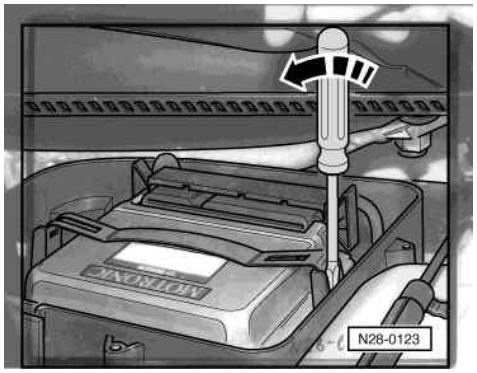
- -> Remove rubber seal from the front -arrow-.
- Remove plenum chamber cover -1- from the front.
- Remove cover for electronics box in plenum chamber.




- -> Carefully lever off the retainer bar with a screwdriver -arrow-.
- Release catches and unplug control unit connectors.

### Installing engine control unit

Installation is performed in the reverse sequence.

### The following operations must be carried out after installing the engine control unit:

- Code control unit => Page 22 .
- Adapt immobiliser to engine control unit

- On vehicles equipped with cruise control system (CCS): cruise control system must be activated

=> Electrical system; Self-diagnosis of cruise control system (CCS) -diesel engine-; Testing cruise control system (CCS).

- Perform basic setting on vehicles equipped with automatic gearbox:

=> Automatic gearbox 01N Self-diagnosis; Repair group 01; Performing self-diagnosis; Performing basic setting Performing self-diagnosis Performing basic setting

# 2 - Testing injection control

## 2.1 - Testing injection control

## 2.2 - Checking injection timing control range

- Start final control diagnosis and activate commencement of injection valve => Page 16 .

-> Indicated on display:

```
Final control diagnosis
Commencement of injection valve -N108
```

Activating the valve has a noticeable effect on the combustion noise (diesel knock).

- Initiate basic setting, Display Group 00 => Page 20 .

-> Indicated on display (for example):

```
System in basic setting 0
42     46     0     20     90     201
64     153     127     83
```

- If necessary, correct the commencement of injection => Page 59 .
- Remove fuse for engine electronics from electronics box.
- Observe display in display zone 2.

```
Basic setting 0
42     255     0     20     90     201
64     153     127     83
```

-> The display should go up 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 obtained:

- Replace injection pump.
- Interrogate and erase fault memory=> Page 4 .

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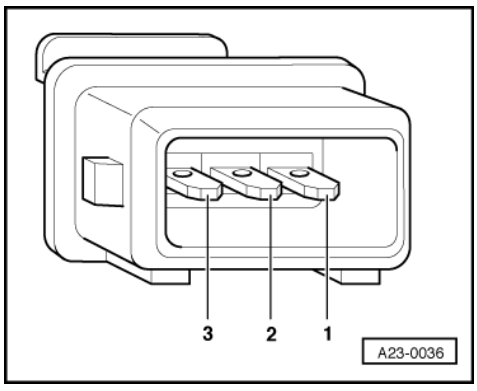
## 2.3 - Checking commencement of injection valve



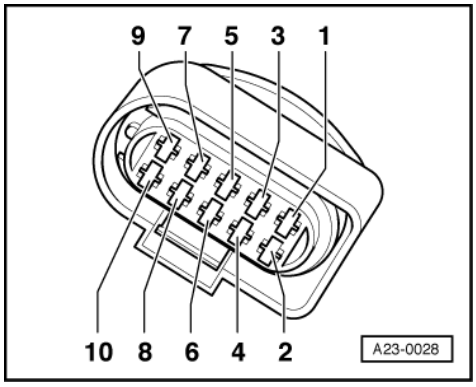
### Electrical test of commencement of injection valve

- Unplug connector for commencement of injection valve
  =>Fitting locations overview, Page 40 .

Measuring resistance on vehicles with 3-pin connector:

- -> Connect hand-held multimeter (resistance test range) between contacts 2 and 3.

  Specification: 12...20ω

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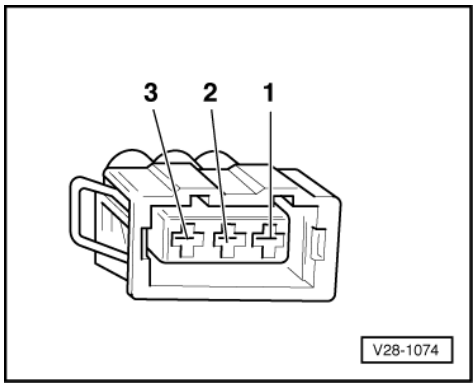
Measuring resistance on vehicles with 10-pin connector:

- -> Connect hand-held multimeter (resistance test range) between contacts 9 and 10.

  Specification: 12...20 ω

If the specification is not obtained:

- Renew commencement of injection valve (N108).

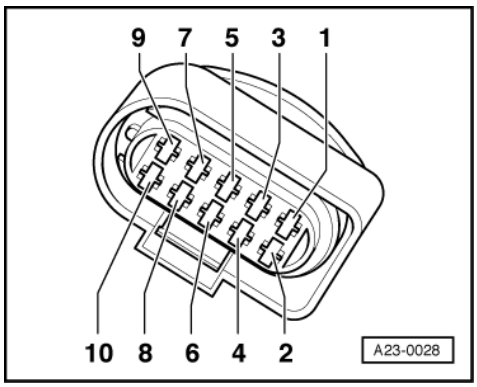



If the specification is obtained:

### Testing voltage supply of commencement of injection valve

Measuring voltage on vehicles with 3-pin connector:

- -> Connect hand-held multimeter (voltage test range) between engine earth and contact 3 on the connector.
- Switch ignition on.




