

Audi A4 1995 ➤

#Diesel direct injection and glow #plug system (4-cyl.)
>06.97

Engine ID	AFF	AHU	AFN	1Z					
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Edition 10.1995

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List of Workshop Manual Repair GroupsList of Workshop Manual
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#Diesel direct injection and glow #plug system (4-cyl.)
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Repair Group

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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23 - Mixture preparation, Injection

1 - Servicing diesel direct injection system

1.1 - Servicing diesel direct injection system

1.2 - Safety precautions

To avoid injury to persons and/or destruction of the glow plug and injection system, always observe the following:

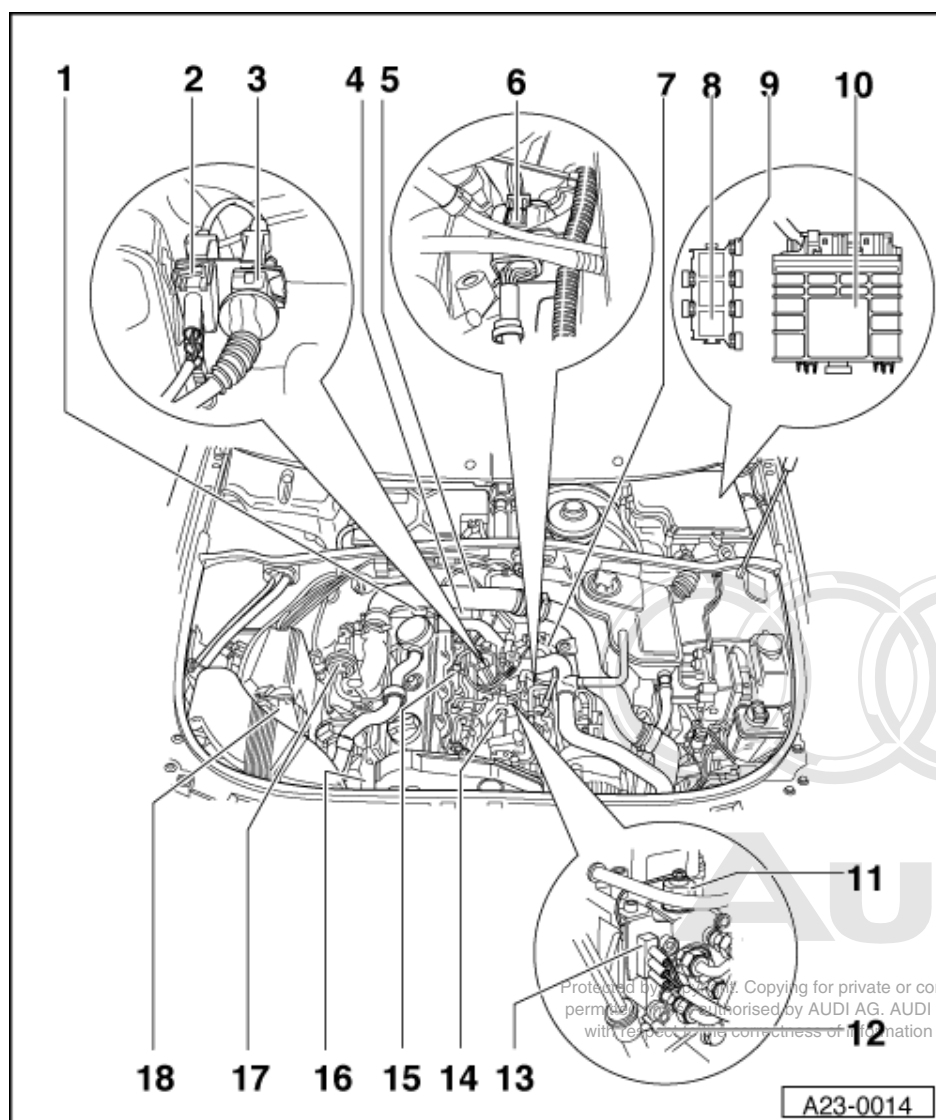
- ♦ Always switch off ignition before disconnecting and connecting cables of glow plug and injection system - including tester cables.
- ♦ If the engine is to be run at cranking speed without starting, e.g. when testing compression, detach fuel cut-off valve N109 connector at injection pump and 8-pin plug for quantity adjuster.
- ♦ Where radios with anti-theft coding are fitted, establish coding before disconnecting battery.
- ♦ Always switch off ignition before disconnecting and connecting battery, as otherwise the diesel direct injection system control unit could be damaged.

1.3 - Rules for cleanliness

Pay careful attention to the following rules for cleanliness when working on the fuel supply/injection system:

- ♦ Thoroughly clean connection points and surrounding areas before detaching connections.
- ♦ After removal, place components on a clean surface and cover them. Do not use fluffy cloths.
- ♦ Carefully cover/close off open components if repair is not carried out immediately.
- ♦ Only install clean components:
Leave parts in their packaging until immediately prior to installation.
Do not use parts which have been stored unpacked (e.g. in tool boxes).
- ♦ When system is open:
Avoid working with compressed air, if at all possible.
Do not move vehicle unless absolutely necessary.
- ♦ Care is also to be taken to ensure that no diesel fuel spills onto the coolant hoses. If necessary, the hoses are to be cleaned immediately. Hoses affected by fuel are to be replaced.

1.4 - Overview of fitting locations



Components A and B are not shown in the exploded view.

A - Glow plug relay -J52

Relay position 6 in central electrics beneath shelf on driver's side

B - Accelerator position sender -G79

in footwell on accelerator pedal

=> Page 12

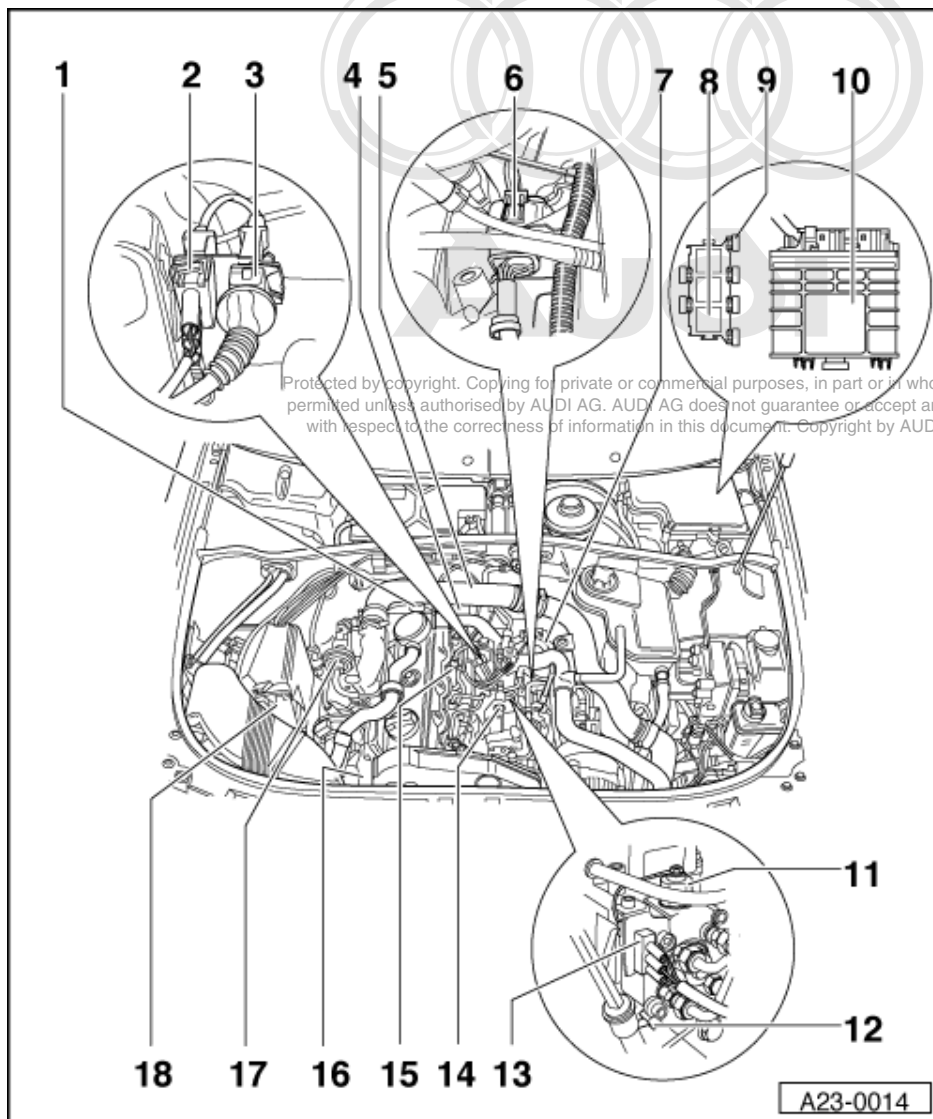
1 Intake manifold temperature sender- G72

2 Connector

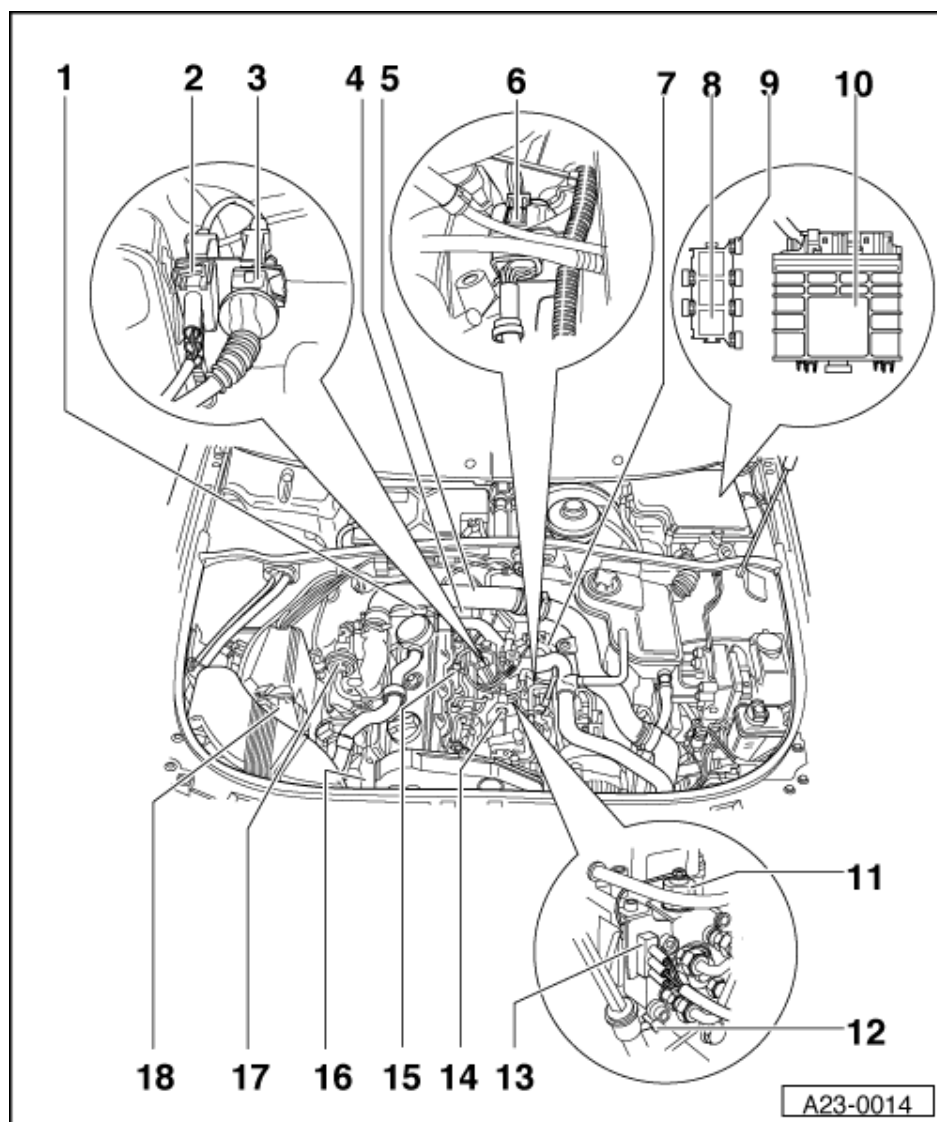
- ♦ For engine speed sender -G28

3 Connector

- ♦ For needle lift sender -G80



- 4 EGR valve -N18
- 5 Coolant temperature sender -G62
- 6 Connector
 - ◆ For fuel temperature sender -G81
 - ◆ For quantity adjuster -N146
 - ◆ For modulating piston movement sender -G149
- 7 Engine speed sender -G28
- 8 Diesel direct injection system relay -J322
- 9 Fuse for glow plugs



10 Control unit for diesel direct injection system -J248

- ◆ With intake manifold pressure sender -G71 and altitude sender -F96

11 Fuel cut-off valve -N109

12 Start of injection valve -N108

13 Connector

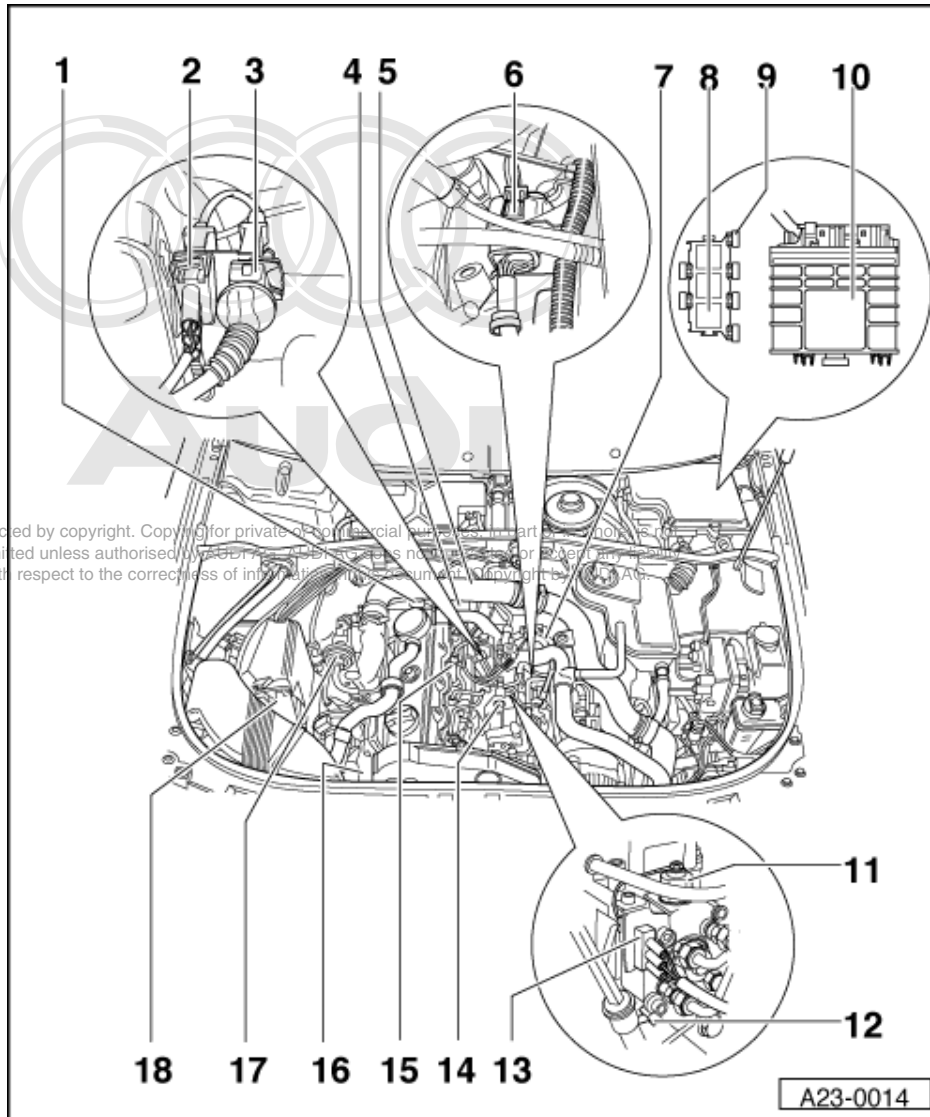
- ◆ For fuel cut-off valve -N109
- ◆ For start of injection valve -N108

14 Injection pump metering control assembly

- ◆ With fuel temperature sender
- ◆ With quantity adjuster -N146
- ◆ With modulating piston movement sender -G149



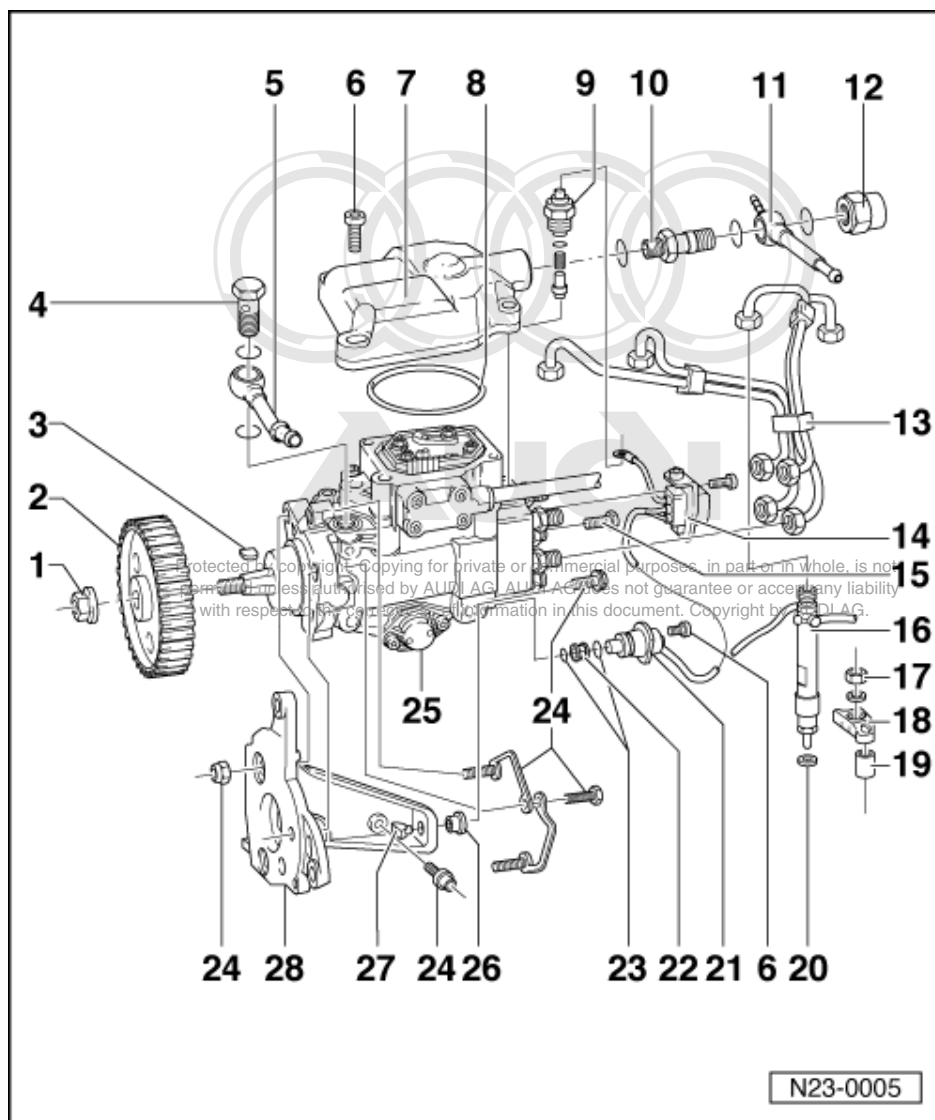
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- 15 Injector with needle lift sender -G80
- 16 Solenoid valve for boost pressure limitation -N75
- 17 Mechanical exhaust gas recirculation valve
- 18 Air mass meter -G70

