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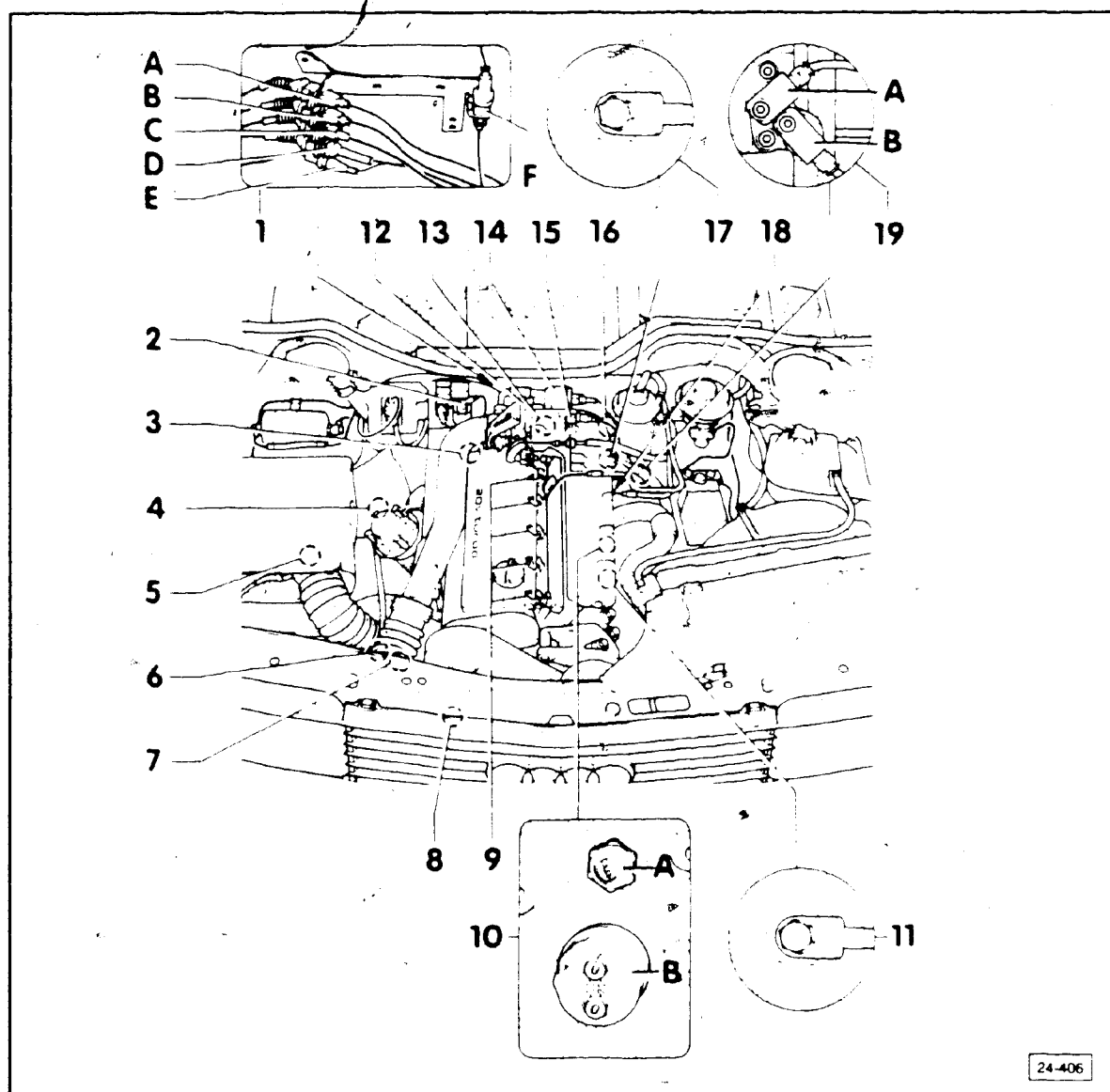
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Ignition System



- | | |
|--|---|
| 1 — Harness connector mounting bracket
(for harness connectors A through F) | 2 — Ignition coil (N)
checking page 28 37 |
| A Ignition timing sender (G 4)
(Black connector) | 3 — Engine coolant temperature sensor (G 62)
(on right rear of cylinder head)
checking page 28 43 |
| B Engine speed sensor (G 28)
(Gray connector) | 4 — Oxygen sensor (G 39)
checking, see Repair Group 24 |
| C Knock sensor I (Front) (G 61)
(Brown connector) | 5 — Air mass sensor (G 19)
checking, see Repair Group 24 |
| D Oxygen sensor heater connector (D 19)
(2 pin Black connector) | 6 — Wastegate frequency valve (N 75)
checking, see Repair Group 24 |
| E Oxygen sensor (G 39)
(Green signal wire) | |
| F Knock sensor II (Rear) (G 66)
(Blue connector) | |