Specification: approx. battery voltage

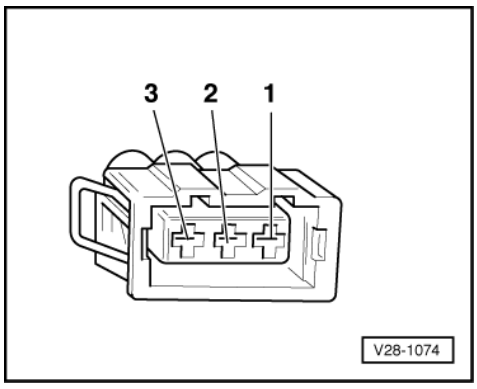
Measuring voltage on vehicles with 10-pin connector:

- -> Connect hand-held multimeter (voltage test range) between engine earth and contact 10 on the connector.
- Switch ignition on.

Specification: approx. battery voltage

If the specification is not obtained:

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 69 .

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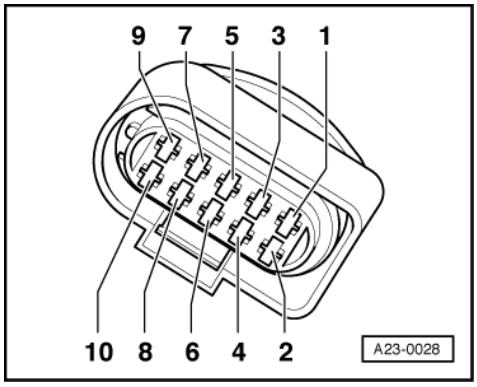
The following wiring connections are to be checked for open circuits and/or short to positive or negative.

-> Testing wiring connection on vehicles with 3-pin connector.

| 3-pin connector on wiring harness, contact | Test box V.A.G 1598/31, socket |
|---|---|
| 2 | 114 |
| 3 | 1 and 2 |



-> Testing wiring connections on vehicles with 10-pin connector.

| 10-pin connector on wiring harness, contact | Test box V.A.G 1598/31, socket |
|---|---|
| 9 | 114 |
| 10 | 1 and 2 |

- Rectify any open/short circuit as necessary.

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

## 2.4 - Checking fuel temperature sender -G81

- Read measured value block, Display Group 07, engine cold and not running => Page 33 .

-> Indicated on display:

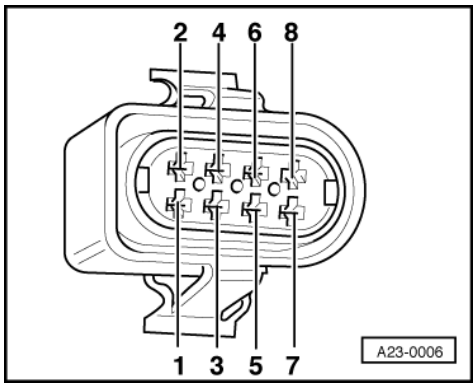
```
Read measured value block 7
     15.4 5C          15.9 5C     16.7 5C
```

- Observe display in display zone 1.

  If the wiring to the sender has an open circuit, a substitute value of -5.4 °C will be displayed.

If an implausible value or a substitute value of 5.4 °C is displayed:

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 69 .
- Unplug connector on injection pump=>Fitting locations overview, Page 40 .




The following wiring connections are to be checked for open circuits and/or short to positive or negative.

-> Testing wiring connections on vehicles with 8-pin connector.

| 8-pin connector on wiring harness, contact | Test box V.A.G 1598/31, socket |
|---|---|
| 4 | 103 |
| 7 | 111 |

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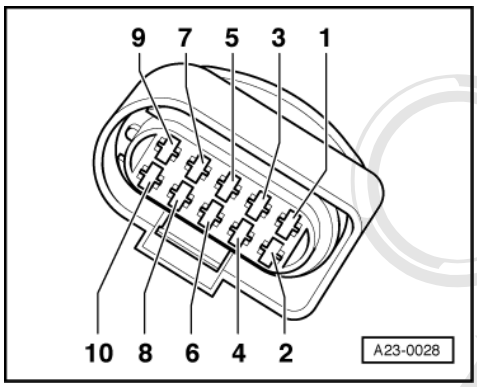


-> Testing wiring connections on vehicles with 10-pin connector.

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| 10-pin connector on wiring harness, contact | Test box V.A.G 1598/31, socket |
|---|---|
| 4 | 103 |
| 7 | 111 |

- Rectify any open/short circuit as necessary.

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

# 3 - Checking control unit input values

## 3.1 - Checking control unit input values

## 3.2 - Checking Diesel direct injection system voltage supply

The injection system receives its current supply via the Diesel direct injection system relay (J322).

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

**Test conditions**

- Battery voltage OK.

**Testing voltage supply at terminal 15**

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 69 .
- Connect multimeter (voltage test range) between earth and socket 37 of the test box.
- Switch ignition on.

  Specification: approx. battery voltage

If the specification is not obtained:

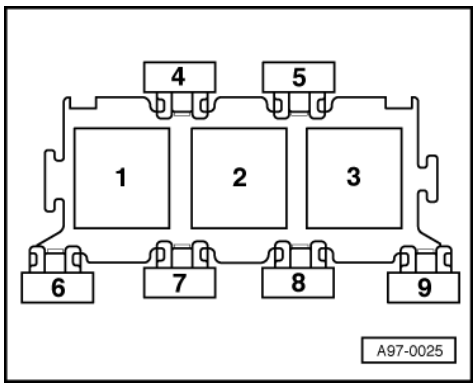
- Check the wiring.