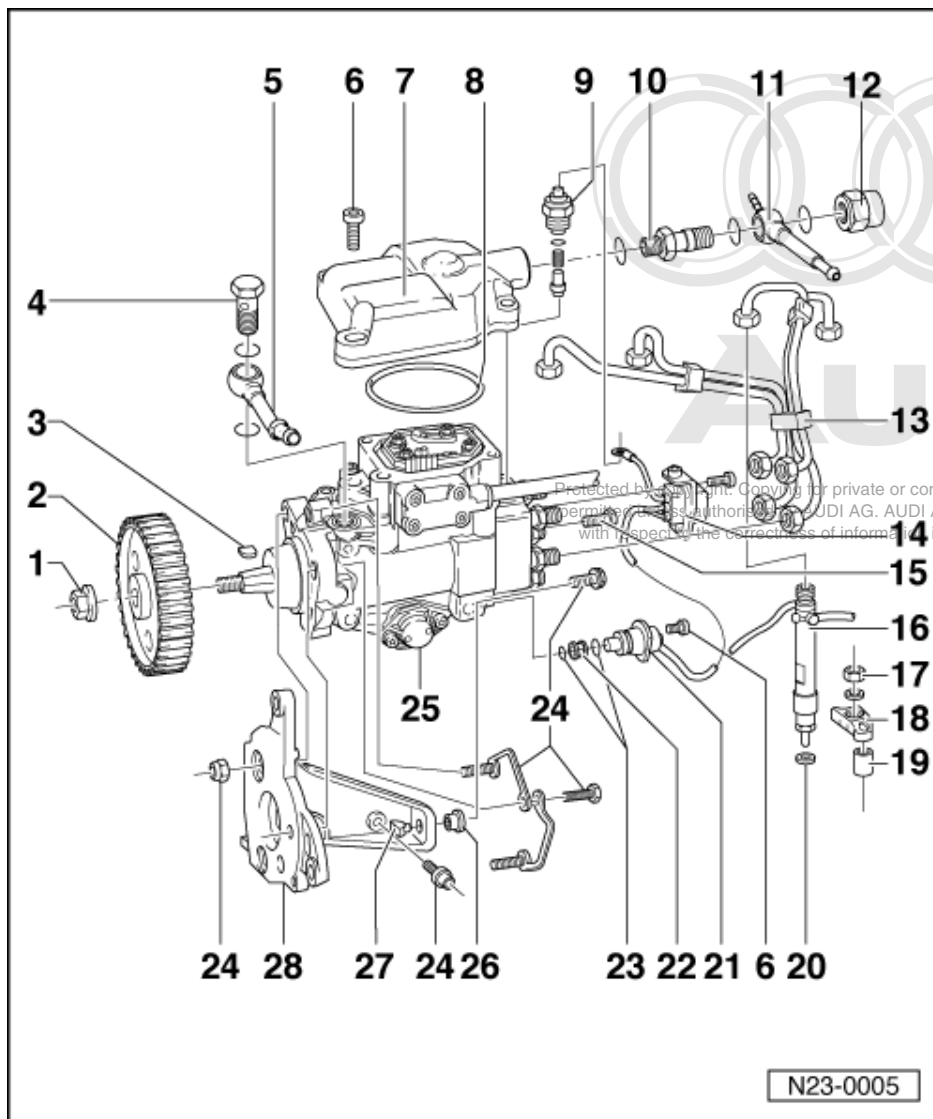


1.5 - Servicing injection pump



- ♦ Observe safety precautions => Page **1**
- ♦ Observe rules for cleanliness
=> Page **1**
- ♦ Removing and installing injection pump
=> Page **13**
- ♦ Dynamic testing and adjustment of start of injection => Page **19**

- 1 45 Nm
- 2 Injection pump gear
- 3 Woodruff key
- 4 25 Nm
- 5 Feed line
 - ♦ From fuel filter
- 6 10 Nm



7 Injection pump cover

8 Seal

9 Fuel cut-off valve

- ◆ 20 Nm

10 Connection

- ◆ For return line
- ◆ 28 Nm

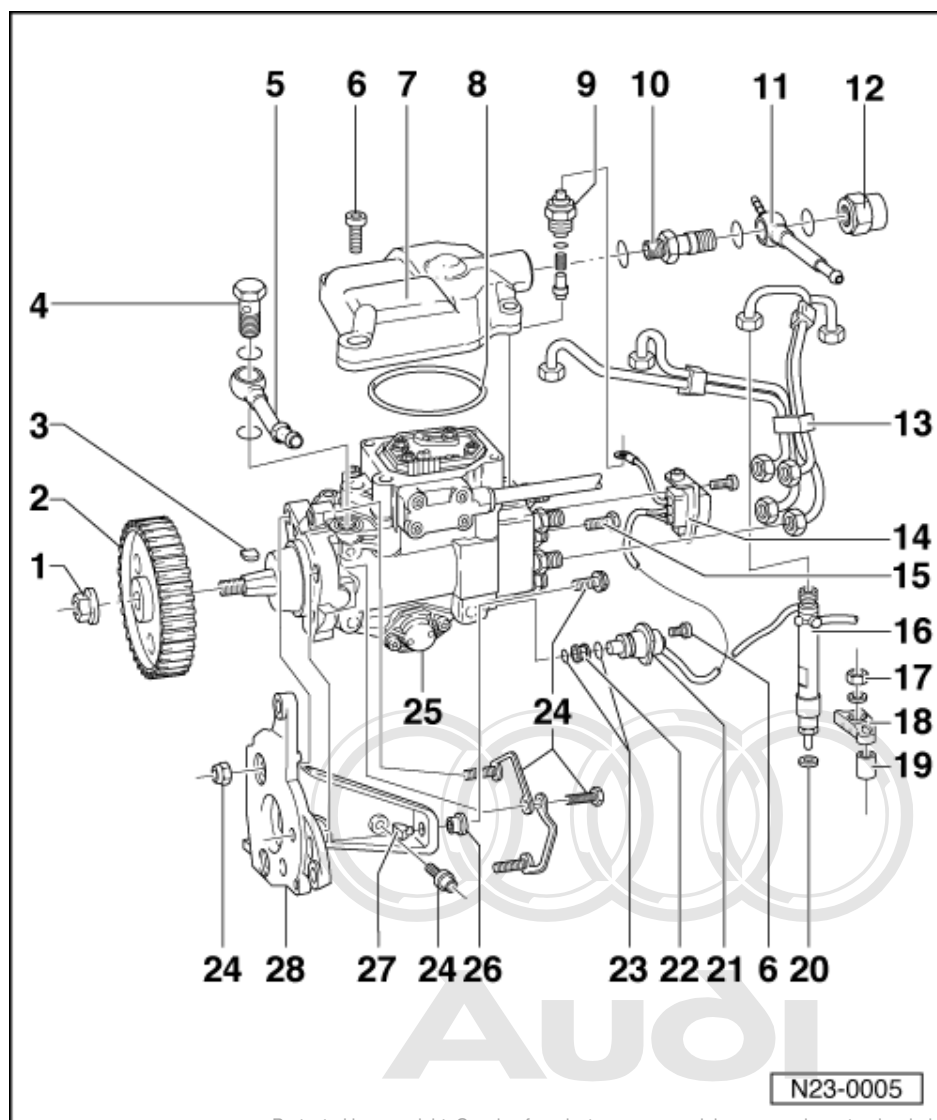
11 Return line

- ◆ To control valve/fuel filter

12 25 Nm

13 Injection pipes

- ◆ Tighten to 25 Nm
- ◆ Remove using 3035
- ◆ Always remove pipe set complete
- ◆ Do not alter pipe shape



14 Connector

- ♦ For fuel cut-off valve and start of injection valve

15 25 Nm

16 Injector

- ♦ For cylinder 3 with needle lift sender
- ♦ Removing, installing and testing => Page **21**

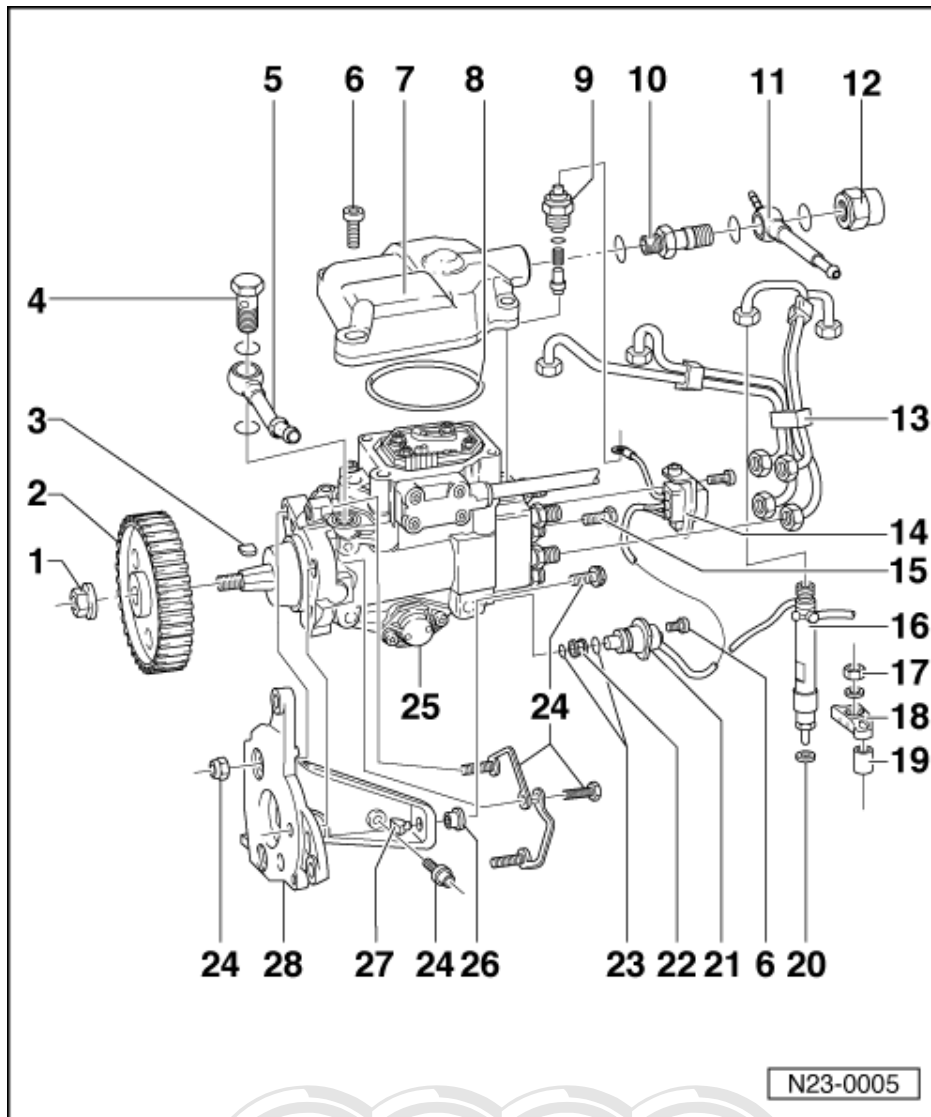
17 20 Nm

18 Clamping collar

19 Bracket

20 Copper seal

21 Start of injection valve -N108



22 Strainer

23 O-ring

24 25 Nm

25 Injection timing device cover

- ♦ Replace O-ring in the event of leakage =>Page **23**

26 Bush

- ♦ With taper

27 25 Nm

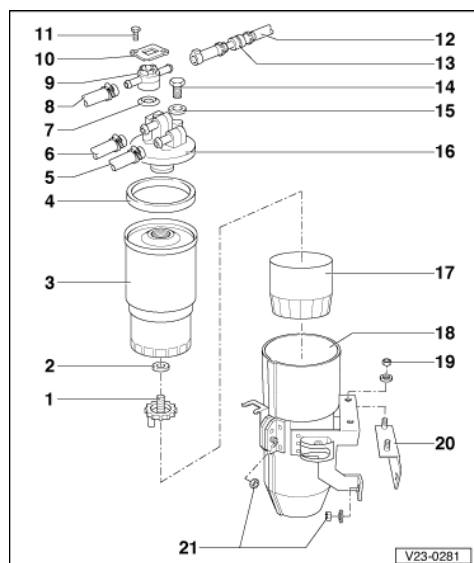
- ♦ Nut with cone

28 Bracket

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1.6 - Servicing fuel filter



1 Water drain plug

- ◆ Loosen and drain off approx. 100 cm³
- ◆ To drain off water, loosen vent screw -14-

2 Seal

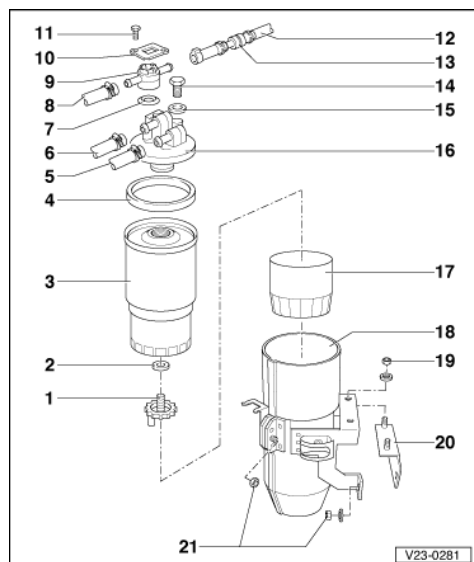
- ◆ Replace if damaged

3 Fuel filter

- ◆ Loosen with strap wrench
- ◆ Moisten sealing rings with diesel fuel before fitting
- ◆ Hand-tighten
- ◆ Fill with clean fuel before fitting

4 Seal

- ◆ Replace if damaged



5 Feed line

- ◆ From fuel tank

6 Feed line

- ◆ To injection pump

7 O-ring

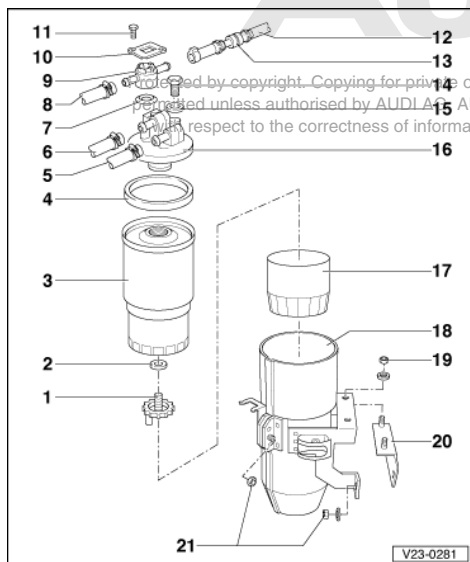
- ◆ Replace

8 Return line



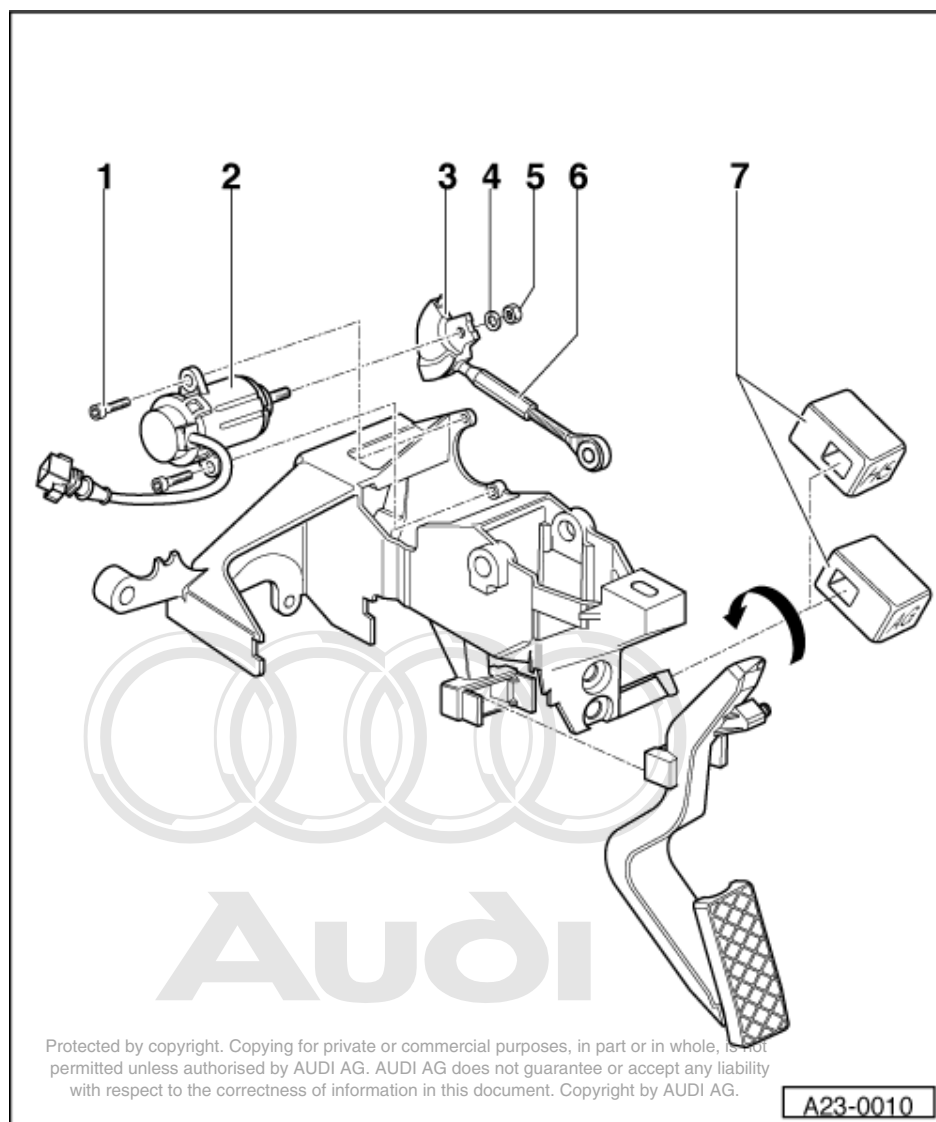
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- ♦ From injection pump
- 9 Control valve**
 - ♦ Position: Arrow facing fuel tank
- 10 Retaining plate**
- 11 5 Nm**
- 12 Return line**
 - ♦ To fuel tank



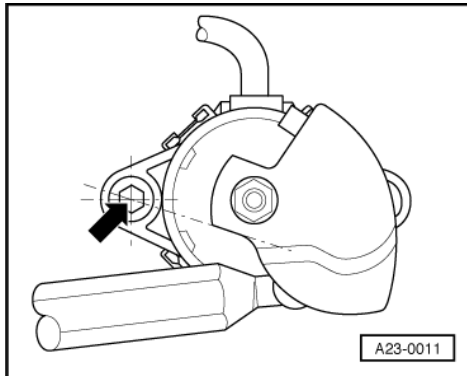
- 13 Non-return valve**
 - ♦ Position: Arrow facing fuel tank
- 14 Vent screw**
 - ♦ Loosen to drain off water
 - ♦ 10 Nm
- 15 Seal**
- 16 Fuel filter flange**
- 17 Insert**
- 18 Guard**
- 19 10 Nm**
- 20 Bracket**
- 21 10 Nm**

1.7 - Servicing accelerator linkage



- 1 Hexagon socket-head bolt**
 - ♦ 10 Nm
- 2 Accelerator position sender -G79**
 - ♦ Adjusting =>Page **13**
 - ♦ Testing => Page **55**
- 3 Cable pulley**
- 4 Washer**
- 5 10 Nm**
- 6 Adjusting screw**
- 7 Stop buffer**
 - ♦ Vehicles with manual gearbox: "HS" marking visible
 - ♦ Vehicles with automatic gearbox: "AG" marking visible

Adjusting accelerator position sender -G79



If the sender has been removed, mount cable pulley as follows:

- -> In rest position, extended edge of wrench face must be in line with centre of hole.
- Install sender with pre-assembled cable pulley.

