SERVICE

944 Turbo

DME
KLR

TEST PLAN

'85

INFORMATION

TECHNIK

Printed in Germany

WKD 453 920

CAUTIONS WHEN REPAIRING ELECTRONIC IGNITION SYSTEMS

Modern engines requiring more from ignition systems and the objective of low (or even no) maintenance have led to the application of electronic ignition systems in standard production some time ago. Normally the ignition output of an electronic system (almost all manufacturers) will be higher than that of a conventional system, whereby even greater ignition output is feasible. Consequently electronic ignition systems are in an output range, where touching current carrying parts or terminals on both primary and secondary sides could be dangerous.

Always turn off the ignition or disconnect the battery when working on the ignition system. Such jobs include the following.

- Connecting engine testing equipment (timing light, dwell angle/speed tester, ignition oscilloscope, etc.).
- Replacement of ignition system parts (spark plugs, ignition coils, distributor, ignition cables, etc.).

If testing the ignition system or making engine adjustments requires turning on the ignition, the mentioned dangerous voltage will be in **the entire system.**

Thus the danger is not only present at the individual parts of the ignition system (for example, distributor, ignition coil, control unit, ignition cables, etc.), but even on the wire harness (as for example, tachometer connection, diagnosis plug), plug connections and any testing equipment connected.

Working with Oscilloscope

Bosch Engine Tester Mot 300/400

SUN Engine Tester 1010

All sensor and ignition timing signals of Porsche cars can be checked with the engine testers, SUN 1010/1080/1019 or Bosch Mot 300/400, recommended by Porsche.
Always check for correct tester connections, since they will vary depending on the make of tester. However, since the engine tester operating instructions do not always include information on the curve shape or signal voltage values from inductive sensors, we want to provide you with some details on correct connections.

The following sensor signals can be checked with an oscilloscope:

1. Reference mark sensor
2. Speed sensor
3. ABS wheel speed sensor
4. Sensor coil signals from breakerless distributors
5. Injection signals
6. Consumption signal
7. Reed contact function
8. Positioner activation

Connections:

Bosch Mot 300/400: Use the positive and negative leads (red and black clips) for connection on sensor connections. Press buttons "Special" / "10 V" and "%" on the oscilloscope.

SUN 1010/1080: Use the single tester leads of inductive clip term. 4 (blue and black). The blue and black clips are connected on the sensor.
Set tester to: "primary +" / "4 H" / "2 Cyl." / "50 V".

Note: (1010) (1019) The screen is only calibrated in the primary position, i. e. voltage values can be read from scale.

Important! (1010) (1080) Only connect the blue tester lead via the L-Jetronic test lead for checking the signals on a fuel injector. The black terminal must be connected on ground, connect trigger clip red on cyl. no. 1.

Note: (1080) The "coil test" button should be pressed while testing with SUN 1080. Set the right regulator underneath the scope setting cover to 25 V.

SUN 1019: Same connections as SUN 1010, however connect green (term. 1) and blue (term. 15) leads.

Important! Only connect the green tester lead via the L-Jetronic test lead for checking the signals on a fuel injector. Connect blue lead on ground. Connect red trigger clip on cyl. no. 1.

Testing Requirements	Possible Defect Sources														
Engine in perfect running condition Battery charged	Ground connections Plug connections	Power supply to control unit / fuel pump	Speed sensor	Reference mark sensor	Ignition system	Air flow sensor	Fuel pressure	Idle positioner	Throttle switch	Temperature sensor II	Fuel injectors	Flashing code	Leaks in intake	Ignition signal KLR	Trigger signal
See test point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Possible Conditions:															
Engine cannot be started or is hard to start	x	x	x	x	x	x	x			x	x	x	x	x	x
Erratic idling	x		x	x	x	x	x	x	x	x	x	x	x		
Poor pick-up	x		x	x	x	x	x	x	x	x	x	x	x		
Misfiring	x	x	x	x	x	x	x		x	x	x				
High fuel consumption			x	x	x	x	x		x	x	x		x		
Poor engine power	x		x	x	x	x	x		x	x	x	x	x		

x = Check with a suitable tester!

Equipment Required to Test Digital Motor Electronics (DME and KLR):

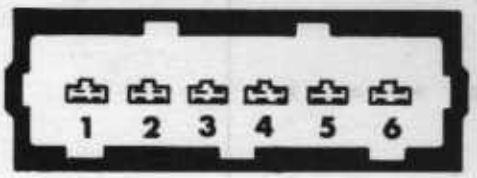
1 oscilloscope, e. g. SUN or Bosch
1 volt/ohmmeter (internal resistance at least 20 k-ohms/V)
1 test lead (Bosch "L-Jetronic Lead" No. 1684 463 093)
2 control unit plug test leads, approx. 600 mm long, with
2 bunch plugs 4 mm and 2 insulated alligator clips, as well as 2 flat male plugs N 17.457.2.
2 adapter test leads, approx. 200 mm long, with
4 plug connectors N 017.483.1
1 testing relay with LED (P 9246)

Always use the test leads for tests!

PLUG CONNECTIONS

Throttle Switch Plug

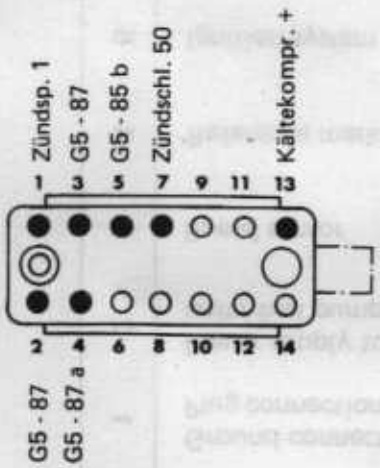
Throttle switch plug pulled off as seen looking at plug receptacles.



Oxygen Sensor Plug

Plug section as seen looking at sensor.

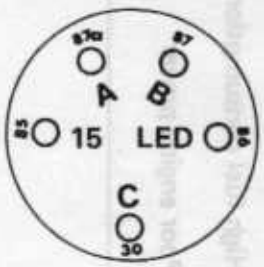
14-pin Plug Connection in Engine Compartment



Reference Mark Sensor/Speed Sensor

Plug section for sensor

Test Socket



Idle Positioner

DME PLUG CONNECTIONS – 944 Turbo

1 – Ignition pulses on ign. coil – 1

2 – Throttle switch
Idle contact – 2

3 – Full load signal from KLR

4 – Start signal (ign. lock – 50)

5 – Ground and shielding from reference mark sensor

6 – Air flow sensor – 4 (NTC I)

7 – Air flow sensor – 2
(sensor plate potentiometer)

8 – Speed sensor

9 – Air flow sensor – 3

10 – Perf. data change (to ⊣
for CH, S, AUS, NZL, Cal., Japan)

11 – Conn. point 4-pin term. 1
(economy control)

12 – Test socket (A)
(USA / unleaded gasoline engines)

13 – NTC II

14 – ti-signals, injectors 3 + 4

15 – ti-signals, injectors 1 + 2

16 – Ground

17 – Ground

18 – Power supply
Relay G 5 – 87

19 – Ground

20 – Ground activation relay G 5 – 85 b

21 – Conn. point 4-pin term. 2
(tachometer – 1)

22 – Air flow sensor – 1 (NTC I)

23 – Shielding (speed sensor/
oxygen sensor)

24 – Oxygen sensor
(USA/unleaded gas. engines)

25 – Reference mark sensor

26 – Reference mark sensor

27 – Speed sensor

28 – Ground

29 – A/C compressor (+)

30 – Altitude correction unit
(USA/unleaded gas. engines)