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

**Testing earth activation for Diesel direct injection system relay -J322**

**Test conditions**

- Battery voltage OK.
- Terminal 15 voltage supply OK

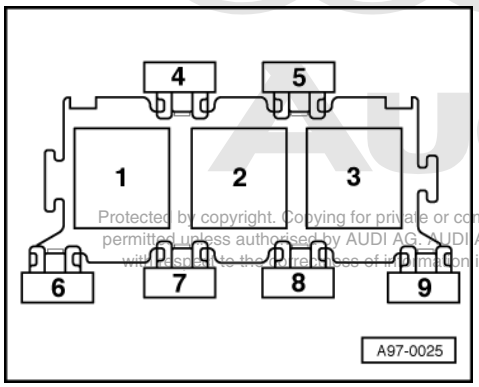



- Open electronics box in plenum chamber.
- Switch ignition on.

-> Specification: Diesel direct injection system relay (electronics box, relay position 3) should pick up.

***Note:***

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

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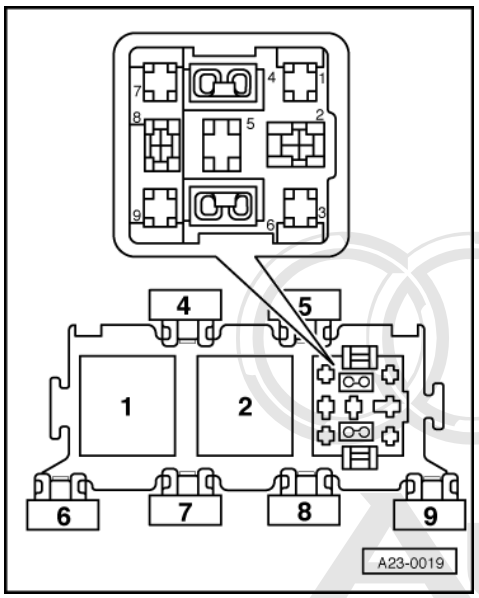
If the relay does not pick up:

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 69 .
- Connect together sockets 18 and 4 on the test box using an auxiliary cable from V.A.G 1594.

-> Specification: Diesel direct injection system relay (electronics box, relay position 3) should pick up.

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




- Replace Diesel direct injection system control unit.

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If the relay does not pick up:

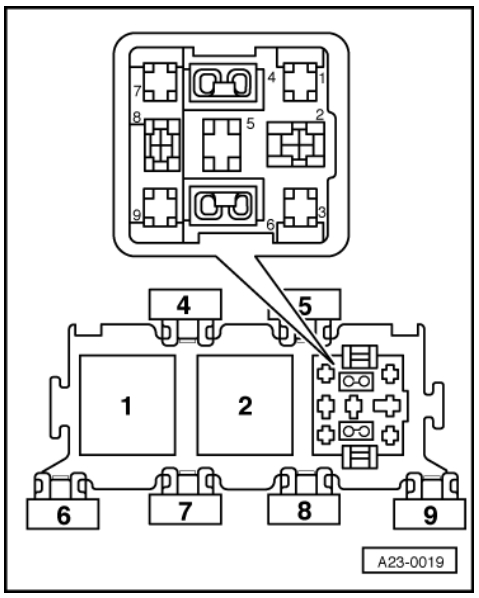
- Switch off ignition.
- -> Unplug Diesel direct injection system relay -J322 from relay panel (electronics box, relay position 3).

The following wiring connections are to be checked for open circuits and/or short to positive or negative.

| Electronics box, relay position 3, contact | Test box V.A.G 1598/31, socket |
|---|---|
| 9 | 18 |

- Rectify any open/short circuit as necessary.

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



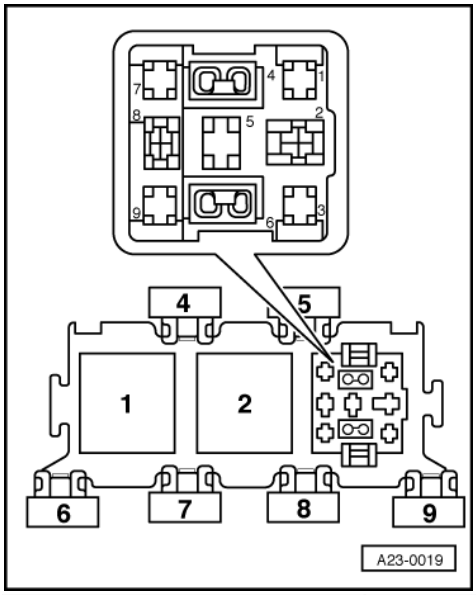
### Testing voltage supply at terminal 30

### Test conditions

- Battery voltage OK.
- Terminal 15 voltage supply OK
- Earth activation for relay -J322 OK

- Switch off ignition.
- -> Unplug Diesel direct injection system relay -J322 from relay panel (electronics box, relay position 3).

- Connect multimeter (voltage test range) between the following contacts on the relay panel:




| Electronics box, relay position 3, contact | Specification |
|---|---|
| 2 + earth | approx. battery voltage |

If the specification is not obtained:

- Check the wiring.

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

If the specification is obtained:

- Plug relay back into relay panel (electronics box, relay position 3).
- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 69 .
- Connect together sockets 18 and 4 on the test box using an auxiliary cable from V.A.G 1594.