Fine adjustment in-situ:

- Turn stop buffer to manual gearbox position, even on vehicles with automatic gearbox => Pos 7 - Page 12.

"HS" marking is visible.

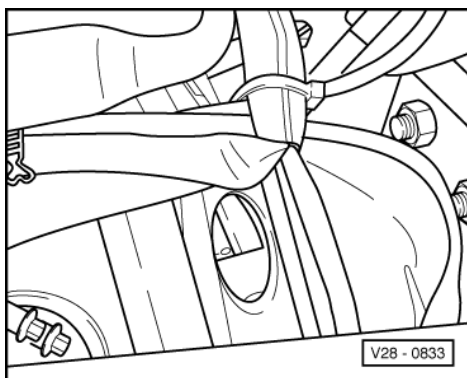
- Depress accelerator by hand until buffer stop is reached.

Use the adjusting screw to set accelerator pedal such that pressure point of kickdown switch is just reached when accelerator pedal makes contact with buffer.

- If stop is reached without pressure point (distinct resistance) being felt, turn adjusting screw anti-clockwise until pressure point is felt.
- If pressure point is reached before contact is made with buffer stop, turn adjusting screw clockwise until accelerator pedal can be depressed right down to the buffer without encountering resistance.
- On vehicles with automatic gearbox, turn stop buffer through 180° so that "AG" marking becomes visible => Page 12

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1.8 - Removing, installing and adjusting injection pump





Removal

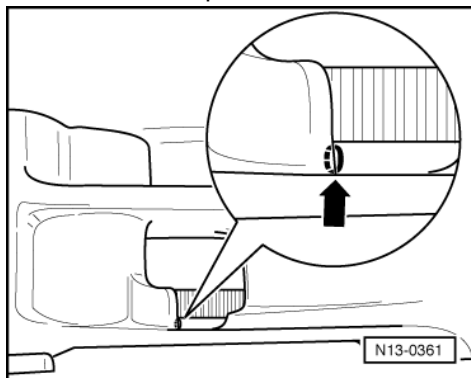
- Remove top toothed belt guard.
- Remove cylinder head cover.

Crankshaft TDC position on vehicles with manual gearbox

- Rotate crankshaft to TDC for cylinder 1.

-> The -0- mark on the flywheel must be under the edge of the inspection hole ...

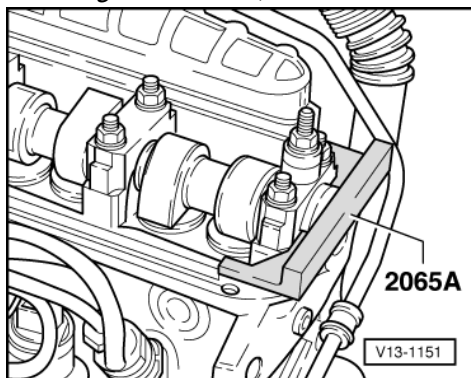
Crankshaft TDC position on vehicles with automatic gearbox.



- -> Rotate crankshaft to TDC for cylinder 1.

Note:

With engine removed, rotate crankshaft to TDC for cylinder 1 => Page 18.

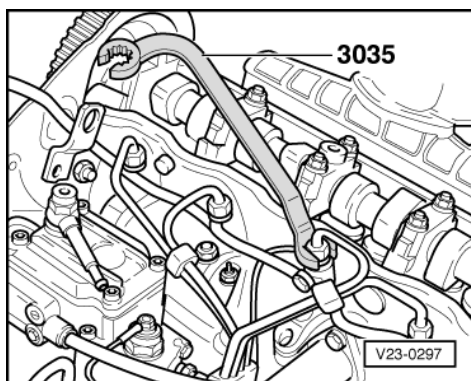


-> ... and at the same time it must be possible to insert the setting bar 2065 A in the groove on the back of the camshaft.

Note:

If the groove on the camshaft is concealed by the top edge of the cylinder head, move the crankshaft on by one revolution. Should it not be possible to insert the setting bar with the crankshaft in TDC position, correct the mechanical basic setting on installing the injection pump.

- Lock camshaft with setting bar.



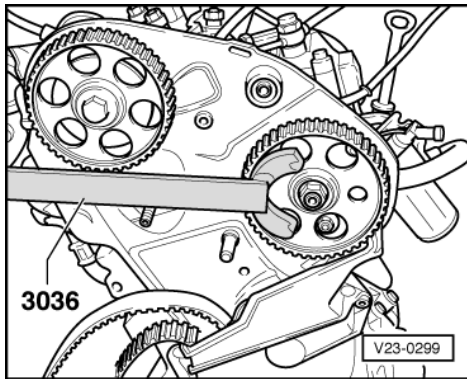
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- Unscrew fuel lines from injection pump and detach electrical connections.
- -> Use open ring spanner 3035 to remove injection pipes.

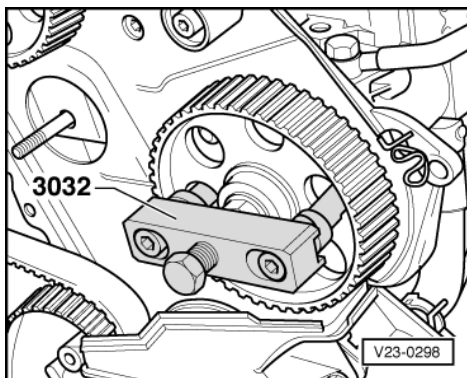
Note:

Always remove complete set of injection pipes. Do not alter pipe shape.

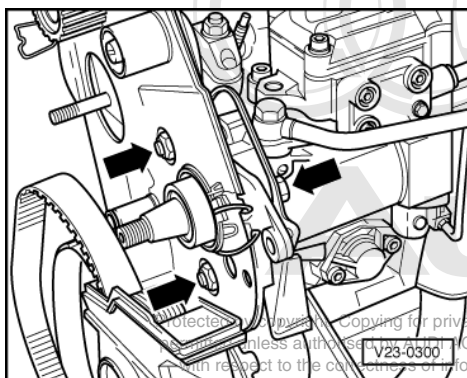
- Unscrew tensioner nut, slacken off toothed belt and remove from toothed belt sprockets of camshaft and injection pump.



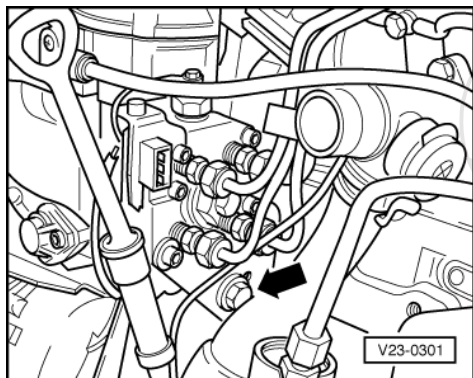
- -> Unscrew nut for injection pump gear with the aid of holding tool 3036.



- -> Loosen arms of puller and place puller in position.
- Align arms with holes in injection pump gear and tighten.
- Use puller to tension injection pump gear.
- Loosen injection pump gear with puller. Do not strike spindle.
- Unscrew nut and remove injection pump gear. Take care not to lose Woodruff key.



- -> Unscrew securing bolts of bracket -arrows-.

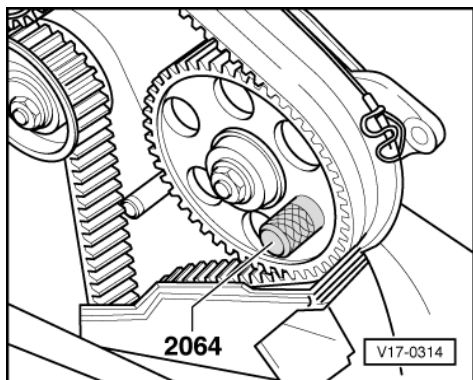


- -> Unscrew securing bolt from rear support
- -arrow-.
- Remove injection pump.

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Installation

- Insert injection pump in bracket and first fasten securing bolt at rear support with cone nut.
- Centre injection pump in bracket slots and initially hand-tighten.



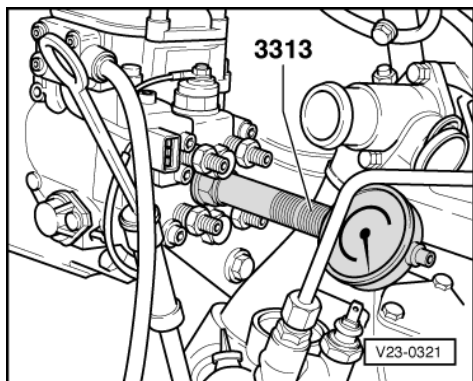
- -> Install injection pump gear and lock with setting pin 2064.
- Pay attention to seating of Woodruff key.
- Tighten fastening nut to 45 Nm.
- Installing and tensioning toothed belt

=> Engine mechanical system; Repair Group 13

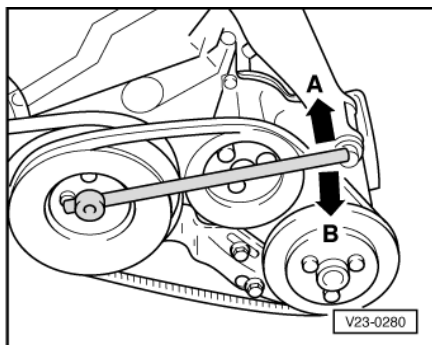
Adjustment

Testing and adjustment conditions

- Mechanical basic setting of engine OK
- Toothed belt tension OK
- Engine in TDC position



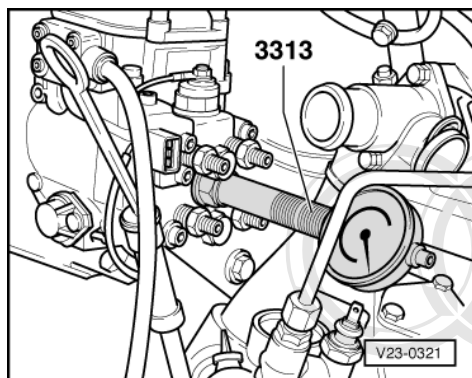
- Unscrew threaded plug from injection pump.
- -> Screw in adapter 3313 for dial gauge in place of threaded plug.
- Insert dial gauge with plunger in adapter.
- Pretension dial gauge to approx. 2 mm; tighten adapter tensioning nut.



- -> Slowly rotate crankshaft in opposite direction to that of engine rotation -arrow direction A- until pointer of dial gauge stops moving.
- Loosen dial gauge and re-tighten to approx. 1 mm pretension.
- Set dial to "0".
- -> Slowly rotate crankshaft in direction of engine rotation -arrow direction B- until -0- mark on flywheel is in alignment with reference mark/edge of setting bar.

Note:

TDC mark is to be approached by rotating crankshaft in direction of engine rotation. If the TDC mark is accidentally passed:



- Turn crankshaft back until dial gauge reading is "0" again and re-approach TDC mark.
- -> Read off start of delivery from dial gauge.

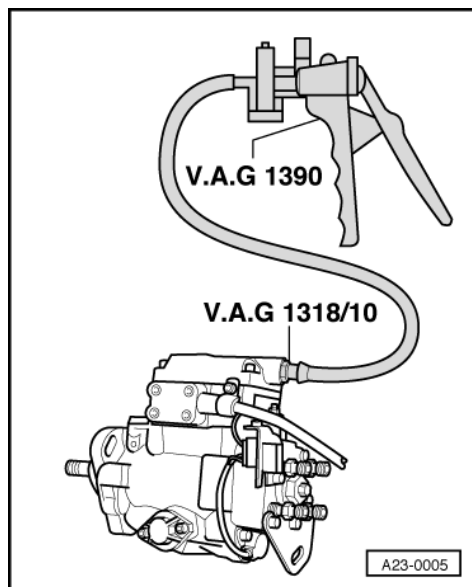
Setting: $0,7 \pm 0,02$ mm stroke

- To adjust, loosen securing bolts of injection pump by roughly one turn.
- Adjust start of delivery by turning injection pump.

Tightening torques:

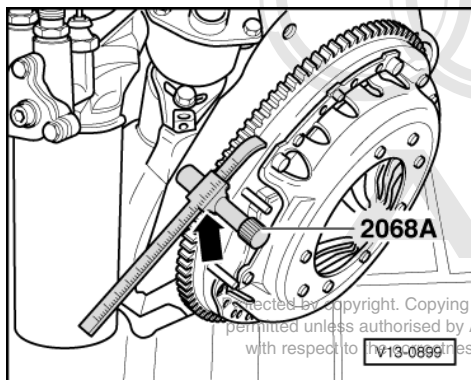
Injection pump securing bolts: 25 Nm
Threaded plug: 20 Nm

- Connect injection pipes, fuel feed line and cables.



- -> Fill injection pump with fuel as follows:
 - Screw connection fitting V.A.G 1318/10 into return opening of injection pump.
 - Connect vacuum hand pump V.A.G 1390 to return line using approx. 1 m transparent plastic tubing.
 - Operate vacuum hand pump until fuel emerges from return opening. Do not draw fuel into vacuum hand pump.
 - Connect return line.
 - Install toothed belt guard.
 - Dynamic testing and adjustment of start of injection
- => Page **19**

1.9 - Crankshaft TDC position with engine removed

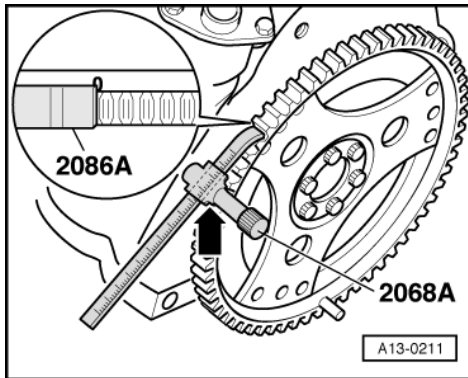


Test prerequisites:

- Oil cleaner removed

Vehicles with manual gearbox

- -> Screw in adjustment appliance 2068 A as shown.
- Set adjustment appliance to 107 mm -arrow-. Left notch of the vernier is reference point.
- Rotate crankshaft until TDC mark on flywheel is level with the edge of adjustment appliance -arrow-.



Vehicles with automatic gearbox

- -> Screw in adjustment appliance 2068 A as shown.
- Set adjustment appliance to 99 mm -arrow-. Left notch of vernier scale is reference point.
- Rotate crankshaft until TDC mark on flywheel is level with edge of adjustment appliance.

1.10 - Dynamic testing and adjustment of start of injection

Notes:

- ♦ The start of injection must always be checked and, if necessary, adjusted after replacing the toothed belt and after loosening screw connections at injection pump or toothed belt sprockets.
- ♦ Dynamic checking and correction of the start of injection are only possible in function 04 "Basic setting of engine", as the start of injection valve is constantly actuated during this function and the injection timing device thus moves to "late".

Testing and adjustment conditions

- Mechanical basic setting of engine OK
- Toothed belt tension OK

Basic setting 0

1	2	3	4	5	6	7
8	9	10				

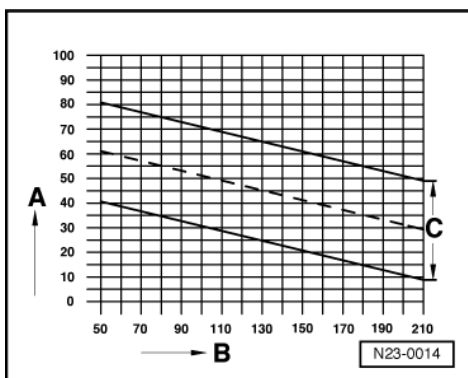
- > Initiate basic setting and select display group 00 => Page .
- Observe display in display field 7 (coolant temperature).

Basic setting 0

1	2	3	4	5	6	7
8	9	10				

-> Desired value: Less than 73 (corresponds to 85 oC)

Do not continue with test until coolant temperature has been reached.



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- -> The start of injection in display field 2 is governed by the fuel temperature (display field 9).

Desired value: => Fig. Area C

A - Display field 2: Start of injection

B - Display field 9: Fuel temperature

Notes:

- ♦ If start of injection is too early, injection pump is to be turned in direction of engine rotation; if it is too late, pump must be turned in opposite direction to engine rotation.
- ♦ If start of injection is in the desired value range -C- when checked, re-adjustment is not necessary. Set start of injection to mid value (dashed line) of desired value range -C- after performing repairs such as removal and installation of injection pump or adjustment of valve timing.
- Loosen securing bolts for injection pump roughly one turn, loosening most readily accessible bolt last.
- Keep injection pump pretensioned by hand in advance direction, carefully loosen last securing bolt such that pump can be turned slightly, and re-tighten securing bolt.

Basic setting 0

1 2 3 4 5 6 7

8 9 10

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-> Observe value in display field 2 and repeat adjustment if necessary until value displayed remains on mid value of desired value range -C-.

- Tighten securing bolts for injection pump (25 Nm).
- Recheck start of injection for desired value.

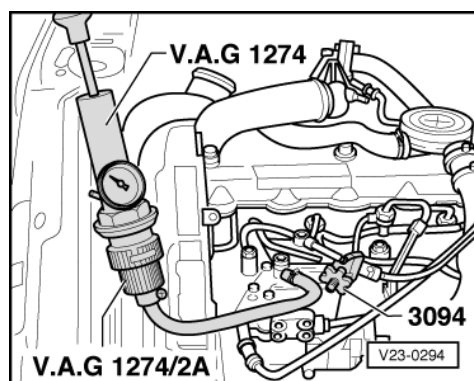
Note:

Following dynamic adjustment of injection pump, always loosen injection pipes at injection pump and then re-tighten (25 Nm). This relieves the strain on the pipes and avoids fatigue fracture.

1.11 - Testing fuel system for leaks

A leaking fuel system can cause:

- ♦ Foaming and/or air bubbles in feed line
- ♦ Lack of power, misfiring
- ♦ Starting problems



- -> Attach adapter V.A.G 1274/2 A to cooling system tester V.A.G 1274.
- Unscrew return line at injection pump.
- Attach adapter hose to injection pump in place of return line.
- Attach hose clamps 3093 or 3094 at the following points:
 - Feed line behind fuel filter
 - Return line behind fuel filter
 - Return line to injection pump
- Use hand pump of tester to generate a pressure of 1.0...1.5 bar.

- If pressure constantly decreases, localise leak and rectify fault.

Note:

Moving the hose clamps from the filter to the fuel tank connections also enables the fuel lines to be tested.