31 – Trigger signal for KR

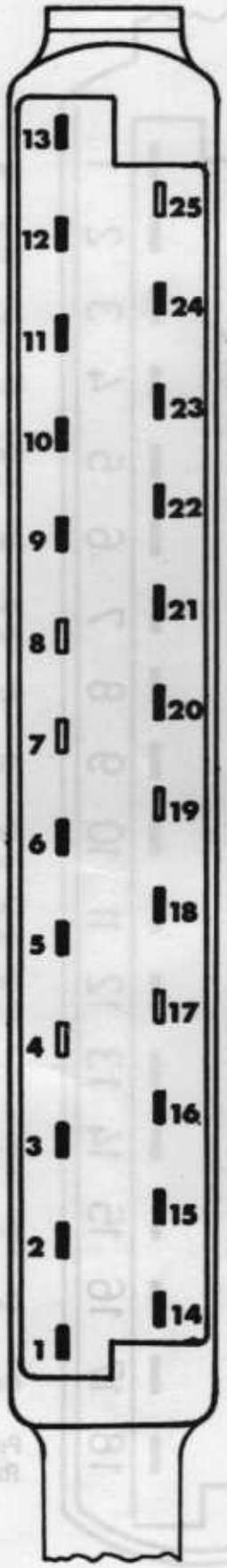
32 – TD* input final stage from KR

33 – Idle positioner – 3

34 – Idle positioner – 5

35 – Power supply
Relay G 5 – 87

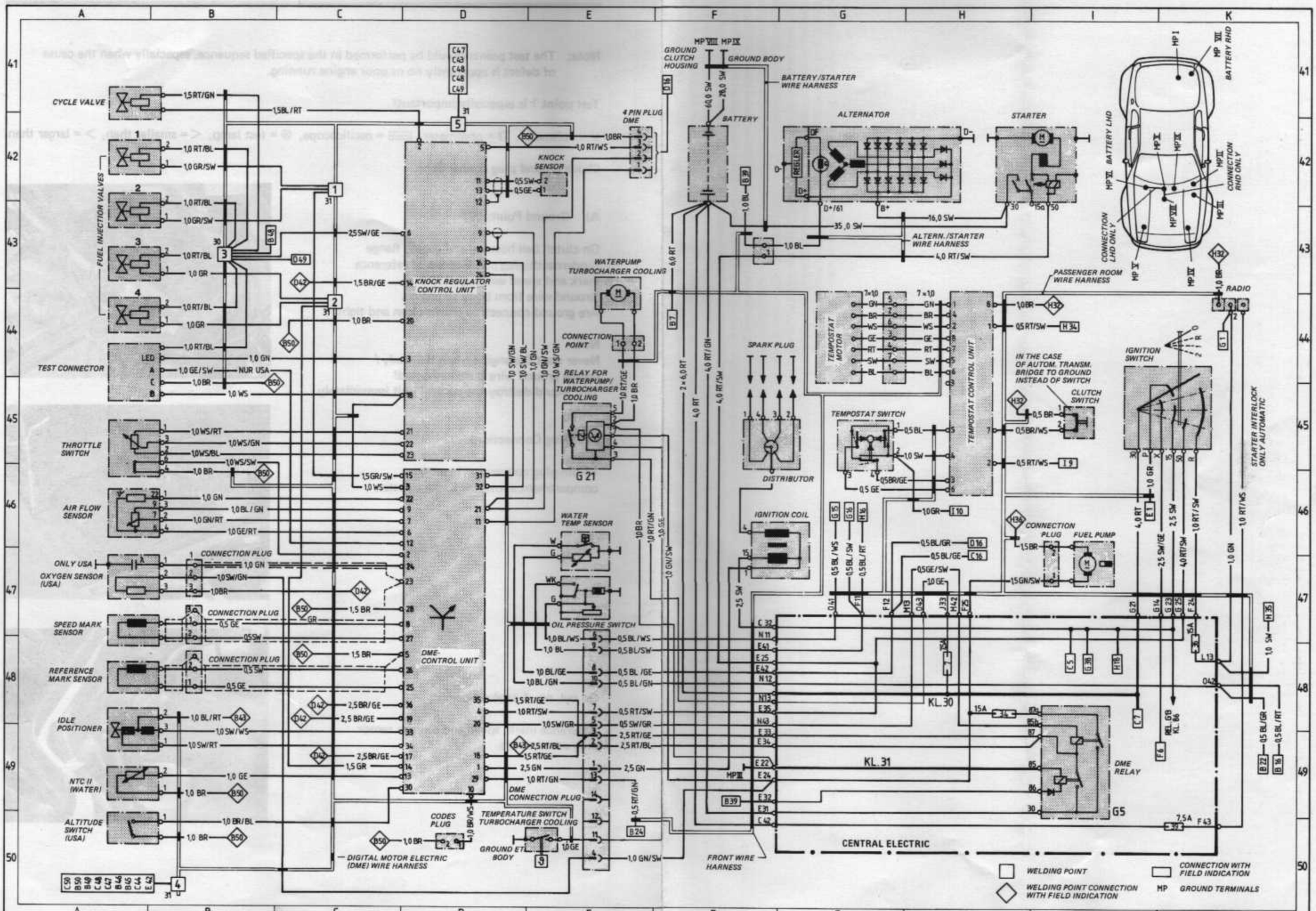
KNOCK CONTROL PLUG CONNECTIONS – 944 Turbo



Knock sensor	13	25	
Ground, shield knock sensor	12	24	tr-signal (input)
Ground	11	23	Angle sensor – ground, shield for angle sensor wire
Ground	10	22	Angle sensor – tap (throttle valve position)
Ignition signal (input)	9	21	Angle sensor – supply (throttle valve position)
	8	20	Car ground (electronic ground connection)
	7	19	
U (sheet)	6	18	Full load signal (output)
Intake vacuum signal (output for pressure display)	5	17	
	4	16	Ignition signal (output)
LED	3	15	Knocking yes / no (output)
Timing valve (output)	2	14	Car ground final stage timing valve
Diagnosis	1		

Wiring Diagram Type 944, 944 turbo Model 85

ENGINE COMPARTMENT



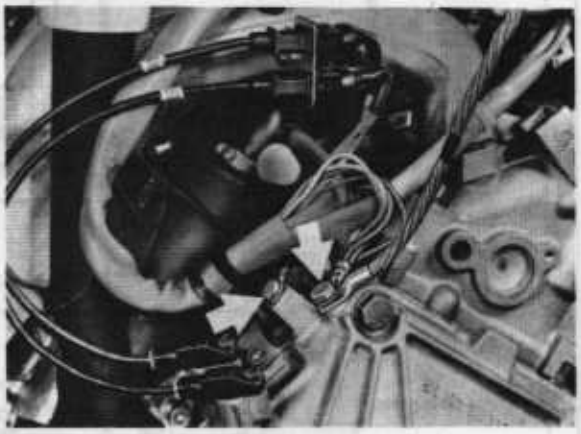
SW = BLACK WS = WHITE RT = RED GN = GREEN GE = YELLOW GR = GREY BR = BROWN BL = BLUE LI = VIOLET

Note: The test points should be performed in the specified sequence, especially when the cause of defect is apparently no or poor engine running.

Test point 1 is especially important!

V = voltmeter, Ω = ohmmeter, ▭ = oscilloscope, ⊗ = test lamp, < = smaller than, > = larger than

Check ground plug connections.



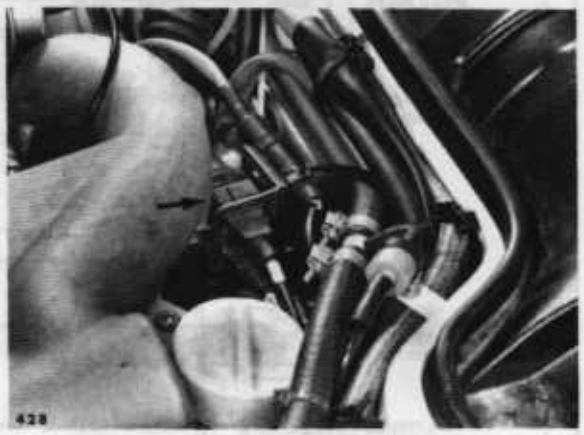
A) Ground Points (V)

On clutch bell housing and engine flange (underneath plug connections of reference mark and speed sensors).
Ground wire from body to engine.
Are ground connection points clean and tight?

Note:
Never start the engine when the body / engine ground wire is disconnected!
This would destroy the control unit immediately.

B) Plug Connections

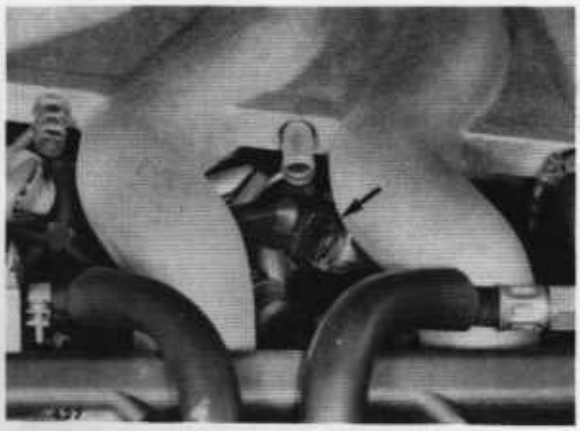
14-pin plug connection in engine compartment above the brake booster.



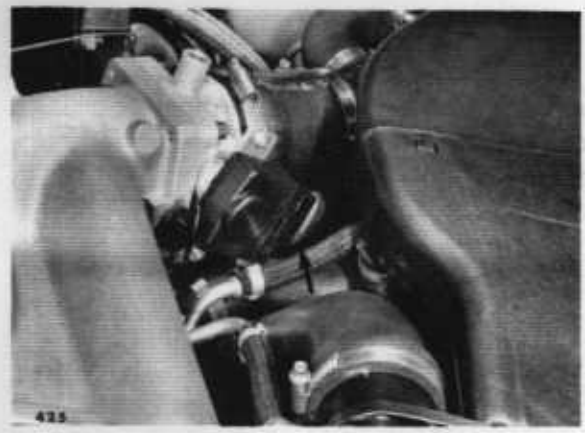
On cyl. no. 4 intake pipe.

Reference mark, speed and oxygen sensor plug connections.

