24-1

Motronic injection system, servicing

Safety precautions

If special testing equipment is required during road test, note the following:

WARNING!

- ***Scan tools and testing devices must always be secured on the rear seat and operated from there by a second person.***

- ***If a scan tool or testing device were to be operated from the passenger seat and there were an accident involving activation of the passenger-side airbag, the person seated there could be seriously injured.***

To reduce the risk of personal injury and/or damage to the fuel injection and ignition system, always observe the following:

- Only disconnect and reconnect wires for injection and ignition system, including test leads, when ignition is turned off.

- If engine is to be cranked at starting RPM without starting (e.g. for compression testing),

disconnect connector from ignition coils and from fuel injectors.

24-2

- It is possible that the control module will recognize a malfunction and store a DTC during some tests. After completing all tests and repairs, DTC memory should therefore be checked and erased if necessary. Readiness code must be generated after DTC memory is erased ⇒ Page 01-82 .

- Always switch ignition off before cleaning engine.

- The battery should only be disconnected and reconnected when the ignition is turned off, since otherwise the Engine Control Module (ECM) can be damaged.

WARNING!

Fuel system is under pressure! Place a cloth around the connection point before opening system. Then release pressure by carefully loosening connection point.

24-3

Rules of cleanliness

When working on the fuel supply or fuel injection systems, the following "6 rules of cleanliness" should be carefully observed:

- Thoroughly clean all connections and the surrounding area before disconnecting.
- Place parts that have been removed on a clean surface and cover. Use lint-free cloths only!
- Carefully cover opened components or seal them if repairs are not carried out immediately.
- Only install clean components: Only unpack replacement parts immediately prior to installation. Do not use parts that have been stored loose (in tool boxes etc.)
- When the system is open: Do not work with compressed air if it can be avoided. Do not move vehicle unless absolutely necessary.
- Disconnected electrical harness connectors: Protect from dirt and moisture. Be sure harness connector is dry before connecting.

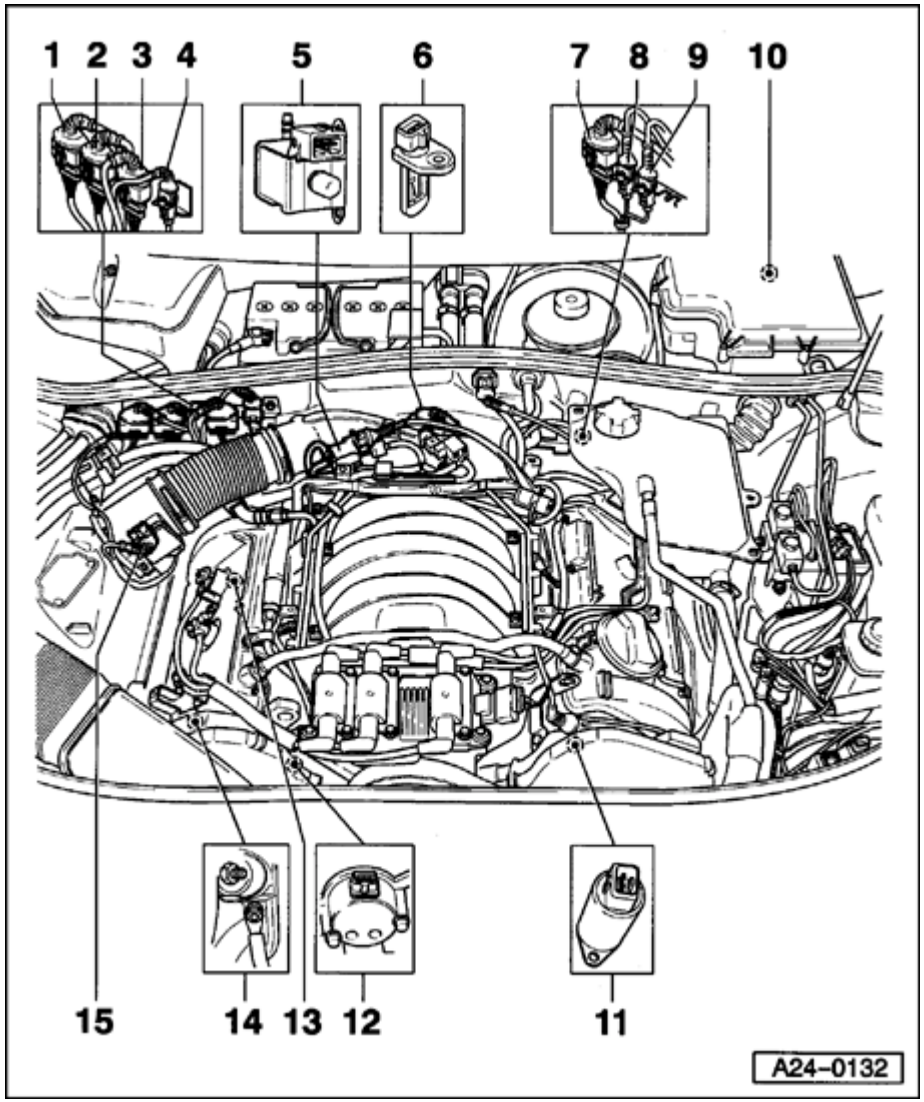
24-4

Technical data

Engine identification		ATQ (2.8 L / 5V/ 147 kW-engine)
Idle speed Engine speed cannot be adjusted, it is regulated by idle stabilization		720 to 820 RPM (front wheel drive) 630 to 730 RPM (all wheel drive)
Engine speed (RPM) limitation via fuel injector shut-off		about 6800 RPM
Fuel pressure at idle speed	Vacuum hose connected	3.2 to 3.8 bar
	Vacuum hose disconnected	3.8 to 4.2 bar
Residual pressure after 10 min.	cold engine	about 2.2 bar positive pressure
	warm engine	about 3.0 bar positive pressure
Fuel injectors	Injection stream	Dual-hole nozzle / same for all injectors
	Injection quantity (30 s)	90 to 125 ml.
	Resistance (room temperature) [1)]	13.5 to 15.5 Ω

1) With an engine at normal operating temperature, the resistance of the fuel injectors increases by approx. 4 to 6 Ω

24-5



Component locations, overview

Notes:

- *Other component Locations ⇒ Fig. ⇒ 7 , page ⇒ Page 24-11 up to Fig. ⇒ 12 , page ⇒ Page 24-13 .*
- *Component Locations without illustration:*

A - Oxygen Sensor (O2S) Behind Three Way Catalytic Converter (TWC) -G130- with Oxygen Sensor (O2S) Heater 1 -Z29-

- Bank 2, sensor 1
- Accessible from below after vehicle has been lifted

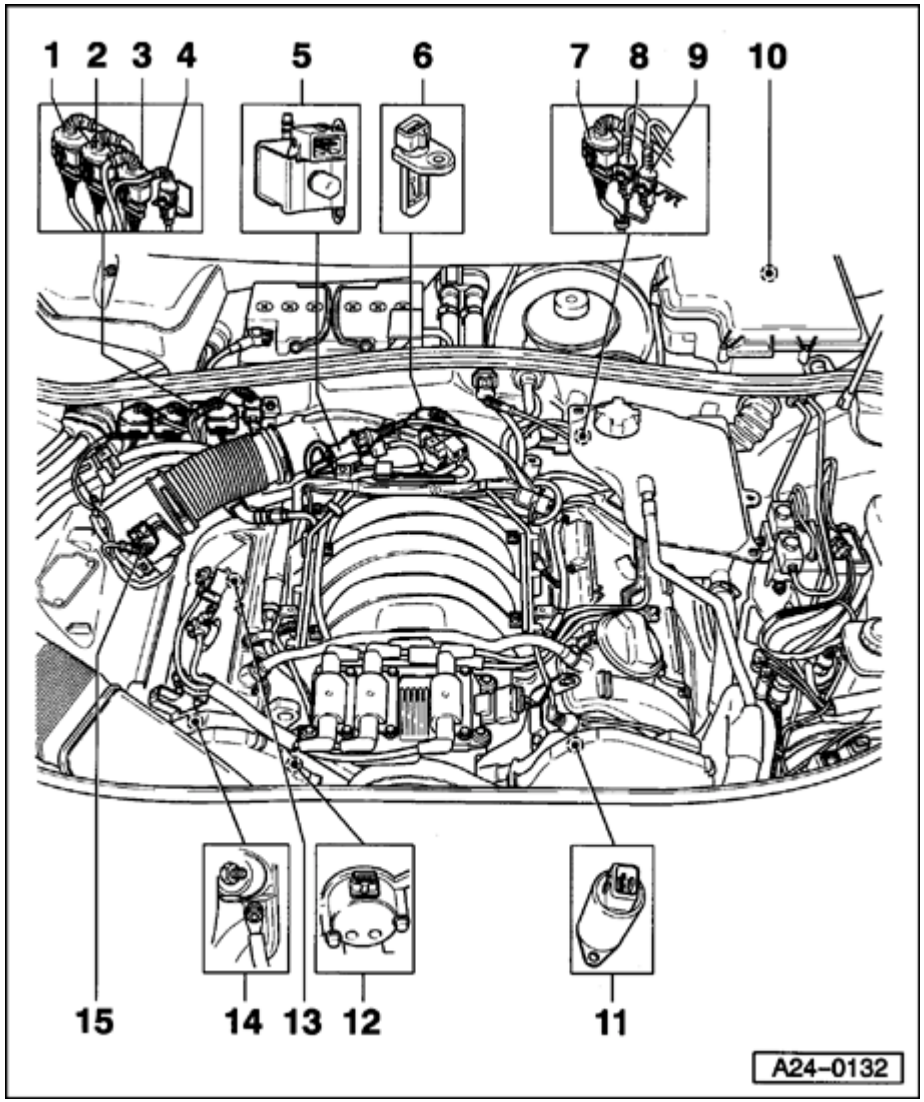
B - Oxygen Sensor (O2S) 2 Behind Three Way Catalytic Converter (TWC) -G131- with Oxygen Sensor (O2S) Heater 2 -Z30-

- Bank 2, sensor 2
- Accessible from below after vehicle has been lifted

C - Leak Detection Pump (LDP) -V144-

- Below the rear left wheelhousing liner

24-6



1 - 4-pin harness connector

- for Oxygen Sensor (O2S) behind Three Way Catalytic Converter (TWC) -G130- and Oxygen Sensor (O2S) Heater 1 -Z29- (bank 1 sensor 2)
- green

2 - 4-pin harness connector

- for Oxygen Sensor (O2S) 2 behind Three Way Catalytic Converter (TWC) -G131- and Oxygen Sensor (O2S) Heater 2 -Z30- (bank 2 sensor 2)
- brown

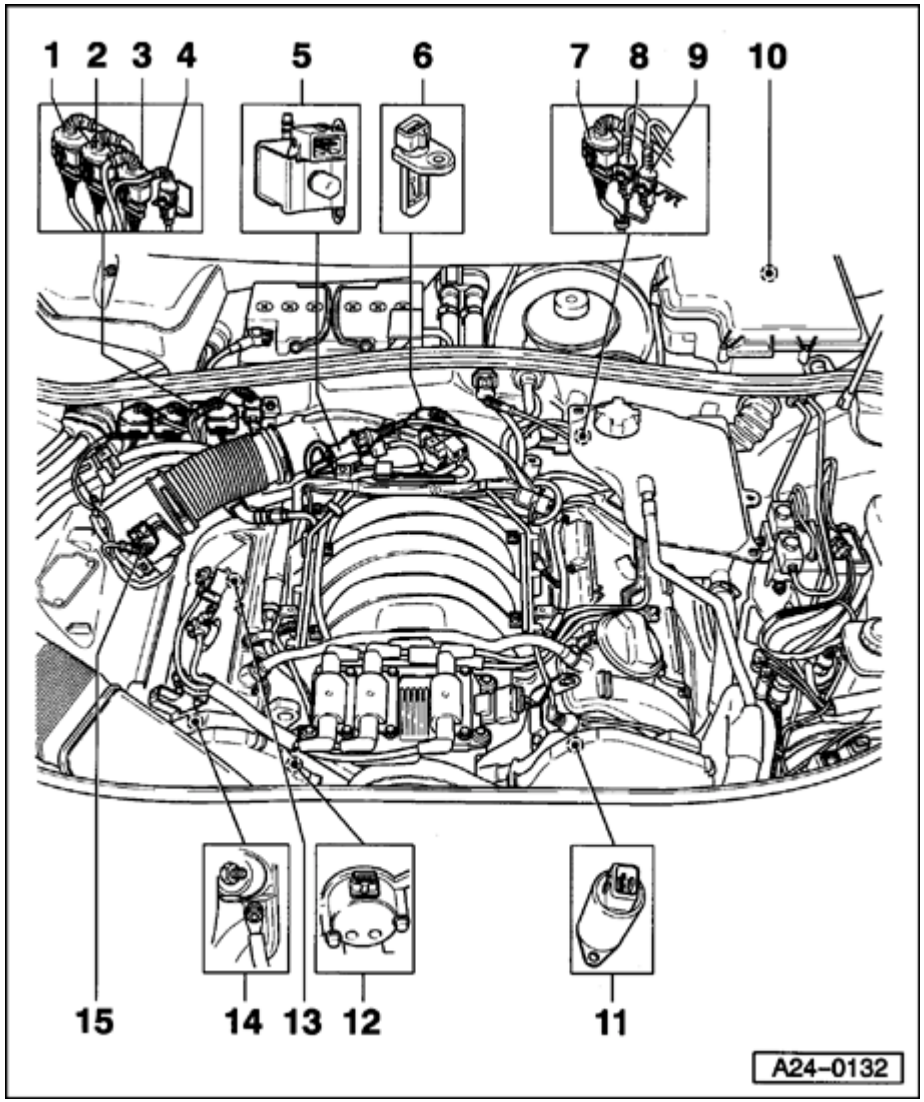
3 - 4-pin harness connector

- for Heated Oxygen Sensor (HO2S) -G39- before catalytic converter and Oxygen Sensor (O2S) Heater -Z19- (bank 1 sensor 1)
- Black