1.12 - Removing, installing and testing injectors

Note:

Defective injectors cause the following problems:

- ◆ Loss of power
- ◆ Excessive black exhaust smoke
- ◆ Excessive blue smoke when starting from cold
- ◆ High fuel consumption
- ◆ Overheating of engine
- ◆ Knocking in one or more cylinders
- ◆ Misfiring

Removal

- Remove injection pipes with open ring spanner 3035.

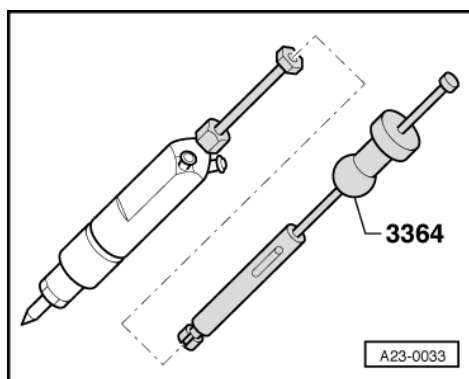
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Note:

Always remove complete set of injection pipes. 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:



- 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.

Installation

Note:

Always renew copper seal between cylinder head and injectors.

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



- Fit retainer.

Tightening torques:

Injection pipes: 25 Nm
Retainer clip nut: 20 Nm

Testing

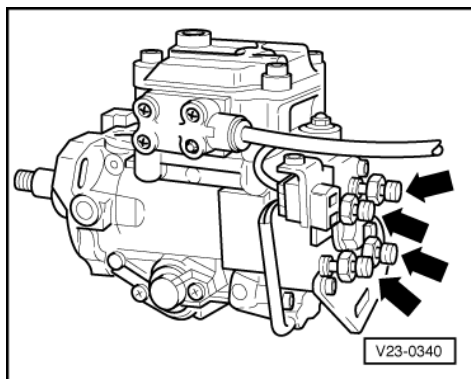
- ->

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

Read measured value block (function 08) and select display group 13, engine idling
=> Page

Desired value:-1.50 mg/S...+1.50 mg/S (milligrams per stroke)

- If one or more of desired values is/are outside the tolerance, swap the injectors round (except the injector for cylinder 3).
- If the fault moves along with the injector, fit a new injector.

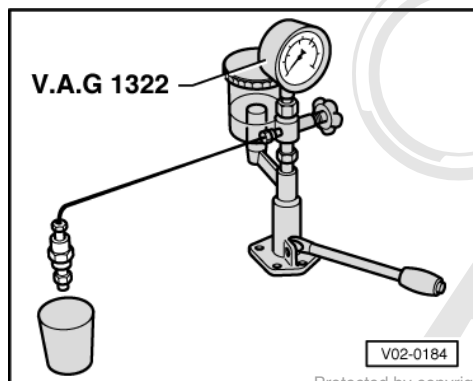


- If the fault remains on the same cylinder, check the compression.
- -> If compression is OK, replace corresponding constant pressure valve -arrow- with sealing ring (tightening torque 50 Nm).

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.

This engine is equipped with dual spring injectors. The fuel injected therefore occurs in 2 stages.
If faults occur with these injectors they are to be exchanged as neither servicing nor pressure setting is possible.



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

Warning!

When testing injectors ensure that the jet of fuel does not contact the hands as the high pressure will cause the fuel to penetrate the skin and may cause severe injuries.

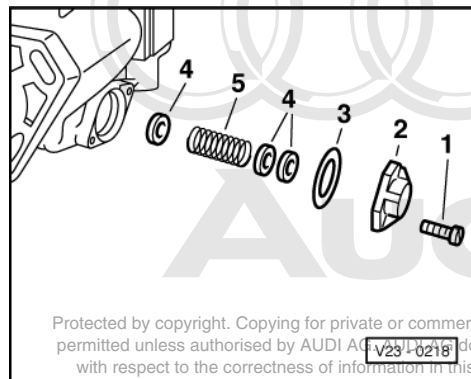
- Pressure gauge on
- Move pump lever down slowly. When injection begins, read off spray pressure. If the pressure does not match the desired value, fit a new injector.

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

Checking for leaks

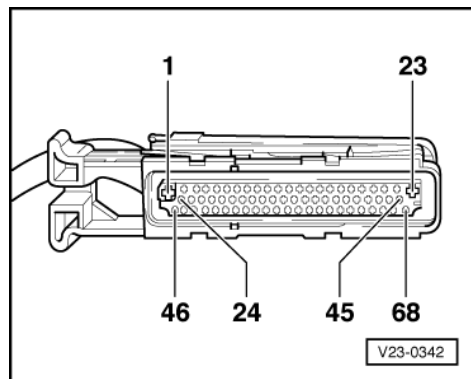
- Pressure gauge on
- Move pump lever down slowly and maintain a pressure of approx. 150 bar for 10 seconds. No fuel should leak from the nozzle tip.
- If injector leaks, replace.

1.13 - Replacing O-ring on injection timing device



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

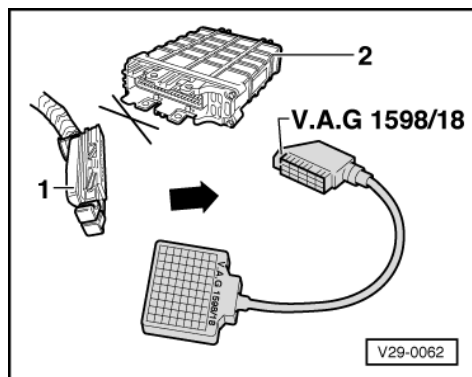
1.14 - Testing wiring and components with test box V.A.G 1598/18





Notes:

- ♦ Testing is to be performed using the hand-held multimeter V.A.G 1526 or the multimeter V.A.G 1715 and the LED test lamp V.A.G 1527.
- ♦ Use auxiliary leads from measuring tool set V.A.G 1594 for connection of testers to test box.
- ♦ -> The contact numbers of the connector coincide with the socket numbers of the test box.



- -> Pull connector -1- off control unit -2- with ignition switched off.
- Connect test box to connector of wiring loom.
- Perform testing as described in the respective repair operations.

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Warning!

To avoid damaging electronic components, activate respective measuring range before connecting test leads and ensure compliance with test prerequisites.

1.15 - Replacing control unit for engine electronics

Removal and installation

Position => Overview of fitting locations - Page 4

Always switch off ignition before detaching/attaching control unit connector.

Adapting control unit for engine electronics to electronic immobiliser

Test prerequisites:

- Availability of authorised vehicle key
- Connect fault reader V.A.G 1551
=> Page

-> Display:

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

```
Rapid data transfer      Q
25 - Immobiliser
```

- > Enter 25 for address word "Immobiliser" and acknowledge with Q.
- Press =>-button..

-> Display:

Rapid data transfer
Select function XX HELP

- Enter 10 for function "Adaption" and acknowledge with Q.

-> Display:

Adaption Q
Enter channel number XX

- Enter 00 for "Channel number 0" and acknowledge with Q.

-> Display:

Adaption Q
Erase adaption values?

- Acknowledge entry by pressing Q button.

-> Display:

Adaption
Adaption values erased

- Terminate adaption by pressing =>-button.

Note:

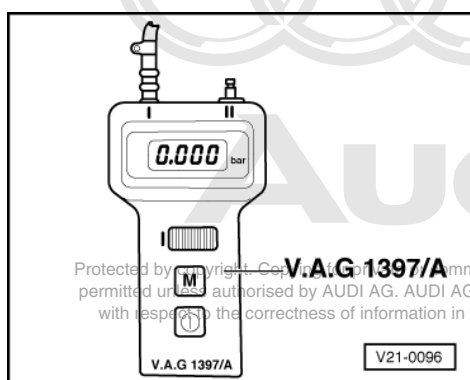
Engine control unit identifier is read into immobiliser control unit when ignition is next switched on.

2 - Testing boost pressure system

2.1 - Testing boost pressure system

2.2 - Testing boost pressure - engine code AFF, 1Z

To localise faults, the turbocharger (without boost pressure control) must always be checked first and then the boost pressure with boost pressure control.



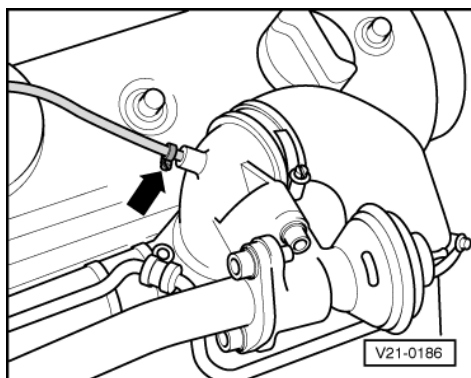
- Pull connector off solenoid valve for boost pressure limitation -N75 => Overview of fitting locations - Page 5.
- -> Boost pressure is measured in the course of a test drive with the turbocharger tester V.A.G 1397/A and the fault reader V.A.G 1551.

Test prerequisites:

- No leaks in intake and exhaust system.



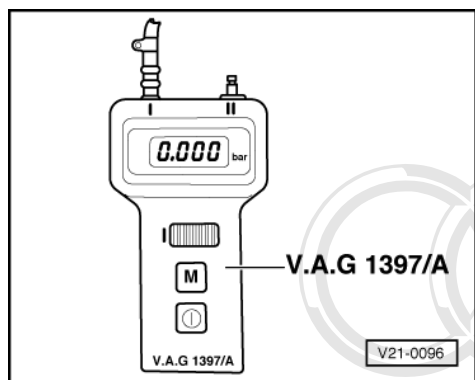
- Compression, hydraulic tappets and injectors OK.
- Pull cap off connecting pipe of intake manifold.
- Test connecting pipe for blockage (if applicable, penetrate soot layer with wire).



- -> Attach measuring hose of turbocharger tester to connecting pipe and secure with hose clamp.
- Feed measuring hose over rear edge of bonnet and through right-hand window opening into passenger compartment.

Notes:

- ♦ The hose connection must be absolutely tight to prevent measurement errors.



- ♦ Make sure that measuring hose does not become trapped at bonnet or side window.
- -> Switch on turbocharger tester, set measuring range switch to -I- and attach measuring hose to connection -I-.

Warning!

Second person is required to operate V.A.G 1397/A and V.A.G 1551.

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- ->

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

Read measured value block (function 08) and select display group 11, => Page .

- Accelerate vehicle in 3rd gear from roughly 1500 rpm at full throttle.
- At approx. 3000 rpm, simultaneously press memory button -M- on V.A.G 1397/A and PRINT button on V.A.G 1551.

Desired value on V.A.G 1397/A: 1.550...1.750 bar

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

-> Desired value on V.A.G 1551: 1550...1750 mbar (in display field 3)

Note:

The boost pressure level is to be determined with the turbocharger tester V.A.G 1397/A. The fault reader V.A.G 1551 is designed to check whether the boost pressure has also been recorded in the control unit.

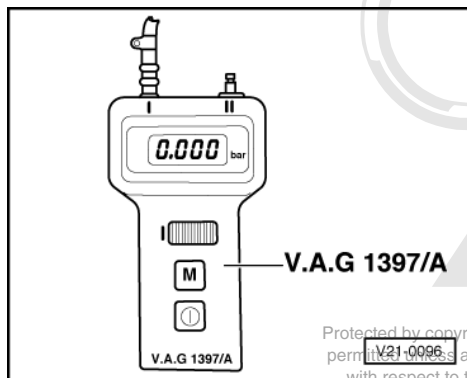
If the measured boost pressure is too low, this may be due to the following:

- Leakage between turbocharger and intake manifold
- Turbocharger defective (turbine blocked by foreign bodies)
- Actuator (linkage, shaft) of bypass valve stiff or stuck (bypass valve always open)

If the measured boost pressure is too high, this may be due to the following:

- Boost pressure control hoses fallen off, leaking or clogged.
- Solenoid valve for boost pressure limitation -N75 clogged
- Actuator (linkage, shaft) of bypass valve stiff or stuck (bypass valve always closed)
- Aneroid box leaking

If measured boost pressure is OK, repeat boost pressure measurement with boost pressure control:



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- Attach connector to solenoid valve for boost pressure limitation -N75.
- -> Boost pressure is measured in the course of a test drive with the turbocharger tester V.A.G 1397/A and the fault reader V.A.G 1551.

Warning!

Second person is required to operate V.A.G 1397/A and V.A.G1551.

- ->

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

Read measured value block (function 08) and select display group 11, => Page .

- Accelerate vehicle in 3rd gear from roughly 1500 rpm at full throttle.
- At approx. 3000 rpm, simultaneously press memory button -M- on V.A.G 1397/A and PRINT button on V.A.G 1551.

Desired value on V.A.G 1397/A: 1.800...2.050 bar

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

-> Desired value on V.A.G 1551: 1800...2050 mbar (in display field 3)

If the measured boost pressure is too low, this may be due to the following:

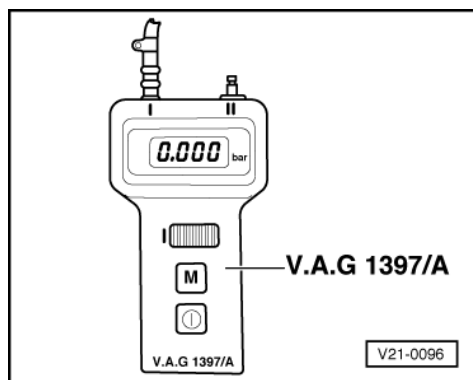
- No electrical function of solenoid valve for boost pressure limitation.
- Solenoid valve for boost pressure limitation -N75 stuck open.

If the measured boost pressure is too high, this may be due to the following:

- Solenoid valve for boost pressure limitation -N75 sometimes stuck closed.

- Boost pressure increase as a result of tuning

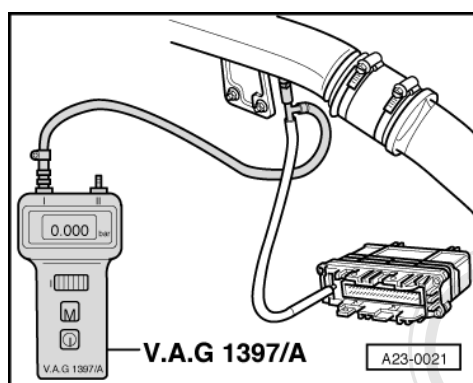
2.3 - Testing boost pressure - engine code AFN



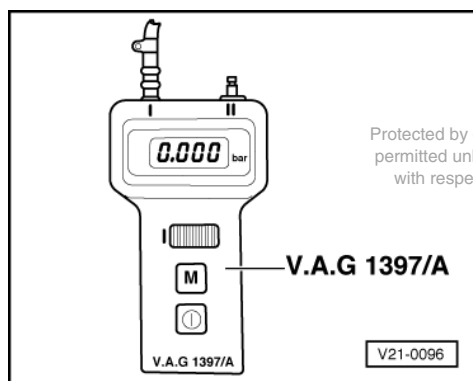
- -> Boost pressure is measured in the course of a test drive with the turbocharger tester V.A.G 1397/A and the fault reader V.A.G 1551.

Test prerequisites:

- No leaks in intake and exhaust system
- Compression, hydraulic tappets and injectors OK



- -> Additionally connect measuring hose of turbocharger tester with T-piece to pressure connection of intake manifold pressure sender and secure with hose clip.
- Feed measuring hose over rear edge of bonnet and through right-hand window opening into passenger compartment.



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Notes:

- ♦ The hose connection must be absolutely tight to prevent measurement errors.

- ♦ Make sure that measuring hose does not become trapped at the bonnet or side window.
- -> Switch on turbocharger tester, set measuring range switch to -I- and attach measuring hose to connection -I-.

Warning!

Second person is required to operate V.A.G 1397/A and V.A.G1551.

- ->

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

Read measured value block (function 08) and select display group 11, => Page .

- Accelerate vehicle in 3rd gear from roughly 1500 rpm at full throttle.
- At approx. 3000 rpm, simultaneously press memory button -M- on V.A.G 1397/A and PRINT button on V.A.G 1551.

Desired value on V.A.G 1397/A: 1.850...2.200 bar

Read measured value block 11			
3090 rpm	1948 mbar	1989 mbar	62 %

-> Desired value on V.A.G 1551: 1850...2200 mbar (in display field 3)

Note:

The boost pressure level is to be determined with the turbocharger tester V.A.G 1397/A. The fault reader V.A.G 1551 is designed to check whether the boost pressure has also been recorded in the control unit.

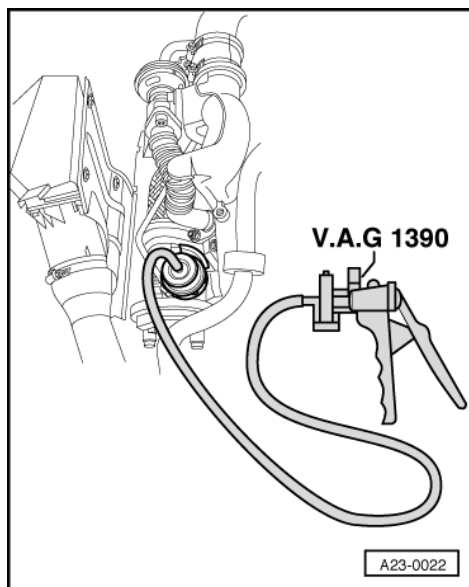
If measured boost pressure is not OK:

Final control diagnosis	
Solenoid valve for boost pressure limitation - N75	

-> Perform final control diagnosis and actuate solenoid valve for boost pressure limitation => Page .

Solenoid valve must operate (can be felt by touching valve).

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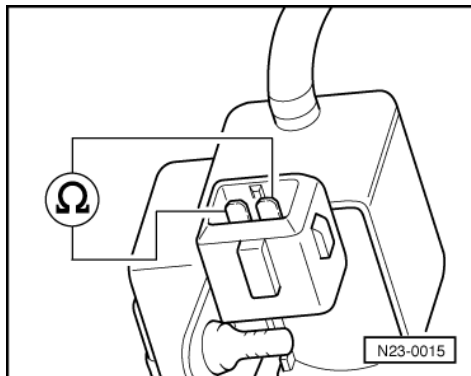
- If solenoid valve does not operate, test solenoid valve for boost pressure limitation -N75
=> Page 30

... and linkage of vacuum unit at turbocharger must move back and forth at least 3...4 times (as long as vacuum is present).

- -> If linkage does not move, connect vacuum hand pump V.A.G 1390 to vacuum unit and test freedom of movement of linkage.

- If linkage moves freely, test vacuum hoses => Page **35** .

2.4 - Testing solenoid valve for boost pressure limitation

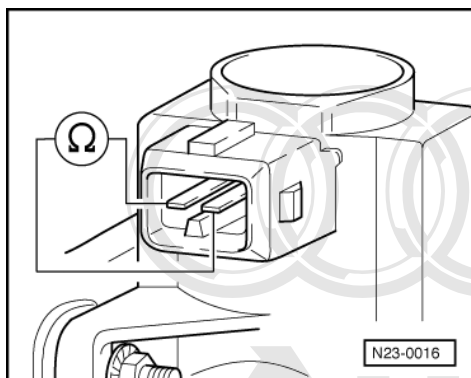


Electrical testing of solenoid valve for boost pressure limitation -N75

- Pull connector off valve => Overview of fitting locations, Page **5** .
- Measure resistance with hand-held multimeter V.A.G 1526 between contacts of solenoid valve.