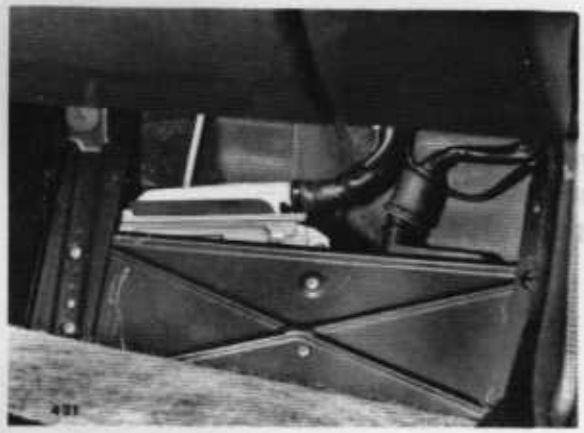
On idle positioner –
3-pin plug connection.



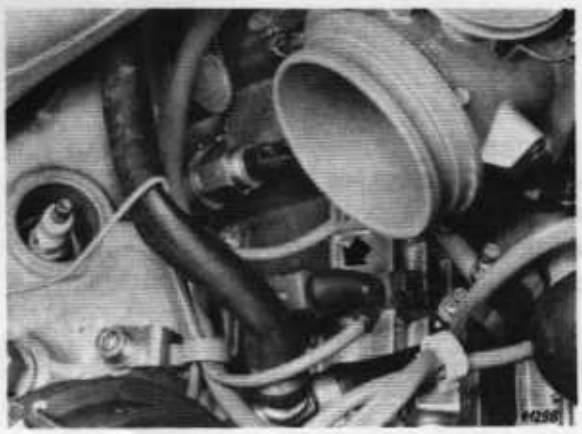
On throttle valve potentiometer –
6-pin plug connection.



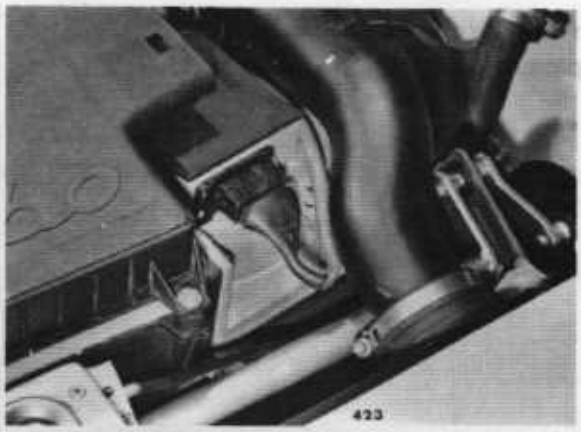
On DME control unit –
35-pin plug connection –
and on knock/charging pressure control unit –
25-pin plug connection
(behind front passenger's foot support).



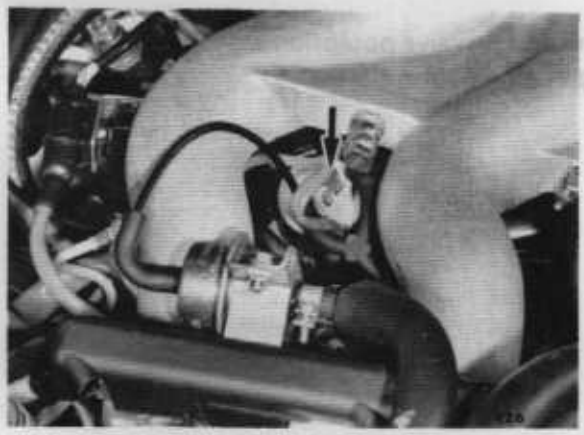
NTC II in engine block above
left balancing shaft –
2-pin plug connection.



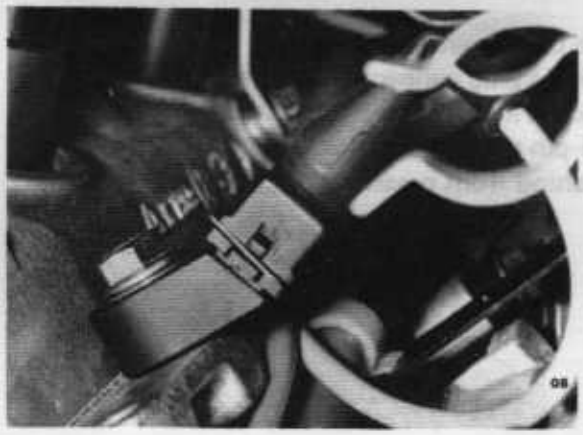
On air flow sensor –
4-pin plug connection.



On timing valve between intake pipes
3 and 4 –
2-pin plug connection.



On knock sensor/engine block
between cylinders 2 and 3 –
2-pin plug connection.



Finally the 4 plugs for fuel injectors –
each 2-pin.
Are plugs connected correctly,
not corroded and with tight plug contacts?

Power Supply (V)

A) **DME and KLR Control Unit (V)** (located behind passenger's foot support).

Note: Turn off ignition and then pull off control unit plug!

Plugs of control units are locked with a catch. First unlock this catch and then swing plug off of the control unit.

Connect voltmeter with help of test leads on term. 35 and 5 or 18 and 5 in second test on the DME control unit.
Connect term. 6 and 14 on KLR control unit.
Turn on ignition.

Display = battery voltage each time.

Turn off ignition. Check and connect DME plug!
No display, then check:

Disconnect 14-pin plug on engine.
Connect voltmeter on term. 3 and ground on receptacle end. Turn on ignition.

Display = battery voltage.

No display, leave test connections and check:
Pull off DME relay G 5. Bridge term. 30 and 87 in CEL socket.

Display = battery voltage.

Pull off plug of one fuel injector. Connect voltmeter with help of test leads on one plug contact and ground.

Display = battery voltage.

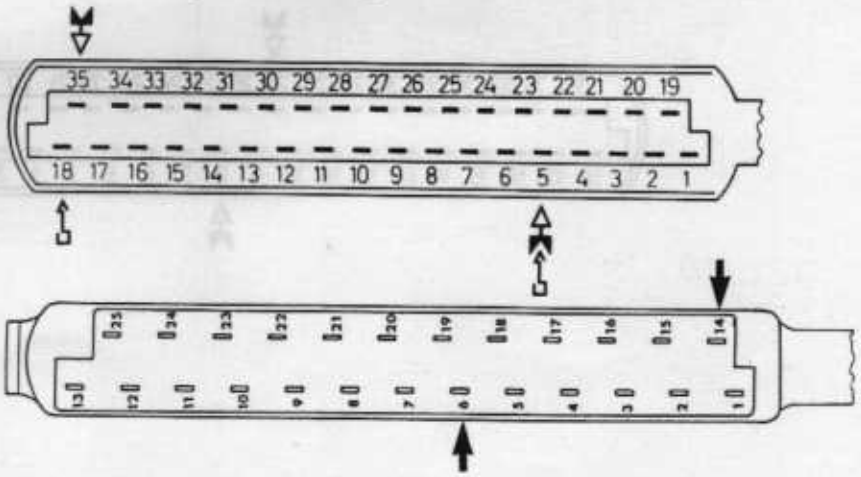
Turn off ignition. Connect all plugs!

B) **Fuel Pump**

Start engine – fuel pump should be running while starting.
If not, check:

Fuse no. 34 (15 A)

Pull off relay G 5.
Bridge term. 30 and 87 b in CEL socket.



Fuel pump should run.

Check wiring diagram for electric wire routing.

Speed Sensor (⊟)

Speed sensor operation can only be checked with an oscilloscope.

You will have to use a workshop oscilloscope to have the correct oscillograph.
Adjust oscilloscope to supplied instructions.

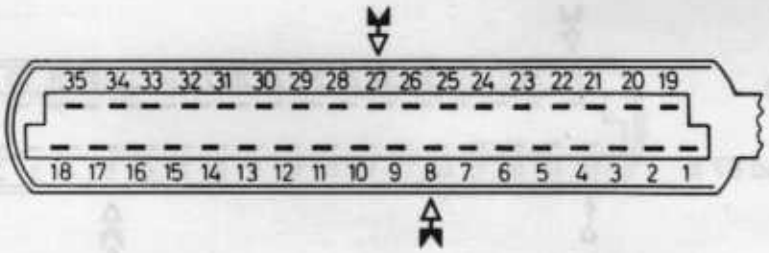
Connect control unit plug term. 8 and 27 on the oscilloscope tester with help of test leads.
Start engine: The screen should show sine oscillation, of which the **amplitude is greater than 2.5 V!**

If the voltage signal is too small (less than 2.5 V), the distance between the sensor and gear ring is too large or the speed sensor is defective.

Sensor distance: 0.8 ± 0.3 mm betw. ring gear and sensor.

No Display:

Disconnect speed sensor plug on plug plate in engine compartment. Connect oscilloscope tester leads on sensor plug section with help of test leads.
Connect test leads on center and outer plug contacts (term. 1 and 2) (see testing requirements).
Start engine. Sine oscillation must be visible on screen.
Check power flow in sensor, distance to gear ring and for dirt, replacing the sensor if necessary.
Sensor adjustments: see repair manual.