4 - 3-pin harness connector

- for Knock Sensor (KS) 1 -G61-
- blue

24-7



5 - Secondary Air Injection (AIR) solenoid valve -N112-

6 - Intake Air Temperature (IAT) sensor -G42-

7 - 4-pin harness connector

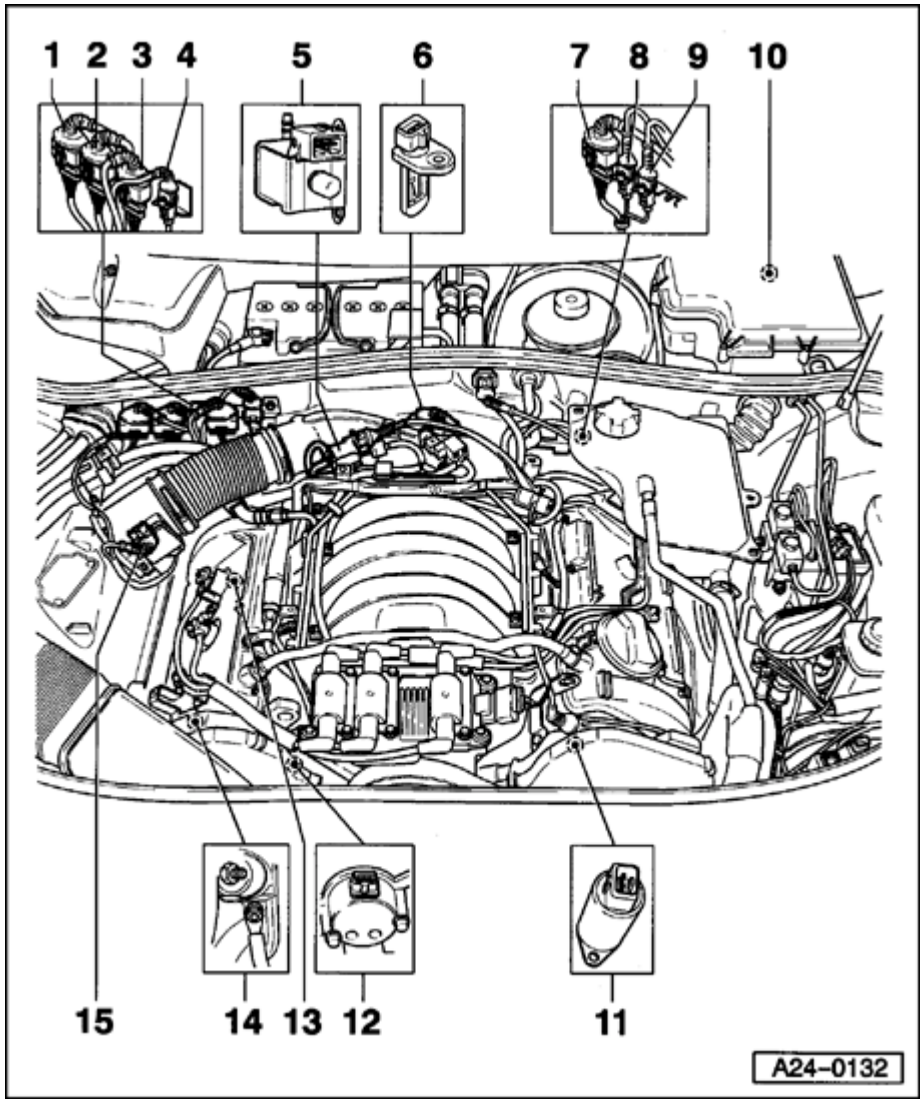
- for Heated Oxygen Sensor (HO2S) 2 -G108- before catalytic converter and Oxygen Sensor (O2S) 2 Heater -Z28- (bank 2 sensor 1)
- Black

8 - 3-pin harness connector

- for engine speed (RPM) sensor -G28-
- gray

9 - 3-pin harness connector

- for Knock Sensor (KS) 2 -G66-
- blue



10 - E-box in plenum chamber

- Motronic Engine Control Module (ECM) -J220-
- Secondary Air Injection (AIR) Pump Relay -J299- ⇒ Fig. ⇒ 10 , page ⇒ Page 24-12

11 - Valve -2- for camshaft adjustment -N208-

12 - Camshaft Position (CMP) sensor 2 -G163-

- Bank 1

13 - Heated Oxygen Sensor (HO2S) -G39- before catalytic converter with Oxygen Sensor (O2S) Heater -Z19-

- Bank 1, sensor 1

14 - Ground connection

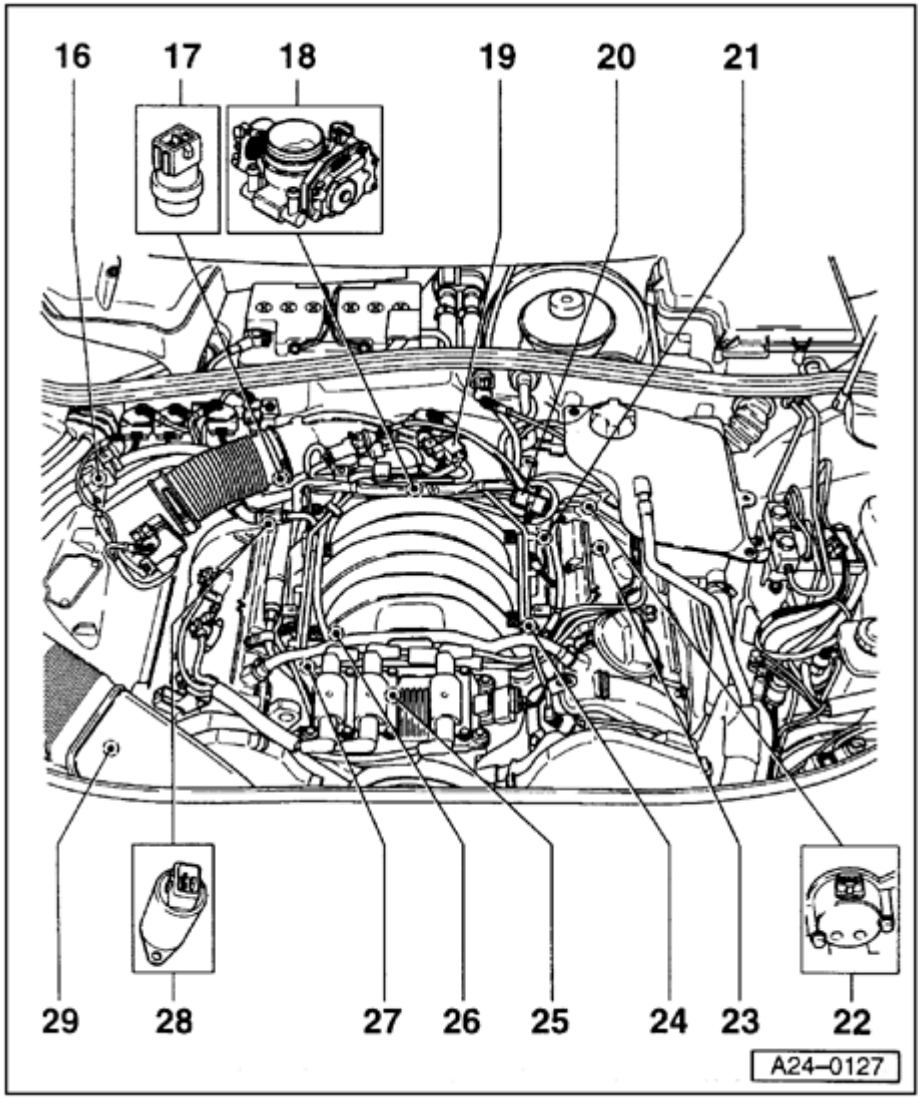
- on the engine bracket, right side

15 - Mass Air Flow (MAF) sensor -G70-

- Checking ⇒ Page 24-56

16 - Evaporative Emission (EVAP) canister purge regulator valve -N80-

24-9



17 - Engine Coolant Temperature (ECT) sensor -G62-

- for Engine Control Module (ECM)
- At coolant line behind cylinder head engine bank 1
- with Engine Coolant Temperature (ECT) Sensor -G2-
- Checking ⇒ Page 28-23
- If necessary, release pressure in cooling system before removing

18 - Throttle valve control module -J338-

- With throttle drive (power accelerator actuation) -G186-, angle sensor -1- for throttle drive (power accelerator actuation) -G187-, and angle sensor -2- for throttle drive (power accelerator actuation) -G188-

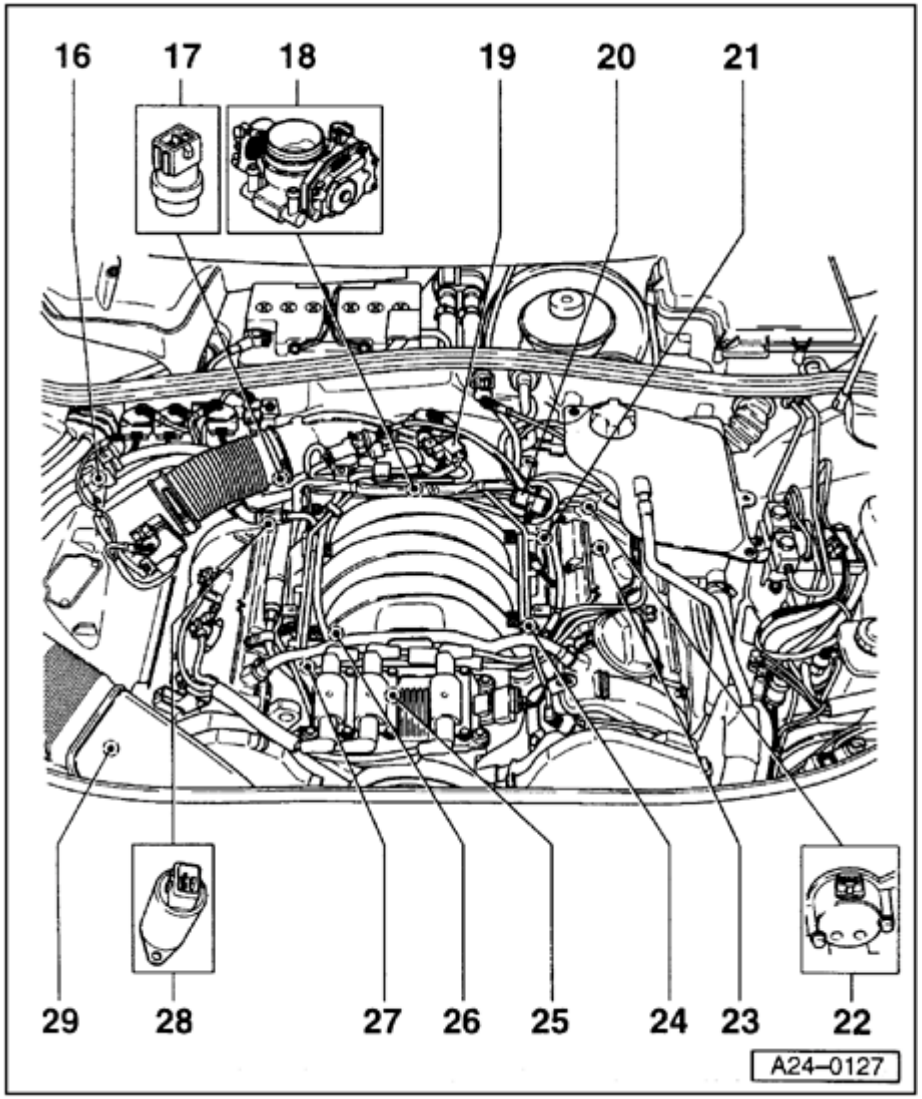
19 - Intake Manifold Change-Over Valve -N156-

20 - Fuel pressure regulator

21 - Engine Speed (RPM) sensor -G28-

- in transmission housing via ring gear
- Checking ⇒ Page 28-19

24-10



22 - Camshaft Position (CMP) sensor 2 -G40-

- Bank 2

23 - Heated Oxygen Sensor (HO2S) 2 -G108- before catalytic converter with Oxygen Sensor (O2S) 2 Heater -Z28-

- Bank 2, sensor 1

24 - Knock Sensor (KS) 2 -G66-

25 - Ignition coils (-N-, -N128-, -N158-)

- with power output stage -N122-

26 - Knock Sensor (KS) 1 -G61-

27 - Fuel injectors -N30- through -N33- ,Cylinder 5/6 Fuel Injector -N83-, -N84-

28 - Valve -1- for camshaft adjustment -N205-

29 - Secondary Air Injection (AIR) pump motor-V101-

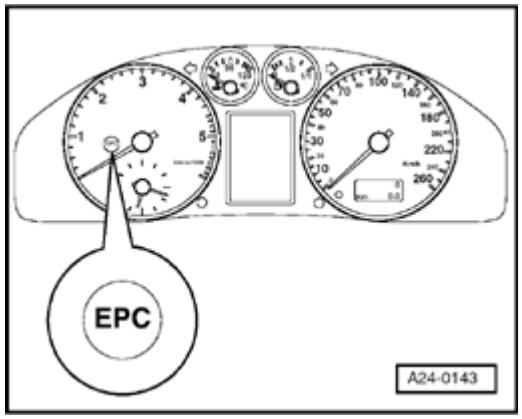


Fig. 7 Component location, fault light for power accelerator activation -K132-

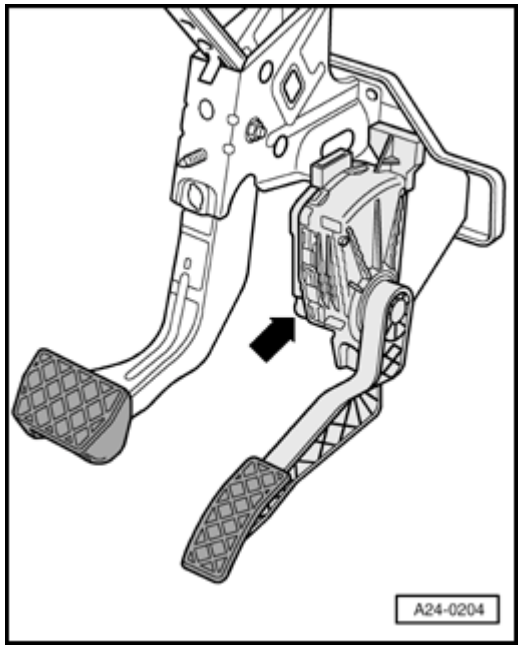


Fig. 8 Installation position, Throttle Position (TP) sensor -G79- and sender 2 for accelerator pedal position -G185-

24-12

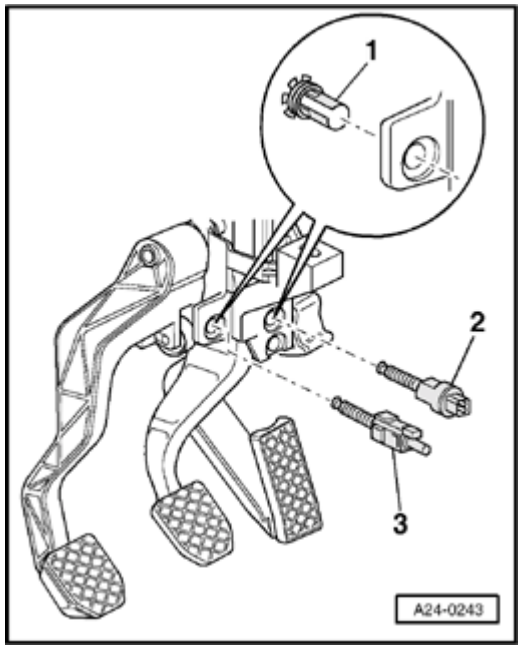


Fig. 9 Component location Brake Light Switch -F- and Brake Vacuum Vent Valve Switch For Cruise Control/Diesel Fuel Injection, Clutch Vacuum Vent Valve Switch -F36-

1 - Clip

2 - Brake Light Switch -F-, Brake Vacuum Vent Valve Switch For Cruise Control/Diesel Fuel Injection -F47-

3 - Clutch vacuum vent valve switch -F36-

Note:

In order to assure sufficiently secure fitting, switches must not be installed more than once.