-> Engine code AFF, 1Z

Desired value: 25 ... 45 ω



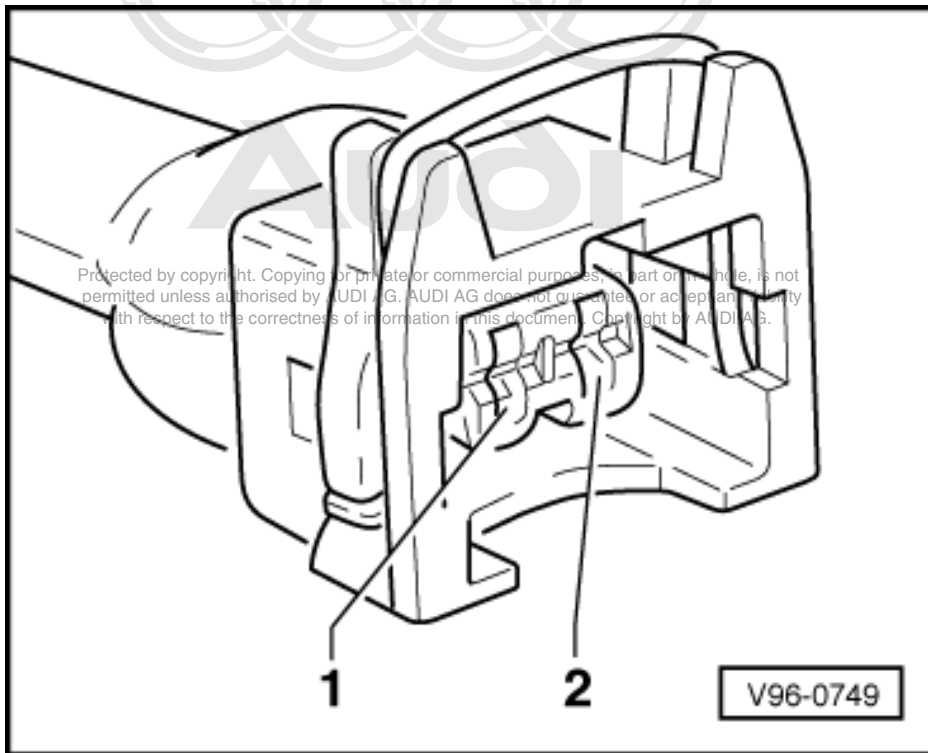
-> Engine code AFN

Desired value: 14 ... 20 ω

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- If the desired value is not attained, replace solenoid valve for boost pressure limitation -N75.

Testing voltage supply of solenoid valve for boost pressure limitation -N75.



- Pull connector off valve => Overview of fitting locations, Page 5 .
- -> Use auxiliary leads from V.A.G 1594 to connect hand-held multimeter V.A.G 1526 to contact 2 of connector and to earth.
- Activate 20 V measuring range.
- Switch on ignition.

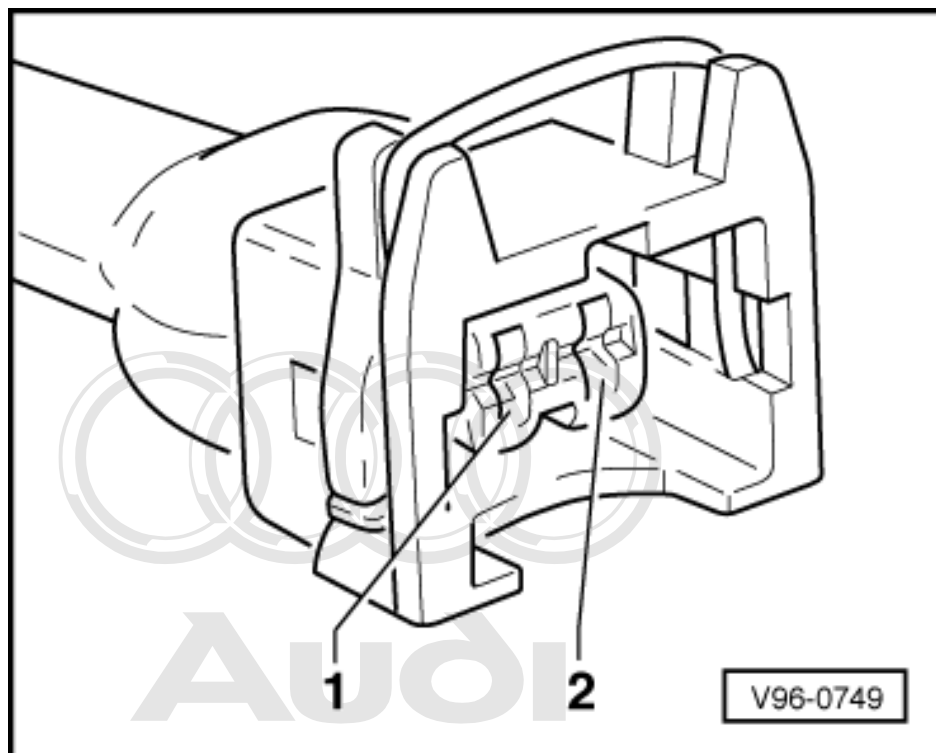
Desired value: approx. battery voltage

- If desired value is not attained, test cable connections to valve -N75.

Testing cable connection to solenoid valve for boost pressure limitation -N75.

- Pull connector off valve => Overview of fitting locations, Page 5 .
- Connect test box => Page 23

Check the following cable connections for short circuit to positive/negative and breaks.



2-pin connector at wiring loom, contact socket->	
1	47
2	68

- If applicable, eliminate cable break/short circuit.

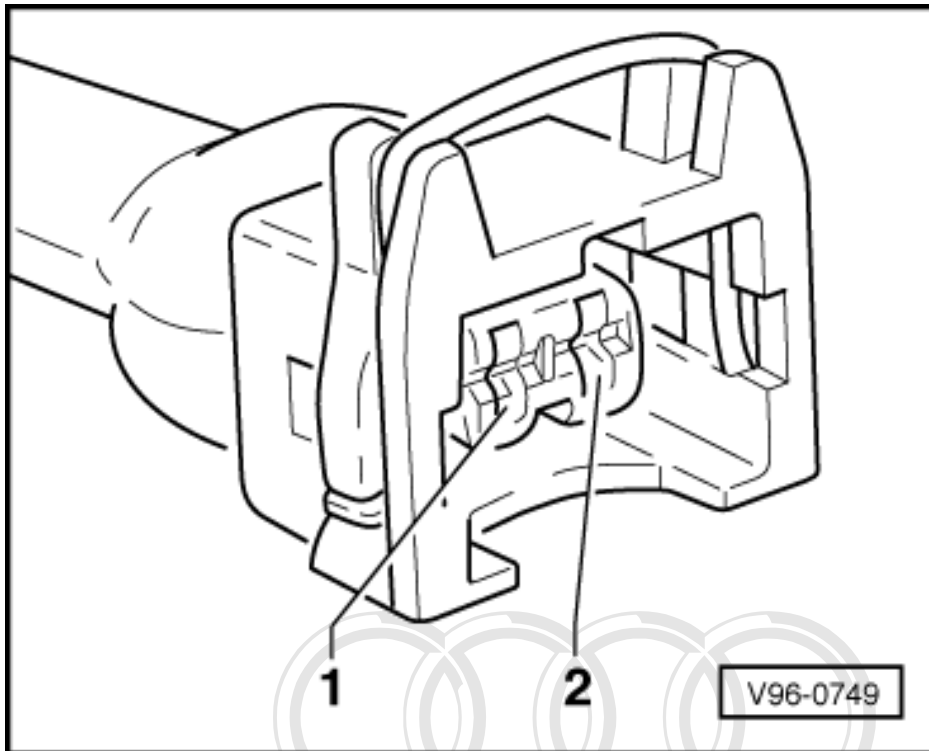
2.5 - Testing intake manifold temperature sender

Read measured value block 7
15.4 oC 15.9 oC 16.7 oC

- > Read measured value block (function 08) and select display group 07, engine stopped => Page .
- Observe reading in display field 3.

A substitute value of 18.9 oC is displayed in the event of a break in the cable to the intake manifold temperature sender.

- If reading in display field 3 is unrealistic or if substitute temperature of 18.9 oC is displayed, connect up test box =>Page 23 .
- Pull plug off sender => Overview of fitting locations, Page 2 .



Check the following cable connections for short circuit to positive/negative and breaks.

2-pin connector at wiring loom, contact	Test box V.A.G 1598/18, socket->
1	64
2	33

- If applicable, eliminate cable break/short circuit.
- If cable connections are OK, replace intake manifold temperature sender -G72.

2.6 - Testing intake manifold pressure sender and altitude sender

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

- ->

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

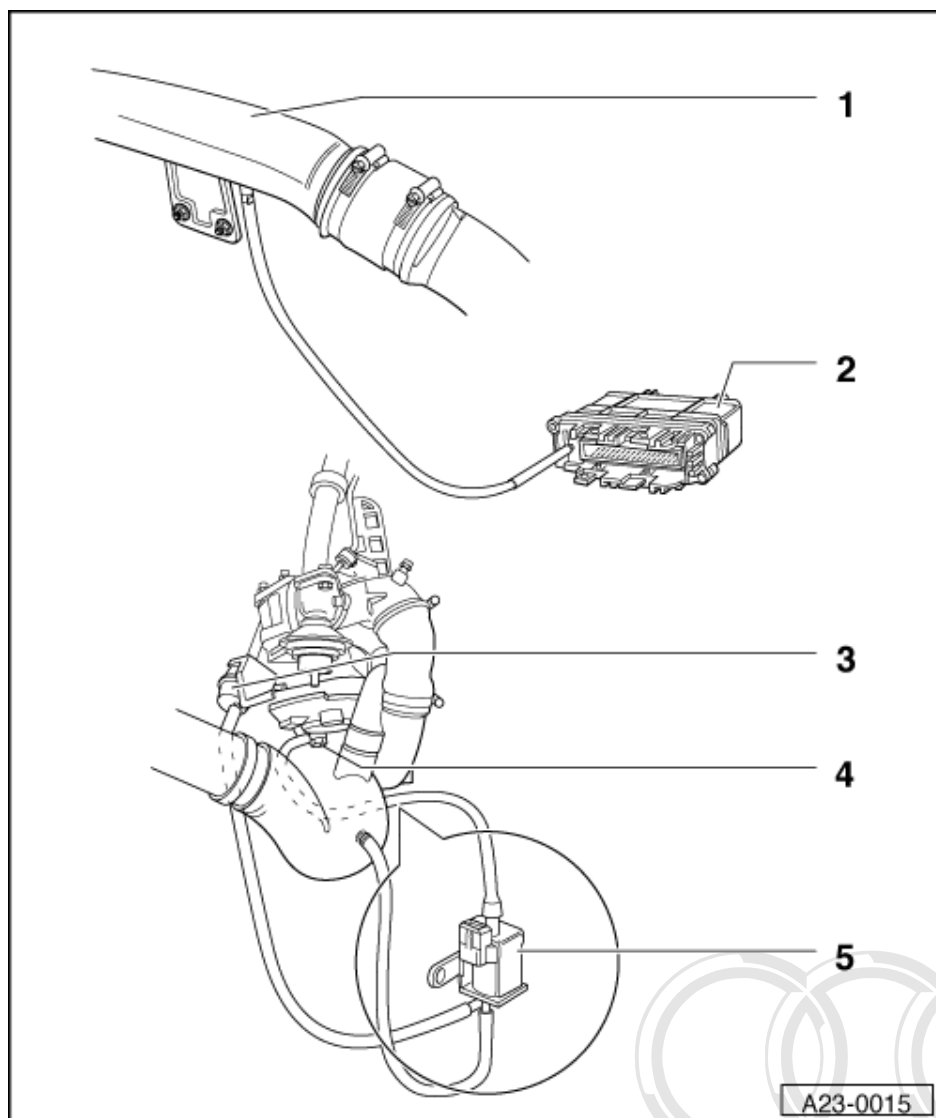
Read measured value block (function 08) and select display group 10, engine stopped => Page .

- Compare reading in display field 2 (altitude sender -F96) to that in display field 3 (intake manifold pressure sender -G71).

Desired value: Pressures match
(Tolerance ± 30 mbar)

- If desired value is not attained, pull pressure hose off control unit.
- If the desired value is still not attained, replace diesel direct injection system control unit.

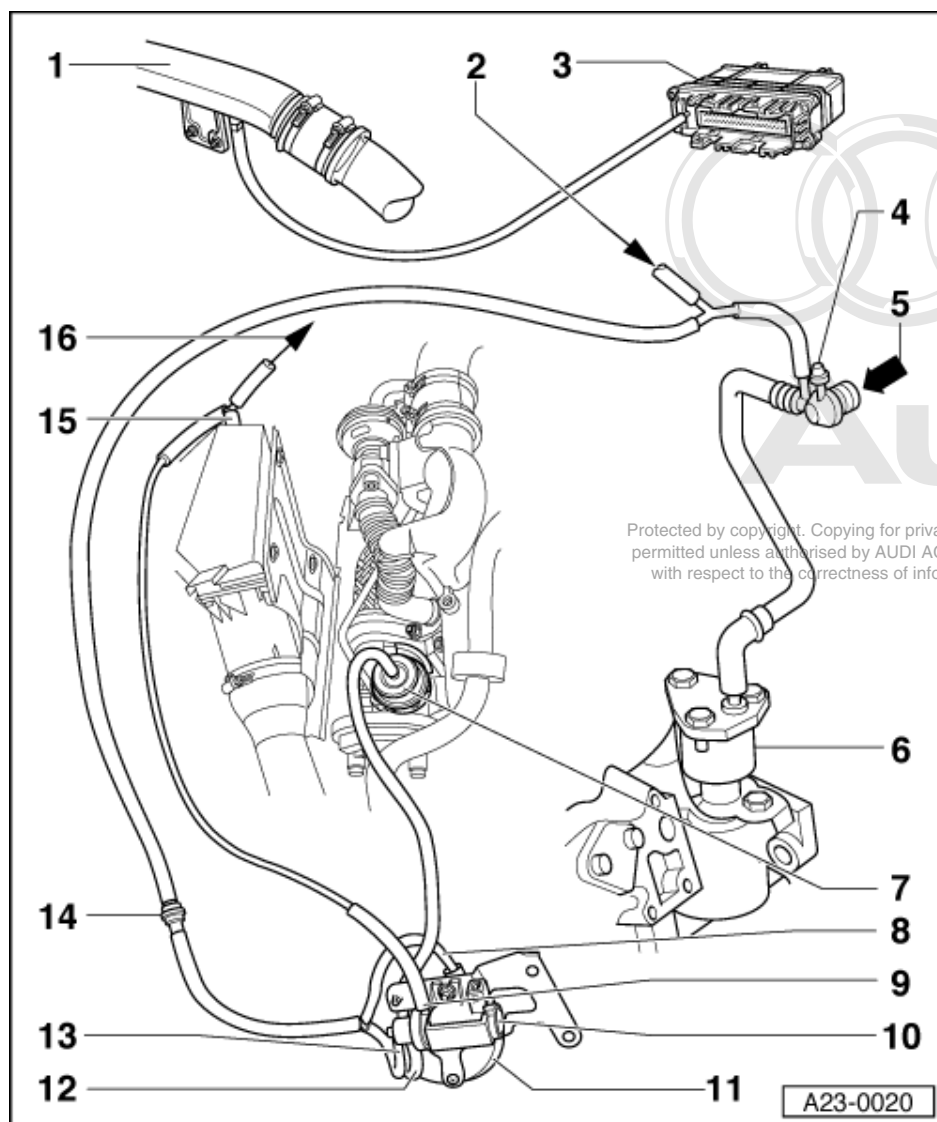
2.7 - Diagram of hoses for boost pressure control - engine code AFF, 1Z



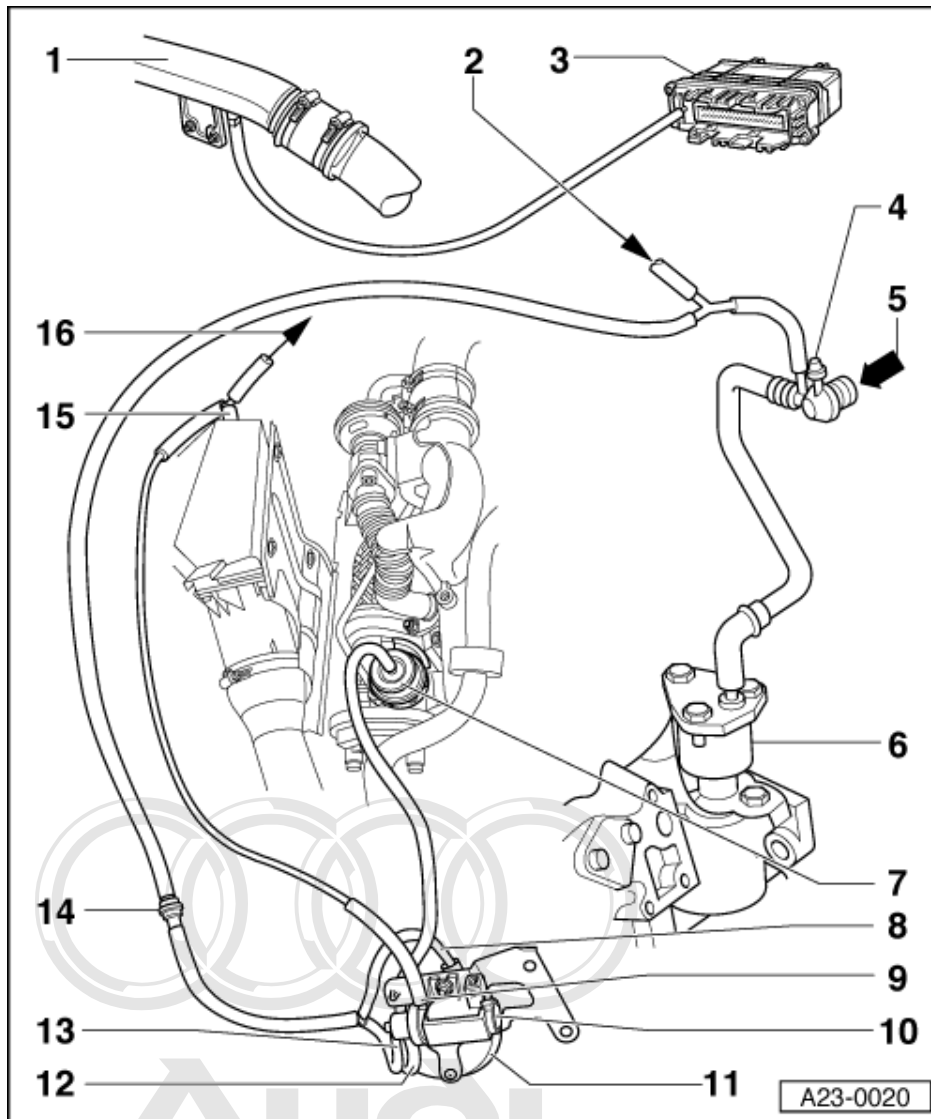
- 1 Connecting pipe between intercooler and intake manifold with pressure connection from intake manifold pressure sender -G71
- 2 Control unit with intake manifold pressure sender -G71
- 3 Aneroid box for boost pressure control
- 4 Pressure connection on turbocharger (pressure supply for boost pressure control)
- 5 Solenoid valve for boost pressure limitation -N75

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- 7 Vacuum unit for boost pressure control**
- 8 Vacuum connection on vacuum reservoir**
 - ♦ To non-return valve - Item **14**
- 9 Vent connection**
 - ♦ To air cleaner - Item **15**
- 10 Solenoid valve for boost pressure limitation -N75**
- 11 Vacuum reservoir**
- 12 Control connection**
 - ♦ To vacuum unit - Item **7**
- 13 Vacuum connection**
 - ♦ To non-return valve - Item **14**



14 Non-return valve

- ♦ Position: Grey connection facing solenoid valve

15 Vent connection on air cleaner
 16 Vent line

- ♦ For exhaust gas recirculation

3 - Testing fuel injection control

3.1 - Testing fuel injection control

3.2 - Testing injection timing device

Final control diagnosis
 Start of injection valve- N108

-> Perform final control diagnosis and actuate start of injection valve => Page .