- Connect multimeter (voltage test range) between the following contacts on the test box:

| Test box V.A.G 1598/31, socket | Specification |
|---|---|
| 1 + 4 | approx. battery voltage |
| 2 + 4 | approx. battery voltage |
| 1 + 5 | approx. battery voltage |
| 2 + 5 | approx. battery voltage |

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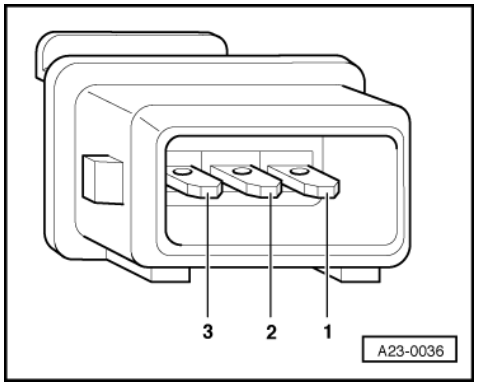
If the specification is not obtained:

- Check the wiring.

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

## 3.3 - Checking engine speed sender -G28

The engine speed sender is both a speed sender and a reference mark sender. If it fails the engine will cut out.




- Switch off ignition.
- Disconnect sender connector
  =>Fitting locations overview, Page 40 .
- -> Connect multimeter (resistance test range) between contacts 1 and 2 on the sender connector.

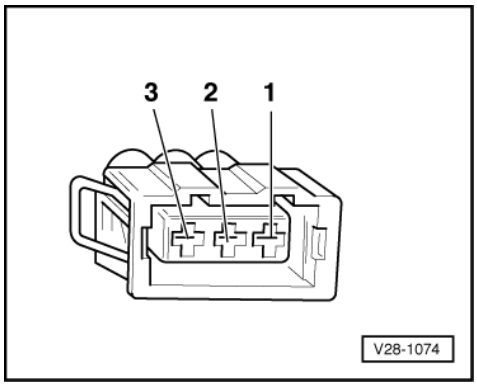
  Specification: approx. 1 kω

If the specification is not obtained:

- Replace engine speed sender (G28).

If the specification is obtained:

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 69 .

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The following wiring connections are to be checked for open circuits and/or short to positive or negative.

| 3-pin connector on wiring harness, contact | Test box V.A.G 1598/31, socket |
|---|---|
| 1 | 102 |

| 3-pin connector on wiring harness, contact | Test box V.A.G 1598/31, socket |
|---|---|
| 2 | 110 |
| 3 | 86 |

- Rectify any open/short circuit as necessary.

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

## 3.4 - Checking air mass meter -G70

The signal from the air mass meter is required by the control unit to calculate the required injection quantity and to control the exhaust gas recirculation. The weaker the signal from the air mass meter, the less fuel can be injected.

Important:
Secure fault reader to rear seat and operate from this location. When doing this, always observe the relevant safety precautions => Page 39 .

- Read measured value block, Display Group 10, engine running at idling speed => Page 36

-> Indicated on display:

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

- Observe display in display zone 1.

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

-> Specification: 230...370 mg/H (mg/stroke)

If the specification is not obtained:

- Check exhaust gas recirculation:

=> 4-Cyl. Diesel Direct Injection Engine (TDI), Mechanics; Repair Group 26; Testing exhaust gas recirculation system Testing exhaust gas recirculation system

If the specification is obtained:

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- Accelerate vehicle from approx. 1500 rpm at full throttle, in second gear for manual gearbox or second driving range for automatic gearbox.
- Press PRINT key on V.A.G 1551 at approx. 3000 rpm. The accelerator pedal must be fully depressed at this moment in time.

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

-> Specification for display zone 4: 100 % (accelerator pedal position)

If the specification is not obtained:

- Repeat test and accelerate vehicle at full throttle.

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

-> Specification for display zone 3: (charge pressure)

Engine code AFF, AHU, AHH:
1800...2050 mbar
Engine code AFN, AVG:
1800...2250 mbar

If the specification is not obtained:

- Test charge pressure

=> 4-Cyl. Diesel Direct Injection Engine (TDI), Mechanics; Repair Group 21; Testing charge pressure system
Testing charge pressure system

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

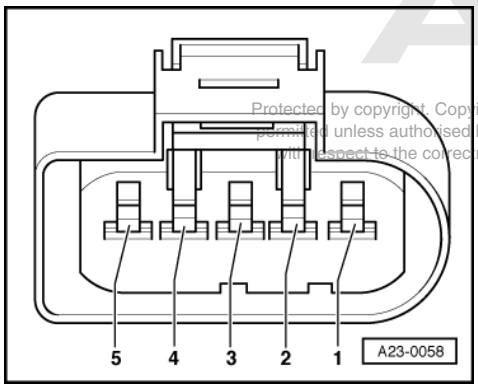
-> Specification for display zone 1: intake air mass
Engine code AFF, AHU, AHH:
> 750 mg/H (mg/stroke)
Engine code AFN, AVG:
> 800 mg/H (mg/stroke)

If the specification is not obtained:

- Renew air mass meter (G70).

If display zone 1 shows a fixed substitute value:

- Switch off ignition.
- Disconnect connector for air mass meter
  =>Fitting locations overview, Page 40 .
- Switch ignition on.

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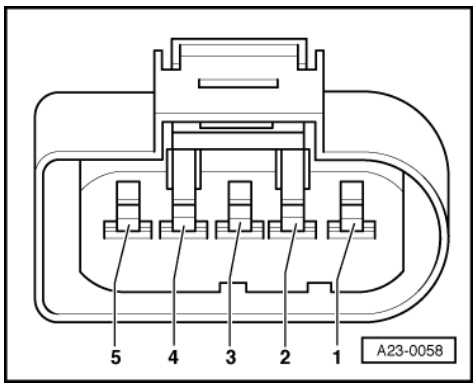
- -> Connect hand-held multimeter (voltage range) between the following contacts on the connector:

| 5-pin connector on wiring harness, contact | Specification |
|---|---|
| 2 + earth | Battery voltage |
| 2 + 3 | Battery voltage |
| 4 + earth | approx. 5 V |
| 4 + 3 | approx. 5 V |

If the specifications are not obtained:

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 69 .