Adjusting switch:

⇒ *Repair Manual, Brake System, ABS, ABS/EDL, Repair Group 46*

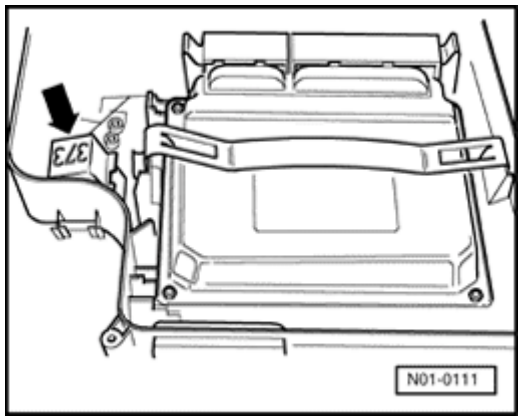


Fig. 10 Component location for Secondary Air Injection (AIR) Pump Relay -J299-

Secondary Air Injection (AIR) Pump Relay -J299- (arrow) in 3-pin relay carrier in E-box, plenum chamber.

24-13

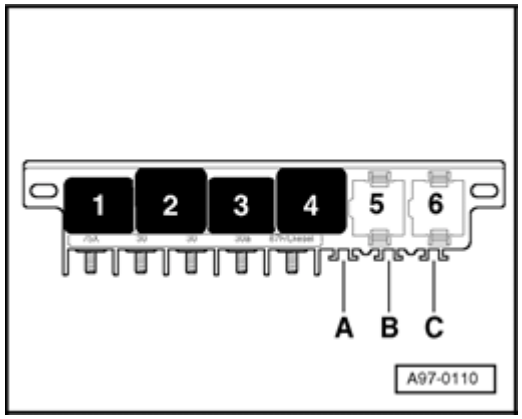


Fig. 11 Component locations Fuel Pump (FP) Relay -J17-

Fuel Pump (FP) Relay -J17- is located at position 4 of central electrics in driver's footwell, left.

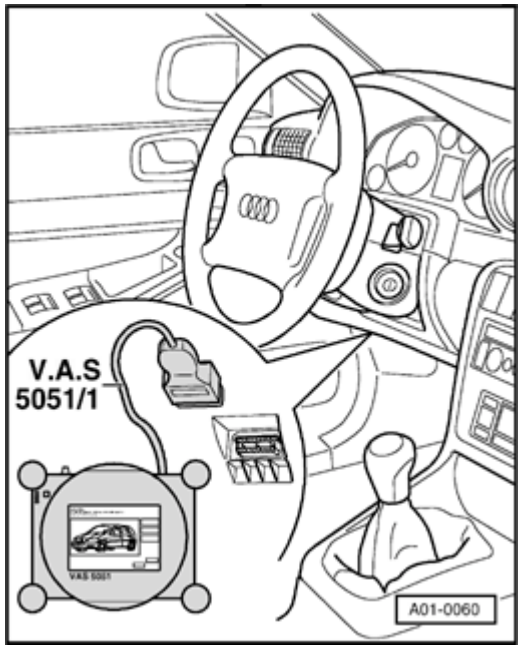
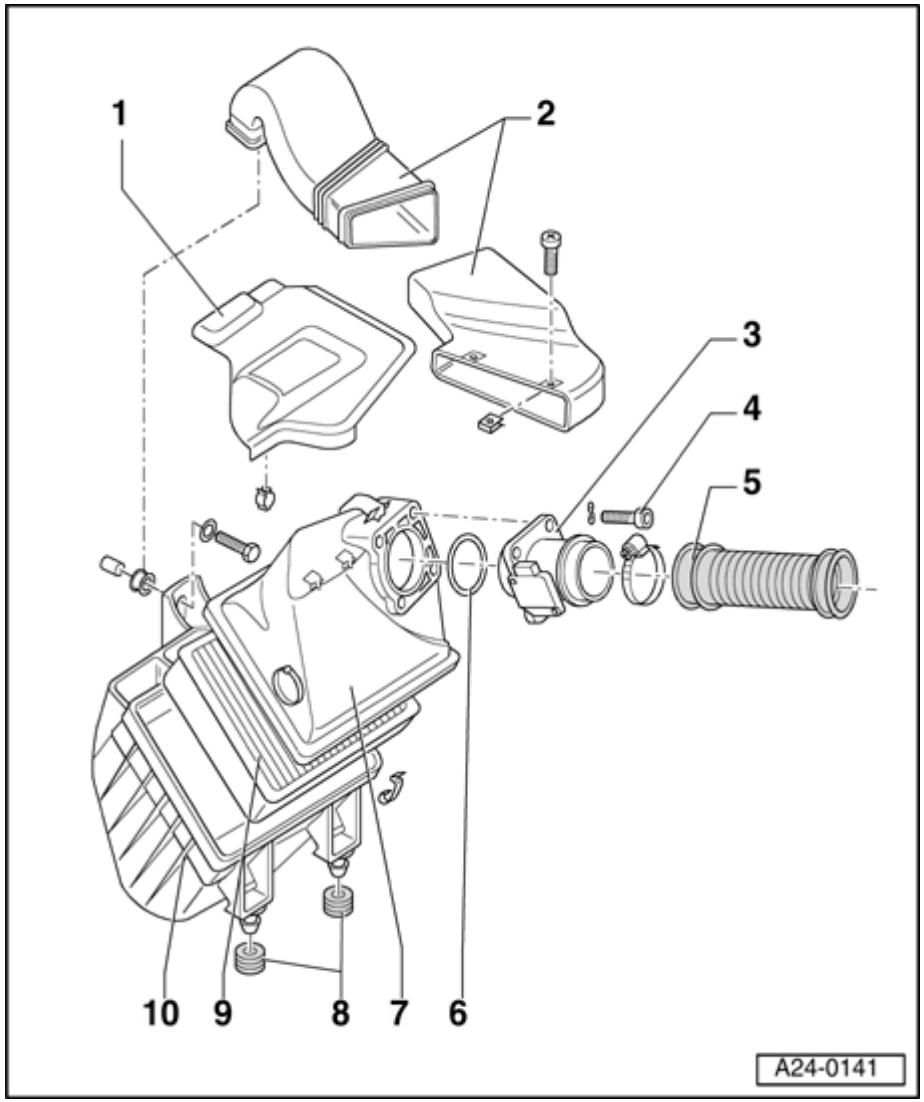


Fig. 12 Component location of Data Link Connector (DLC)

Data Link Connector (DLC) in knee bolster on driver's side.

24-14



Air filter, disassembling and assembling

1 - Cover

2 - Air duct

- to metering unit

3 - Mass Air Flow (MAF) sensor -G70-

4 - 10 Nm

5 - Connection hose

6 - Seal

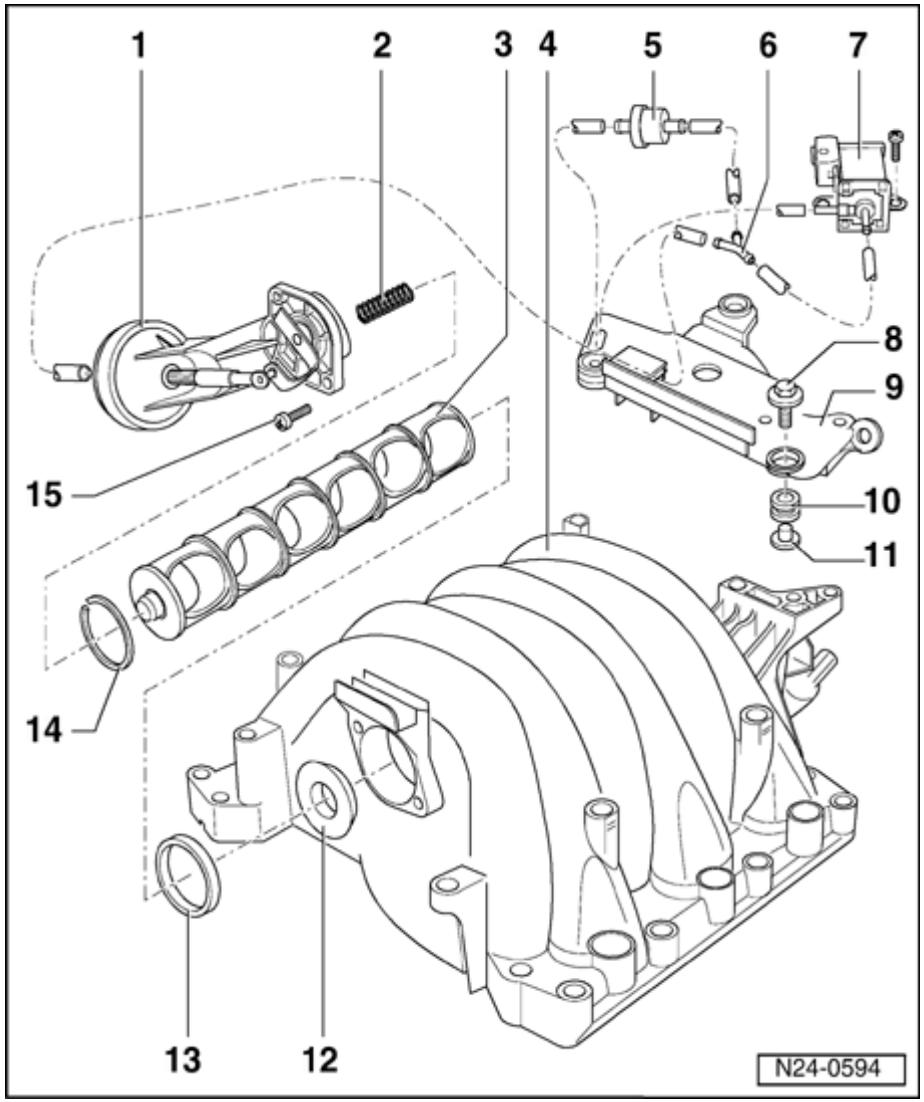
7 - Air filter, upper portion

8 - Rubber grommet

9 - Filter element

10 - Air filter, lower portion

24-15



Intake manifold change-over components, removing and installing

1 - Vacuum setting element

2 - Compression spring

3 - Rotary change-over valve

4 - Intake Manifold

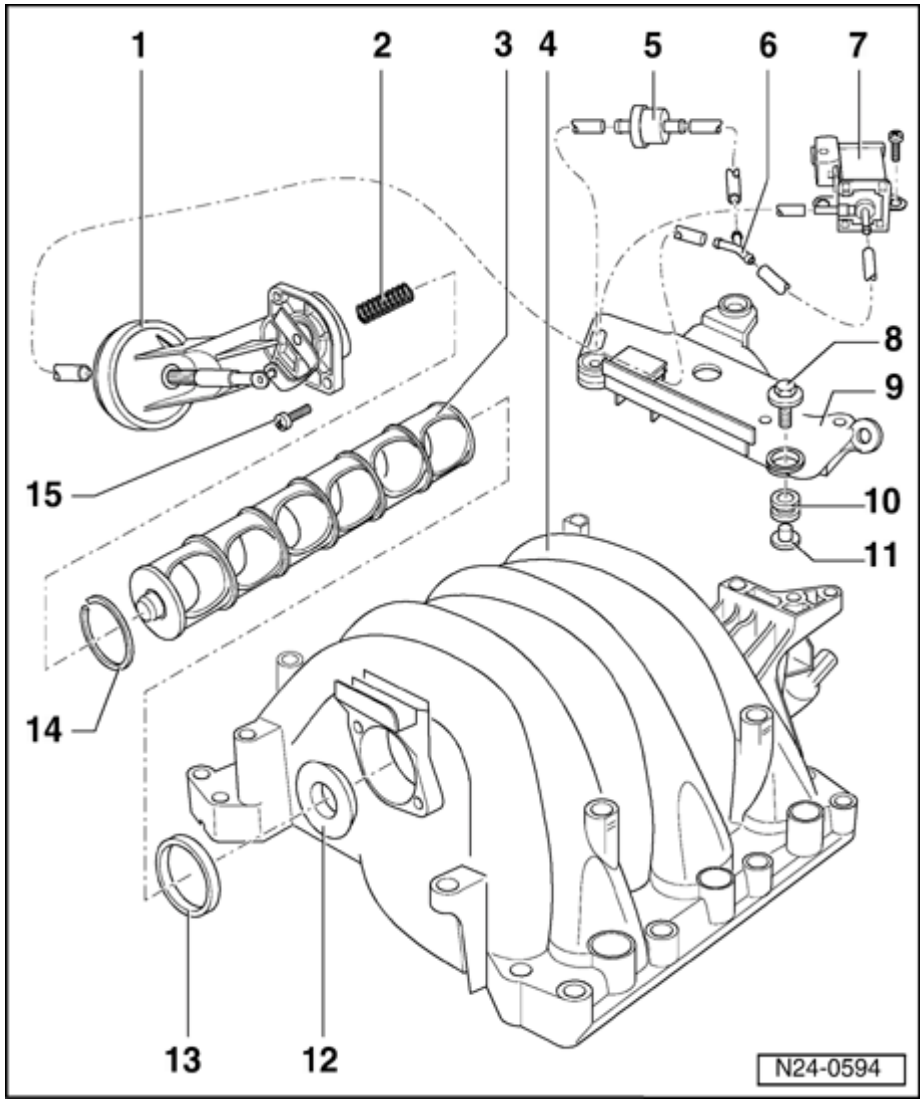
5 - Check-valve

- Installed position: blue side toward Y-piece

6 - Y-piece

7 - Intake manifold change-over valve -N156-

24-16



8 - 10 Nm

9 - Securing plate

10 - Rubber grommet

11 - Spacer sleeve

12 - Washer

- conical side toward intake manifold

13 - Seal

- Replace if damaged

14 - Seal

- for rotary change-over valve
- Replace if damaged

15 - 6 Nm

24-17

Wire and component test using VAG1598/31 test box

Notes:

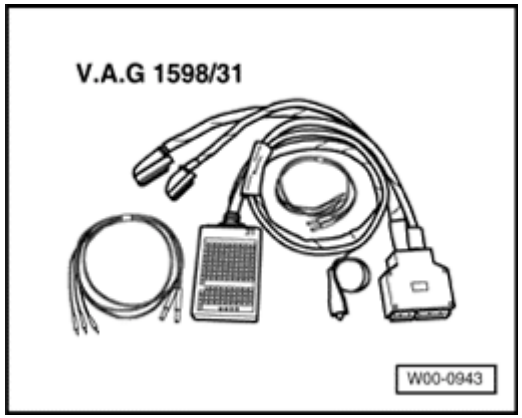
- *VAG1598/31 test box is designed so that it can be simultaneously connected to the wiring harness at the Engine Control Module (ECM) and also to the ECM itself.*
- *This is advantageous because electronic engine control remains fully functional (e.g. measurement of signals with engine running) when the test box is attached.*
- *Relevant test procedures note whether Engine Control Module (ECM) should also be connected to the test box or not.*
- *Always use VAG1594A connector test kit to attach measurement devices (e.g. VAG1527B voltage tester, VAG1526 multimeter etc.).*

CAUTION!