When start of injection valve is actuated, a distinct change in combustion noise must be heard (injection timing device fluctuates between "late" and "early").

Basic setting 0					
40	46	0	20	90	201
153	127	83			64

- > Initiate basic setting (function 04) and select display group 00 => Page .
- Correct start of injection if necessary => Page 19 .
- Pull out fuse for engine electronics in E-box.
- Observe reading in display field 2.

-> Reading in display field 2 must run up to 255.

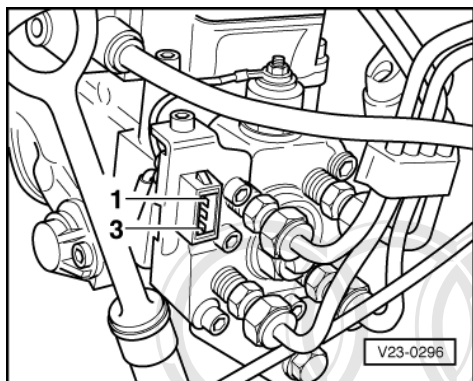
Basic setting 0					
40	255	0	20	90	201
64	153	127	83		

Note:

The break in voltage causes the start of injection valve to close. The internal pump pressure can no longer be reduced and acts in full on the timing device plunger. The timing device moves to the "early" stop.

- If desired value is not attained, timing device is blocked in injection pump and injection pump must be replaced.
- Interrogate and erase fault memory. Several faults may have been stored as a result of pulling out the fuse.

3.3 - Testing start of injection valve



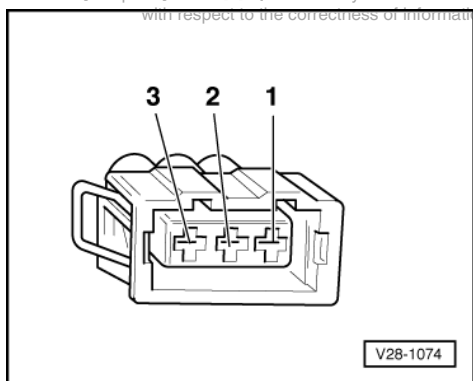
Electrical testing of start of injection valve -N108

- Detach connector at injection pump => Overview of fitting locations, Page 4 .
- -> Use hand-held multimeter V.A.G 1526 to measure resistance between contacts 2 and 3.

Desired value: 12 ... 20 ω

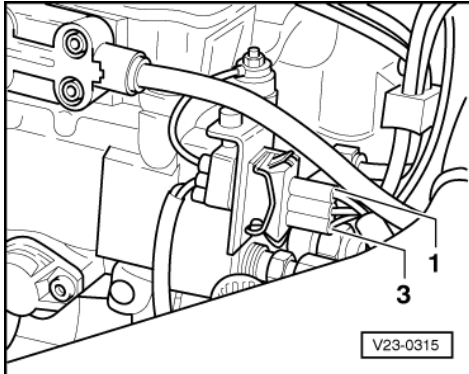
- If desired value is not attained, replace start of injection valve -N108 => Page 8

Testing voltage supply of valve -N108



- -> Use auxiliary leads from V.A.G 1594 to connect hand-held multimeter V.A.G 1526 to contact 3 of connector and to engine earth.
- Activate 20 V measuring range.
- Switch on ignition.

Desired value: approx. battery voltage



- If desired value is not attained, eliminate cable break or short circuit.

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

Testing actuation of valve -N108

- -> Connect LED test lamp V.A.G 1527 with test prods from measuring tool set V.A.G 1594 between contacts 2 and 3 of connector.

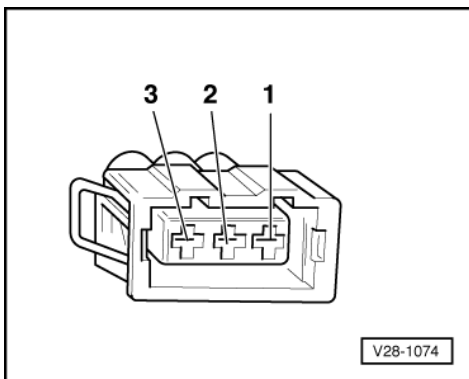
Final control diagnosis
Start of injection valve- N108

-> Perform final control diagnosis and actuate start of injection valve => Page .

LED test lamp must flash on actuation of start of injection valve.

- If LED test lamp does not flash or if it remains constantly lit, conect up test box => Page 23 .

Check following cable connections for short circuit to positive/negative and breaks.



3-pin connector at wiring loom, contact	Test box V.A.G 1598/18, socket->
2	51

- If applicable, eliminate cable break/short circuit.
- If there is neither a cable break nor a short circuit, replace diesel direct injection system control unit =>Page 24

3.4 - Testing fuel temperature sender

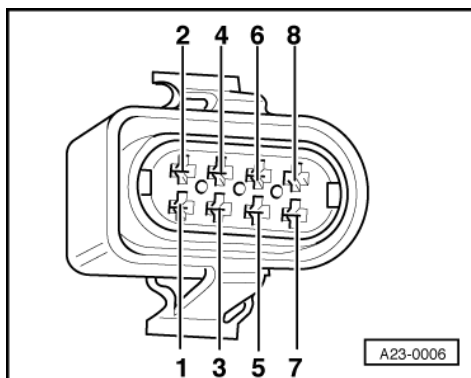
-> Read measured value block (function 08) and select display group 07, engine stopped => Page .

Read measured value block 7
15.4 oC 15.9 oC 16.7 oC

- Observe reading in display field 1.

A substitute value of -5.6 oC is displayed in the event of a break in the cable to the fuel temperature sender.

- If reading in display field 1 is unrealistic or if substitute temperature of -5.6 oC is displayed, connect up test box =>Page 23 .
- Detach sender connector => Overview of fitting locations, Page 3 .



Check the following cable connections for short circuit to positive/negative and breaks.

8-pin connector at wiring loom, contact	Test box V.A.G 1598/18, socket->
4	33
7	63

- If applicable, eliminate cable break/short circuit.

4 - Testing exhaust gas recirculation

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4.1 - Testing exhaust gas recirculation

4.2 - Testing operation

The exhaust gas recirculation function is tested by way of the intake air mass. If exhaust gas is being recirculated, the proportion of fresh air sensed by the air mass meter is smaller. The greater the volume of exhaust gas recirculation, the lower the signal from the air mass meter.

-> Read measured value block (function 08) and select display group 01, engine idling
=> Page

Read measured value block 1
840 rpm 6.5 mg/S 1.480 V
87.3 oC

- Observe reading in display field 4 (coolant temperature).

Read measured value block 1
840 rpm 6.5 mg/S 1.480 V 87.3
oC

-> Desired value: at least 80 oC.

Do not continue with test until coolant temperature has been attained.

- Press button C and enter 03 for "Display group 03".

-> Display:

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

- Give short burst of throttle, then allow engine to return to idle.
- Observe readings in display fields 2 and 3.

-> Display:

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

Display field 2 (desired)	Display field 3 (actual)	Possible cause
230...370 mg/S	230...370 mg/S	OK
Greater than 370 mg/S	Greater than 370 mg/S	Engine too cold Load switched on Injection pump too lean
230...370 mg/S	Less than 230 mg/S	Leakage air Excessive ex- haust gas recir- culation
230...370 mg/S	Greater than 370 mg/S	not enough or no exhaust gas recirculation
	Constant 425 mg/ S	Fixed substitute value because: Break in cable to air mass me- ter or measure- ment of implau- sible air mass

Final control diagnosis
EGR valve -N18

-> If desired values are not attained, perform final control diagnosis and actuate EGR valve -N18 => Page .

EGR valve must click when actuated.

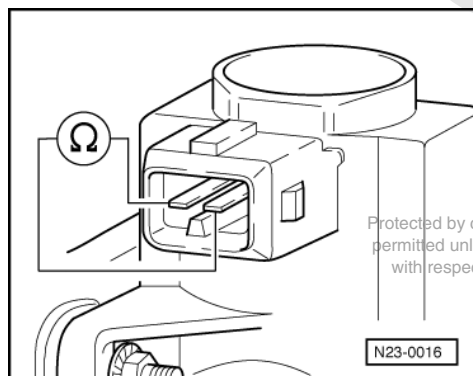
- If valve does not click, test EGR valve -N18 => Page 42 .
- If valve clicks, check vacuum hoses => Page 46 .
- If vacuum hoses are OK, test mechanical EGR valve

=> Engine mechanical system; Repair Group 26



4.3 - Testing exhaust gas recirculation valve

Electrical testing of EGR valve -N18

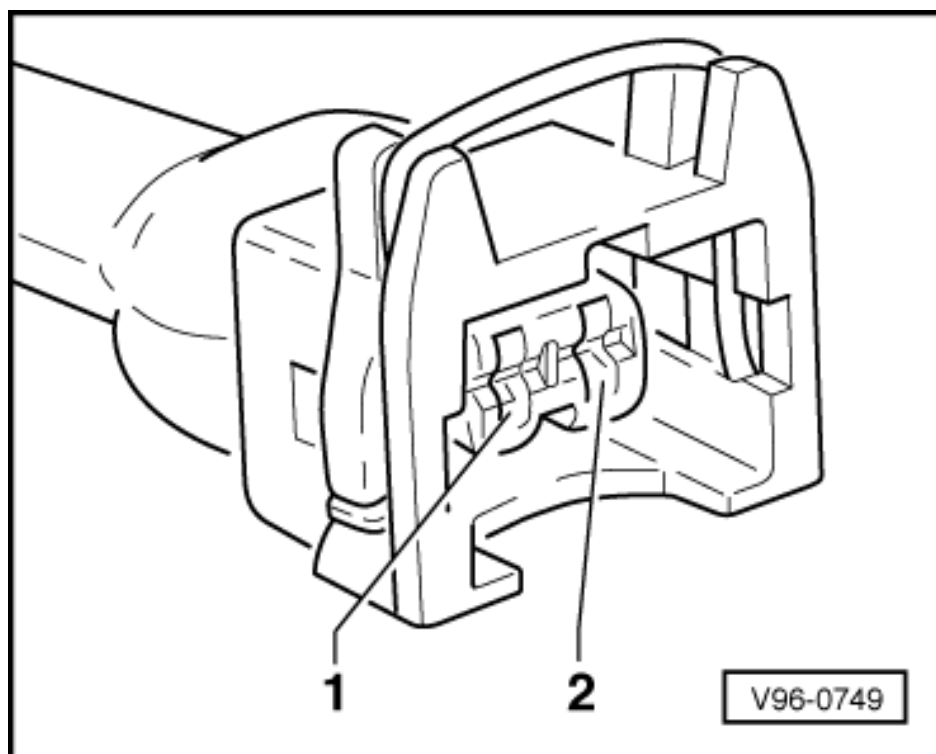


- Pull connector off valve=>Overview of fitting locations, Page 3 .
- -> Use hand-held multimeter V.A.G 1526 to measure resistance between valve contacts.

Desired value: 14...20 Ω

- If the desired value is not attained, replace EGR valve -N18.

Testing voltage supply for EGR valve -N18



- Pull connector off valve=>Overview of fitting locations, Page 3 .
- -> Use auxiliary leads from V.A.G 1594 to connect hand-held multimeter V.A.G 1526 to contact 2 of connector and to engine earth.
- Activate 20 V measuring range.
- Switch on ignition.

Desired value: approx. battery voltage

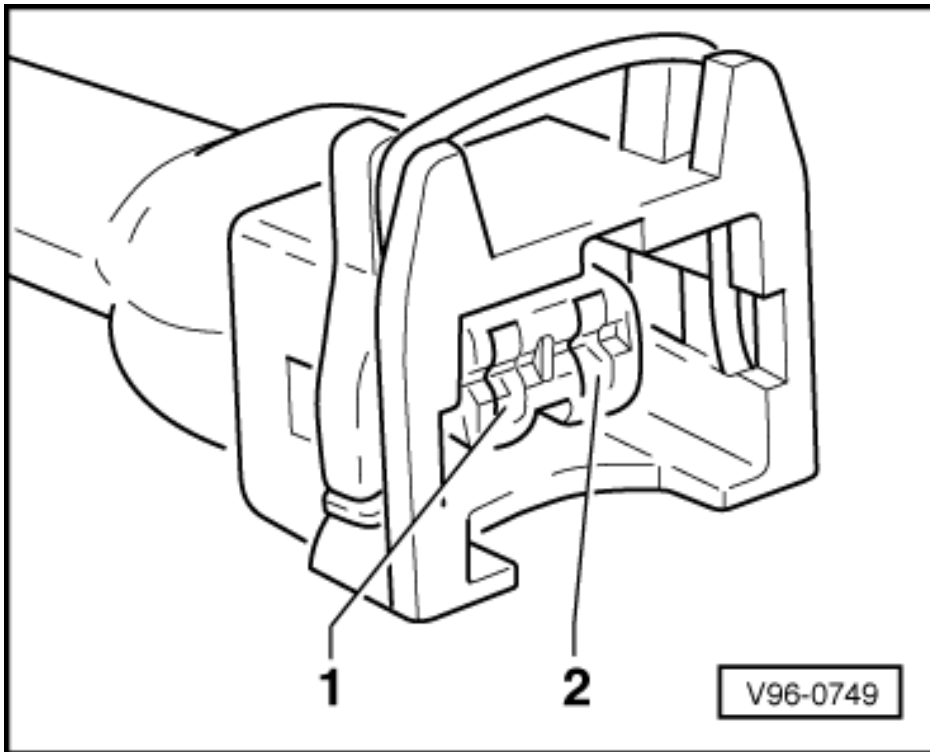
- If desired value is not attained, rectify cable break or short circuit.

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

Testing cable connection to EGR valve (N18)

- Pull connector off valve => Overview of fitting locations, Page 3 .
- Connect up test box => Page 23

Check following cable connections for short circuit to positive/ negative and breaks.



2-pin connector at wiring loom, contact	Test box V.A.G 1598/18, socket->
1	25

- If applicable, eliminate cable break/short circuit.
- If there is neither a cable break nor a short circuit, replace diesel direct injection system control unit =>Page 24

4.4 - Testing air mass meter

Testing operation

The air mass meter signal is required by the control unit for calculating the permissible injection quantity and for regulating the exhaust gas recirculation. The lower the signal from the air mass meter, the less fuel may be injected.

Read measured value block 10

309 mg/S 1030 mbar 1011 mbar 0.0 %

- > Read measured value block (function 08) and select display group 10, engine idling => Page
- Observe reading in display field 1 (intake air mass).

Read measured value block 10

309 mg/S 1030 mbar 1011 mbar 0.0 %

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-> Desired value: 230...370 mg/S

- If desired value is not attained, test exhaust gas recirculation => Page 40 .

Warning!

Second person is required to operate V.A.G 1551.

- Accelerate vehicle in 3rd gear from roughly 1500 rpm at full throttle.
- At approx. 3000 rpm, press PRINT button on V.A.G 1551.

-> Desired value in display field 4: 100% (accelerator pedal position)

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

- If value in display field 4 is less than 100%, full throttle has not been applied and the test is to be repeated.

-> Desired value in display field 3: (boost pressure)

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

Engine code AFF, 1Z: 1800...2050 mbar
Engine code AFN: 1850...2200 mbar

- If the value in display field 3 is outside tolerance, test boost pressure system => Page 25 .

-> Desired value in display field 1: (intake air mass)

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

Engine code AFF, 1Z: > 750 mg/S
Engine code AFN: > 850 mg/S

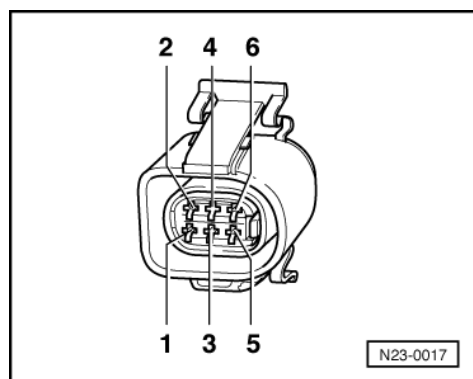
- If desired value in display field 1 is not attained, replace air mass meter -G70.

If reading in display field 1 is a constant 425 mg/S (fixed substitute value), this may be due to the following:

- ♦ Cable break or short circuit
- ♦ Measurement of implausible air mass (leakage air, air mass meter defective)

Testing voltage supply of air mass meter -G70

- Detach connector for air mass meter => Overview of fitting locations, Page 5 .
- Switch on ignition.
- Activate 20 V measuring range.



- -> Use hand-held multimeter V.A.G 1526 to measure voltage between following connector contacts.

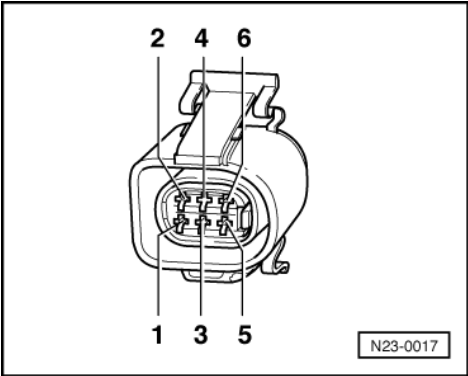
6-pin connector at wiring loom, contact	Desired value
3 + earth	Battery voltage 1)
3 + 5	Battery voltage 1)
1 + earth	approx. 5 V2)
1 + 5	approx. 5 V2)

- 1) If desired value is not attained
- => Current Flow Diagrams, Electrical Fault-Finding and Fitting Locations binder
- 2) If desired value is not attained, test cable connections.

Testing cable connection to air mass meter -G70

- Detach connector for air mass meter => Overview of fitting locations, Page 5 .
- Connect up test box => Page 23

Check following cable connections for short circuit to positive/ negative and breaks.