- 7 — **By-pass valve (N 65)**
checking, see Repair Group 21
- 8 — **Oil temperature sensor (G 68)**
- 9 — **Fuel injector (N 30, 31, 32, 33, 83)**
checking, see Repair Group 24
- 10 — **Dynamic oil pressure switches**
 - A Oil pressure switch (F 1)
 - B Oil pressure sensor (G 10)
- 11 — **Knock sensor I (Front) (G 61)**
checking page 28.45
- 12 — **Throttle potentiometer (G 69)**
(Integrated with idle switch)
- 13 — **Carbon canister frequency valve (N 80)**
checking, see Repair Group 24
- 14 — **Idle stabilizer valve (N 71)**
checking, see Repair Group 24
- 15 — **Intake air temperature sensor (G 42)**
checking page 28.42
- 16 — **Ignition distributor (O) with Hall sender (G 40)**
 - checking Hall sender, page 28.46
 - basic adjustments, page 28.47
- 17 — **Knock sensor II (Rear) (G 66)**
checking page 28.45
- 18 — **Fuel pressure regulator**
system pressure and residual pressure checking, see Repair Group 24
- 19 — **Flywheel sensors**
 - A Ignition timing sender (G 4)
(**Black** connector)
 - checking, page 28.39
 - B Engine speed sensor (G 28)
(**Gray** connector)
 - checking, page 28.41

Tuneup specifications

2.22 liter 20 Valve Turbo

Engine code		3B
Ignition timing sender resistance checking, page 28.39		approximately 1000 Ohms
Engine speed sensor resistance checking, page 28.41		approximately 1000 Ohms
Spark plugs	part number tightening torque electrode gap	F 5 DPOR N 100 807 05 30 Nm (22 ft lb) 0.6 + 0.1 mm (0.024 + 0.004 in.)
Firing order	cylinders	1 2 4 5 3
RPM cutoff (upper limit) via Motronic control unit		7200 ± 40 RPM
Ignition coil	Secondary resistance Primary resistance	approximately 5000 to 9000 Ohms approximately 0.5 to 1.5 Ohms
Distributor rotor	resistance	approximately 1000 Ohms
Note The ignition rotor must NOT be turned for any reason.		
Ignition wire	resistance	approximately 1000 Ohms
Spark plug connector	resistance	approximately 5000 Ohms
Ignition timing		Ignition timing is determined by the control unit map and CANNOT be adjusted.
*Idle speed	checking value	800 ± 30 RPM
*CO content	checking value	0.7 ± 0.2 vol. %

*checking conditions

- activate fault memory, see Repair Group D2 for additional information
- engine warm, oil temperature 80°C (176°F) minimum
- throttle in idle position (against stop)
- all electrical consumers switched **OFF**
- A C switched **OFF**
- **NO** fuel pressure measuring devices connected
- radiator cooling fan **NOT** running during measurements

Safety measures

Note

A variety of electrical connectors are used on this vehicle. **ALWAYS** use the **VW 1594** adaptor kit to connect test instruments to these connectors.

CAUTION

Before disconnecting a customer's battery; **ALWAYS** ask for the radio code (if equipped with an anti-theft radio).

CAUTION

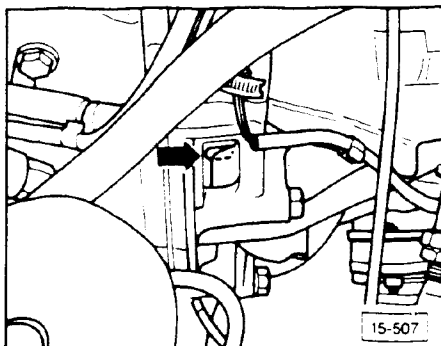
Observe the following precautions to prevent personal injury as well as possible damage to the ignition system components.

- do **NOT** disconnect the Motronic control unit until at least 20 seconds after switching off the ignition
- switch **OFF** the ignition before connecting or disconnecting components or test equipment
- connect and disconnect battery **ONLY** with ignition switched **OFF** otherwise the Motronic control unit could be damaged
- if the engine must be cranked but not started (for compression testing etc.) disconnect power output stage of ignition coil
- after each start attempt wait at least one minute before trying again
- do **NOT** crank engine with injectors removed
- do **NOT** use battery booster longer than one minute nor should 16.5 volts be exceeded
- do **NOT** wash engine unless ignition is switched **OFF**
- disconnect **BOTH** battery terminals whenever arc or spot welding
- before towing, vehicles with a defective ignition system (or where this is suspected) must have terminal 1 (green) of the ignition coil disconnected
- do **NOT** connect a condenser of any kind to terminal 1 of the ignition coil
- when installing noise suppressors, **ONLY** use 1000 ohms for high tension wires and 5000 ohms for spark plug connectors
- do **NOT** replace distributor rotor (marked **R1**) with a different type
- if the vehicle is heated up (e.g. in a painting booth) do **NOT** start the engine until it has had sufficient time to return to room temperature

TDC markings, checking

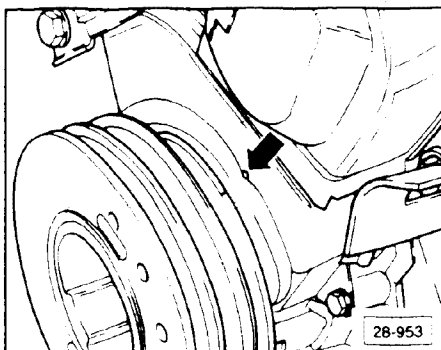
Engine installed

- TDC marking -0- is aligned with casting on clutch housing



Engine NOT installed

- rotate engine until notch on vibration damper aligns with stamping on drive belt cover



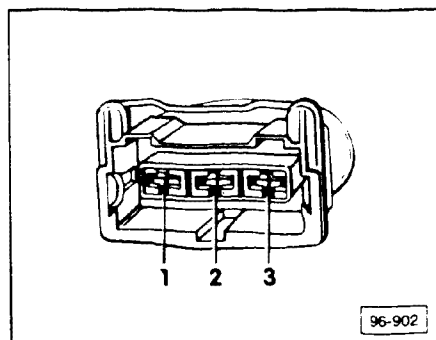
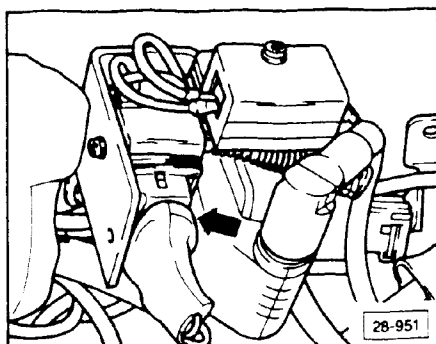
Note

To check TDC marking with drive belt cover removed see Repair Group 13.