To reduce the risk of damaging electronic components, set the tester to the approprate test range and observe test requirements before connecting test leads.

24-18

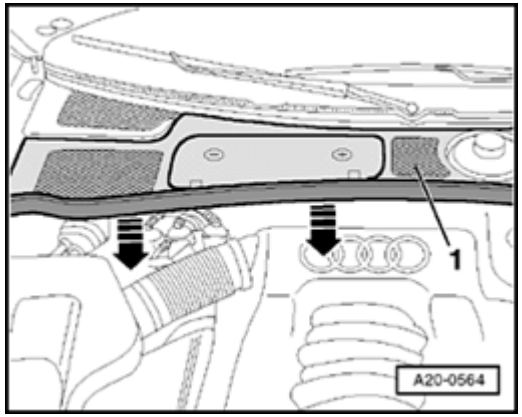
Special Tools and Equipment



- VAG1598/31

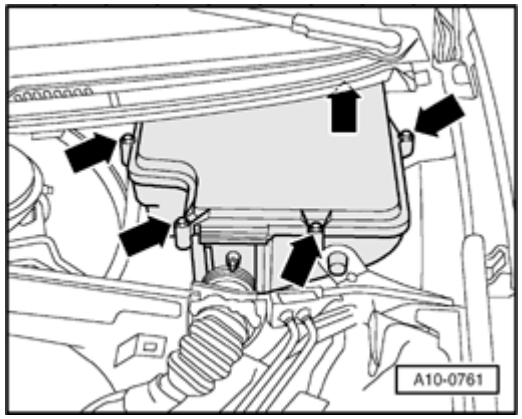
Procedure

- Switch ignition off.

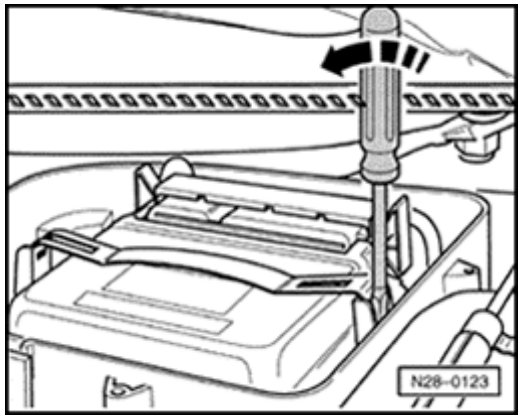


- Pull off rubber seal of plenum chamber cover in direction of arrow.
- Remove cover -1- toward front.

24-19



- Remove Heater Core E-box cover -arrows-.

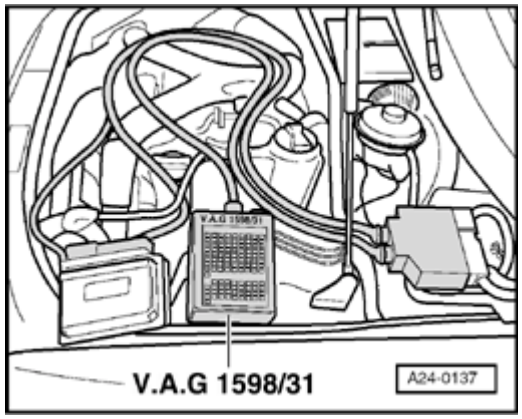


- Using a screwdriver, carefully pry off retaining bracket (arrow).
- Disengage locking lugs and remove control module connector.

Note:

Adaptation values are erased when connector is disconnected from the Engine Control Module (ECM), DTC memory content remains intact.

24-20



- Connect VAG1598/31 test box to connector of wiring harness. Ground (GND) clip at test box (not visible in illustration) must be connected to Ground (GND). Relevant test procedures note whether Engine Control Module (ECM) should also be connected to the test box.
- Perform test as described in relevant repair sequence.

Important note:

After re-connecting the Engine Control Module (ECM), the following work steps must be performed:

- Check DTC memory and erase it if necessary ⇒ *Page 01-15* .

- Perform adaptation of the Throttle Valve Control Module -J338- ⇒ *Page 24-142* .

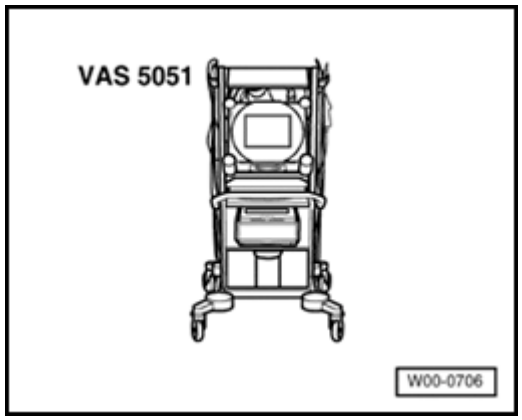
Note:

In the first adaptation phase during engine basic setting, it is possible that idle will be rough and vehicle may shake lightly in drive mode.

24-21

Engine Control Module (ECM), replacing

Special Tools and Equipment



- VAS5051 with VAG5051/1

  or

- VAG1551 with VAG1551/3B

Removing

- Connect VAS5051 tester or VAG1551 scan tool and select the control module for engine electronics using "address word" 01 ⇒ Page 01-9 .

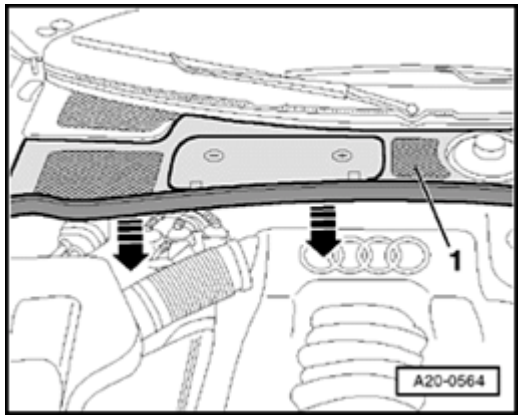
  Ignition must remain switched on for this.

3B0907551BA 2.8l V6/5V G 0003 →
Coding 07252 WSC 12345

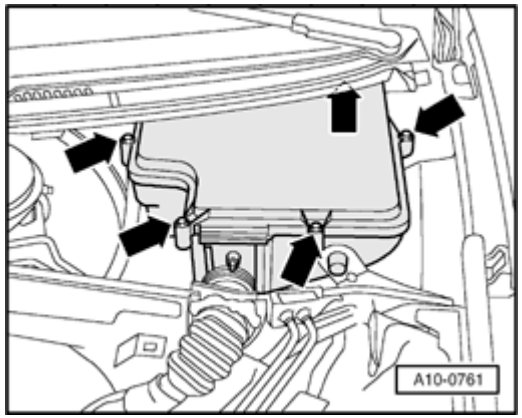
VAG1551 Scan Tool (ST) display indicates control module identification, e.g.:

- First, always allow display of control module identification and print it out ⇒ Page 01-11 .
- Compare coding with coding versions ⇒ Page 01-73 .
- Switch ignition off.

24-22

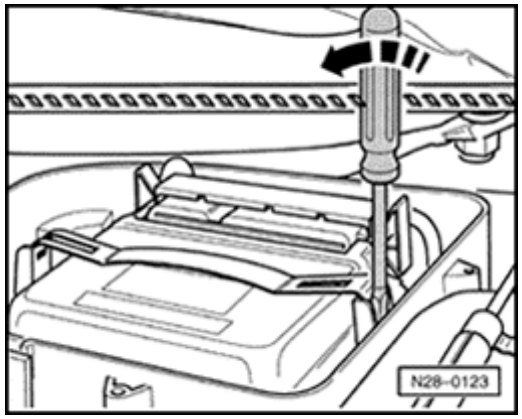


- Pull off rubber seal of plenum chamber cover in direction of arrow.
- Remove cover -1- toward front.



- Remove Heater Core E-box cover -arrows-.

24-23



- Using a screwdriver, carefully pry off retaining bracket (arrow).
- Disengage locking lugs and remove control module connector.
- Remove Engine Control Module (ECM).

Installing

Installation is reverse of removal, noting the following:

Important note:

After installing new Engine Control Module (ECM), the following work steps must be performed:

- Check DTC memory and erase it if necessary ⇒ *Page 01-15* .

- Perform adaptation of the Throttle Valve Control Module -J338- ⇒ *Page 24-142* .

24-24

- Observe notes for coding new Engine Control Module (ECM) ⇒ Page 01-71 .

- For vehicles with cruise control (discernable at steering column), switch this free in ECM:

⇒ Repair Manual, Electrical Equipment, Repair Group 01; On Board Diagnostic (OBD) of cruise control system; Cruise control system, checking

- Adapt immobilizer to Engine Control Module (ECM):

⇒ Repair Manual, Electrical Equipment, Repair Group 01; On Board Diagnostic (OBD) of immobilizer after replacing Engine Control Module (ECM)

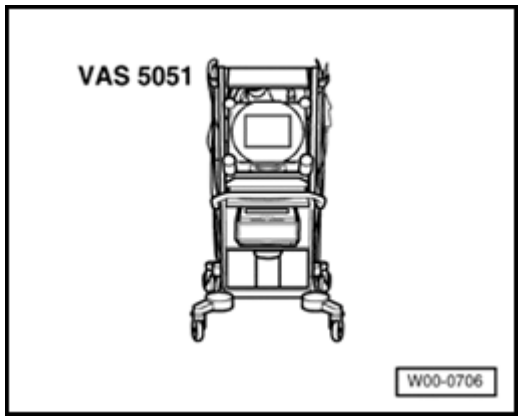
- For vehicles with automatic transmission, the kick down function must be learned ⇒ Page 24-161 .

- Generate readiness code ⇒ Page 01-82 .

Note:

In the first adaptation phase during engine basic setting, it is possible that idle will be rough and vehicle may shake lightly in drive mode.

24-25



Idle speed (RPM), checking

Special Tools and Equipment

- VAS5051 with VAG5051/1

or

- VAG1551 with VAG1551/3B

Test requirements:

- Exhaust system free of leaks.
- Coolant Temperature at least 80 °C.
- Electrical consumers switched off (radiator fan must NOT run during test).
- A/C switched off.
- No pressure gauge connected.
- Vehicles with automatic transmission Selector lever in P or N.

24-26

Notes:

- *Idle speed cannot be adjusted.*
- *Idle speed is checked during basic setting of the engine.*
- *During basic setting, the Evaporative Emission (EVAP) canister purge regulator valve (EVAP valve -N80-) is closed and the A/C compressor is switched off*

Test sequence

- Check DTC Memory ⇒ Page 01-15 . There must not be any DTCs stored, repair malfunctions if necessary, erase DTC memory, switch engine off and start again, road test vehicle and check DTC memory again as a control measure.

- Let engine continue to run at idle.

CAUTION!

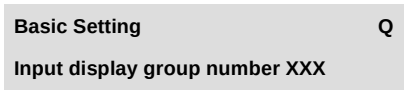
The electric cooling fan must not run.

Rapid data transfer	**HELP**
Select function XX	

When indicated on display:

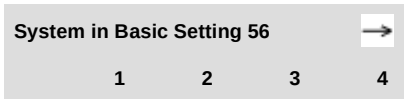
- Press buttons -0- and -4- to select "Initiate basic setting" and press -Q- button to confirm input.

24-27



➢ When indicated on display:

- Press buttons -0-, -5- and -6- to select "display group number 056" and press -Q- button to confirm input.



➢ When indicated on display:

- Check whether the engine speed in display field 1 (actual engine speed) is within tolerated range.

	Display fields			
	1	2	3	4
Display group 056: Idle stabilization with engine at idle and operating temperature				
Display	**xxx /min**	**xxx /min**	x.x %	X X X X X
Indicated	**Engine speed (actual)**	**Engine speed (specified)**	Idle control Torque change	Operating conditions
Specified value	**720 to 820 RPM** [1)] **630 to 730 RPM** [2)]	**770 RPM** [1)] **680 RPM** [2)]	-5 to 5 %	0 0 0 0 0
Notes	**If specified value is not obtained** ⇒ **Page 24-29**			Significance of numbers ⇒ Page 24-29

1) Front Wheel Drive Vehicles

2) All-Wheel Drive Vehicles

24-28

Notes:

- *Engine speed in display field 1 (actual engine speed) is the current engine speed.*
- *Engine speed in display field 2 (specified engine speed) is a theoretical engine speed calculated by the ECM.*
- *At idle, the ECM always attempts to adapt the engine speed (actual) to the specified engine speed (specified).*
- *This means that the engine speed (actual) must always approximately match the engine speed (specified) at idle.*
- *Display fields 3 and 4 provide information, but are not relevant for checking idle speed.*

If specified value is obtained:

- Press →button.

Rapid data transfer **HELP**	
Select function XX	

Indicated on display (function selection):

If specified value is not obtained:

- Check DTC memory again ⇒ Page 01-15 .

- If DTC memory was erased, readiness code must be re-generated ⇒ Page 01-82 .

24-29

If idle speed is too high or low and there are no DTCs in DTC memory, the following tests (marked with dots) must be performed:

- False air in intake air system, checking ⇒ Page 24-64 .
- Throttle valve control module, checking ⇒ Page 24-141 .
- Evaporative Emission (EVAP) canister purge regulator valve always open, checking ⇒ Page 24-128 .
- Perform adaptation of throttle valve control module ⇒ Page 24-142 .