The following wiring connections are to be checked for open circuits and/or short to positive or negative.

| 5-pin connector on wiring harness, contact | Test box V.A.G 1598/31, socket |
|---|---|
| 1 | - |
| 2 | 1 and 2 |
| 3 | 49 |
| 4 | 30 |
| 5 | 68 |

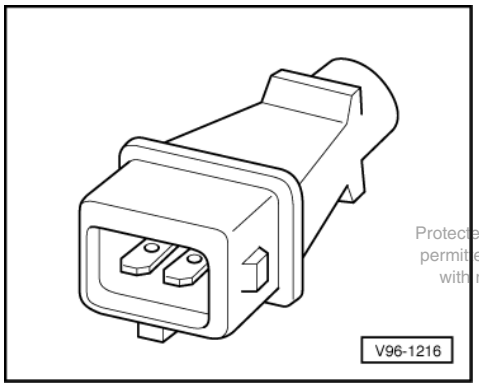
- Rectify any open/short circuit as necessary.

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

## 3.5 - Checking needle lift sender

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).

- Switch off ignition.
- Disconnect connector for sender
  =>Fitting locations overview, Page 40 .

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- -> Connect hand-held multimeter (resistance test range) between the contacts on the sender connector.

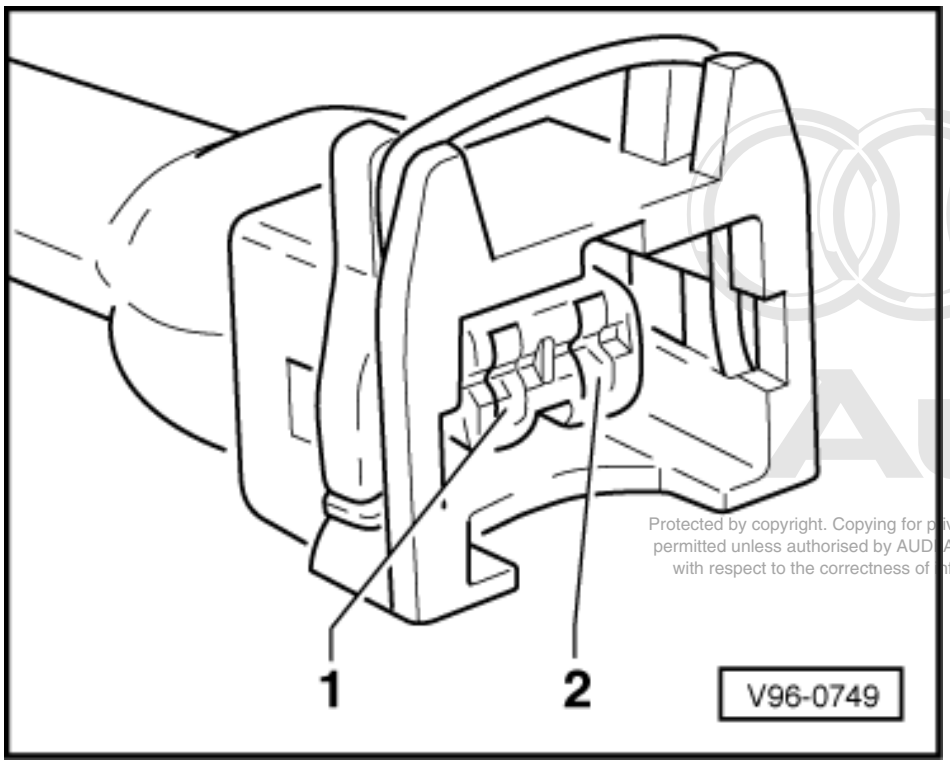
  Specification: 90...120ω (when the engine is hot the resistance may be up to 20 ω higher)

If the specification is not obtained:

- Replace cylinder 3 injector with needle lift sender (G80).

If the specification is obtained:

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 69 .

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The following wiring connections are to be checked for open circuits and/or short to positive or negative.

| 2-pin connector on wiring harness, contact | Test box V.A.G 1598/31, socket |
|---|---|
| 1 | 109 |
| 2 | 101 |

- Rectify any open/short circuit as necessary.

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

## 3.6 - Testing coolant temperature sender -G62

- Read measured value block, Display Group 07, engine cold and running at idling speed => Page 33

-> Indicated on display:

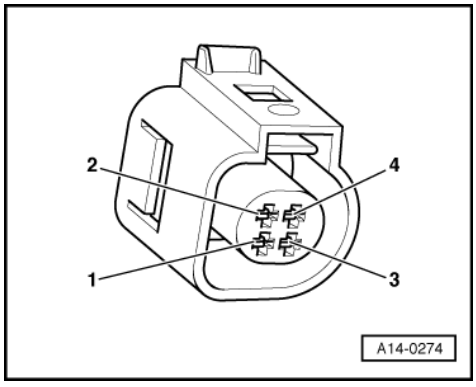
```
Read measured value block 7
     15.4 5C          15.9 5C     16.7 5C
```

- Check display in display zone 4 (coolant temperature).

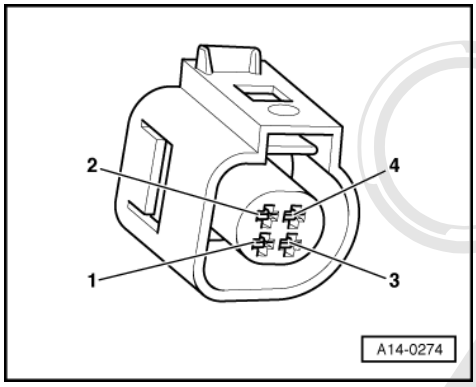
  Specification: The temperature reading should increase at a uniform rate.