Ignition coil power output stage (N 70), checking

Power output stage triggering, checking

- disconnect harness connector (**arrow**) from ignition coil power output stage
- switch multimeter **US 1119** to 20 volt range



- connect multimeter between terminal 1 and ground and then between terminals 1 and 3
- switch ignition **ON**
 - must be approximately 12 volts

If NO

- check for break in wiring using wiring diagram, replace or repair as necessary
- connect multimeter between terminals 2 and 3
- crank engine with starter
 - must be 0.2 volts minimum

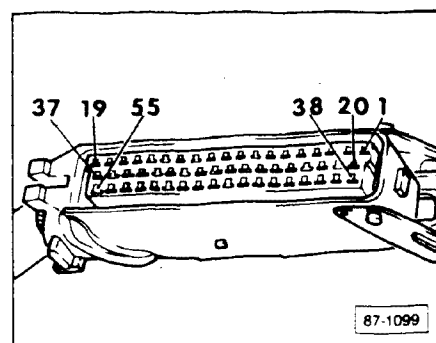
If NO

- connect **VAG 1598** Test box to control unit harness connector using adaptor cable **VAG 1598/5**, see Repair Group D2 for additional information
 - control unit is not connected

- switch multimeter **US 1119** to resistance range
- check for continuity or ground short between terminal 2 of power output stage harness connector and terminal 1 of Test box, repair as necessary
 - terminal 1 of Test box corresponds with terminal 1 of control unit harness connector

If wiring OK

- replace Motronic control unit

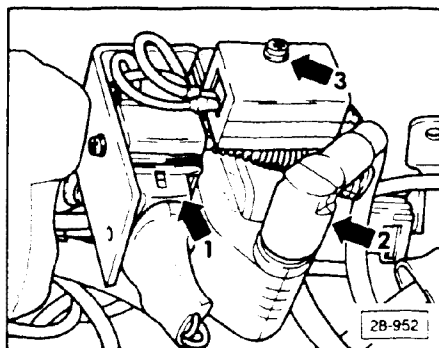


Ignition coil (N), checking

Note

Check wiring between power output stage and ignition coil as well as between power output stage and engine for corrosion and/or insulator damage.

- disconnect harness connector 1 from power output stage and connector 2 from terminal 4 of ignition coil
- remove screw 3

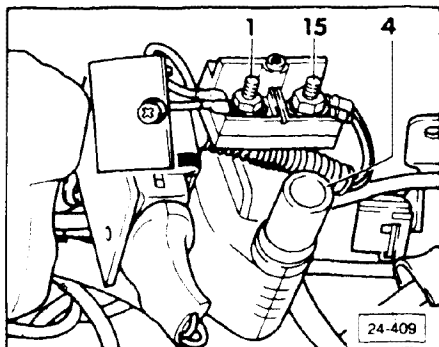


Secondary resistance, checking

- connect multimeter between terminals 1 and 4 of ignition coil
 - must be between 5000 and 9000 Ohms

If **NO**

- replace ignition coil



Primary resistance, checking

- connect multimeter between terminals 1 and 15 of ignition coil
 - must be between 0.5 and 1.5 Ohms

If **NO**

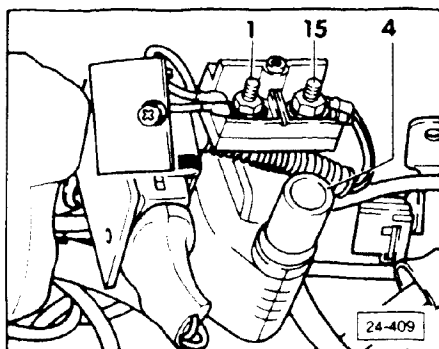
- replace ignition coil

If coil resistance values are obtained but engine does **NOT** run

- check distributor cap, distributor rotor and ignition wiring for damage, replace or repair as necessary

If **OK**

- replace ignition coil



Ignition timing sender (G 4), checking

For sender location see page 28.34

- disconnect ignition timing sender harness connector (BLACK)
- switch multimeter **US 1119** to resistance range
- connect multimeter between terminals 1 and 2 of ignition timing sender terminals
 - must be approximately 1000 Ohms

If **NO**

- replace ignition timing sender

If **YES**

- connect multimeter between terminals 1 and 3
 - must be open (infinite Ohms)