Significance of 5 digit indication of display group 056

x	x	x	x	x	Display field 4
				0	A/C compressor 0 = A/C compressor off 1 = A/C compressor on
			0		Driving mode selected 0 = selector lever in P or N

					1 = selector lever in 2/3/4/D/R
		0			A/C readiness maximum heating/cooling power
	0				Indication always 0
0					Indication always 0

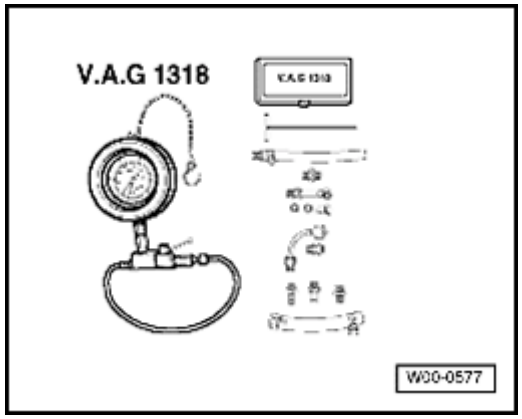
24-30

Fuel pressure regulator and residual pressure, checking

Note:

Fuel pressure regulator regulates fuel pressure according to intake manifold pressure. This ensures that the pressure drop at the fuel injectors remains the same for each speed and load range of the engine.

Special Tools and Equipment



- VAG 1318 with VAG 1318/7 adapter, VAG 1318/8 pressure hose with connectors and VAG 1318/15 adapter

Test requirements:

- Fuel Pump (FP) OK, checking ⇒ Page 24-49 .
- Fuel Pump (FP) OK, checking:

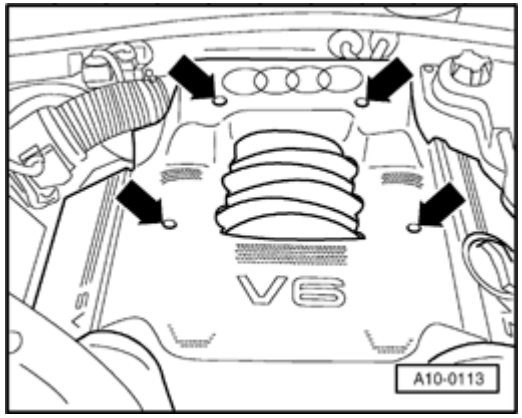
⇒ *Repair Manual, Fuel Supply System, Repair Group 20; Fuel supply Front Wheel Drive or fuel supply - All Wheel Drive*

- Fuel filter OK
- Battery voltage at least 12.7 V
- Vehicles with automatic transmission Selector lever in P or N.

24-31

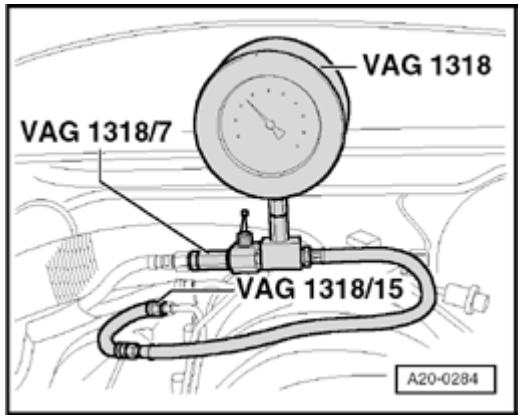
WARNING!

Fuel system is under pressure! Place a cloth around the connection point before opening system. Then release pressure by carefully loosening connection point.



- Remove engine cover (arrows).

Checking system pressure



- Connect VAG1318 pressure gauge using adapters VAG1318/7, /1318/8 pressure hose with connectors and 1318/15 adapter in supply line.
- Disconnect vacuum hose from pressure regulator to intake manifold at pressure regulator and seal line.

Note:

If fuel should escape at the vacuum connection of the pressure regulator during the following pressure test, replace pressure regulator.

- Start engine and let run at idle.

24-32

- Measure fuel pressure.

  - Specification: 3.8 to 4.2 bar

- If the specified value is not reached, replace pressure regulator on a trial basis and repeat pressure test.

- If the specified value is not reached again, check Fuel Pump (FP) or supply line for damage (e.g. pinched areas) and replace if necessary.

- If the specified value is exceeded, check return line for damage (e.g. pinched areas) and replace if necessary.

Note:

During the following test, the engine must not run for an unnecessarily long period of time with the vacuum hose removed. Otherwise, the higher fuel pressure can cause enrichment of the fuel to air ratio, which under some circumstances can cause the oxygen sensor control limits to be exceeded, causing a DTC to be stored.

- Start engine and let run at idle.

- Switch of electrical consumers (A/C system

etc.).

- Connect vacuum hose at pressure regulator while observing pressure drop at pressure gauge.

24-33

- Fuel pressure must drop by approx. 0.5 bar when connecting the vacuum hose.

  If the pressure change does not occur, the following tests must be performed:

  - Check vacuum hose for tears and damage.
  - Check vacuum hose at intake manifold for throughput by disconnecting from pressure regulator and blowing into it.

- If no leaks can be detected and if the vacuum hose has throughput, replace the pressure regulator.

Checking residual pressure

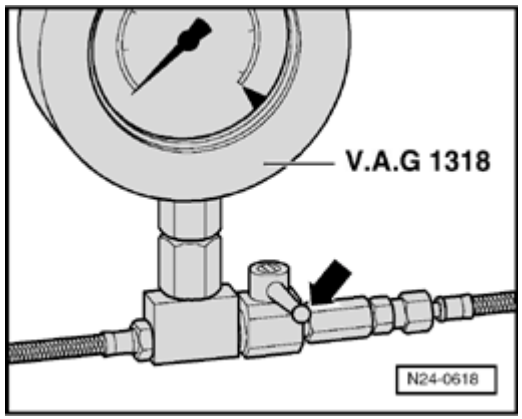
- Residual pressure 10 minutes after switching engine off (minimum pressure).

  - Specified value with a cold engine: approx. 2.2 bar
  - Specified value with the engine at operating temperature: approx. 3.0 bar

Note:

Pressure increase for an engine at operating temperature limited by the fuel expansion is normal.

24-34



- Start engine and let run at idle.

- Wait until pressure has dropped, and then switch off ignition. Simultaneously close shut-off valve of VAG1318 pressure gauge (lever perpendicular to direction of flow -arrow-).

The following malfunction are possible if the pressure does not drop:

- There is a leak in the threaded connection between the pressure gauge and the fuel supply line
- There is a leak at the supply line at fuel tank.
- There is a leak in the check valve in the Fuel Pump (FP).

⇒ *Repair Manual, Fuel Supply System, Repair Group 20; Fuel supply - Front Wheel Drive or fuel supply - All Wheel Drive*

Note:

Pressure gauge displays the pressure behind the stopcock "intake manifold side" after the stopcock is closed (in direction of fuel injector, fuel pressure regulator). If the pressure drops in front of the stopcock (in direction of fuel tank), the device cannot detect it. For this reason, the center of this page states "If the pressure does not drop...".

24-35

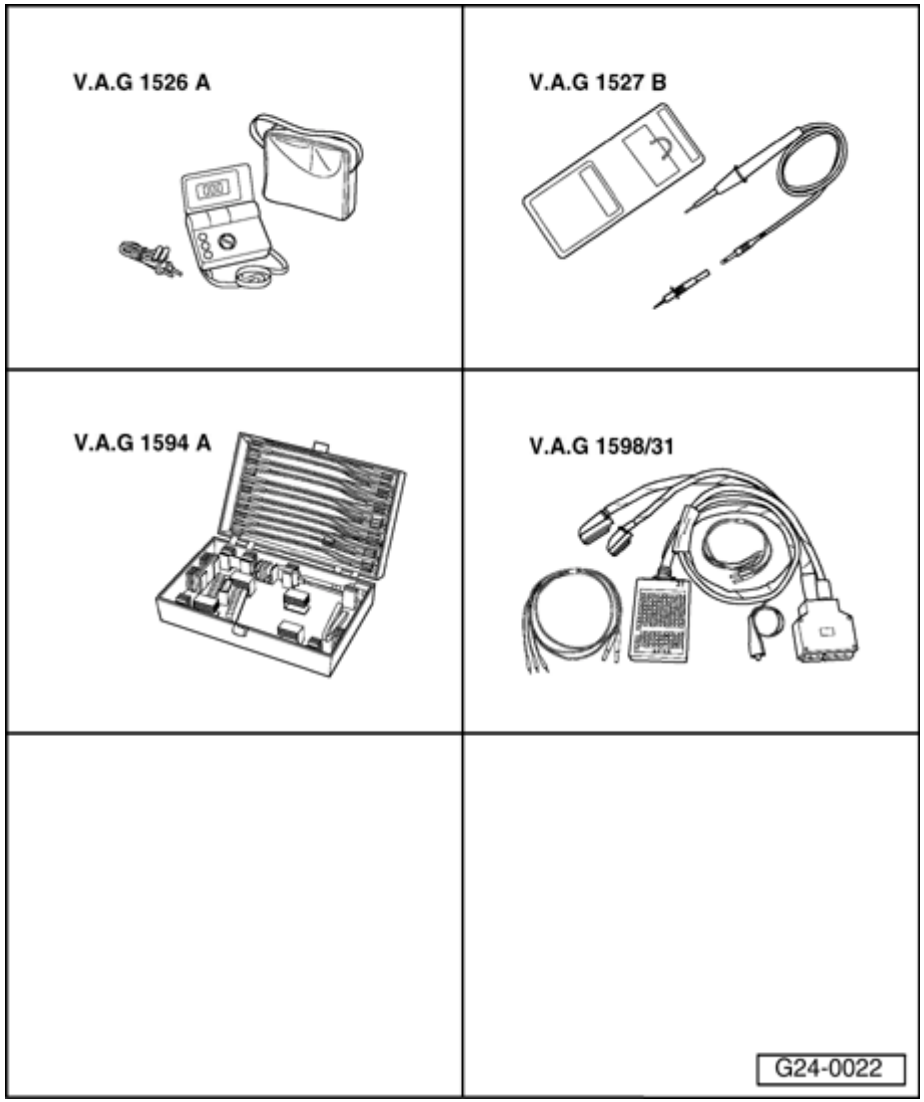
The following malfunctions are possible if the pressure drops again:

- Fuel pressure regulator faulty
- Fuel injectors not properly sealed
- Threaded connections of pressure gauge behind stopcock is not properly sealed.

Note:

Close stopcock for removing the pressure gauge, loosen threaded connection at VAG1318/15 adapter and let excess fuel escape into catch reservoir by opening stopcock.

24-36



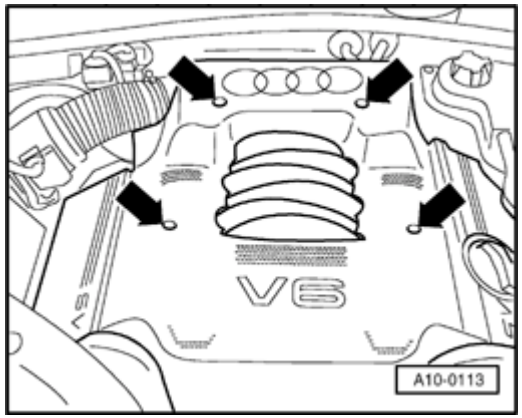
Fuel injectors, checking

Special Tools and Equipment

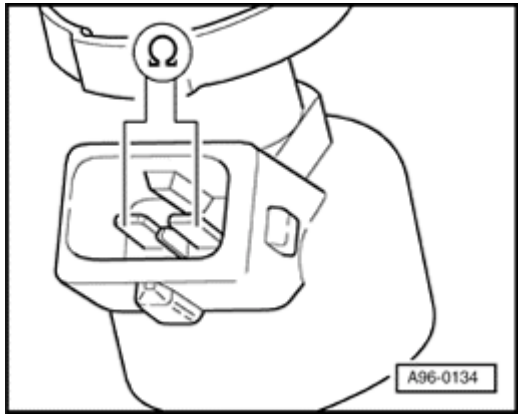
- VAG1526A
- VAG1527B
- VAG1594A
- VAG1598/31

24-37

Checking internal resistance



- Remove engine cover (arrows).
- Disconnect harness connector at the fuel injector to be tested.



- Connect multimeter at valve for resistance measurement.
  - Specification: 13.5 to 15.5 Ω

With an engine at operating temperature, the resistance increases by approx. 4 to 6 Ω.

If specified value is not obtained:

- Replace fuel injector ⇒ Page 24-43 .

24-38

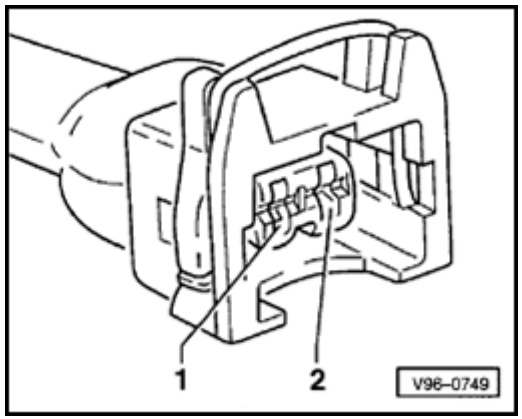
Checking voltage supply

Test requirements:

- Fuel Pump (FP) OK, checking ⇒ Page 24-49 .
- Fuse for fuel injectors OK

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

- Disconnect harness connector at the fuel injector to be tested.



- Connect VAG1527B voltage tester as follows:

Harness connector Terminal	Measure to
1	Engine Ground (GND)

- Switch ignition on.
  - ♦ LED must light up.

If LED does not light up:

- Check wire connection between terminal 1 and fuse for injector valves for open circuit:

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

24-39

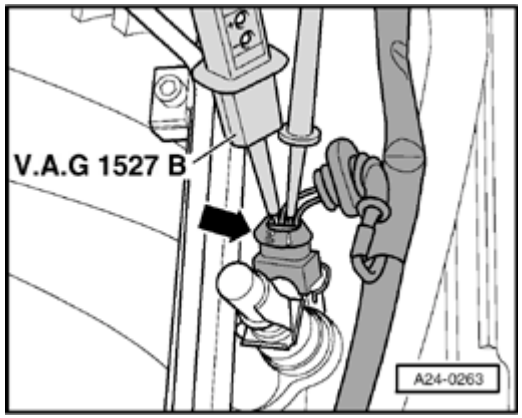
- Repair open circuit if necessary.