If there is a fault the fuel temperature (display zone 1) will be displayed as a substitute value.

If an implausible value is displayed in display zone 4, or if the fuel temperature is displayed as a substitute value:




- Switch off ignition.
- -> Unplug connector from sender=>Fitting locations overview, Page 40 .
- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 69 .




The following wiring connections are to be checked for open circuits and/or short to positive or negative.

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| 4-pin connector on wiring harness, contact | Test box V.A.G 1598/31, socket |
|---|---|
| 3 | 112 |
| 4 | 104 |

- Rectify any open/short circuit as necessary.

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

If no wiring fault is detected:

- Replace coolant temperature sender (G62).

## 3.7 - Checking intake manifold temperature sender

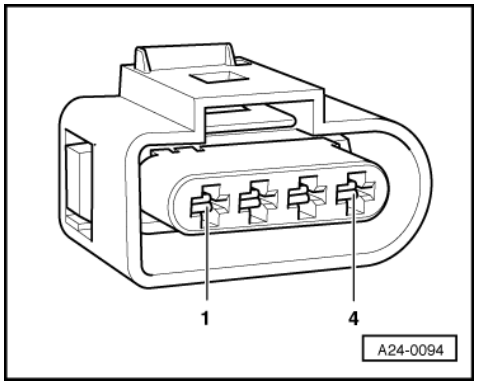
```
Read measured value block 7
     15.4 5C          15.9 5C     16.7 5C
```

-> Read measured value block, Display Group 07, engine cold and not running => Page 33 .

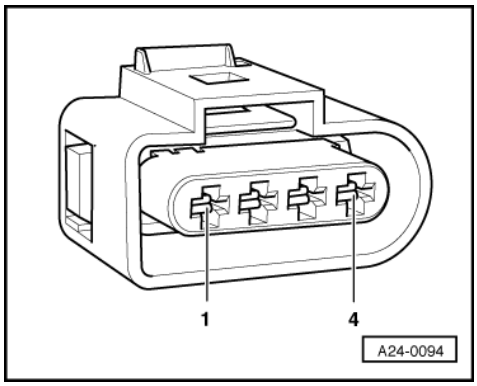
- Observe display in display zone 3.

  If the wiring to the sender has an open circuit, a substitute value of 136.8 °C will be displayed.

If an implausible value or a substitute value of 136.8 °C is displayed:




- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 69 .
- -> Unplug connector from sender=>Fitting locations overview, Page 40 .

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The following wiring connections are to be checked for open circuits and/or short to positive or negative.

| 4-pin connector on wiring harness, contact | Test box V.A.G 1598/31, socket |
|---|---|
| 1 | 52 |
| 2 | 73 |

- Rectify any open/short circuit as necessary.

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

If no wiring fault is detected:

- Replace intake manifold temperature sender (G72).

## 3.8 - Checking modulating piston movement sender -G149 and quantity adjuster -N146

The metering unit (quantity adjuster) is an electromagnetic swivelling positioner which is controlled by the control unit via a directed duty cycle (on-off ratio). The eccentric shaft on the metering unit 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.

- Read measured value block, Display Group 01, engine at idling speed => Page 29

-> 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).

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

-> Specification: At least 85 °C

Continue with check when coolant temperature is attained.

- Switch off any electrical consumers that may be on (air conditioner, rear window heater, lights etc.).
- Check display in display zone 3 (voltage supplied from modulating piston movement sender).

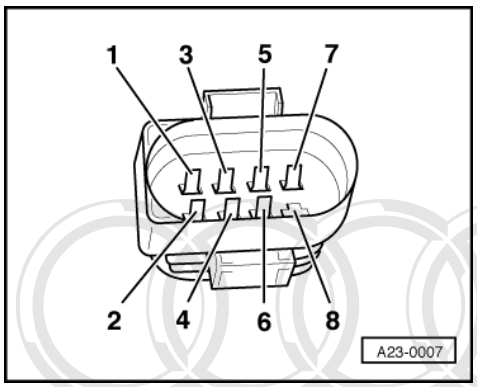
```
Read measured value block 1      "
     840 rpm     5.6 mg/H     1.480 V     87.3
5C
```

-> Specification: 1.250...1.700 V

If the specification is not obtained:

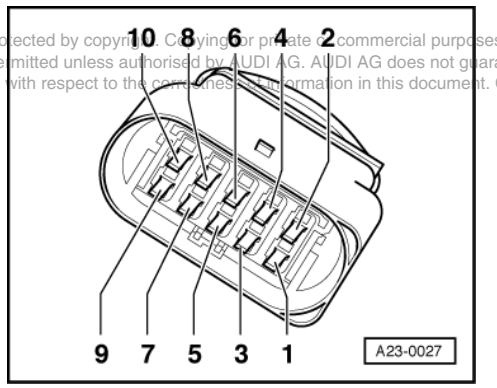
- Replace injection pump.

**Electrical check of modulating piston movement sender (G149) and quantity adjuster (N146)**




- Switch off ignition.
- Disconnect connector for sender=>Fitting locations overview, Page 40 .
- Connect hand-held multimeter (resistance test range) between the following contacts on the injection pump connector:

-> Testing wiring connections on vehicles with 8-pin connector.

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-> Testing wiring connections on vehicles with 10-pin connector.