If **NO**

- replace ignition timing sender

If **YES**

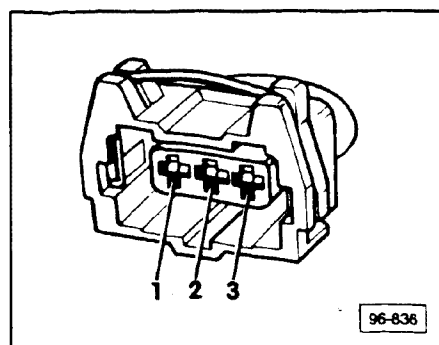
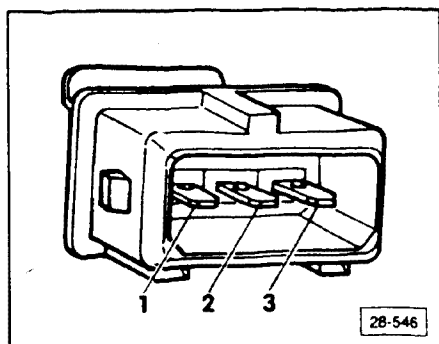
- connect multimeter between terminals 2 and 3
 - must be open (infinite Ohms)

If **NO**

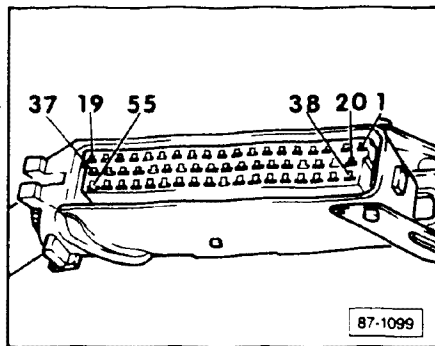
- replace ignition timing sender

If resistance **OK**

- check wiring between sensor harness connector and Motronic control unit as follows:
- connect **VAG 1598** Test box to control unit harness connector using adaptor cable **VAG 1598/5**, see Repair Group D2 for additional information
 - control unit is not connected
- check following wires, one after the other, for continuity or short circuit using wiring diagram, replace or repair as necessary
 - between sender harness connector terminal 1 and Test box terminal 48
 - between sender harness connector terminal 2 and Test box terminal 49
 - between sender harness connector terminal 3 and Test box terminal 19 (ground)



Ignition System



Note

Test box terminals 48, 49 and 19 correspond to harness connector terminals 48, 49 and 19.

If wiring **OK**

- check ignition timing sender pin on flywheel

Timing sender pin, checking

- remove ignition timing sender mounting bracket from bell housing to expose pin on flywheel
- turn engine over slowly by hand until pin appears in opening
- check condition of pin (damaged or bent), check for secure fit, replace if necessary

If all wiring checks **OK** and pin is **OK**

- replace Motronic control unit

Engine speed sensor (G 28), checking

For sensor location see page 28.34

- disconnect gray harness connector from engine speed sensor (mounted on bracket on left side of engine)
- switch multimeter **US 1119** to resistance range
- connect multimeter between terminals 1 and 2 of speed sensor
 - must be approximately 1000 Ohms

If **NO**

- replace engine speed sensor

If **YES**

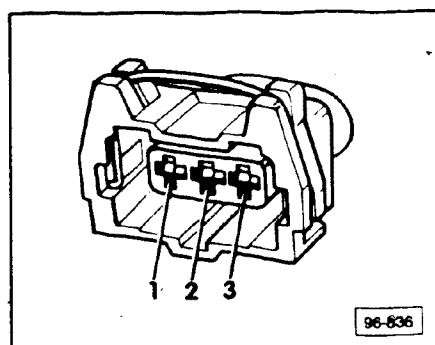
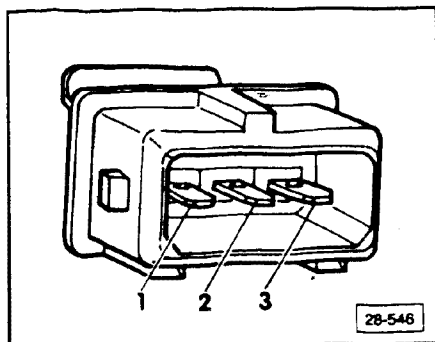
- connect multimeter between terminals 1 and 3
 - must be open (infinite Ohms)
- connect multimeter between terminals 2 and 3
 - must be open (infinite Ohms)

If **NO**

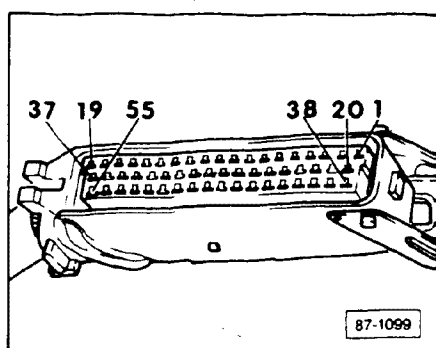
- replace engine speed sensor

If **YES**

- connect **VAG 1598** test box to control unit harness connector using adaptor cable **VAG 1598/5**, see Repair Group D2 for additional information
 - control unit is not connected during this check
- check following wires, one after the other, for continuity or short circuit using wiring diagram, replace or repair as necessary
 - between sender harness connector terminal 1 and Test box terminal 48
 - between sender harness connector terminal 2 and Test box terminal 47
 - between sender harness connector terminal 3 and Test box terminal 19 (ground)



Ignition System



Note

Test box terminals **48**, **49** and **19** correspond to harness connector terminals **48**, **47** and **19**.