If LED lights up:

Checking activation

Test requirement:

- Internal resistance of valve OK

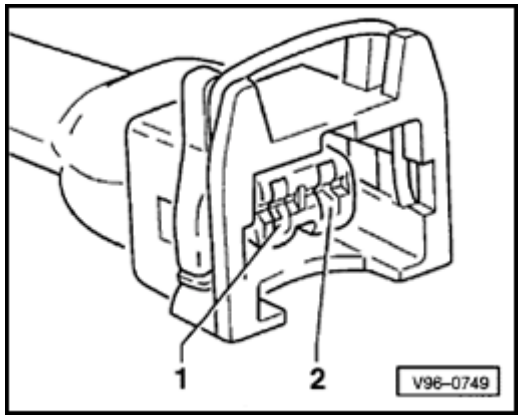


- Slide back rubber grommet of fuel injector connector (arrow), but leave connector connected.
- Connect VAG1527B voltage tester between sockets 2 (signal) and 1 (B+).
- Operate starter briefly (engine can also start).
  - ♦ LED must blink.

Note:

Voltage testers do not go out completely during low current pick-up between activations by the ECM, but rather continue to glow a little and then get slightly brighter during activation.

24-40



If LED does not blink:

- Connect VAG1598/31 test box at wiring harness to ECM, do not connect ECM ⇒ Page 24-17 .

- Check the following wire connections for open circuit and short circuit to Ground (GND) and B+:

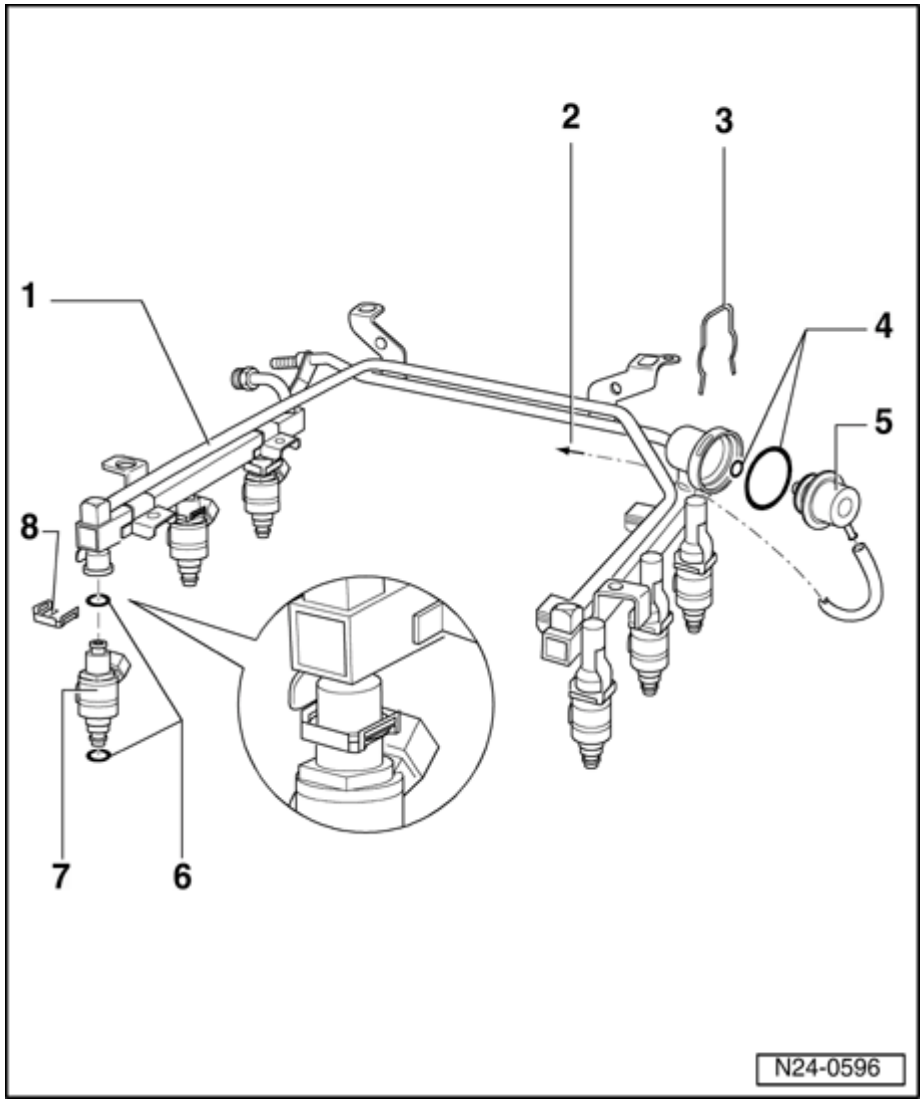
Cylinder	Fuel injector harness connector Terminal	VAG1598/31 test box Socket
1	2	96
2	2	112
3	2	88
4	2	97
5	2	113
6	2	89

- Repair open circuit or short circuit if necessary.

If wire connection is OK:

- Replace Engine Control Module (ECM) ⇒ Page 24-21 .

24-41



Fuel rail with fuel injectors, disassembling and assembling

1 - Fuel distributor

2 - to T-piece

3 - Retaining clip

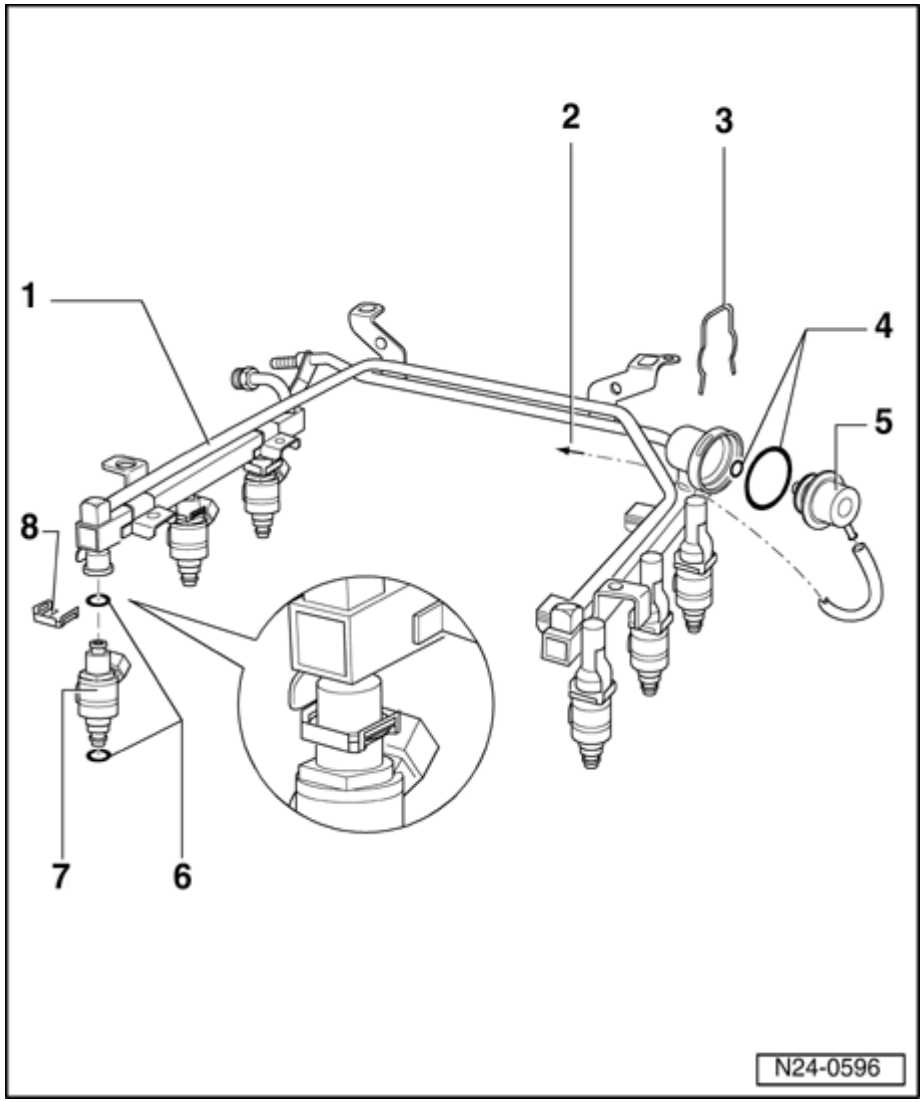
- Check for secure fitting

4 - O-ring

- Removing and installing ⇒ Page 24-43
- Always replace
- Coat with clean engine oil

5 - Fuel pressure regulator

24-42



6 - O-ring

- Removing and installing ⇒ Page 24-43
- Always replace
- Coat with clean engine oil

7 - Fuel injectors -N30- through -N33- ,Cylinder 5/6 Fuel Injector -N83-, -N84-

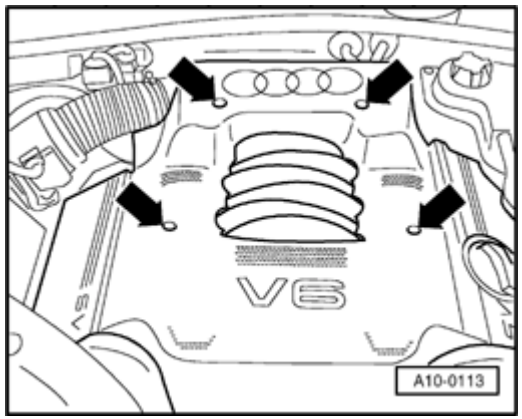
- Removing and installing ⇒ Page 24-43

8 - Retaining clip

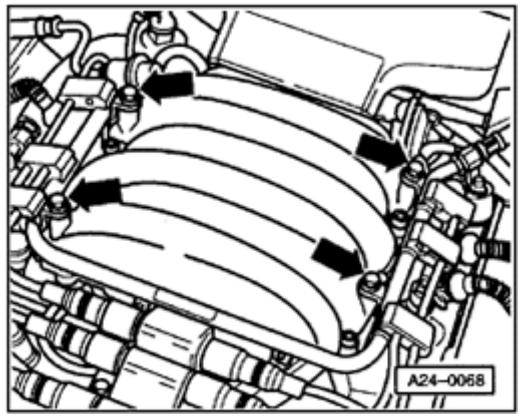
- Make sure clip is correctly seated on fuel injector and fuel rail

24-43

Fuel injectors, removing and installing



- Remove engine cover (arrows).
- Remove intake air hose between Mass Air Flow (MAF) sensor and intake air elbow.
- Remove all harness connectors to injectors.
- Disconnect vacuum hose from fuel pressure regulator.
- Expose wires at fuel distributor.



- Unscrew fuel distributor from intake manifold (arrows) .
- Remove fuel distributor with injectors from intake manifold simultaneously upward and set aside in rear of engine compartment on a clean cloth.

WARNING!

Fuel system is under pressure! Place a cloth around the connection point before opening system. Then release pressure by carefully loosening connection point.

24-44

- Disengage retaining clip and remove fuel injector.

Note:

Fuel lines must be disconnected before replacing fuel distributor.

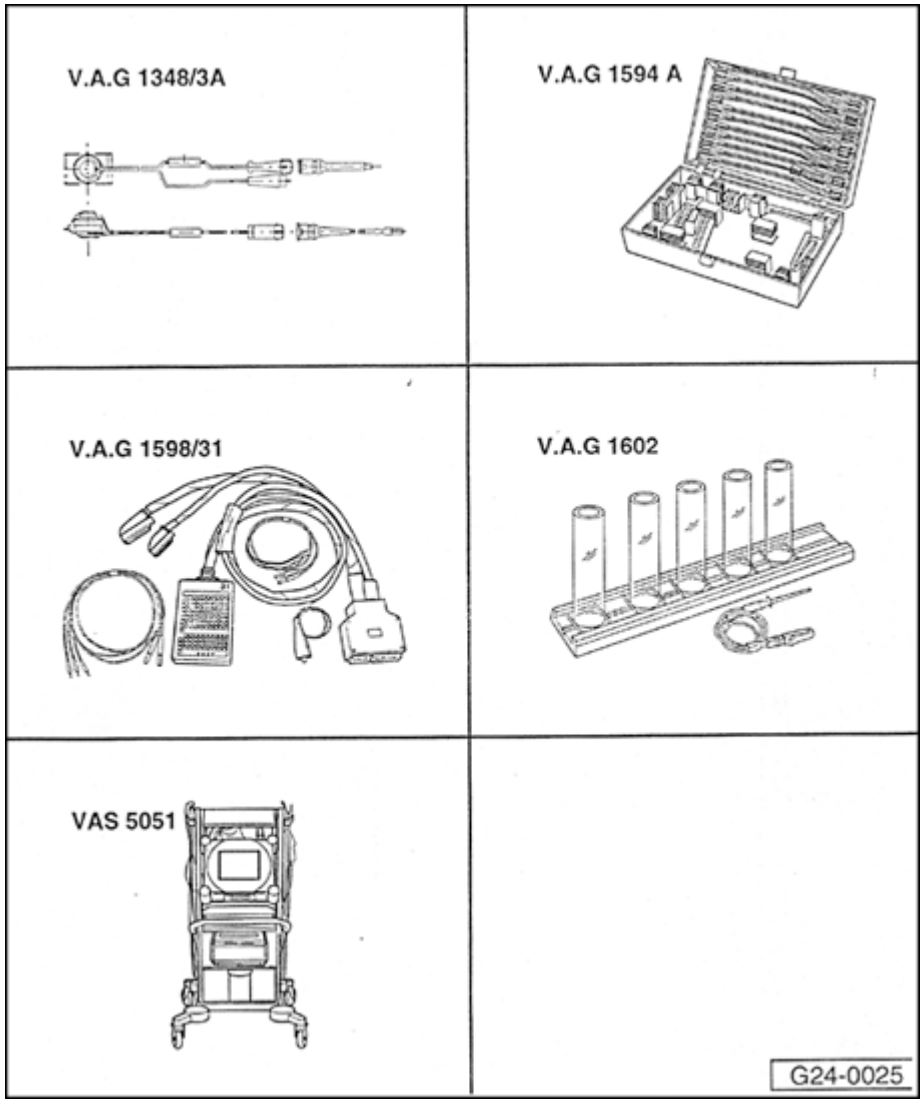
Installation is reverse of removal, noting the following:

- Remove O-rings at all opened connections. (Never remove plastic cap from valve head to replace front O-ring - pry O-ring off over plastic cap).
- Lightly lubricate O-rings with clean engine oil.
- Make sure fuel injectors are in place and seated correctly
- Check clip for unobstructed fitting.
- Place fuel rail with secured fuel injectors onto intake manifold, and apply uniform pressure to press it in.