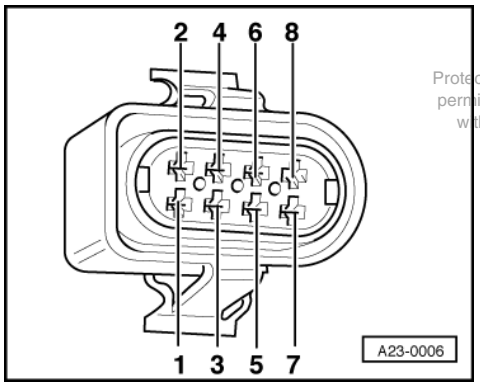
| 8-pin or 10-pin injection pump connector | Specification |
|---|---|
| 1 + 2 | 4.9...7.5 ω |
| 3 + 2 | 4.9...7.5 ω |
| 6 + 5 | 0.4...1.1 ω |

If the specifications are not obtained:

- Replace injection pump.

**Testing current supply and wiring connections**

- Switch off ignition.
- Disconnect connector for sender=>Fitting locations overview, Page 40 .
- Switch ignition on.

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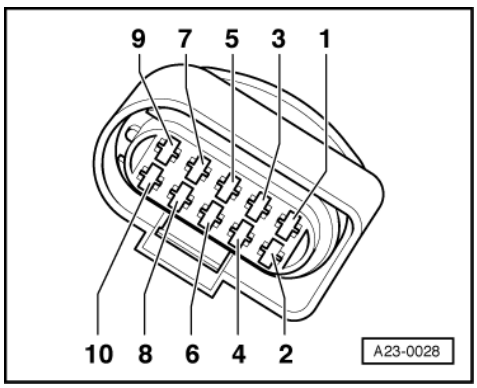
- Connect hand-held multimeter (voltage test range) between the following contacts on the wiring harness connector:

-> Measuring voltage on vehicles with 8-pin connector.

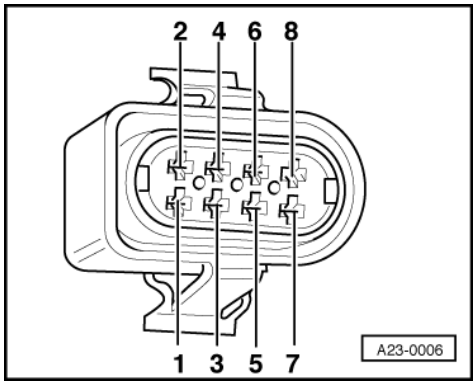



-> Measuring voltage on vehicles with 10-pin connector.

| 8-pin or 10-pin connector on wiring harness, contact | Specification |
|---|---|
| 1 + earth | approx. 2.5 V |
| 3 + earth | approx. 2.5 V |
| 5 + earth | approx. battery voltage |

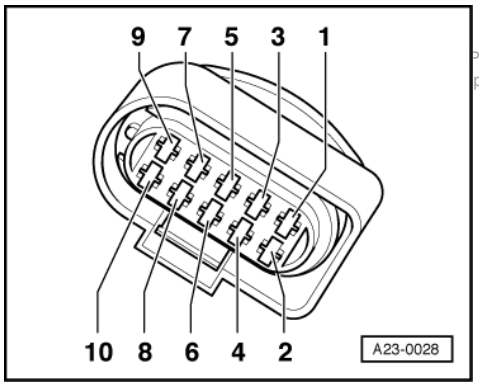
If the specifications are not obtained:

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 69 .




The following wiring connections are to be checked for open circuits and/or short to positive or negative.

-> Testing wiring connections on vehicles with 8-pin connector.

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-> Testing wiring connections on vehicles with 10-pin connector.

| 8-pin or 10-pin connector on wiring harness, contact | Test box V.A.G 1598/31, socket |
|---|---|
| 1 | 108 |
| 2 | 106 |
| 3 | 99 |
| 5 | 1 and 2 |
| 6 | 116 and 121 |

- Rectify any open/short circuit as necessary.

# 4 - Testing auxiliary signals

## 4.1 - Testing auxiliary signals

## 4.2 - Testing signals from and to air conditioner

### Testing air conditioner compressor shut-off

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

### Test conditions

- Air conditioner OK
- Air conditioning system switched on
- No faults recorded in fault memory

```
Final control diagnosis
```

-> Start final control diagnosis and activate conditioner compressor interruption => Page 16 .

The air conditioner compressor should cut out within 5 seconds (visual check), then start and stop again every 5 seconds.

If the conditioner compressor is not switched off:

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 69 .

The following wiring connections are to be checked for open circuits and/or short to positive or negative.

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| Test box V.A.G 1598/31, socket | Air conditioner operating and display unit, contact |
|---|---|
| 29 | => 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 02, engine running at idling speed => Page 32
- Observe display in display zone 3, the air conditioner must not be switched on.

-> 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.
- Select lowest temperature and highest blower speed. The air conditioner compressor must run.

- Check display in display zone 3.

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

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

If the specification is not obtained:

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 69 .

The following wiring connections are to be checked for open circuits and/or short to positive or negative.

| Test box V.A.G 1598/31, socket | Air conditioner operating and display unit, contact |
|---|---|
| 34 | => Current flow diagrams, Electrical fault finding and Fitting locations binder |

- Rectify any open/short circuit as necessary.

## 4.3 - 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).

**Test conditions**

- Speedometer OK., checking:

=> Electrical System; Repair Group 90

Important:
Secure fault reader to rear seat and operate from this location. When doing this, always observe the relevant safety precautions => Page 39 .

- Read measured value block, Display Group 06, engine running at idling speed => Page 23

-> Indicated on display:

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

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- Take vehicle for a test drive.
- Observe display in display zone 1.