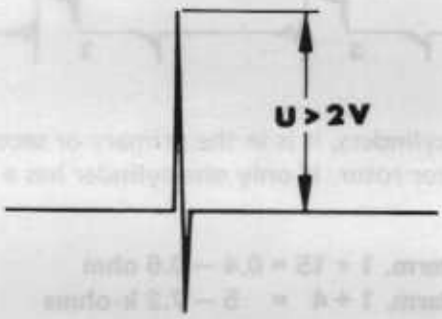


Reference Mark Sensor (⊟/Ω)

Adjust oscilloscope as described in test point 3. Connect oscilloscope tester leads on term. 25 and 26 of control unit plug with help of test leads.

Start engine:

One single sine oscillation should be visible on the screen. It is important that the oscillation begins with a **positive** flank and more than 2 V is displayed on the scale for a starter speed of at least 200 rpm (signal amplitude depends on the starter speed).



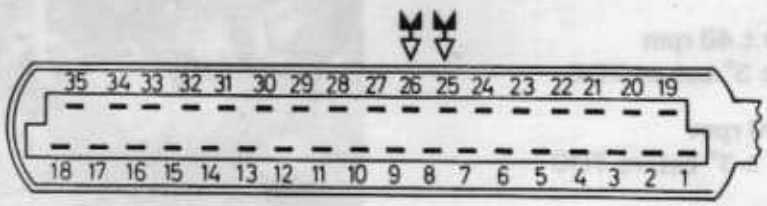
The voltage signal is less than 2 V:
distance between sensor and reference mark is excessive (specification: 0.8 ± 0.3 mm).

No Display:

Disconnect reference mark sensor plug on plug plate in engine compartment. Connect oscilloscope tester leads on sensor plug section with help of test leads.

Connect test leads on center and outer plug contact term. 1 and 2 of plug (see testing requirements).
Start engine.
No display:

Check tester connections on plug.
Check power flow in sensor, distance to mark and for dirt, replacing sensor if necessary.
Sensor adjustments: see repair manual.



Ignition System (⊟/Ω)

a) Secondary Display

Adjust secondary display on the oscilloscope. Connect tester leads to supplied instructions.

Note: If a fault is displayed for all cylinders, it is in the primary or secondary circuit between the ignition coil and distributor rotor. If only one cylinder has a fault, this fault is after the distributor rotor.

Primary resistance:	**term. 1 + 15 = 0.4 – 0.6 ohm**
Secondary resistance:	**term. 1 + 4 = 5 – 7.2 k-ohms**

b) Spark Plug Connectors (Ω)

Shielded resistance: **3 k-ohms**
Visual check for damage or traces of burning.

c) Distributor (Ω)

Distributor arm, distributor cap: shielded resistance **each 1 k-ohm**
Visual check for damage, dirt or incorrect installed position.

d) Ignition Timing

Ignition timing is not adjusted.
It is only necessary to check the ignition timing at idle speed.
Engine at operating temperature.

Test Values:

Ignition timing at **840 ± 40 rpm**
= **5° ± 3° before TDC**

Control value: at **2500 rpm**
= **35° ± 3° before TDC**

The TDC sensor system can be used together with an engine tester, which has this testing equipment, to test the engine speed ignition timing.

Air Flow Sensor (V/Ω)

A) Power Supply (V)

Pull back plug seal of air flow sensor (plug remains connected). Connect voltmeter on term. 3 and ground through back of plug.
Turn on ignition.

Display: **5 ± 0.5 volts**

B) Voltage Drop on Air Sensor Potentiometer (V)

Take off air cleaner. Connect voltmeter on term. 2 and ground.
Display: **approx. 250 to 260 mV**

Press air flow sensor plate to full load position. The air flow sensor plate must move easily and without resistance.
Display: air flow sensor flap at **full load = approx. 4.60 volts.**

Turn off ignition. Pull off plug and install plug seal.

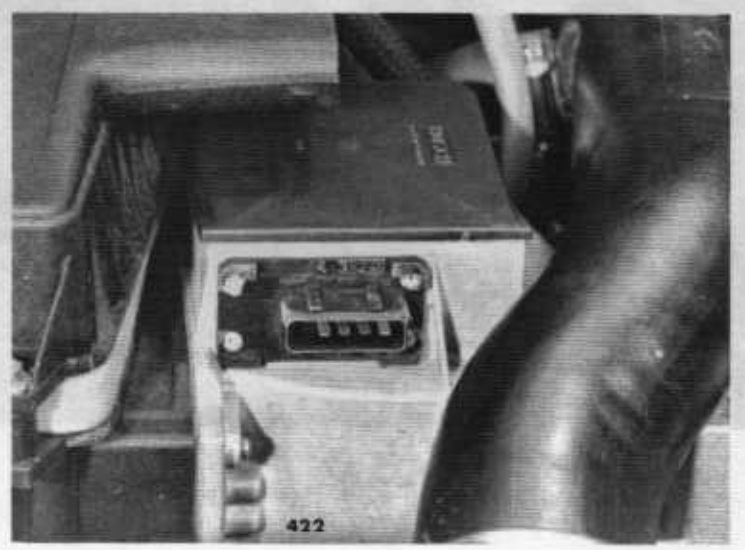
C) NTC I (Intake Air Temperature)

Pull off air flow sensor plug.
Connect ohmmeter on term. 1 and 4 of air flow sensor (on control unit term. 22 and 6, air flow sensor plug connected!).

Display:
0 °C = 4.4 to 6.8 k-ohms
15 – 30 °C = 1.4 to 3.6 k-ohms
40 °C = 1.0 to 1.3 k-ohms

Note: Temp. sensor break: richer mixture
Temp. sensor short: leaner mixture

Air Flow Sensor Plug Connections:



Fuel Pressure (Pressure Tester P 378)

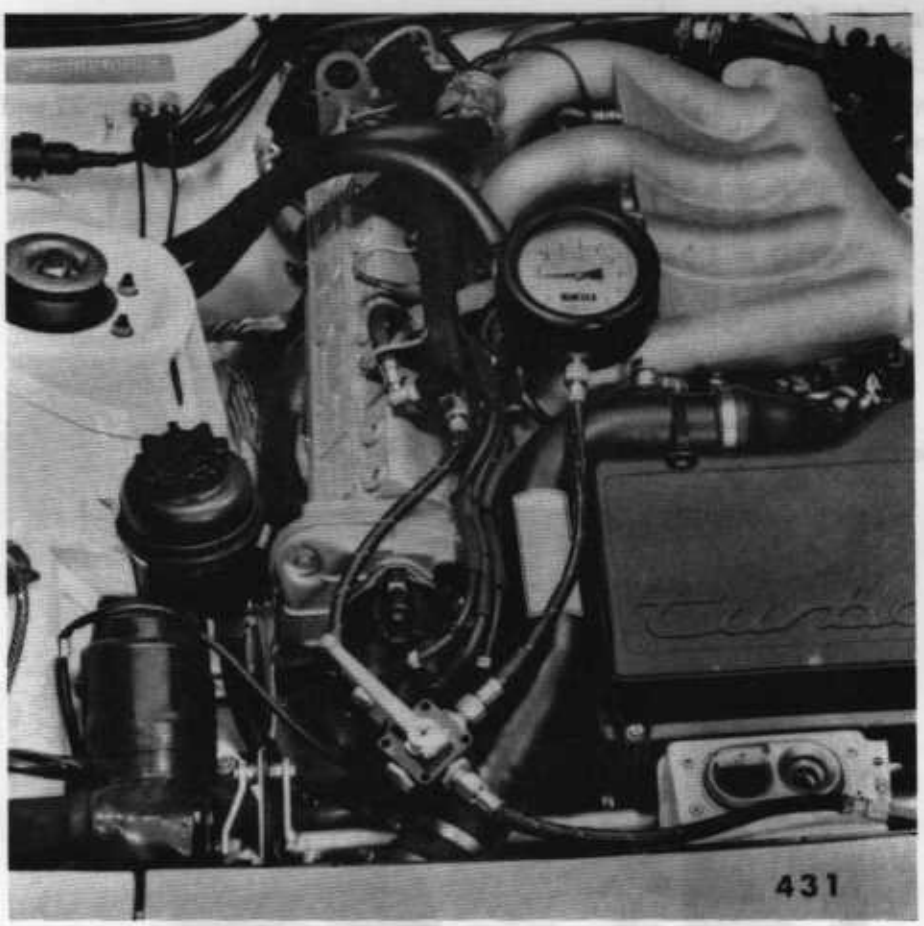
A capped nut is located on the end of cyl. no. 1 fuel injection line. Unscrew this nut.
Caution: The sealing ball could fall out!
Connect pressure tester P 378 on the adapter.

Start engine.
Test pressure at idle speed: 2.0 bar.

Pull off vacuum hose on pressure regulator.
Test pressure: 2.3 to 2.7 bar.

Pinch return hose of pressure regulator with a hose clamp slowly.
Pressure less than 4 bar: Check fuel filter or replace fuel pump.