Tightening torque

Component	Nm
Fuel distributor at intake manifold	10

24-45



Injection quantity, proper seal and spray pattern of fuel injectors, checking

Special Tools and Equipment

- VAG1348/3A with VAG1348/3-2
- VAG1594A
- VAG1598/31
- VAG1602
- VAS5051 with VAG5051/1

- or

- VAG1551 with VAG1551/3B

24-46

Test requirement:

- Fuel pressure OK, checking ⇒ Page 24-30 .

Test sequence

- Remove fuel distributor including fuel injectors from intake manifold ⇒ Page 24-43 . Fuel lines remain connected.

- Connect VAG1598/31 test box at wiring harness to ECM, do not connect ECM ⇒ Page 24-17 .

- Bridge terminals 1 and 65 at test box using adapter cables from VAG1594A connector test kit (this step supplies Ground -GND- to one side of relay coil for Fuel Pump -FP- relay).

Note:

Fuel Pump (FP) relay is supplied with B+ via the central electric (terminal 30). Fuel Pump (FP) relay receives minus via the cable bridge in test box. The Fuel Pump (FP) is now running constantly.

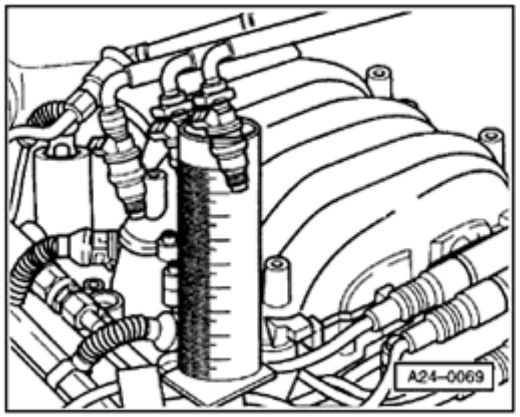
24-47

Checking Proper Seal

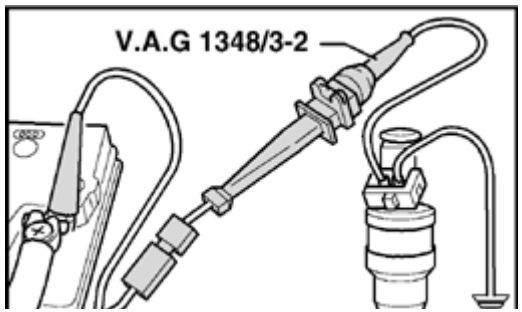
- Check proper seal of fuel injectors (visual inspection). With Fuel Pump (FP) running, only 1 to 2 drops per minute may drip out per injector.

- If fuel loss is greater, stop Fuel Pump (FP) from running (disconnect cable bridge) and replace faulty fuel injector ⇒ Page 24-43 .

Checking Injection Quantity



- Insert fuel injector to be tested in a measuring glass from VAG1602 injection quantity test device.



- Connect one terminal of fuel injector to engine Ground (GND) using an adapter cable and an alligator clip from VAG1594A connector test kit.
- Connect the second terminal of fuel injector to B+ using VAG1348/3A remote control, VAG1348/3-2 adapter cable and assisting cable.

24-48

- Bridge terminals 1 and 65 at test box using wires from VAG1594A adapter test kit.

  - Fuel Pump (FP) must run.

- Operate VAG1348/3A remote control for 30 seconds.

- After all three fuel injectors of one cylinder row have been activated, place measuring glasses on an even surface.

  - Specified value for each fuel injector: 90 to 125 ml.

- If measured value of one or more fuel injectors is outside of specified range, switch Fuel Pump (FP) off (disconnect cable bridge) and replace faulty fuel injector ⇒ Page 24-43 .

- Repeat test at fuel injectors of second cylinder row.

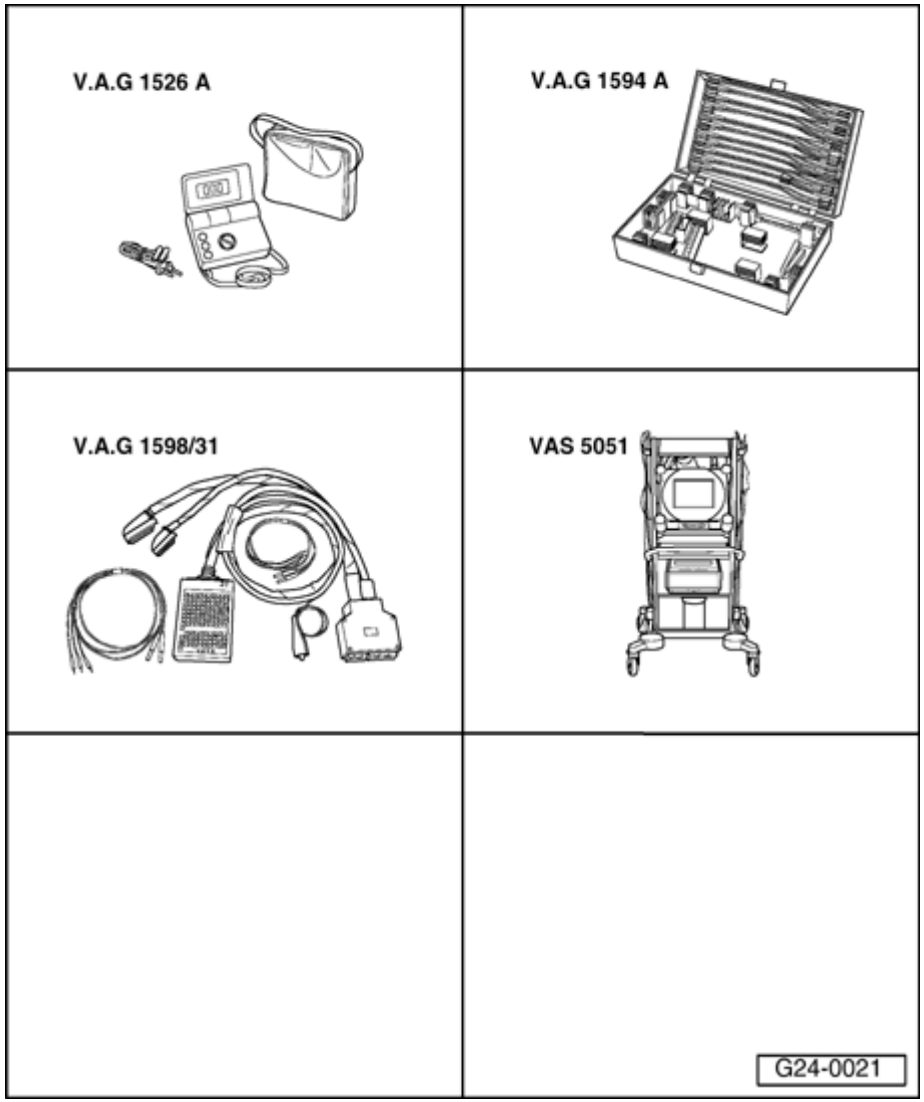
- If the measured values of all fuel injectors are outside the specified range, check fuel pressure ⇒ Page 24-30 .

Note:

Also check spray pattern when checking injection quantity. Spray pattern must be the same for all injectors

- Install fuel injectors together with fuel distributor ⇒ Page 24-44 .

24-49



Fuel Pump (FP) relay -J17- and activation, checking

Special Tools and Equipment

- VAG1526A
- VAG1594A
- VAG1598/31
- VAS5051 with VAG5051/1

- or

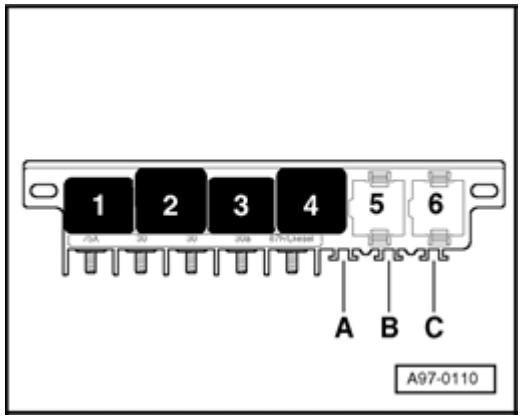
- VAG1551 with VAG1551/3B

24-50

Voltage is supplied to the Fuel Pump (FP) and several components of the injection system via the Fuel Pump (FP) relay -J17-.

Engine must be turning for Fuel Pump (FP) relay -J17- to close. This means that the relay does not receive Ground (GND) (via ECM) until the ECM recognizes RPM signals.

Note:



➢ *Fuel Pump (FP) relay is located at position 4 of central electrics in driver's footwell, left.*

Test requirement:

- Battery voltage at least 12.7 V

24-51

Function test of Fuel Pump (FP) relay

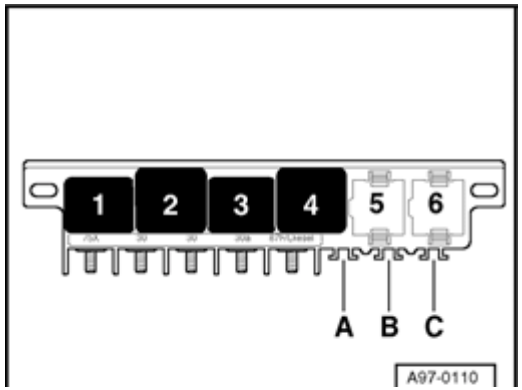
- Remove driver-side storage compartment.

⇒ *Repair Manual, Body-Interior, Repair Group 68; Instrument Panel; Removing Driver-Side Storage Compartment*

- Connect VAS5051 tester or VAG1551 scan tool and select the control module for engine electronics using "address word" 01 ⇒ Page 01-9 .

  Ignition must remain switched on for this.

- Initiate output Diagnostic Test Mode ⇒ Page 01-56 and activate Evaporative Emission (EVAP) canister purge regulator valve -N80-.



- ♦ Fuel Pump (FP) relay (at position 4 of central electrics in driver's footwell, left) must trigger and Fuel Pump (FP) must run.

A - If relay does not trigger:

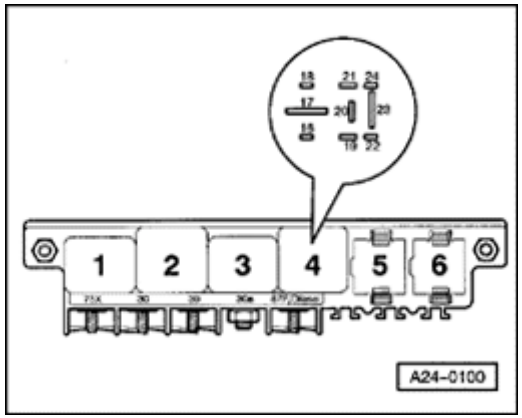
- Check voltage supply of Fuel Pump (FP) relay ⇒ Page 24-52 .
- Checking activation of Fuel Pump (FP) relay ⇒ Page 24-52 .

B - If relay triggers, but Fuel Pump (FP) does not run:

- Check voltage supply for Fuel Pump (FP) and components (via Fuel Pump -FP- relay) ⇒ Page 24-54 .

Check voltage supply of Fuel Pump (FP) relay

- Remove Fuel Pump (FP) relay.



- Connect multimeter to terminal 17 of relay socket and Ground (GND) for voltage measurement.
  - ♦ Specification: approx. battery voltage

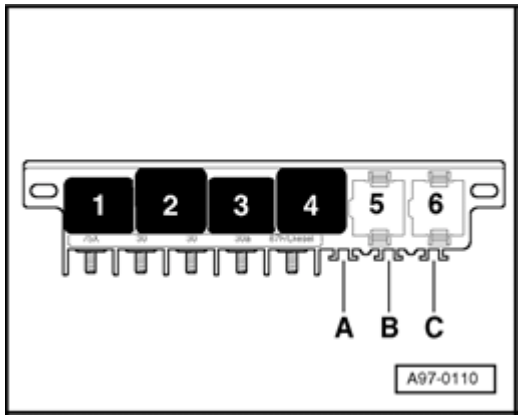
If specified value is not obtained:

- Replace central electrics.

Checking activation of Fuel Pump (FP) relay

- Switch ignition off.
- Connect VAG1598/31 test box at wiring harness to ECM, do not connect ECM ⇒ Page 24-17 .
- Bridge terminals 1 and 65 at test box using wires from VAG1594A adapter test kit.

24-53



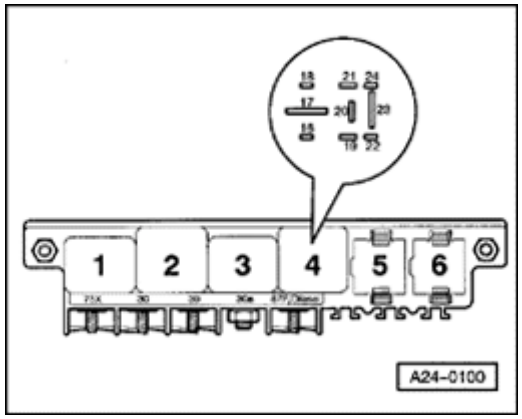
- ♦ Fuel Pump (FP) relay (at position 4 of central electrics in driver's footwell, left) must trigger.

If relay triggers now, but didn't during output DTM:

- Replace Engine Control Module (ECM) ⇒ Page 24-21 .

If relay does not trigger:

- Remove cable bridge.
- Remove Fuel Pump (FP) relay.



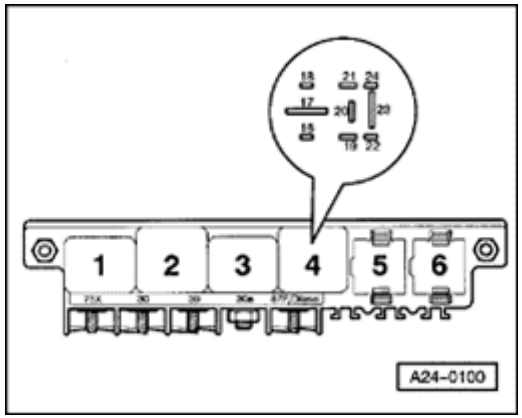
- Connect multimeter to terminal 19 of relay socket and Ground (GND) for voltage measurement.
  - ♦ Specification: approx. battery voltage

If specified value is not obtained:

- Check wire connections.

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

24-54



If specified value is obtained:

- Check the following wire connection for open circuit and short circuit to Ground (GND) and B+:

Central electric in driver-side footwell, left, position 4 Terminal	VAG1598/31 test box Socket
16	65

- Repair open circuit or short circuit if necessary.

If no malfunctions are detected:

- Replace Fuel Pump (FP) relay -J17-.
- Re-connect Engine Control Module (ECM).