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

-> Specification: The current road speed should be displayed (compare with speedometer).

If the specification is not obtained:

- Connect test box V.A.G 1598/31 to wiring harness for engine control unit. Do not connect to the engine control unit itself.
  => Page 69 .

The following wiring connections are to be checked for open circuits and/or short to positive or negative.

| Test box V.A.G 1598/31, socket | Dash panel insert, contact |
|---|---|
| 20 | => 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 electrical "consumers" (e.g. radio, automatic gearbox, air conditioner etc.) are using the speed signal, disconnect them one by one from the dash panel insert, then keep repeating the test until the cause of the problem has been identified.

## 4.4 - 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 the engine speed sender (G28), it has to be processed by the engine control unit.

Identify the engine speed signal as follows:

### Dash panel insert

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- Observe rev counter reading.
  Specification: The current engine speed should be displayed.

### Air conditioner

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

Testing signal

=> Heating, Air Conditioner; Repair Group 01

Specification: 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; Repair Group 01

Specification: 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 binder

- 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

## 4.5 - Testing a "two-wire data bus system"

- By referring to the appropriate current flow diagram, check how many control units are connected to the CAN data bus (Controller Area Network).
- Check that the multi-pin connectors on the control units are properly seated.
- Connect fault reader V.A.G 1551 and press key 0 twice to select the function "Automatic test sequence".

Before testing the bus wires, make sure that there are no faults in any of the control units connected to the data bus.

If a fault exists, rectify this fault first.

- Make a note of any faults and erase the fault memories of all control units.

- Press keys 0 and 6 for the function "End output" and confirm entry with the Q key.
- Rectify the faults as described in the fault table in the relevant Workshop Manual.

If communication between the control units is still not working properly when all faults have been rectified, test the data bus wires.

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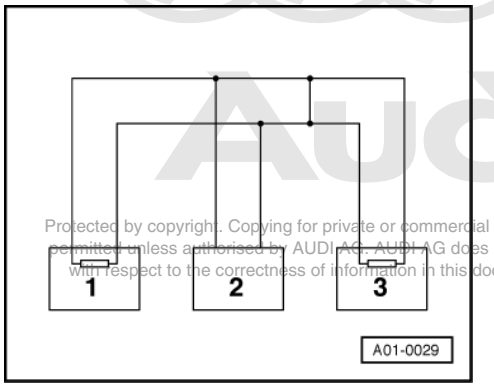
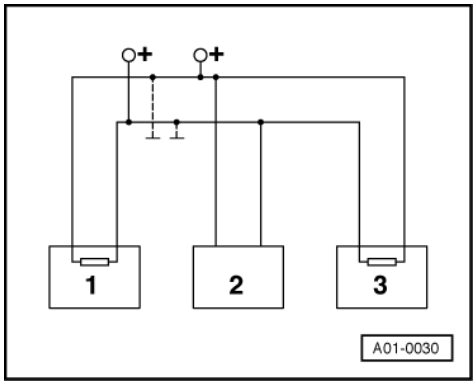



- Switch off ignition.
- -> Disconnect the control units which are linked by the bus wires and check for a short circuit between the bus wires

=> Current Flow Diagrams, Electrical fault Finding and Fitting Locations




- -> Check the bus wires for short to positive and short to earth.

If the bus wires do not cause the fault reading "Defective hardware", test the control units.

At this stage all the control units which communicate via the CAN data bus are disconnected. The ignition is switched off.

- Connect one of the control units.
- Connect fault reader V.A.G 1551.
- Switch ignition on and erase fault memory of the control unit that has just been connected.
- Terminate fault readout by selecting function 06 "End output".
- Switch the ignition off and then on again.
- Leave the ignition switched on for 10 seconds. Then interrogate the fault memory of the control unit that has just been connected, using the fault reader.

- If the fault "Defective hardware" is now indicated, replace the control unit which has just been connected.
- If the fault "Defective hardware" is not indicated, connect the next control unit, and repeat the above procedure.

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# 28 - Glow plug system

## 1 - Checking glow plug system

### 1.1 - Checking glow plug system

### 1.2 - Testing operation

- Pull glow plug connectors off glow plugs.
- Connect multimeter (voltage test range) between engine earth and one of the glow plug connectors.
- Initiate final control diagnosis and activate glow plug relay
  => Page 16 .

-> Indicated on display:

```
Final control diagnosis
Glow plug relay -J52
```

Specification: approx. battery voltage (every 5 seconds)

If the specification is not obtained:

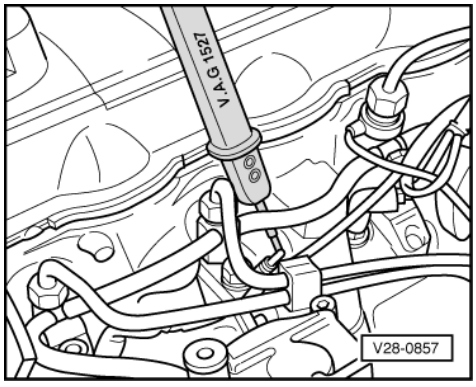
- Rectify any open/short circuit as necessary.

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

### 1.3 - Checking glow plugs

**Test conditions**

- Battery voltage at least 11.5 V




- Switch off ignition.
- Pull glow plug connector off glow plug.
- -> Connect diode test lamp wire using auxiliary clips from auxiliary cable set to battery positive (+).
- Place diode test lamp probe on each glow plug one after the other.

If diode lights up: glow plug OK.

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If diode does not light up: fit a new glow plug

- Remove and install glow plugs with jointed spanner 3220.

  Tightening torque: 15 Nm

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