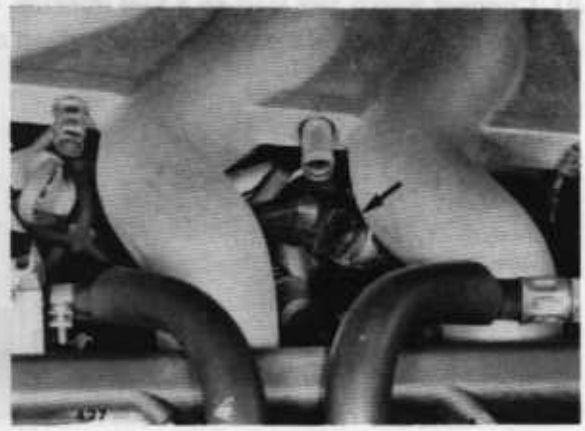
Running engine is not possible:
Bridge term. 30 and 87 b of DME relay G 5. Fuse no. 34 is okay.
Test pressure specification: 2.3 to 2.7 bar.



Idle Positioner

The idle positioner cannot be checked in a simple manner.

Brief Check: engine idle speed (840 rpm)



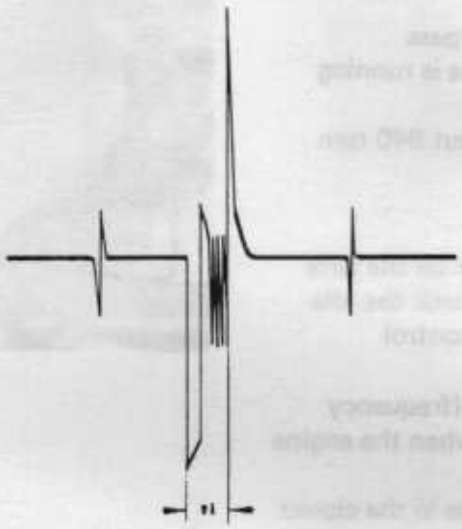
A) Screw in the throttle valve bypass screw completely when engine is running at a steady idle speed.
Idle speed must return to about 840 rpm after a brief deviation.

B) Connect a new idle positioner on the wire plug, in order to be able to check the idle positioner activation by the control unit.
The idle positioner vibration (frequency activation) must be noticed when the engine is operated.
The idle positioner must move in the closed direction when boosting the engine speed with the bypass screw.
Dropping the engine speed should cause the idle positioner to move in open direction.

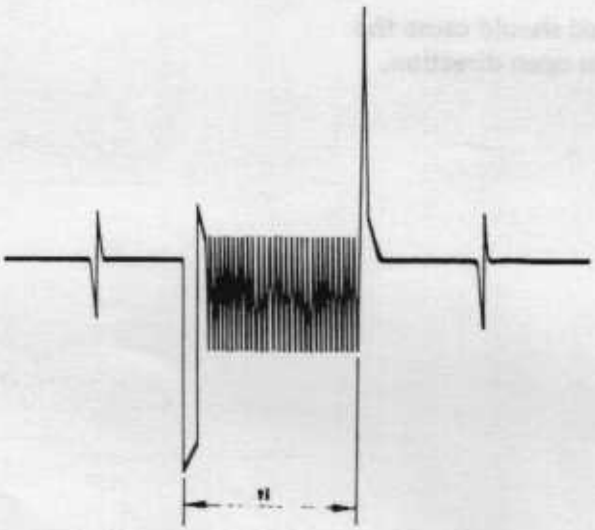
Throttle Switch

1. Idle Contact

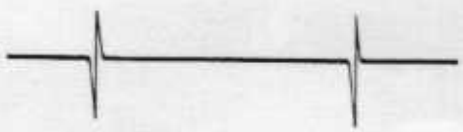
A) Connect Bosch test lead on a fuel injector. Connect oscilloscope on test lead to instructions (see testing requirements). This idle speed oscillograph should be displayed.



Accelerate engine to approx. 4,000 rpm – the injection time section should widen.



Return throttle valve to the idle stop quickly. The injection time section should no longer be seen on the scope (coasting shutoff).



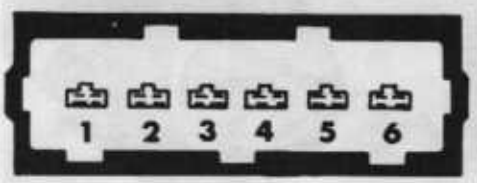
The idle speed oscillograph should be seen again from a speed of approx. 1200 rpm (approx. 1300 rpm at 20 °C) on.

If coasting shutoff is not displayed on the screen, there is a fault either in the power supply wire to the control unit, the control unit itself or the throttle switch.

Throttle Valve Potentiometer (V)

B) Power Supply to Throttle Valve Potentiometer

Pull off plug on throttle valve potentiometer.
Connect voltmeter on term. 1 and 2 on plug end. Turn on ignition.
Display = approx. 5 V (full load).
Connect voltmeter on term. 4 and 6.
Turn on ignition.
Display = approx. 5 V (idle speed).

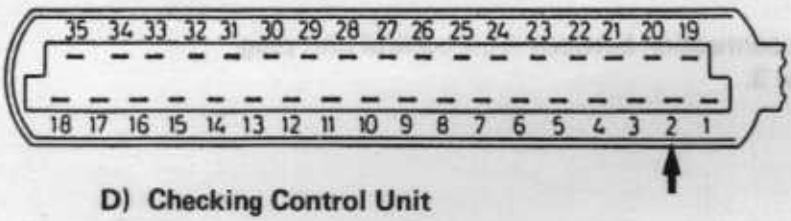


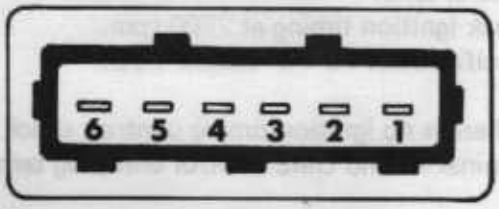
C) Idle Speed Contact (Ω)

Connect ohmmeter on term. 12 and ground of disconnected DME control unit plug.
Display = throttle valve closed 0 – 10 ohms
throttle valve opened (approx. 1°) inf. ohms

No Display:
Make test direct on throttle valve potentiometer. Connect ohmmeter on term. 6 and 4.

Display:
Check power flow from plug to control unit.





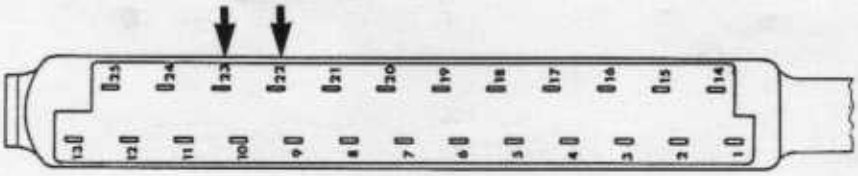
D) Checking Control Unit

Pull off plug on throttle valve housing.
Start and run engine at idle speed.
Bridge term. 4 and 6 on disconnected plug with a piece of wire. Boost engine speed to approx. 1600 rpm. Engine begins to surge (coasting shutoff).

E) Full Load Contact

Check tap resistance.
Pull off KLR control unit plug.
Connect ohmmeter on term. 22 and 23.
Display: throttle valve closed = 320 to 670 ohms
throttle valve wide open = 2.7 to 4.7 k-ohms

This test can also be made direct on term. 2 and 3 of the throttle valve potentiometer.



Since the full load pulse is triggered by the KLR control unit with a throttle valve gap of 65°, this test can only be made on a running engine. It is recommended to pull off two fuel injector plugs, to avoid racing the engine.

Connect voltmeter on test connection term. B and C.
Start and run engine at idle speed.
Display = approx. 5 V.
Floor accelerator briefly (without racing the engine).
Display = returns to 0 V.

No Display:
Check connection between B and term. 18 on the disconnected KLR plug.

Connection Okay:
Replace KLR control unit.

Checking DME Control Unit:
Check ignition timing at 2500 rpm.
Specification: 35 ± 3° before TDC.
Bridge test connection term. B and C with a piece of wire.
Check ignition timing at 2500 rpm.
Specification: 18 ± 3° before TDC.

If there is no ignition timing control, check the connection between KLR control unit plug terminal 18 and DME control unit plug terminal 3.

Connection Okay:
Replace DME control unit.

NTC II (Ω) (Engine Temperature)

Connect ohmmeter on control unit plug term. 13 and ground.

Sensor Test Values: at

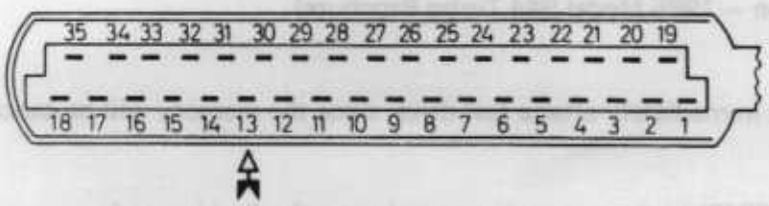
0 °C	= 4.4 to 6.8 k-ohms
15 – 30 °C	= 1.4 to 3.6 k-ohms
40 °C	= 1.0 to 1.3 k-ohms
80 °C	= 250 to 390 ohms
100 °C	= 160 to 210 ohms

Make test direct on the temperature sensor, if these values are not reached.