If wiring **OK**

- check teeth on flywheel ring gear as follows:
- remove engine speed sensor mounting bracket which will expose a portion of the ring gear
- slowly rotate engine and observe condition of ring gear, checking for:
 - out of roundness
 - broken teeth
- replace ring gear if necessary

If ring gear **OK**

- replace Motronic control unit

Intake air temperature sensor (G 42), checking

For intake air temperature sensor location see
page 28.34

- connect **VAG 1598** Test box to control unit
harness connector using adapter cable
VAG 1598/5, see Repair Group D2 for
additional information
 - control unit is not connected
- switch **US 1119** multimeter to resistance
range
- connect multimeter between terminals
30 and **44**
 - must be between 450 and 550 Ohms

If **NO**

- push back rubber boot on intake air sensor
harness connector
- connect multimeter between both terminals
of sensor
 - must be approximately 450 to 550 Ohms

If **NO**

- replace intake air temperature sensor
(**G 42**)

If YES

- check wires between sensor and control unit as follows:
- connect multimeter between terminal **30** of test box and terminal **1** of sensor
- connect multimeter between terminal **30** of test box and terminal **2** of sensor
 - must be approximately 450 to 550 Ohms for one measurement and continuity (approximately 0 Ohms) for the other measurement (does not matter which combination)
- connect multimeter between terminal **44** of test box and terminal **1** of sensor
- connect multimeter between terminal **44** of test box and terminal **2** of sensor
 - must be approximately 450 to 550 Ohms for one measurement and continuity (approximately 0 Ohms) for the other measurement (does not matter which combination)

If specified values **NOT** obtained

- repair break in wiring and/or short circuit using wiring diagram

Intake air temperature sensor (G 42), replacing

- remove intake air temperature sensor
- push back rubber boot on intake air sensor
- cut wires at sensor terminals and remove rubber boot
- slip new rubber boot over wiring
- slip shrink tubing over both wires
- attach terminals (without insulation) to wiring ends and attach to sensor
- carefully solder both terminals to sensor
- push shrink tubing over solder points and shrink using heat gun
- push rubber boot over connections and install sensor

CAUTION

Do **NOT** allow sensor to become too hot. Use heat sinks on sensor terminals if possible.

Do **NOT** allow solder to travel beyond the terminal and onto the wire. A break point in the wire could be created.

Coolant temperature sender (G 62), checking

For coolant temperature sensor location see page 28.34

Requirement

- sensor must be at approximately 20°C (68°F)
- disconnect harness connector from coolant temperature sender
- switch **US 1119** multimeter to resistance range
- connect multimeter between terminals 1 and 2 of coolant temperature sender
 - must be between approximately 1500 and 3000 ohms

If NO

- replace coolant temperature sender

If YES

- check wiring from sender to Motronic control unit as follows:
- connect **VAG 1598** test box to control unit harness connector using adaptor cable **VAG 1598/5**
 - control unit is not connected during this check
- check continuity between terminal 2 of harness connector and terminal 45 of test box
 - must not be greater than 0.5 ohms
- check continuity between terminal 1 of harness connector and terminal 30 of test box
 - must not be greater than 0.5 ohms

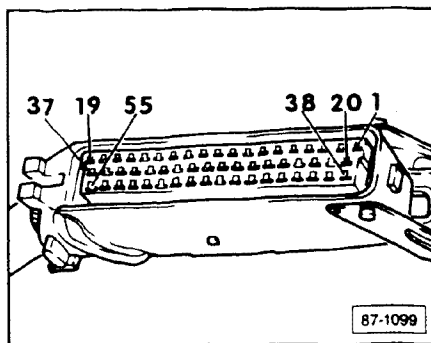
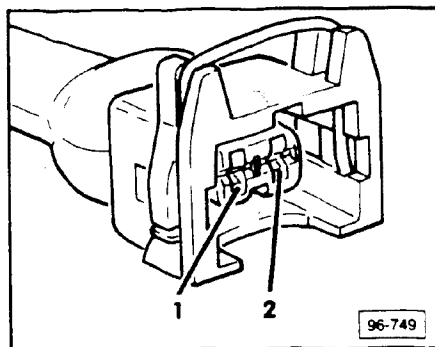
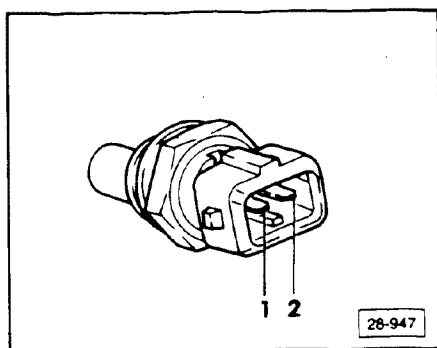
Note

Terminals 45 and 30 of Test box corresponds with terminals 45 and 30 of control unit harness connector.

- check both wires for shorting, repair or replace as necessary

If wiring OK

- replace Motronic control unit



Motronic control unit voltage supply, checking

Requirement

- fuse 27 OK
- connect **VAG 1598** Test box to control unit harness connector using adaptor cable **VAG 1598/5**, see Repair Group D2 for additional information
 - control unit is not connected
- connect **US 1115** LED tester between terminal **18** (constant positive) and then in succession between terminals **10, 14, 19, 24** and **54** (grounds)
 - LED tester must light up for each connection

If NO

- repair break in wiring using wiring diagram

Knock sensors (G 61 and G 66), checking

Note

The knock sensors cannot be functionally checked.

CAUTION

Correct knock sensor torque is critical to proper function of the knock sensors!