Check voltage supply for Fuel Pump (FP) and components

- Remove fuses S228, S229, and S234 (positions 28, 29, and S234) from fuse holder.
- Initiate output Diagnostic Test Mode ⇒ Page 01-56 and activate Evaporative Emission (EVAP) canister purge regulator valve -N80-.

24-55

- Connect multimeter for voltage measurement to Ground (GND) and to one terminal of the following fuses in the fuse holder.

Fuse	Specified value at one of the terminals
S228	approx. battery voltage
S229	approx. battery voltage
S234	approx. battery voltage

If specified values are not obtained:

- Repeat test at another terminal of fuse socket.

If specified values are not obtained again:

- Check wire connections.

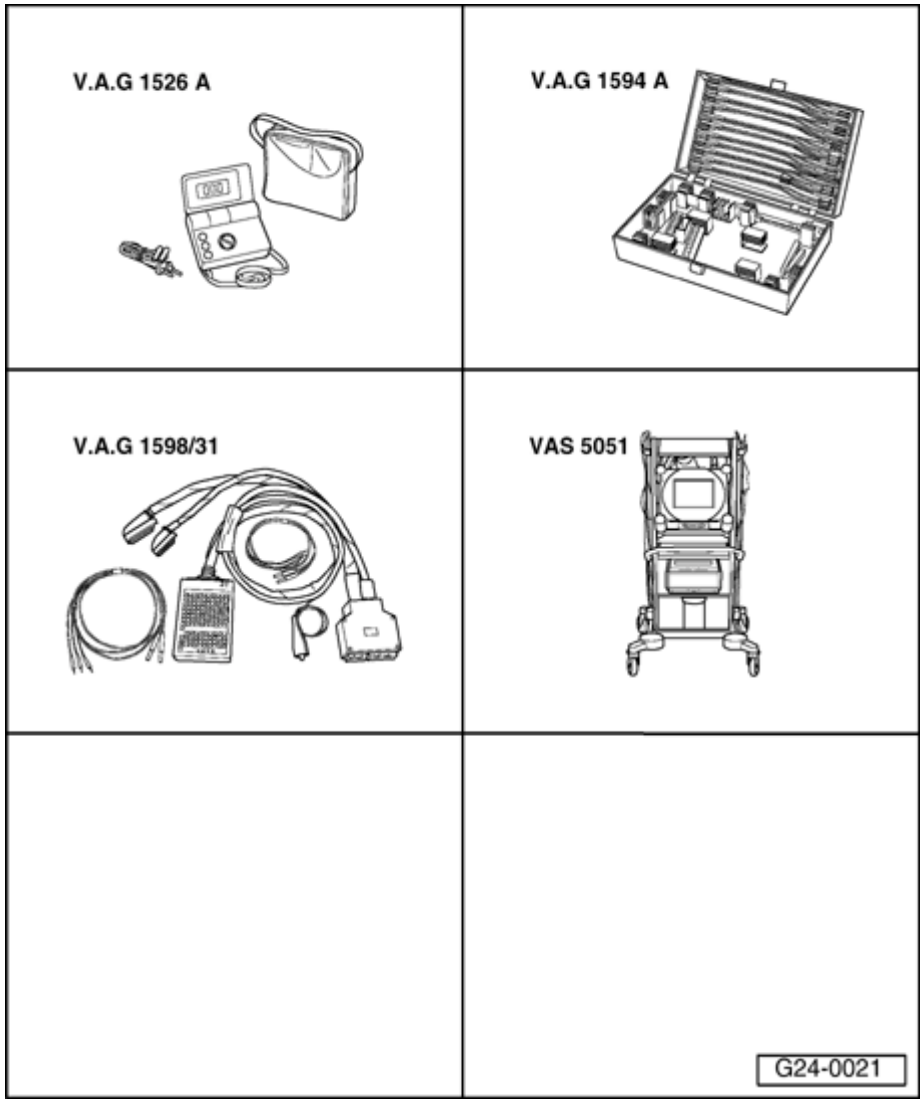
⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

If no malfunctions are detected:

- Replace Fuel Pump (FP) relay -J17-.

- Re-insert the fuses.

24-56



Mass Air Flow (MAF) sensor -G70-, checking

Special Tools and Equipment

- VAG1526A
- VAG1594A
- VAG1598/31
- VAS5051 with VAG5051/1

- or

- VAG1551 with VAG1551/3B

24-57

Test requirements:

- Coolant Temperature at least 80 °C.
- Electrical consumers switched off (radiator fan must NOT run during test).
- A/C switched off.
- Fuse for Mass Air Flow (MAF) sensor OK

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

Checking function

- Connect VAS5051 tester or VAG1551 scan tool and select the control module for engine electronics using "address word" 01 ⇒ Page 01-9 .

  Engine must run at idle for this.

Rapid data transfer	**HELP**
Select function XX	

When indicated on display:

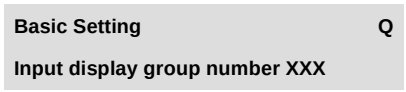
-
  Press buttons -0- and -4- to select "Initiate basic setting" and press -Q-

button to confirm input.

Note:

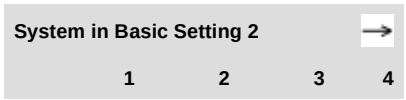
During basic setting, the Evaporative Emission (EVAP) canister purge regulator valve (EVAP valve -N80-) is closed and the A/C compressor is switched off

24-58



When indicated on display:

- Press buttons -0-, -0- and -2- to select "display group number 002" and press -Q- button to confirm input.



When indicated on display:

- Check specified values for load detection in display fields 3 and 4.

	Display fields			
	1	2	3	4
Display group 002: Air mass taken in with engine at idle and operating temperature				
Display	xxx /min	xx.x %	**x.x ms**	**xxx.x g/s**
Indicated	Engine speed (RPM)	Load	**mean injection time**	**Air mass**
Functional range	630 to 6800 RPM	12 to 100 %	**1.0 to 20.0 ms**	**1.0 to 150 g/s**
Specified value	720 to 820 RPM[1)] 630 to 730 RPM[2)]	12.0 to 26.0 %	**1.0 to 4.0 ms**	**1.0 to 5.0 g/s**
Notes	---	---	**If specified value is not obtained: Evaluation display field 3 ⇒ Page 24-59**	**If specified value is not obtained: Evaluation display field 4 ⇒ Page 24-60**

1) Front Wheel Drive Vehicles

2) All-Wheel Drive Vehicles

24-59

If specified values are obtained:

- Press →button.

Rapid data transfer HELP	
Select function XX	

Indicated on display (function selection):

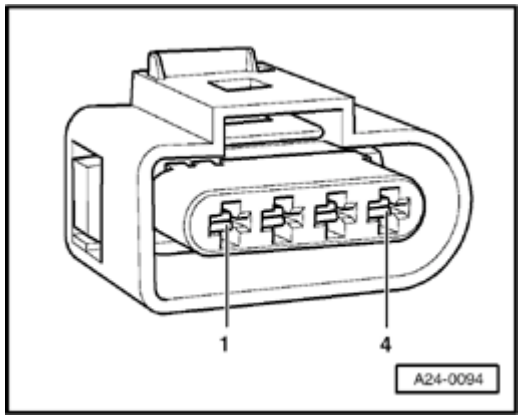
Evaluation display group 002

Display field: 3	Possible cause	Corrective action
less than 1.0 ms	♦ Smaller values are only possible when driving in deceleration mode	
larger than 4.0 ms	♦ Engine under load due to power accessories.	- Reduce load (A/C system/power steering/generator)
	♦ Poor idle (does not run on all cylinders)	- Check spark plugs. - Check fuel injectors ⇒ Page 24-36
	♦ Throttle valve control module - J338- faulty	- Check throttle valve control module ⇒ Page 24-141

Evaluation display group 002

Display field: 4	Possible cause	Corrective action
smaller than 1.0 g/s	♦ large false air mass between intake manifold and Mass Air Flow (MAF) sensor ♦ Voltage supply of Mass Air Flow (MAF) sensor or wire connections to Engine Control Module (ECM)	- Check intake system for leaks (false air) ⇒ Page 24-64 - Check voltage supply ⇒ Page 24-61
larger than 5.0 g/s	♦ Engine under load due to power accessories.	- Reduce load (A/C system/power steering/generator)
	♦ Voltage supply of Mass Air Flow (MAF) sensor or wire connections to Engine Control Module (ECM)	- Check voltage supply ⇒ Page 24-61

24-61



Voltage supply for Mass Air Flow (MAF) sensor, checking

- Disconnect connector from Mass Air Flow (MAF) sensor.

- Connect multimeter for voltage measurement as follows.

Harness connector Terminal	Measure to
3	Engine Ground (GND)

- Operate starter briefly.
  - ♦ Specification: approx. battery voltage

Note:

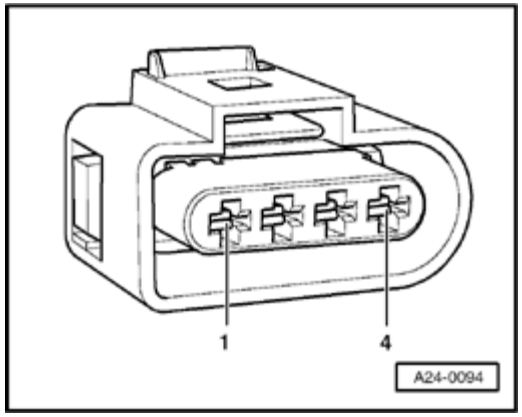
Voltage is supplied to Mass Air Flow (MAF) sensor from Fuel Pump (FP) relay.

If specified value is not obtained:

- Check wire connection from terminal 3 of connector to Fuel Pump (FP) relay via fuse for open circuit and short circuit to Ground (GND):

⇒ *Electrical Wiring Diagrams, Troubleshooting & Component Locations binder*

- Repair open circuit or short circuit if necessary.



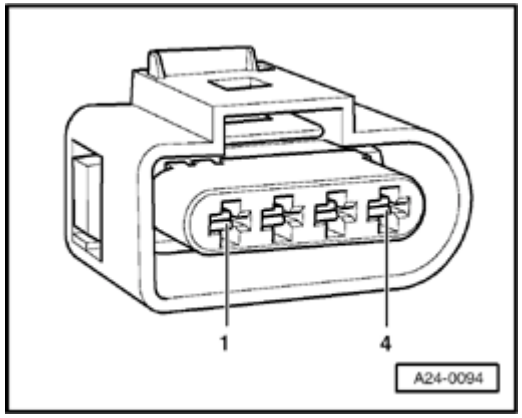
- Connect multimeter to terminal 2 and terminal 3 of connector for voltage measurement.
- Operate starter briefly.
  - Specification: approx. battery voltage

Note:

Ground (GND) from the ECM is present at terminal 2 of connector.

If specified value is not obtained:

- Check wire connections ⇒ Page 24-63 .



- Connect multimeter to terminal 1 and terminal 2 of connector for voltage measurement.
- Switch ignition on.
  - Specification: about 5 V

If specified value is not obtained:

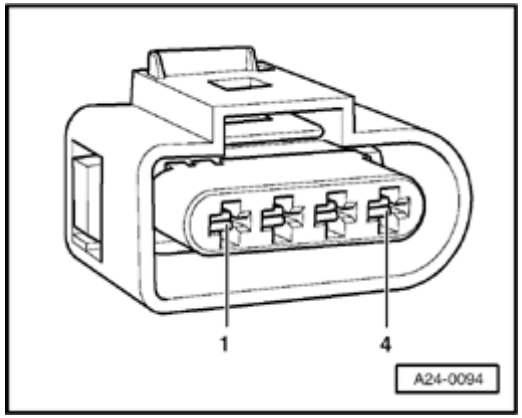
- Check wire connections ⇒ Page 24-63 .

Check wire connections for Mass Air Flow (MAF) sensor

Note:

Signal wire is also checked during wire test.

- Connect VAG1598/31 test box at wiring harness to ECM, do not connect ECM ⇒ Page 24-17 .



- Check the following wire connections for open circuit and short circuit to Ground (GND) and B+:

Harness connector Terminal	VAG1598/31 test box Socket
1	53
2	27
4	29

- Repair open circuit or short circuit if necessary.
- Also check all wires for short circuit to each other.

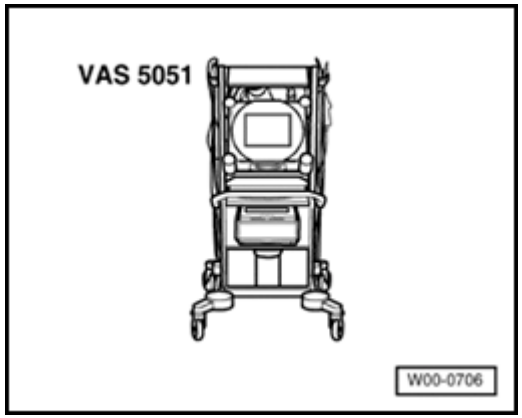
If wire connection is OK:

- Replace Mass Air Flow (MAF) sensor -G70-.

24-64

Intake air system, checking for leaks (unmetered air)

Special tools and equipment



- VAS5051 with VAG5051/1

or

- VAG1551 with VAG1551/3B
- Engine leak detection spray G 001 800 A1

Notes:

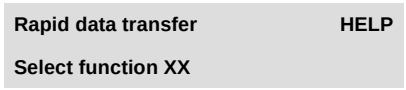
- *The negative pressure in the intake system sucks in the leak detection spray with the unmetered air. Leak detection spray decreases ignition quality and performance of the fuel mixture. This causes a reduction in engine speed and a sharp increase of CO content.*
- *It is absolutely necessary to follow the safety precautions listed on the can.*

24-65

Test sequence

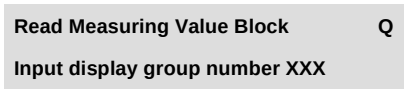
- Connect VAS5051 tester or VAG1551 scan tool and select the control module for engine electronics using "address word" 01 ⇒ Page 01-9 .

Engine must run at idle for this.



When indicated on display:

- Press buttons -0- and -8- to select "Read Measuring Value Block" and press -Q- button to confirm input.



When indicated on display:

- Press buttons -0-, -0- and -1- to select "display group number 001" and press -Q- button to confirm input.

Indicated on display: (1 thru 4 = display fields)

- Make note of engine speed in display field 1.
- Spray intake system parts with engine leak detection spray in a systematic manner.

24-66

If engine speed does not change:

- Press →button.

Rapid data transfer **HELP**

Select function XX

Indicated on display (function selection):

If engine speed decreases:

- Press →button.
- Press buttons -0- and -6- to select "End output" and press -Q- button to confirm input.
- Switch ignition off.
- Check sprayed part of intake system for leaks, and eliminate the error.