Note: Temp. sensor break = richer mixture
Temp. sensor short = leaner mixture

Checking Control Unit

Engine at operating temperature and running at idle speed.
The engine must stop (excessively rich mixture) when pulling off the temperature sensor plug.



Fuel Injectors 951.606.110.00 (Bosch No. 0280 150 803) (V/Ω)

Pull off injector plugs separately, if the engine can be operated.
Engine speed must drop in case of good injectors.
If engine cannot be operated, check:

Pull off injector plugs and turn on ignition.
Connect voltmeter on ground and plug contacts.

Display: **approx. 10 V**

Connect L-Jetronic test lead on plug connection of fuel injector. Connect this lead on the ohmmeter.
Check the coil resistance.

Display: **2 to 3 ohms**

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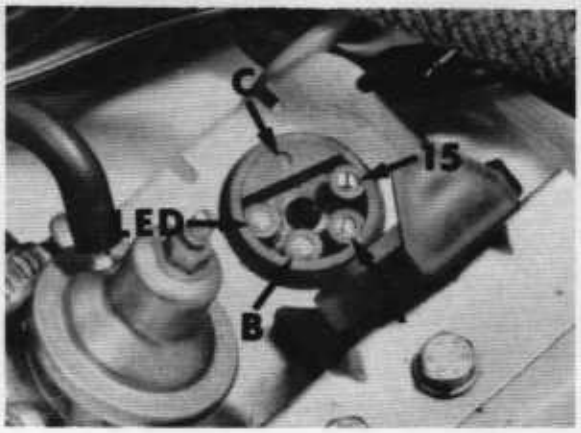
TEST POINT 12 – DME 944 Turbo

Knock and Charging Pressure Control

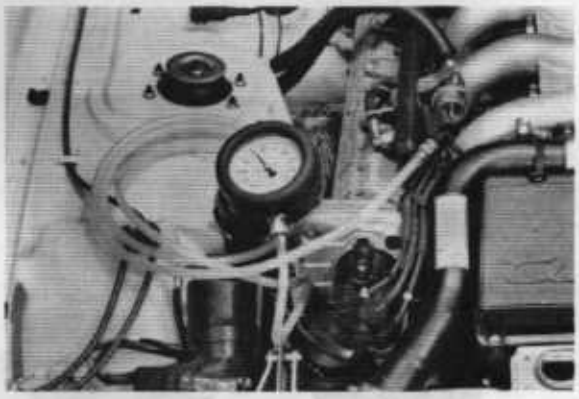
If a fault is assumed in the knock or charging pressure control, it can be identified with help of a flashing code (description – 1985 Model 944 Turbo Brochure).

Caution!
The test should be made immediately after a test drive, since the memory will be cancelled after turning off the ignition.

Connect test adapter (P 9246) in the test socket and observe the flashing code.



Flash Code	Fault	Possible Cause	Test Point / Check
1–2	Battery voltage too low (less than 10.2 V)	Power supply (alternator, regulator, battery)	
2–1	Knock sensor Monitor	Plug loose Wire break Sensor faulty	Knock sensor. Connect ohmmeter on term. 11 and 13 of disconnected KLR control unit plug. Display: 270 – 330 k-ohms. If 0 or inf. ohms are displayed, check wire connections or replace sensor if necessary. Check for correct torque. 11 Nm. Use original screw without a washer!
2–3	Control unit faulty		Replace control unit.
3–1	Charging pressure too low	Charging pressure	Check charging pressure. Connect pressure tester (P 9103/2) on vacuum connection for pressure damper and place in car.



Test Value:
0.70 bar at 3000 rpm and full load (in 3rd gear).

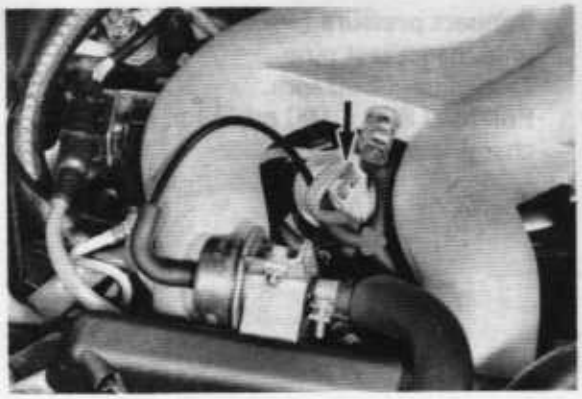
Plug has fallen off of timing valve.
Wire break.
Timing valve faulty.

Timing valve

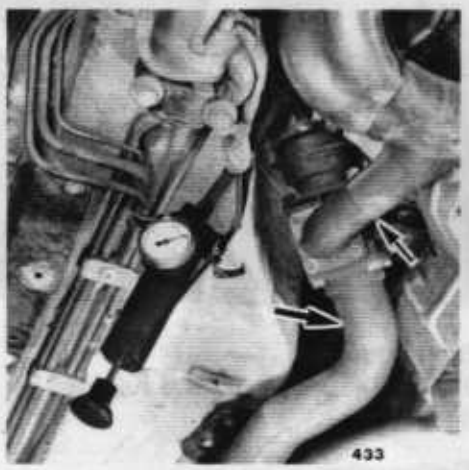
a) Power supply
Connect voltmeter on red/green wire of timing valve plug and ground.
Display: battery voltage.
No display: perform test point 2.

b) Pull off coil resistor from timing valve plug on timing valve.
Connect ohmmeter on both connectors.
Display: 30 ohms.

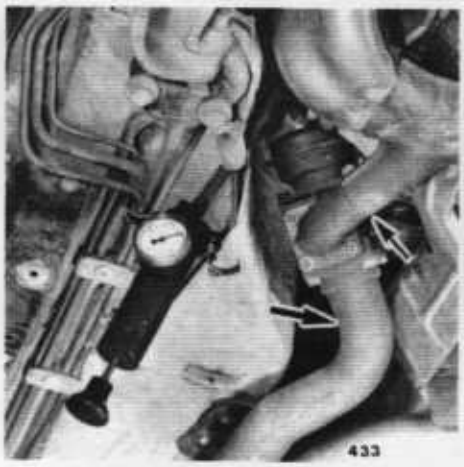
c) Check power flow in wire from KLR control unit plug term. 2 to timing valve.
Replace KLR control unit, if everything is okay.



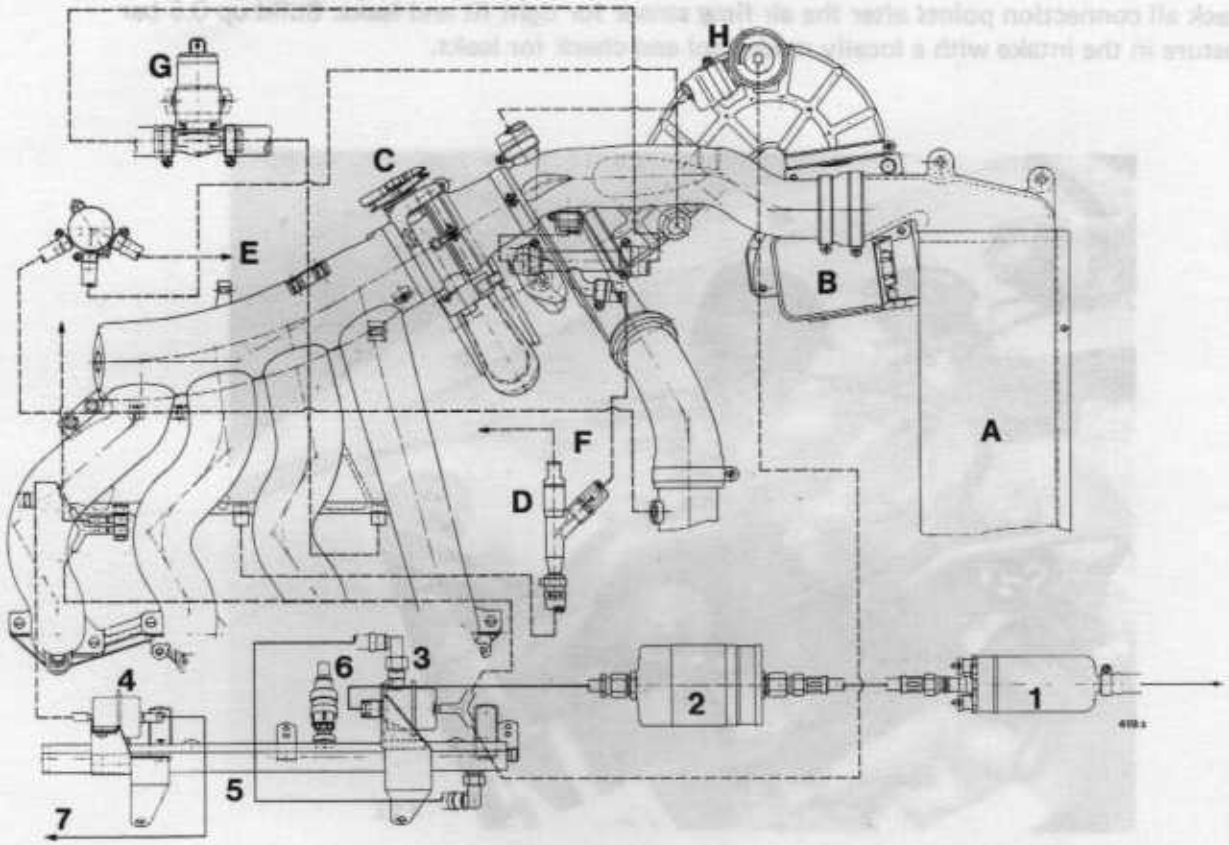
Flash Code	Fault	Possible Cause	Test Point / Check
		Vent line to solenoid valve plugged.	Check flow.
		Exhaust leak.	
		Leak in intake.	See Test Point 14.
		No pressure on bypass valve.	Check activation or operation of bypass valve. Bypass valve must open with vacuum.
		Break in pressure hose to KLR control unit (no pressure display).	Check flow or for leaks.
		Charging pressure control valve seized in open state.	Check charging pressure control valve. The exhaust should be cold to check this control valve. Disconnect pressure hose on charging pressure control valve and connect pressure pump (VAG 1274). Start engine.
			The exhaust pipe (arrow), leading to the charging pressure control valve, must heat up after a short time. The pipe (large arrow) leading away from the charging pressure control valve must remain cold (charging pressure control valve closed).
			Now supply 0.6 bar pressure to the charging pressure control valve; now the pipe leading away from the charging pressure control valve must heat up (control valve opened).
		Turbocharger faulty.	Check turbocharger.
		Exhaust "closed" (with catalytic converter).	Connect pressure tester (P 9103/2) on exhaust test pipe. Test value: 3500 rpm. Full load 800 ± 100 mbar for 700 mbar charging pressure.
		Throttle valve does not open fully.	Adjust, if applicable.