- must be 20 Nm (15 ft lb)

- check condition of connection at knock sensor connector and harness connector for corrosion, replace or repair as necessary
- activate Fault memory, see repair Group D2
 - if any knock sensor faults stored in memory, replace or repair as necessary

Knock sensor wiring, checking

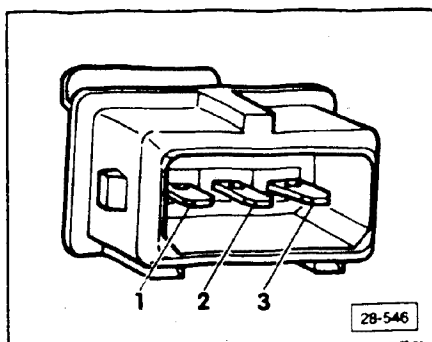
- disconnect knock sensor harness connector, see page 28.34 for location
- check resistance between all 3 terminals of knock sensor
 - must be open (infinite ohms) between all measurements

If **NO**

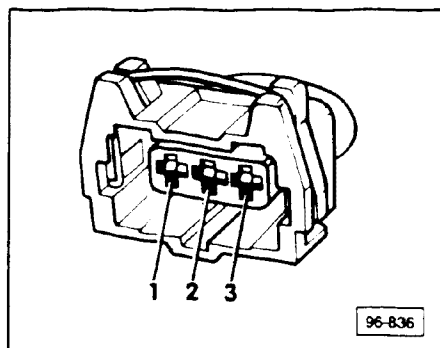
- replace knock sensor

Knock sensor wiring, checking

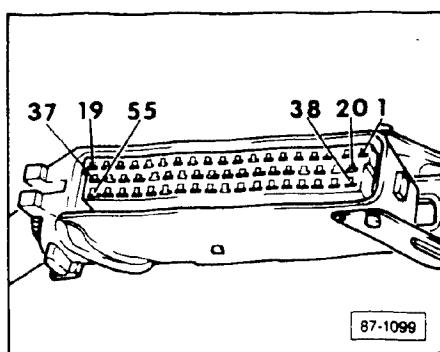
- connect **VAG 1598** test box to Motronic control unit harness connector using **VAG 1598/5** adaptor cable
 - control unit is left disconnected
- check following combinations of wires for continuity or short to one another



Ignition System



Knock sensor I connector terminal number		Test box terminal number
1 (signal)	←→	29 (29)*
2 (ground)	←→	30 (30)*
3 (shield)	←→	19 (19)*



Knock sensor II connector terminal number		Test box terminal number
1 (signal)	←→	11 (11)*
2 (ground)	←→	30 (30)*
3 (shield)	←→	19 (19)*

*number in parentheses is the number of the terminal in the Motronic control unit harness connector

If a short or open circuit is detected between the knock sensor harness connector and the Test box

- replace or repair the actual wiring between control unit harness connector and the sensor harness connector as necessary

Hall sender (G 40), checking

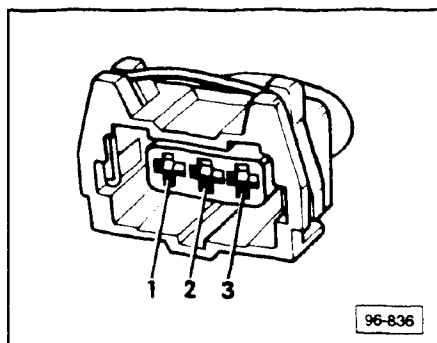
Note

The Hall sender is mounted inside of the ignition distributor.

- connect test box **VAG 1598** to Motronic control unit harness connector using adaptor **VAG 1598/5**, see Repair Group D2 for additional information
- connect LED tester **US 1115 (VAG 1527B)** to Test box terminals as follows: black wire to terminal **8** and red wire to terminal **12**
- activate starter for several seconds
 - LED tester must flash briefly at every second engine revolution

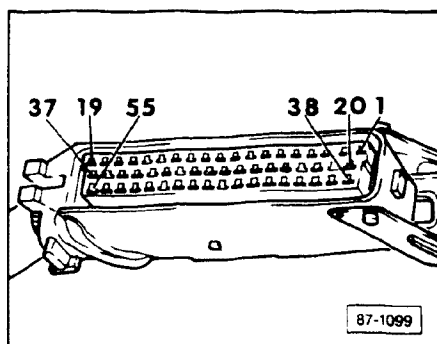
If NO

- switch **OFF** ignition
- disconnect Hall sender harness connector at ignition distributor
- using wiring diagram, check following wires for continuity or short to one another



Hall sender harness connector terminal number	Test box terminal number
1 (ground)	19 (19)*
2 (signal)	8 (8)*
3 (plus)	12 (12)*

*number in parentheses is terminal number for Motronic control unit harness connector



If a short or open circuit is detected between the Hall sender harness connector and the Test box

- replace or repair actual wiring between control unit harness connector and Hall sender harness connector as necessary

If a short or open circuit is detected between the Hall sender harness connector and the Test box

- replace or repair actual wiring between control unit harness connector and Hall sender harness connector as necessary

If wiring **OK**

- switch **ON** ignition
- switch multimeter **US 1119** to 20 volt range
- connect multimeter between terminals **12** and **19** of test box using adaptors from **VW 1594** kit
 - must be 4.5 to 5.5 Volts
- connect multimeter between terminals **8** and **19** of Test box
 - must be 4.3 to 5.2 Volts

If voltage **NOT** obtained

- replace Motronic control unit

If voltage obtained

- replace ignition distributor/Hall sender assembly
- perform ignition distributor basic adjustment, see page 28.47