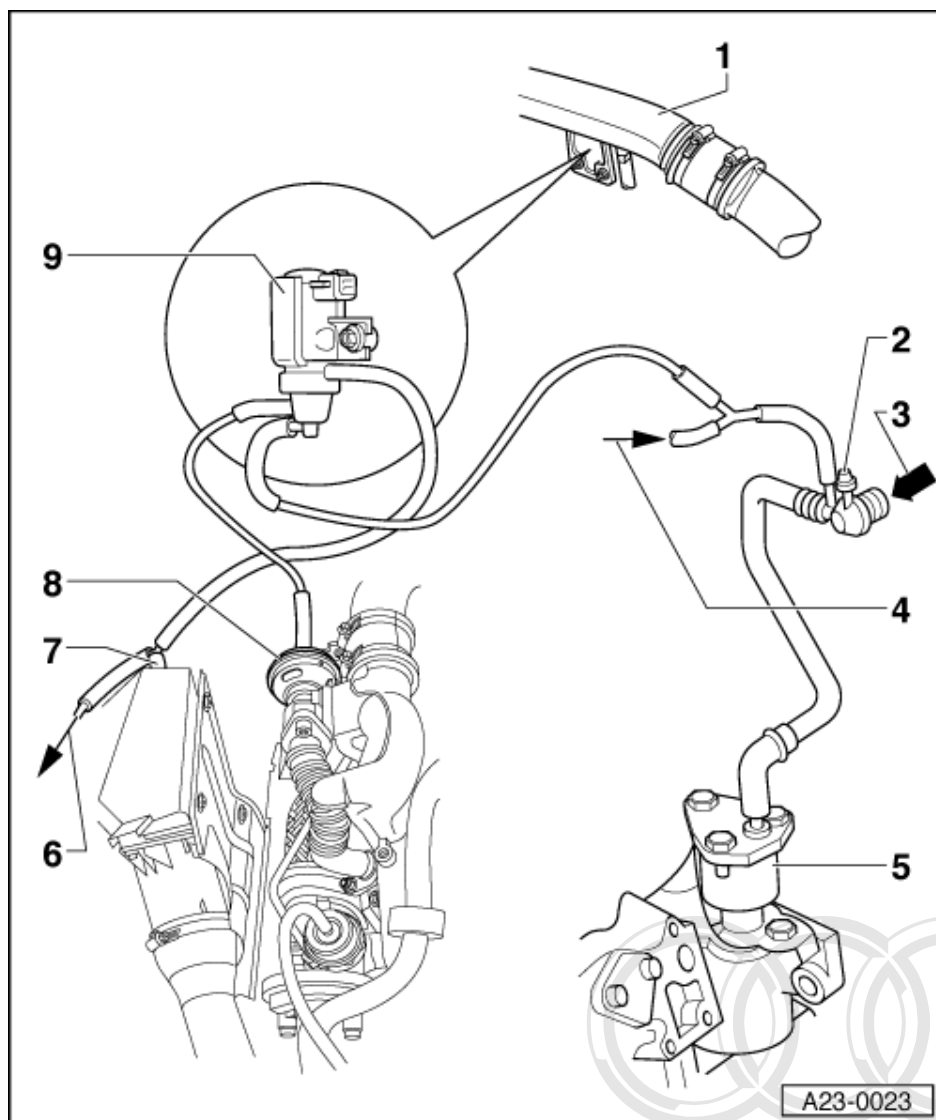


6-pin connector at wiring loom, contact	Test box V.A.G 1598/18, socket->
1	19
2	33
3	23, 45, 68
4	-
5	1, 24, 46
6	13

- If applicable, eliminate cable break/short circuit.



4.5 - Vacuum system diagram



- 1 Connecting pipe between intercooler and intake manifold
- 2 Vacuum supply
 - ♦ For air conditioner
- 3 Vacuum supply
 - ♦ For servo unit
- 4 Vacuum supply
 - ♦ For boost pressure control (engine code AFN only)
- 5 Vacuum pump
- 6 Vent line
 - ♦ For boost pressure control (engine code AFN only)
- 7 Vent connection at air cleaner
- 8 Mechanical exhaust gas recirculation valve
- 9 EGR valve -N18

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5 - Testing control unit input variables

5.1 - Testing control unit input variables

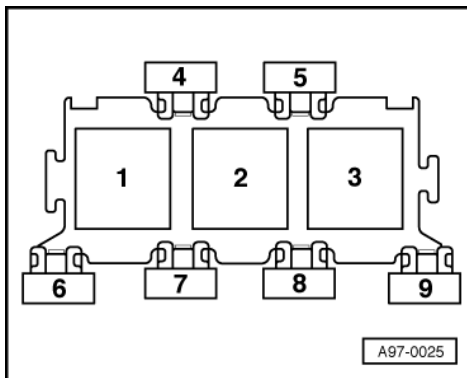
5.2 - Testing voltage supply for diesel direct injection system

The injection system is supplied with voltage via the diesel direct injection system relay -J322.

A prerequisite for making the main contacts at the relay -J322 is application of voltage via terminal 15 at the diesel direct injection system control unit. In other words, relay -J322 is only connected to earth (via diesel direct injection system control unit) when voltage is being applied to the control unit by way of terminal 15.

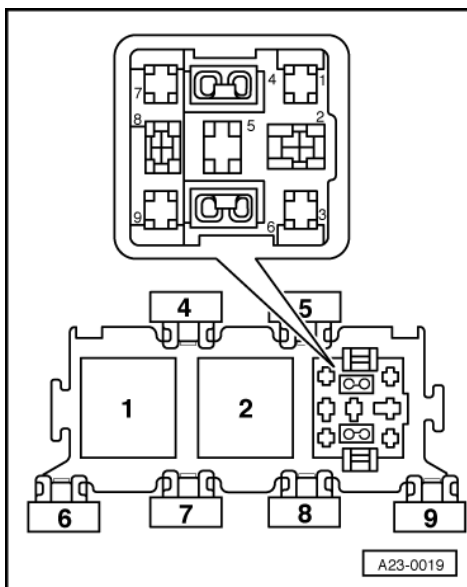
Test prerequisite:

- Battery voltage OK



Testing voltage supply, terminal 15

- -> Pull diesel direct injection system relay -J322 out of relay frame 3 (auxiliary relay plate in E-box).
- Connect up test box => Page 23
- Switch on ignition.
- Activate 20 V measuring range.
- Use hand-held multimeter V.A.G 1526 to measure voltage between following contacts:



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Test box V.A.G 1598/18, socket	Test box V.A.G 1598/18, socket
38	1, 24, 46

Desired value: approx. battery voltage

Relay frame 3 in E-box, contact	Test box V.A.G 1598/18, socket->
1	1, 24, 46

Desired value: approx. battery voltage 1)

1) With engine code AFF and AFN, battery voltage must also be applied to relay frame 3, contact 1 with "Ignition off".

- If the desired values are not attained, check cable connections.

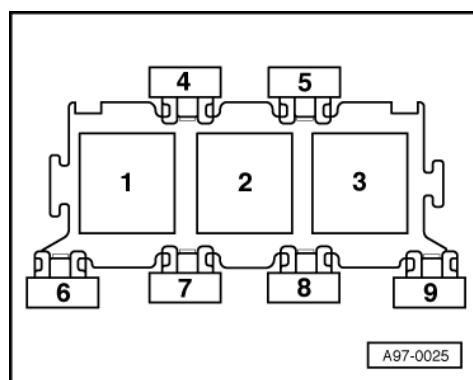
=> Current Flow Diagrams, Electrical Fault-Finding and Fitting Locations binder

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Testing earth actuation of diesel direct injection system relay -J322

Test prerequisite:

- Voltage supply, terminal 15 OK
- Remove cover of E-box.
- Switch on ignition.



-> Desired value: Diesel direct injection relay -J322 at relay position 3 must be energised.

Note:

Clicking of the relay is not easy to hear and can thus be best felt by touching the relay.

- If relay does not energise, switch off ignition.
- Connect up test box => Page 23
- Use auxiliary lead from V.A.G 1594 to connect following sockets of test box.

Test box V.A.G 1598/18, socket	Test box V.A.G 1598/18, socket
42	1

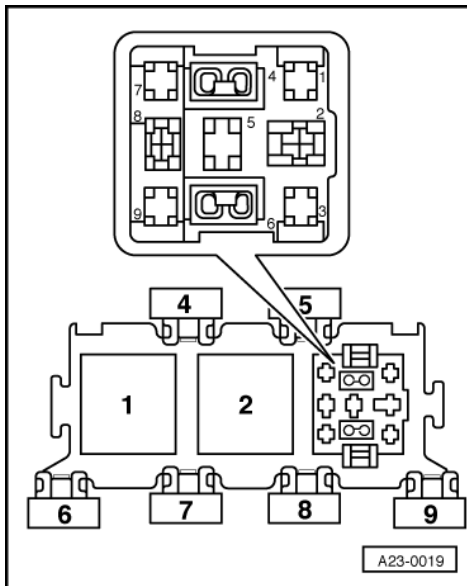
- Switch on ignition.

Desired value: Diesel direct injection relay -J322 at relay position 3 must be energised.

- If relay is now energised, replace control unit for diesel direct injection system -J248 => Page 24 .
- Switch off ignition if relay does not energise.

- Pull relay out of relay frame 3.

Check following cable connections for short circuit to positive/negative and breaks.



Relay frame 3 in E-box, contact	Test box V.A.G 1598/18, socket->
4	42

- If applicable, eliminate cable break/short circuit.
- If there is neither a cable break nor a short circuit, replace diesel direct injection system relay -J322.

Testing voltage supply, terminal 30

Test prerequisites:

- Voltage supply, terminal 15 OK
- Earth actuation of relay -J322 OK.
- Connect up test box => Page 23
- Use auxiliary lead from V.A.G 1594 to connect following sockets of test box.

Test box V.A.G 1598/18, socket	Test box V.A.G 1598/18, socket
42	42

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- Activate 20 V measuring range.
- Connect hand-held multimeter V.A.G 1526 between following test box sockets.

Test box V.A.G 1598/18, socket	Desired value
45 + 46	approx. battery voltage
68 + 46	approx. battery voltage
23 + 46	approx. battery voltage

- If desired values are not attained, check cable connections.

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

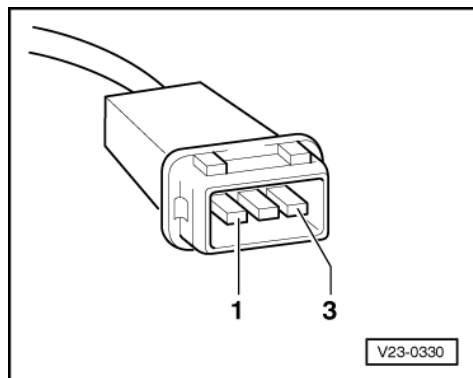
- If there is neither a cable break nor a short circuit, replace diesel direct injection system relay -J322.

5.3 - Testing engine speed sender

The engine speed sender is an engine speed and reference mark sender. In the event of failure, the engine continues to run in the emergency program. The substitute sender is the needle lift sender -G80.

Electrical testing of engine speed sender -G28

- Detach sender connector => Overview of fitting locations, Page 2 .



- -> Use hand-held multimeter V.A.G 1526 to measure resistance between contacts 1 and 2 of connection to sender.

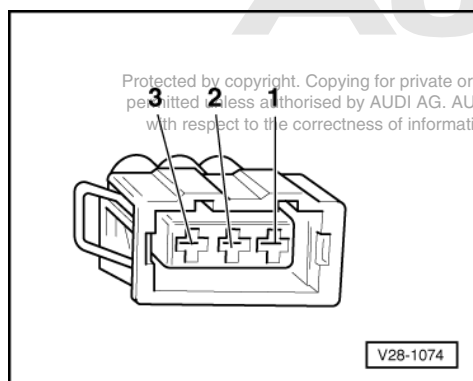
Desired value: approx. 1 kΩ

- If desired value is not attained, replace engine speed sender -G28.

Testing cable connections to engine speed sender -G28

- Detach sender connector => Overview of fitting locations, Page 2 .
- Connect up test box => Page 23

Check the following cable connections for short circuit to positive/negative and breaks.

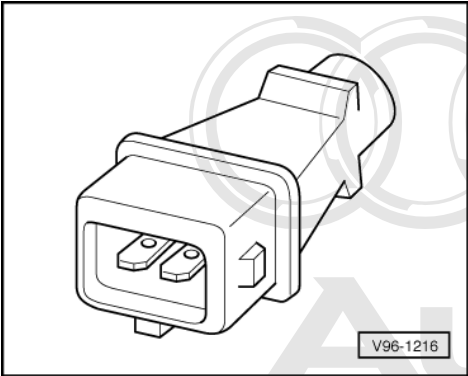


3-pin connector at wiring loom, contact	Test box V.A.G 1598/18, socket->
1	33
2	8
3	1, 24, 46

- If applicable, eliminate cable break/short circuit.

5.4 - Testing needle lift sender

The needle lift sender signal is required for determining the start of injection. In the event of failure, the start of injection is subject to open-loop control (as a function of engine speed and load), whereas in normal operation it is subject to closed-loop control (governed by engine speed, load and temperature).



Electrical testing of needle lift sender -G80

- Detach sender connector => Overview of fitting locations, Page 2
- -> Use hand-held multimeter V.A.G 1526 to measure resistance between connector contacts.

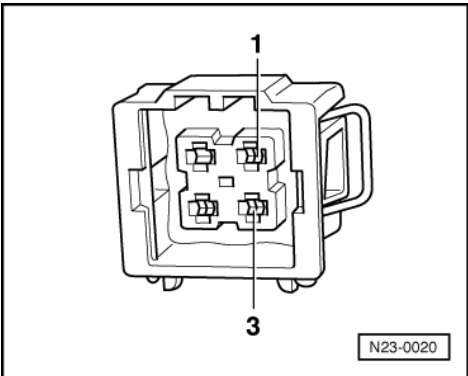
Desired value: 90...120 ω (when the engine is hot the resistance may be up to 20 ω higher)

- If desired value is not attained, replace cylinder 3 injector with needle lift sender -G80.

Testing cable connections to needle lift sender -G80

- Detach sender connector => Overview of fitting locations, Page 2 .
- Connect up test box => Page 23

Check following cable connections for short circuit to positive/negative and breaks.



4-pin connector at wiring loom, contact	Test box V.A.G 1598/18, socket->
1	33
3	14

- If applicable, eliminate cable break/short circuit.

5.5 - Testing coolant temperature sender

Read measured value block 7			
15.4	oC	15.9 oC	16.7 oC

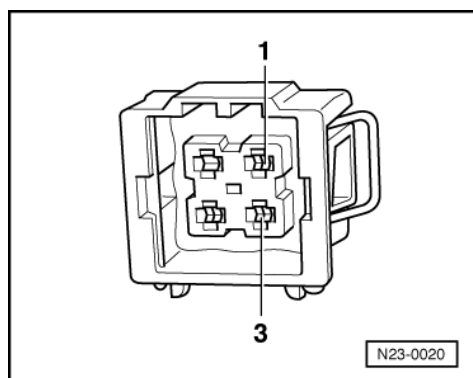


- > Read measured value block (function 08) and select display group 07, cold engine at idle
=> Page
- Observe reading in display field 4 (coolant temperature).

The temperature value must increase steadily.

In the event of a fault, approximate fuel temperature is displayed as substitute.

- If reading in display field 4 is unrealistic or if fuel temperature is displayed as substitute, connect up test box
=>Page **23**.
- Detach sender connector => Overview of fitting locations, Page **3**.



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Check the following cable connections for short circuit to positive/negative and breaks.

4-pin connector at wiring loom, contact	Test box V.A.G 1598/18, socket
1	33
3	14

- If applicable, eliminate cable break/short circuit.
- If cable connections are OK, replace coolant temperature sender -G62.

5.6 - Testing brake light switch and brake pedal switch

As the injection system works with an accelerator pedal sender (potentiometer) which could be defective, the engine speed is regulated for safety reasons when the brake is actuated. The brake light switch signal and also the brake pedal switch signal are required for this purpose in the control unit. If the brake is actuated with the accelerator pedal constantly pressed down, the engine speed is immediately regulated down to approx. 1200 rpm. Incorrect switch settings can lead to unwanted regulation.

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

- > Read measured value block (function 08) and select display group 06, engine idling
=> Page
- Observe reading in display field 2.

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

-> Desired value: 0 0 0

- Slowly apply the brake.

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

-> Desired value: 0 1 1

Both displays must switch simultaneously from 0 to 1.

- Allow brake pedal to slowly return to rest position.

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

-> Both displays must switch back from 1 to 0.

If the displays do not switch at the same time:

- Cause switching points to coincide by turning switches.

Notes:

- ♦ In the case of vehicles only featuring one switch with 4-pin connection, both contact pairs are in one housing. Mutual adjustment of the switching points is thus not possible.
- ♦ When the engine is running, the return force of the brake pedal is substantially less than when it is stopped (servo unit). The switch plungers must be firmly pressed into the switches even when the engine is running and the brake pedal is not pressed.
- ♦ If the engine is subjected to sporadic speed regulation, screw switch further into pedal support and then re-adjust.

If one or both displays does/do not switch from 0 to 1:

- Test switches/cable connections to switches.

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5.7 - Testing modulating piston movement sender and quantity adjuster

The quantity adjuster -N146 is an electromagnetic rotating adjuster which is actuated by the control unit by way of a specific duty cycle. The eccentric shaft of the quantity adjuster moves the control slider on the high-pressure piston and thus determines the injected quantity.

The modulating piston movement sender -G149 signals the position of the quantity adjuster to the control unit and thus defines the amount injected.

Testing operation

Read measured value block 1
840 rpm 5.6 mg/S 1.480 V 87.3
oC

-> Read measured value block (function 08) and select display group 01, engine idling

=> Page

- Check reading in display field 4 (coolant temperature).

Read measured value block 1
840 rpm 5.6 mg/S 1.480 V 87.3
oC

-> Desired value: at least 85 oC.

Do not continue with test until coolant temperature has been reached.

- Switch off any auxiliary loads (AC, rear window heater, light, etc.) which may be on.
- Check reading in display field 3 (modulating piston movement sender voltage).

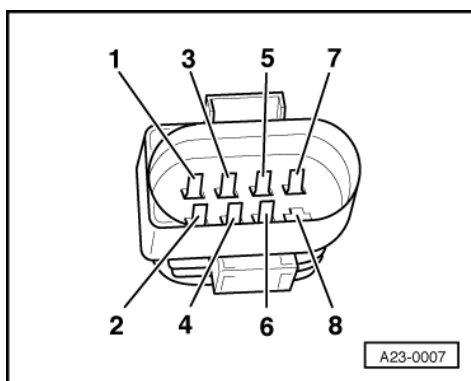
Read measured value block 1
840 rpm 5.6 mg/S 1.480 V 87.3
oC

-> Desired value: 1.250...1.750 V

- If desired value is not attained, replace injection pump.

Electrical testing of modulating piston movement sender -G149 and quantity adjuster -N146.

- Detach connector
=> Overview of fitting locations, Page 3 .
- Use hand-held multimeter V.A.G 1526 to measure resistance between following contacts of injection pump connector:

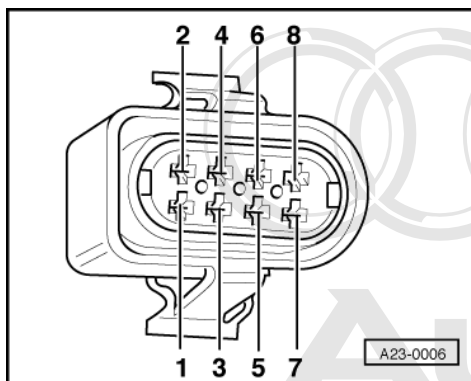


Injection pump connector	Desired value->
1 + 2	4,9...7,5 ω
3 + 2	4,9...7,5 ω
6 + 5	0,4...1,1 ω

- If desired value is not attained, replace injection pump.