Flash Code	Fault	Possible Cause	Test Point / Check
3–2	Charging pressure too high	Timing valve always has electric current.	Timing Valve a) Power supply Connect voltmeter on red / green wire of timing valve plug and ground. Turn on ignition. Display: battery voltage. No display: test point 2. b) Pull off coil resistor from timing valve plug on timing valve. Connect ohmmeter on both connectors. Display: 30 ohms. c) Pull off plug on timing valve. Connect test lamp on plug contacts. Turn on ignition. Test lamp must not come on. Replace KLR control unit, if everything is okay.
		Break in line to timing valve or to charging pressure control valve.	Check flow or for leaks.
		Timing valve inlet (orifice) plugged.	Check flow.
		Charging pressure control valve is seized in closed state. Diaphragm leaks.	Check charging pressure control valve. Exhaust should be cold to check this control valve. Disconnect pressure hose to charging pressure control valve and connect pressure pump (VAG 1274). Start engine. The exhaust pipe (arrow), which leads to the charging pressure control valve, must heat up after a short time. The exhaust pipe (large arrow), leading away from the control valve, must remain cold (charging pressure control valve closed). Now supply 0.6 bar pressure to the charging pressure control valve; the exhaust pipe leading away from the control valve will heat up (charging pressure control valve open).



Flash Code	Fault	Possible Cause	Test Point / Check	
3–3	Pressure sensor faulty.		Replace KLR control unit.	
4–1	Throttle valve potentiometer.	Power supply wire to potentiometer grounded out.	See test point 9.	
		Plug fallen off.	See test point 9.	Note: Also for 3–3 but pressure sensor is okay.
		Potentiometer faulty.	See test point 9.	
4–2	Throttle valve potentiometer.	Break in wire to potentiometer.	See test point 9.	
		Potentiometer faulty.		

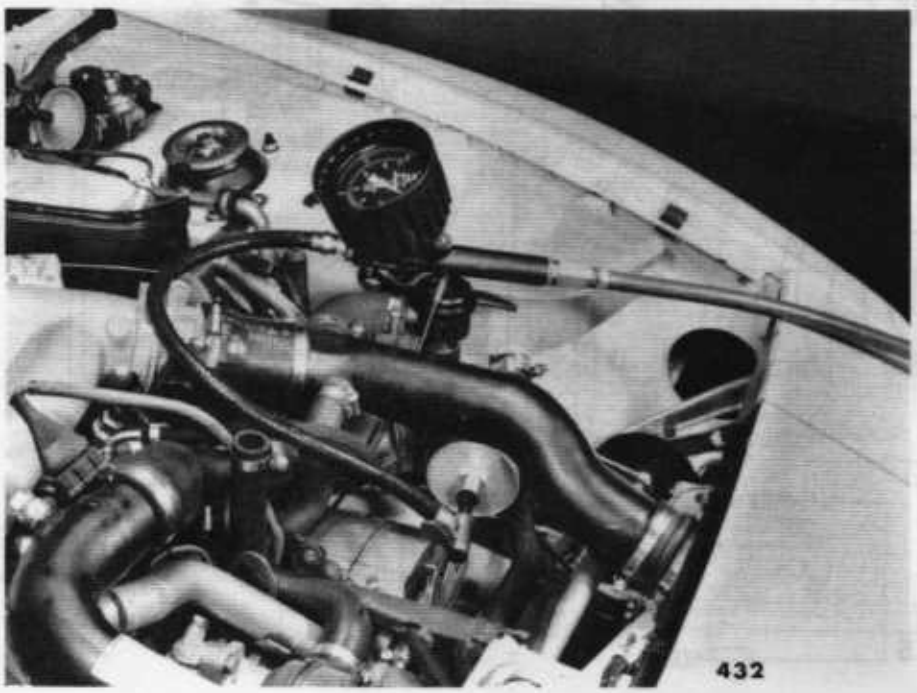


1 – Fuel pump
2 – Fuel filter
3 – Pressure damper
4 – Pressure regulator
5 – Injection line
6 – Fuel injector
7 – Return

A – Charging air cooler
B – Air flow sensor
C – Throttle valve housing
D – Ejection pump
E – To charging pressure control valve
F – To brake booster
G – Idle positioner
H – Bypass valve
I – Temperature valve (open above 58 °C)
J – Shutoff valve
K – Control valve
L – To control unit
(charging pressure control)
M – Timing valve for charging pressure

Intake System Leaks

Check all connection points after the air flow sensor for tight fit and leaks. Build up 0.5 bar pressure in the intake with a locally made tool and check for leaks.



Checking Function of Altitude Compensator
(Only USA Engines and M 298/299)

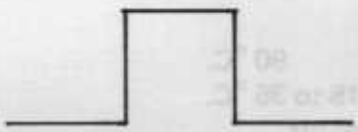
(For testing lower than 1000 meters above sea level.)

The altitude compensator is located near the DME control unit.

1. Engine running at idle speed. Disconnect oxygen sensor plug.
   Check CO in front of catalytic converter.
2. Disconnect altitude compensator plug.
3. Bridge plug connections with a piece of wire.
4. CO must be adjusted in lean direction by approx. 1 % (at idle speed).
5. Connect altitude compensator wire plug on an ohmmeter. Ohmmeter should display infinite ohms (switch open).
   Display higher than 1,000 meters above sea level = approx. 0 to 10 ohms (switch closed).

Ignition Signal from DME Control Unit to KLR Control Unit

Connect oscilloscope on disconnected KLR control unit plug term. 9 and ground.
Start engine.
A square-wave signal should appear on the screen.

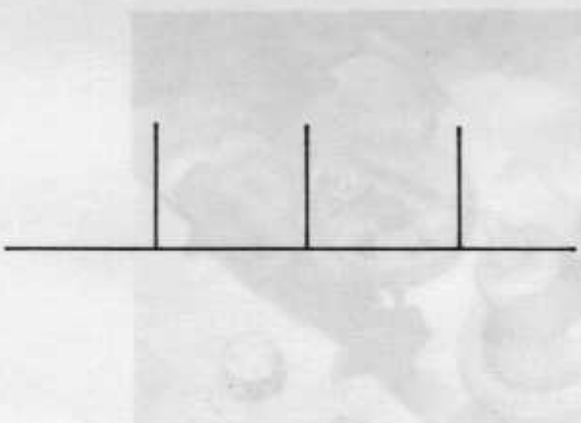


No Display:
Replace DME control unit.

TEST POINT 15 – DME 944 Turbo

Trigger Signal

Connect oscilloscope on disconnected DME/KLR control unit plug term. 24 positive wire and negative wire on ground.
Start engine.
This signal should appear on the screen.



CO and Idle Speed

It is important that the engine has operating temperature for the following tests, especially for checking/adjusting the idle speed and adjusting the CO level. However, the intake pipes must not be heated excessively, since then the test would produce wrong values and/or the engine could not be adjusted.

Operating temperature means:

Engine temperature approx. 90 °C.
Intake air temperature 15 to 35 °C.
All electric equipment switched off.