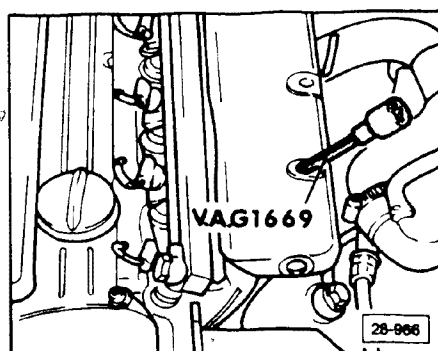
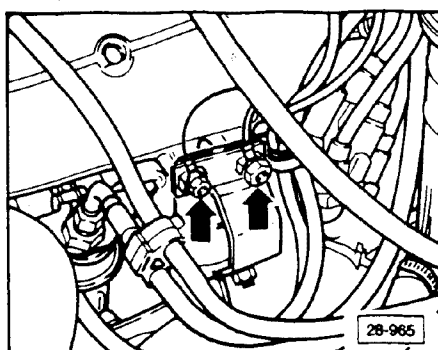
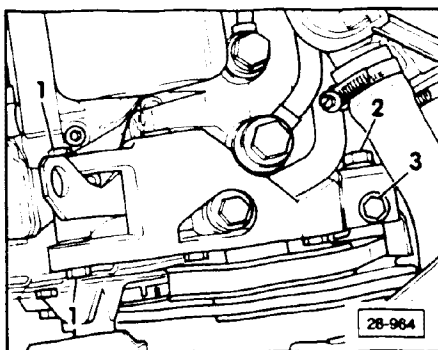
Note

The intake manifold must be removed to remove the ignition distributor, see Repair Group 15 for removal procedures.

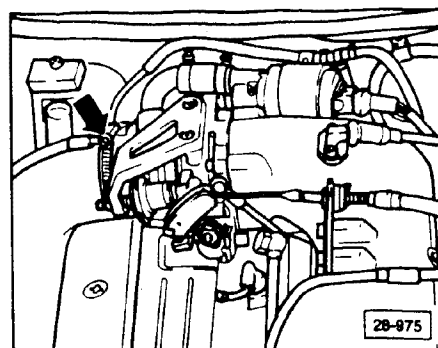
Ignition distributor, basic adjustment

Perform this procedure **ONLY** if fault code **2113** appears or if the ignition distributor has been removed.

- switch ignition **OFF**
- remove upper radiator cover
- loosen 1 hydraulic pump mounting screws (two)
- loosen belt tensioner nut 2 and tension V-belt using screw 3
- remove V-belt
- remove mounting screws 1 and push hydraulic pump slightly to left
- disconnect cruise control system ground wires and vacuum reservoir from manifold (arrows)

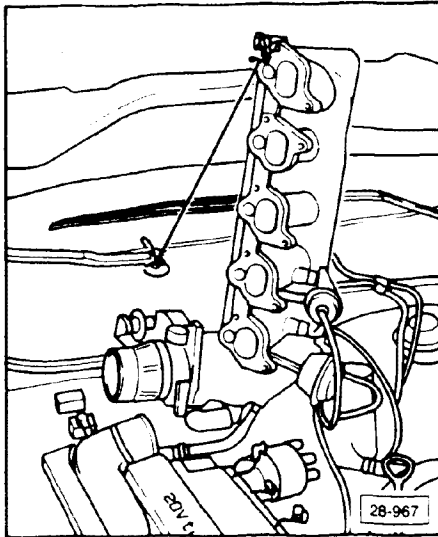


- remove intake manifold mounting bolts using hex extension **VAG 1669**
- disconnect harness connectors from fuel injectors
- loosely connect cruise control vacuum reservoir to manifold using screw (without wiring harness support bracket)



- loosen hose clamp (arrow)

Ignition System

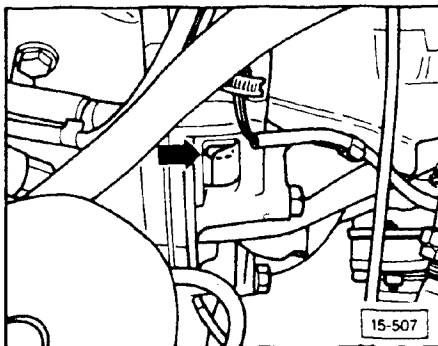


- lift manifold complete with throttle body, idle stabilizer valve and vacuum unit and fasten assembly to windshield wiper arm using scrap wire (as shown)
 - bend over end of wires to prevent injuries

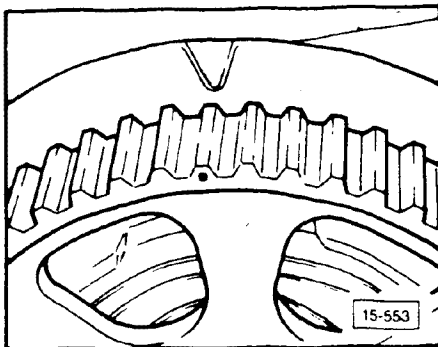
CAUTION

Do not scratch windshield wiper arm.