Testing voltage supply and cable connections

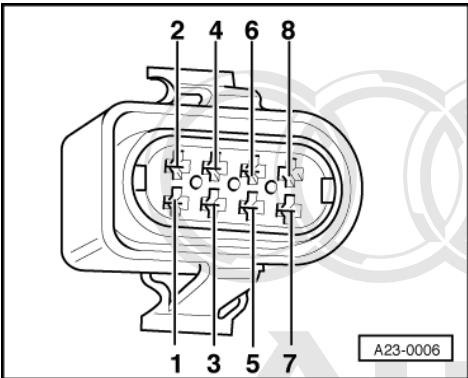
- Detach connector
=> Overview of fitting locations, Page 3 .
- Switch on ignition.
- Activate 20 V measuring range.
- Use hand-held multimeter V.A.G 1526 to measure voltage between following contacts:



8-pin connector at wiring loom, contact	Desired value->
1 + earth	Approx. 2.5 V
3 + earth	Approx. 2.5 V
5 + earth	Approx. 12 V

- If desired values are not attained, connect up test box => Page 23 .

Check following cable connections for short circuit to positive/negative and breaks.



8-pin connector at wiring loom, contact	Test box V.A.G 1598/18, socket->
1	29
2	7
3	52
5	23, 45, 68
6	4, 5, 49

- If applicable, eliminate cable break/short circuit.

5.8 - Testing accelerator position sender

The accelerator pedal position sender is located on the accelerator pedal and conveys driver inputs to the control unit.

- Read measured value block, display group 02, engine not running => Page .

-> Display:

Read measured value block 2
0 rpm 0.0 % 0 1 0
18.4 oC

- Check reading in display field 2 (accelerator pedal position).

Read measured value block 2
0 rpm 0.0 % 0 1 0 18.4
oC

-> Desired value: 0.0 % (accelerator pedal not pressed)

- Check display in display field 3.

Read measured value block 2
0 rpm 0.0 % 0 1 0 18.4
oC

-> Desired value:

0 1 0 (accelerator pedal not pressed)

0 0 0 (accelerator pedal pressed)

- Press accelerator pedal down slowly.

Read measured value block 2
0 rpm 100.0 % 0 0 0
18.4 oC

-> Desired value: Reading in display field 2 must steadily increase to

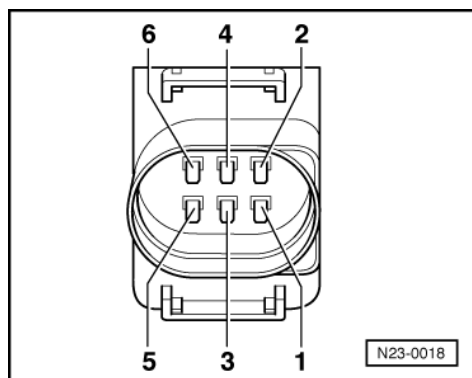
100% (with accelerator floored).

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

- If final desired value is not attained, adjust accelerator position sender => Page 13

If the reading does not change or only changes irregularly:

- Switch off ignition.
- Disconnect connector for sender =>Overview of fitting locations, Page 2.



- -> Connect multimeter to the following contacts on the connector, to measure the resistance:

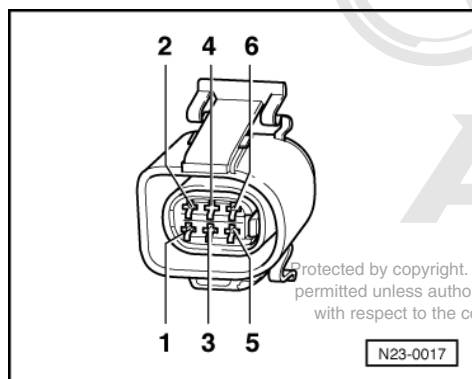
Accelerator pedal	Contacts	Desired value->
Not pressed	1 + 3	0.8...1.4 kΩ
Not pressed	2 + 3	0.8...1.4 kΩ
Not pressed	4 + 6	0.8...1.2 kΩ
Pressed		Infinity Ω
Not pressed	5 + 6 Vehicles with automatic gearbox only	Infinity Ω
Floored		0.8...1.2 kΩ

If desired value is not attained:

- Fit a new accelerator position sender (G79).

If the desired value is attained:

- Connect up test box => Page 23



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Check following wiring connections for short circuit to positive/negative and breaks.

6-pin connector at wiring loom, contact	Test box V.A.G 1598/18, socket->
1	15
2	57
3	55
4	65
6	1, 24, 46
Vehicles with automatic gearbox only:	
5	62

- If applicable, eliminate cable breaks/short circuit.

6 - Testing additional signals

6.1 - Testing additional signals

6.2 - Testing signals from/to automatic gearbox

A - Signal for gear shift

The signal briefly reduces the injected quantity on shifting gear (torque reduction) to make shifting smoother.

Read measured value block 9
1 2 3 4

- > Read measured value block (function 08) and select display group 09, engine idling
=> Page
- Observe reading in display field 3.

Desired value: 51 mg/S

- Perform test drive.

Warning!
Second person is required to operate V.A.G 1551.

- Accelerate vehicle from standstill with full throttle, but not with kickdown.

Read measured value block 9
1 2 3 4

- > Observe display field 3 on shifting into 2nd gear.

Desired value: Briefly less than 51 mg/S

Note:

As a result of the data transfer lag, there may be a delay before the desired value is displayed.

- If desired value is not attained, connect up test box => Page 23
- Test cable connection between test box, socket 18 and control unit for automatic gearbox for continuity/short circuit and repair if necessary.



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

B - Accelerator pedal position signal

This signal is required for load-dependent calculation of the shift times.

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

Signal test

=> Automatic gearbox; Repair Group 01

C - Engine speed signal

This signal is required for calculating the shift comfort.

Signal test

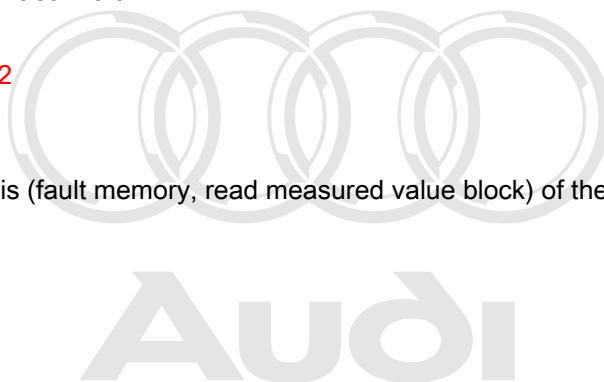
=> "Testing engine speed signal", Page **62**

D - Kickdown signal

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

Signal test

=> Automatic gearbox; Repair Group 01



6.3 - Test signals from/to AC

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Testing AC compressor cut-off

The engine control unit cuts out the AC compressor:

- ♦ On rapid acceleration from low speed (detected via change in angle at accelerator position sender and by way of road speed signal)
- ♦ In emergency program (limp-home mode)
- ♦ If coolant temperature is more than 120 °C
- ♦ After every start for roughly 6 seconds

Test prerequisites:

- Air conditioner OK
- No fault in fault memory

Final control diagnosis

-> Perform final control diagnosis and actuate AC compressor engagement => Page .

The AC compressor must come to a stop within 5 s (visual inspection) and then start up and stop again every 5 s.

- If the compressor does not come to a halt, connect up test box => Page **23** .
- Test cable connection between test box, socket 28 and air conditioner for continuity/short circuit and repair if necessary.

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

Testing AC signal

The AC signal is only required on vehicles with automatic gearbox. On vehicles with manual gearbox, there is no cable connection for the AC signal.

The AC signal informs the engine control unit that the AC needs a higher idling setting to provide the necessary passenger compartment temperature (irrespective of whether cooling or heating is required).

Read measured value block 2						
820 rpm	0.0 %	0	1	0	18.4	
OC						

-> Read measured value block (function 08) and select display group 02, engine idling
=> Page

- Switch on AC, press "Auto" button and select minimum temperature.
- Check display in display field 3.

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Read measured value block 2						
860 rpm	0.0 %	1	1	1	18.4	
OC						

-> Desired value:
X X 1 (AC compressor signal)

- If desired value is not attained, connect up test box => Page 23 .
- Test cable connection between test box, socket 37 and air conditioner for continuity/short circuit.

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

6.4 - Testing clutch pedal switch

This signal is designed to prevent speed overshoots and jerkiness on switching from throttle open to throttle closed and vice versa when declutching. It is needed for the cruise control system.

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

-> Read measured value block (function 08) and select display group 06, engine stopped
=> Page

- Observe reading in display field 2.

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

-> Desired value: 0 0 0

- Press clutch pedal.

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

-> Desired value: 1 0 0

- If desired value is not attained, connect up test box => Page 23 .
- Test cable connection between test box, socket 17 and clutch pedal switch.

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

- Replace clutch pedal switch if cable connection is OK.



6.5 - Testing speed signal

The signal is required for AC compressor cut-off on acceleration, for the cruise control system and to enhance ride comfort (lurch damping).

Test prerequisites:

- Function and display of speedometer OK
- If no speed is indicated on speedometer

=> Electrical System; Repair Group 90

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

- > Read measured value block (function 08) and select display group 06, engine idling
- => Page
- Perform test drive.

Warning!
Second person is required to operate V.A.G 1551.

- Observe reading in display field 1.

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

- > The current speed must be displayed (compare to speedometer).
 - If speed is not displayed, connect up test box => Page 23 .
 - Test cable connection between test box, socket 43 and dash panel insert for continuity/short circuit.
- => Current Flow Diagrams, Electrical Fault-Finding and Fitting Locations binder
- Use current flow diagram to ascertain all additional "receivers" of speed signal (e.g. radio, automatic gear-box, AC), switch off one after the other as the source of interference and repeat test until the cause has been established.

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6.6 - Testing cruise control system (CCS)

With the exception of the operating switch, the CCS has no components of its own. All functions are executed by the diesel direct injection system.

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

- > Read measured value block (function 08) and select display group 06, engine idling
- => Page
- Observe reading in display field 4.

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

-> Desired value: 0

- > If value 255 is indicated in display field 4, there is no CCS function => CCS activation - Page 62 .

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

Vehicles with automatic gearbox only:

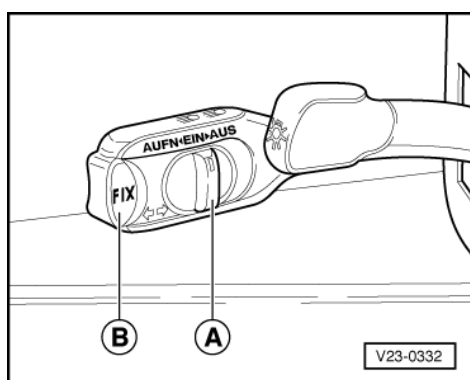
- Perform test drive, exceeding speed of 30 km/h once. Then leave engine running and selector lever in position 2, 3 or D. Apply parking brake.

Note:

On vehicles with automatic gearbox, power is only supplied to the CCS switch at speeds in excess of 30 km/h and with selector lever in position 2, 3 or D. The power supply is then retained even when idling as long as a driving position is engaged (not 1 or R).

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

-> Observe reading in display field 3.

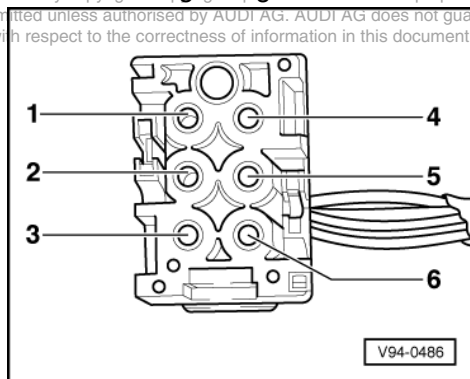


Test prerequisite:	Display field 3->
Switch A on "OFF", engaged	000000
Switch A on "OFF", before engagement point	000010
Switch A on "ON"	000011
Switch A on "RES"	001011
Switch B pressed	000111
Brake pedal pressed	010011
Clutch pedal pressed	100011

- If desired value is not attained, connect up test box => Page 23 .
- Detach connector at CCS switch

=> Electrical System; Repair Group 94

Check following wiring connections for short circuit to positive/negative and breaks.





6-pin connector at wiring loom, contact	Test box V.A.G 1598/18, socket->
1	58
2	34
3	35
4	66
51)	To fuse for engine electronics in E-box.
52)	To automatic gearbox control unit
6	66

1) Vehicles with manual gearbox

2) Vehicles with automatic gearbox

- If applicable, eliminate cable break/short circuit.
- If cable connections are OK, replace CCS switch -E45.

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- Connect fault reader V.A.G 1551
=> Page

-> Display:

Rapid data transfer	HELP
Select function	xx

- Enter 11 for function "Login procedure" and acknowledge with Q.

-> Display:

Login-procedure	HELP
Enter code number	XXXXX

- Enter code number 11463 and acknowledge with Q button.

6.7 - Testing engine speed signal

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

The signal shape generated by the engine speed sender -G28 cannot however be evaluated and is therefore conditioned beforehand in the engine control unit.

Establish engine speed signal as follows:

Dash panel insert

- Observe reading on rev counter.

The current engine speed must be displayed.

Air conditioner

- Connect fault reader V.A.G 1551
=> Page

-> Display:

Rapid data transfer HELP
Enter address word XX

Rapid data transfer Q
08 - Air conditioner

- > Enter 08 for address word "Air conditioner" and acknowledge with Q.
- Press => -button.

-> Display:

Rapid data transfer HELP
Select function XX

- Enter 08 for function "Read measured value block" and acknowledge with Q.

-> Display:

Read measured value block HELP
Enter display group number XX

- Enter 09 for display group "09" and acknowledge with Q.

-> Display:

Read measured value block 9
1 2 3 4

- Observe reading in display field 1.

The current engine speed must be displayed.

Automatic gearbox

- Connect fault reader V.A.G 1551
=> Page

-> Display:

Rapid data transfer HELP
Enter address word XX

Rapid data transfer Q
02 - Gearbox electronics

- > Enter 02 for address word "Gearbox electronics" and acknowledge with Q.
- Press => -button.

-> Display:

Rapid data transfer HELP
Select function XX

- Enter 08 for function "Read measured value block" and acknowledge with Q.

-> Display:

Read measured value block HELP
Enter display group number XX

- Enter 03 for display group "03" and acknowledge with Q.

-> Display:

Read measured value block 3
1 2 3 4



- Observe reading in display field 2.

The current engine speed must be displayed.

If desired value is not attained for all "receivers" of engine speed signal, this may be due to the following:

- ♦ Cable break/short circuit between control unit for diesel direct injection system, contact 2 and distributor in instrument panel wiring loom.

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

- ♦ Short circuit between distributor in instrument panel wiring loom and "receiver".
- ♦ Diesel direct injection system control unit defective

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If desired value is attained with at least one "receiver" of engine speed signal, this may be due to the following:

- ♦ Cable break between distributor in instrument panel wiring loom and "receiver".
- ♦ "Receiver" defective.

6.8 - Testing consumption signal

This signal is required for the consumption display in the vehicle computer.

- Remove dash panel insert and pull off black 20-pin connector for vehicle computer.

=> Electrical System; Repair Group 90

- Use hand-held multimeter V.A.G 1526 to measure voltage between contact 1 of black connector and earth.
- Start engine and continually vary engine speed between 1000 and 4000 rpm.

Desired value: 0.3...7.0 (in line with engine speed)

- If desired value is attained, there is a fault in the vehicle computer

=> Electrical System; Repair Group 90

- If desired value is not attained, connect up test box => Page **23**.
- Test cable connection between test box, socket 9 and dash panel insert for continuity/short circuit.

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

- If there is neither a cable break nor a short circuit, replace control unit for diesel direct injection system
=>Page **24**

6.9 - Testing actuation of radiator fan

The radiator fan -V7 is only actuated by the engine control unit on engines with engine code AFN.

Fan actuation after switching off the engine is only implemented:

- ♦ If coolant temperature is more than 100 °C

and

- ♦ Calculated fuel consumption for last 10 minutes exceeds a certain value, i.e. engine was subjected to considerable loading.

Final control diagnosis
Blower relay -J323

-> Perform final control diagnosis and actuate blower relay => Page .

Radiator fan must start up every 5 s and stop again.

Note:

Temperature-dependent actuation of the radiator fan may also be produced by thermoswitch, automatic gear-box or AC. When performing final control diagnosis ensure that there is no such actuation:

- Ggf. Motor abkühlen lassen.
- If radiator fan is not actuated, connect up test box => Page 23 .
- Connect socket 3 (relay cable) to socket 46 (earth).

The radiator fan must run.

- If the radiator fan now runs, but not during final control diagnosis, replace control unit for diesel direct injection system =>Page 24
- If the radiator fan does not run, test cable connections for continuity and repair if necessary.

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



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28 - Glow plug system

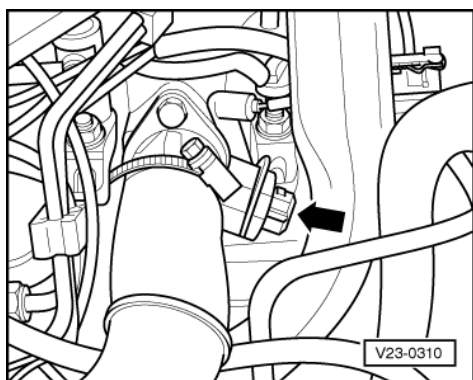
1 - Testing glow plug system

1.1 - Testing glow plug system

1.2 - Testing operation

Test prerequisites:

- Battery voltage at least 11.5 V
- Diesel direct injection system control unit -J248 OK



- -> Pull connector off coolant temperature sender -G62.

Note:

Pulling the connector off the coolant temperature sender -G62 simulates "cold" engine state and leads to appropriate preheating on switching on the ignition.

- Pull connectors off glow plugs.
- Connect hand-held multimeter V.A.G 1526 between one glow plug connector and vehicle earth.
- Switch on ignition.

Desired value: Battery voltage for approx. 20 s.

- If there is no voltage:

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

The glow period warning lamp -K29 must light during simulated preheating. If not:

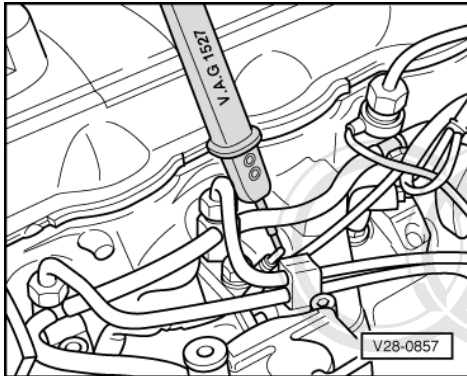
- Test warning lamp => Page 67 .

1.3 - Testing glow plugs

Test prerequisites:

- Battery voltage at least 11.5 V

- Ignition off
- Pull connectors off glow plugs.



- -> Connect LED test lamp V.A.G 1527 to battery positive and apply to each glow plug in succession.

LED lights: Glow plug OK
LED does not light: Replace glow plug

- Remove and install glow plugs with joint spanner 3220.

Tightening torque: 15 Nm

1.4 - Testing glow period warning lamp

Final control diagnosis
Glow period warning light -K29

- > Perform final control diagnosis and actuate glow period warning lamp -K29 =>Page .

Warning lamp must flash

- If warning lamp does not flash, connect up test box => Page 23 .
- Connect socket 48 (warning lamp cable) to socket 46 (earth).
- Switch on ignition.
- If warning lamp now lights, but not during final control diagnosis, replace control unit for diesel direct injection system =>Page 24
- If warning lamp does not light, check cable connection.

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