CO Adjusting Values:

At idle speed (840 ± 40 rpm) and with equipment switched off:
1 ± 0.5 % CO by volume.

For US cars or unleaded gasoline engines, measured ahead of catalytic converter:
0.6 ± 0.2 % CO by volume.

Idle Speed Adjusting Values:

Bridge test socket **term. B and C** on regulator plate.

Idle speed: Adjust to **840 ± 20 rpm** with bypass screw of throttle valve housing, without electric equipment being switched on.

Remove bridge on test socket. Accelerate briefly. Check idle speed (840 ± 40 rpm).

Adjusting Procedures

Rest of World Cars

Exhaust taken in tailpipe.

Check and adjust idle speed CO level.

Specification: 1 ± 0.5 % CO (at 840 ± 40 rpm).

Accelerate briefly after each adjustment.

Connect term. B and C on test socket of regulator plate.

Check / adjust idle speed.

Specification: 840 ± 20 rpm.

Adjust idle speed with bypass screw on throttle valve housing.

Remove bridge on test socket. Accelerate briefly.

Check CO and idle speed.

Note:

A faulty relay (911.615.109.01), contact term. 30 and 87 of which have been soldered together, can be used to bridge the test socket!

It is not necessary to check the CO after a test drive.
Reason: After a test drive the air flow sensor temperature (temperature sensor I) will correspond with the outside air temperature, i. e. a different temperature than during adjustments. The control unit is programed to change the engine via the temperature sensor signal changes.

USA Cars / M 298 / M 299 Engines

Exhaust taken on test pipe on right side in engine compartment ahead of the catalytic converter. Pull off oxygen sensor plug.

Check and adjust idle speed CO level.

Specification: 0.6 ± 0.2 % CO (at 840 ± 40 rpm).

Accelerate briefly after each adjustment. Connect oxygen sensor plug again.

Bridge term. B and C on test socket of regulator plate.

Check / adjust idle speed.

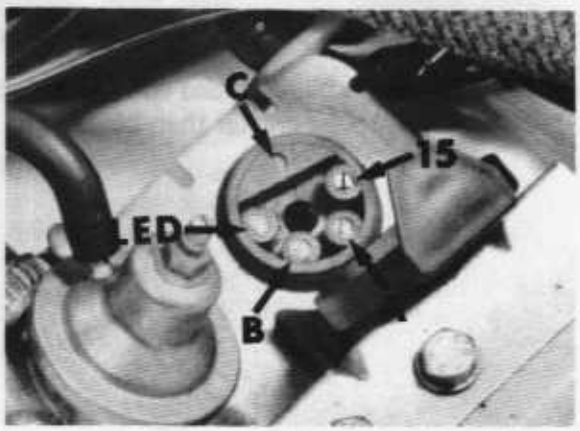
Specification: 840 ± 20 rpm.

Adjust idle speed with bypass screw on throttle valve housing.

Remove bridge on test socket. Accelerate briefly.

Check CO and idle speed. Plug exhaust test line.

Exhaust test pipe (USA)



Oxygen Sensor Test (US Cars and M 298 / M 299 Engines)

A) **Fast Test** (engine at operating temperature, idle speed okay)

Connect exhaust tester on test pipe in engine compartment on right side. Disconnect oxygen sensor plug. Note CO level.

Pull off and plug vacuum hose on fuel pressure regulator.

CO level must rise!

Connect oxygen sensor plug.

CO level must drop to specified **0.6 ± 0.2 %.**

There is a fault in the oxygen sensor or DME control unit, if the CO level does not change.

B) **DME Control Unit Test** (engine at operating temperature, idle speed okay)

Connect exhaust tester on test pipe in engine compartment on right side. Disconnect oxygen sensor plug.

Check CO level.

Connect ground on oxygen sensor plug term. 1 (green) – receptacle – (wire harness to control unit) with a piece of wire.

CO level must rise!

If there is no CO level change, check power flow of wire plug term. 1 (green) to control unit term. 24 before replacing the DME control unit.

C) **Oxygen Sensor Test (V)** (engine at operating temperature, idle speed okay)

Disconnect oxygen sensor plug. Connect a digital voltmeter on ground and term. 1 (pin contact) of the sensor plug.

Display: 0.1 to 1.0 V

Note: The DME control unit will switch off oxygen sensor control for the following operating conditions.

1. Coolant temperature below 15 °C and engine running with open idle speed contact.
2. Coolant temperature below 45 °C and engine running at idle speed.
3. Throttle valve full load contact closed or term. B and C bridged on test socket and engine speed greater than 3600 rpm.

A) Maladjusted Idle Speed ("Idle Positioner" Basic Setting)

1. Speed greater than 880 rpm.

   The jolt from re-engagment of the coasting shutoff is harder as speed deviation from the nominal value increases.

2. Speed less than 800 rpm.

   In extreme cases the engine will stop when switching on the air conditioner (insufficient air). Moving off is not correct. Engine could stop. Engine could stop when engine comes down from high speed into the idle speed range.

B) Maladjusted CO

1. CO less than nominal value (% by volume).

   Idling is more erratic as CO level decreases. Moving off problems in extreme cases (much too lean).

C) Temperature Sensor II

Temperature sensor II is important for engine warm-up. The coolant temperature is used as a factor for recognizing the engine temperature condition. Mixture richness is increased with increasing resistance (coldness).

1. Nominal Resistance Value (ohms)

Engine approx. 20 °C (room temp.)	=	2.2 – 2.8 k-ohms
Engine at operating temperature	=	appr. 250 ohms

   Measure resistance on sensor in engine compartment with the engine stopped.

2. Fault in Temperature Sensor II

   The engine will stop briefly due to excessive richness when plug has fallen off (been disconnected) or wire has a break, since resistance is excessive = infinite ohms (corresponds with – 30 °C outside temperature).

   The engine will run again after bridging the plug, but cold start behavior will not be okay with a bridged plug.
   Consequently bridging is only for an emergency.

3. Ground short – e. g. wire insulation rubbed through (resistance = 0 ohm).
   Engine will not have rich mixture = cold start and warm-up problems.

D) Speed and Reference Mark Sensors

Distance between speed sensor and flywheel teeth = 0.8 ± 0.3 mm.

1. Maladjusted Sensor

   For example, approx. 2 mm distance and cold engine = longer starting time.
   Greater number of starts. Possibly no engine starting at low outside temperature. Engine runs normally during warm-up.

   Sensor distance can be greater as engine temperature increases. Ignition starts to jump because of interconnection of the reference mark sensor signal with the speed sensor signal.

   Engine sometimes runs unmotivately high in idle.
   For example, 3 mm sensor distance and cold engine = strong misfiring and poor moving-off behavior (engine stops suddenly).

E) Fuel Return Line

A bent return line will cause the fuel pressure to rise and the engine runs on an excessively rich mixture or stops because of same condition.

Note: CO cannot be adjusted to nominal value (with correct intake air and engine temperature).
Fuel consumption too high.
Car bucks.

Remedy: Check fuel pressure – line routed correctly.

Tank vent line disconnected

→ same condition, since fuel pressure is too high.

F) Hot Start Problems

Leak Test

Fuel pressure of warm engine must drop by not more than max. 0.5 bar within 30 minutes.

1. **Causes poor hot starting.**
2. Pressure regulator leaks (–) disconnect return line for troubleshooting.
3. Check valve of fuel pump faulty (–) disconnect pressure line for troubleshooting.
4. Fuel injectors leak (–) check by disconnecting pressure and return lines.

G) Idle Speed Switch

Faulty switch (break) causes excessive fuel consumption and poor transition.

H) Spark Plug Wear Limit

The wear limit of spark plugs for 944 cars is an electrode gap of 1.2 mm.

DME Control Unit

The first cars had the following control units:

R. o. W.	control unit	951.618.121.00	
	Bosch No.	0261.200.054	and
USA	control unit	951.618.121.01	
	Bosch No.	0261.200.053	

These control units have been replaced with a standard control unit 951.618.121.02 (Bosch No. 0261.200.075) as of April, 1985.
Coding for different country versions.

Rest of World:
Control unit term. 30 with 1.8 k-ohm adapter (944.612.421.00) against ground.
Control unit term. 10 open (coding plug on DME wire harness).

USA and R. o. W. with Catalytic Converter:
Control unit term. 30 connected with altitude compensator, without adapter.

Switzerland and Sweden:
Control unit term. 30 with 1.8 k-ohm adapter (944.612.421.00) against ground.
Control unit term. 10 with plug (944.612.525.00) against ground.

KLR Control Unit

Installed before April, 1985:

R. o. W.	control unit	951.618.113.00	
	Bosch No.	0261.201.014	and
USA	control unit	951.618.113.01	
	Bosch No.	0261.201.015	

A standard control unit, 951.618.113.02 (Bosch No. 0261.201.019), is installed since April, 1985.

Air Flow Sensor

951.606.121.01 (Bosch No. 0280.203.026)

Fuel Injectors

951.606.110.00 (Bosch No. 0280.150.803)