- switch **OFF** ignition



- select fifth gear and manually push vehicle until crankshaft is at TDC position (**arrow**) or rotate engine by turning crankshaft with wrench
- remove both screws for upper drive belt cover and push cover forward far enough so marking on cam gear is visible



- marking on cam gear must align with marking on cylinder head

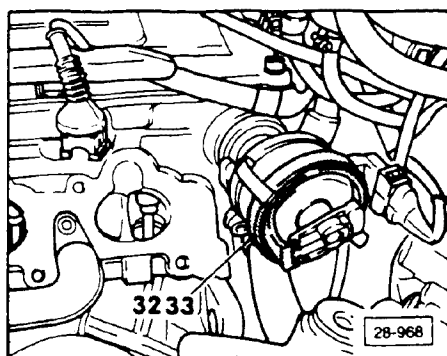
If marking is off 180°

- rotate engine one revolution until crankshaft is at TDC position again
 - marking on cam gear must align with marking on cylinder head

If **NO**

- adjust drive belt, see Repair Group 13
- remove distributor cap

Ignition System



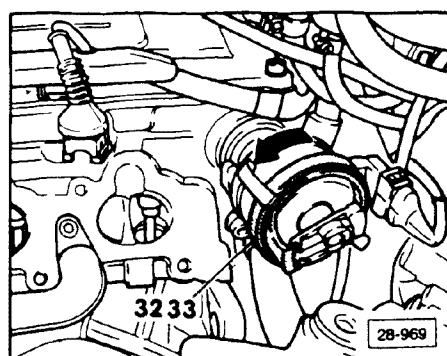
- install adjusting gauge **3233** on ignition distributor so stop lug of adjusting gauge engages on distributor housing and distributor rotor engages in notch of adjusting gauge

If distributor rotor does not engage in adjusting gauge

- loosen distributor mounting (if necessary, remove access guard) and turn distributor until rotor engages

Note

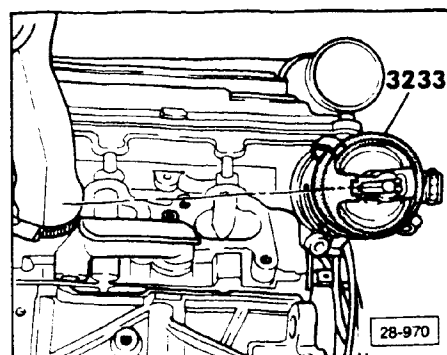
It is **NOT** necessary to re-install the access guard.



- pre-tension distributor by holding in direction of **arrow** (by hand)
- tighten mounting bolt

With Ignition Distributor Removed:

- install adjusting gauge **3233** on ignition distributor so stop lug of adjusting gauge engages on distributor housing and distributor rotor engages in notch of adjusting gauge
- replace seal



- install distributor in cylinder head so distributor rotor points towards front (in direction of coolant flange)
- pre-tension distributor by holding in counter-clockwise direction (by hand)
- tighten mounting bolt

remove **3233** adjusting gauge and install distributor cap

- re-install intake manifold, hydraulic pump and cruise control vacuum reservoir in reverse of removal sequence
- replace manifold flange seal
 - manifold bolts 25 Nm (18 ft lb)
 - hydraulic pump mounting bolts 25 Nm (18 ft lb)
 - cruise control vacuum reservoir mounting bolts 25 Nm (18 ft lb)

CAUTION

The cruise control rod must not touch the ignition distributor.

Ignition wiring, routing

Note

The ignition wires must not be allowed to criss-cross any other wiring. If allowed; sensor signals could be influenced leading to ignition failure.

To prevent disruption influences, do not attach any wiring to the ignition wiring or allow other wiring to be routed in the immediate area of the ignition wires.

CAUTION

Do **NOT** scratch the inner surface of the distributor cap with the distributor rotor during removal or installation.



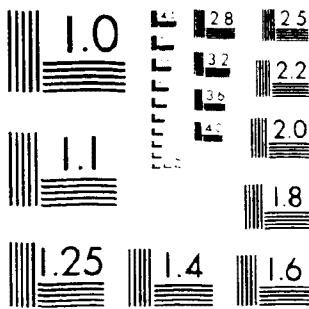
Microfilm Service Information System

Quality Control Test Pattern

ORIGINAL 9-28-81
REVISED 11-17-81

POINT SIZE

LINE WIDTH



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

- 14 ABCDEFGHIJKLMNOPQRSTUVWXYZ
- 13 ABCDEFGHIJKLMNOPQRSTUVWXYZ
- 12 ABCDEFGHIJKLMNOPQRSTUVWXYZ
- 11 ABCDEFGHIJKLMNOPQRSTUVWXYZ
- 10 ABCDEFGHIJKLMNOPQRSTUVWXYZ
- 9 ABCDEFGHIJKLMNOPQRSTUVWXYZ
- 8 ABCDEFGHIJKLMNOPQRSTUVWXYZ
- 7 ABCDEFGHIJKLMNOPQRSTUVWXYZ
- 6 ABCDEFGHIJKLMNOPQRSTUVWXYZ
- 5 ABCDEFGHIJKLMNOPQRSTUVWXYZ
- 12 abcdefghijklmnopqrstuvwxyz,./:/\$1234567890
- 11 abcdefghijklmnopqrstuvwxyz,./:/\$1234567890
- 10 abcdefghijklmnopqrstuvwxyz,./:/\$1234567890
- 9 abcdefghijklmnopqrstuvwxyz,./:/\$1234567890
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- 7 abcdefghijklmnopqrstuvwxyz,./:/\$1234567890
- 6 abcdefghijklmnopqrstuvwxyz,./:/\$1234567890
- 5 abcdefghijklmnopqrstuvwxyz,./:/\$1234567890

- 5 mil.
- 8 mil.
- 10 mil.
- 13 mil.
- 15 mil.
- 20 mil.
- 30 mil.
- 50 mil.

Gray Scale

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Gray Side ... 18% Reflectance

White Side ... 90% Reflectance