

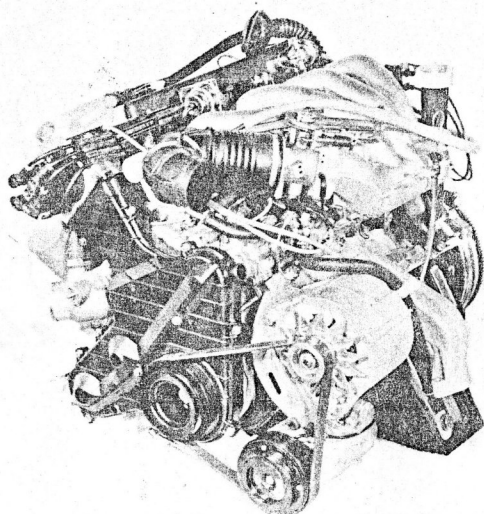


SERVICE

944

DME

TEST PLAN



'85

INFORMATION

TECHNIK

Printed in Germany
Copyright by Dr.-Ing. h. c. F. Porsche
Aktiengesellschaft

WKD 450 821

Testing Requirements	Possible Defect Causes															
Engine in perfect mechanical condition and battery charged	Ground connections, plug connections, and fuel pump	Power supply for control unit	Speed sensor	Reference mark sensor	Ignition system	Air flow sensor	Fuel pressure	Idle positioner	Throttle switch	Temperature sensor II	Fuel injectors	CO level and idle speed	Leaks in intake system (altitude correction box USA)	Oxygen sensor	Economy control	Upshift indicator
See Test Point:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Possible Defects:																
Engine does not start or hard to start	x	x	x	x	x	x	x			x	x		x			
Erratic idling	x		x	x	x	x	x	x	x	x	x	x	x	x		
Poor engine pickup	x		x	x	x	x	x	x	x	x	x	x	x			
Engine misfiring	x	x	x	x	x	x	x		x	x	x		x			
High fuel consumption			x	x	x	x	x		x	x	x	x		x		
Poor engine output	x		x	x	x	x	x		x	x	x		x			
	x = Check with suitable tester!															

Testers and Tools Required for Testing DME (Digital Motor Electronics):

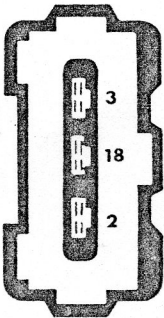
- 1 oscilloscope, e. g. SUN or Bosch
- 1 volt and ohmmeter (internal resistance at least 20 k/ohm / V)
- 1 test lead (Bosch "L-Jetronic Test Lead", No. 1684 463 093)
- 2 control unit plug test leads, approx. 600 mm long, fitted with two 4 mm brush plugs and two insulated alligator clips, as well as two flat male plugs N 17.457.2
- 2 adapter test leads, approx. 200 mm long, fitted with four plug connectors N 0 17.483.1

Always use test leads for tests!

Plug Connections

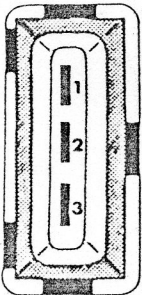
Plug on Throttle Switch

Throttle switch plug seen pulled off toward plug sockets.

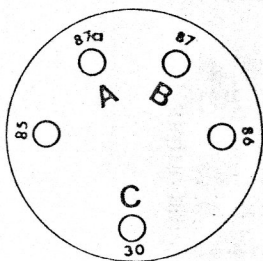


Reference Mark Sensor/Speed Sensor

Plug section toward sensor

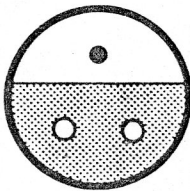


Test Socket

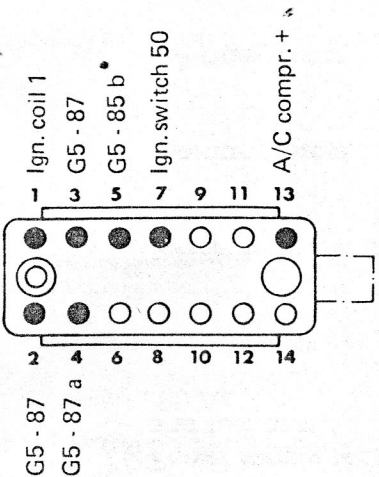


Oxygen Sensor Plug

Plug section in direction of sensor.

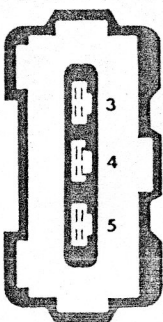


14 Pin Plug in Engine Compartment



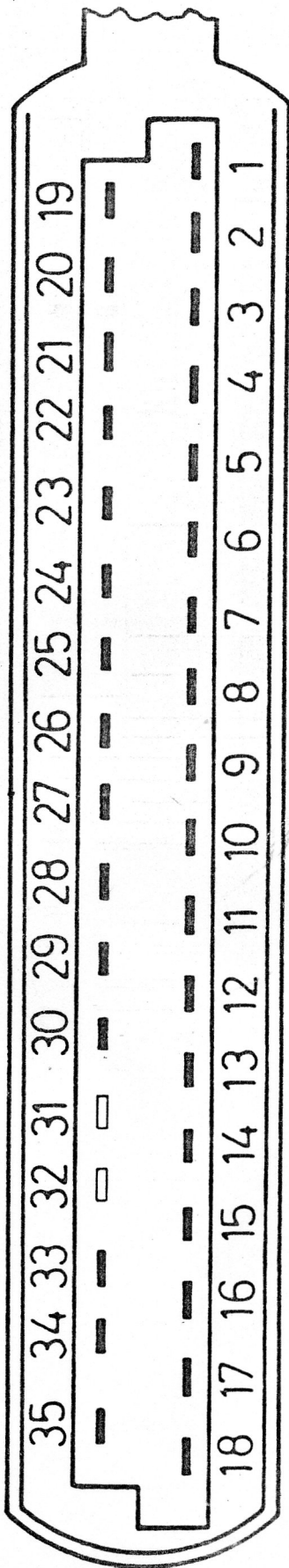
Idle Positioner

Looking at disconnected plug.



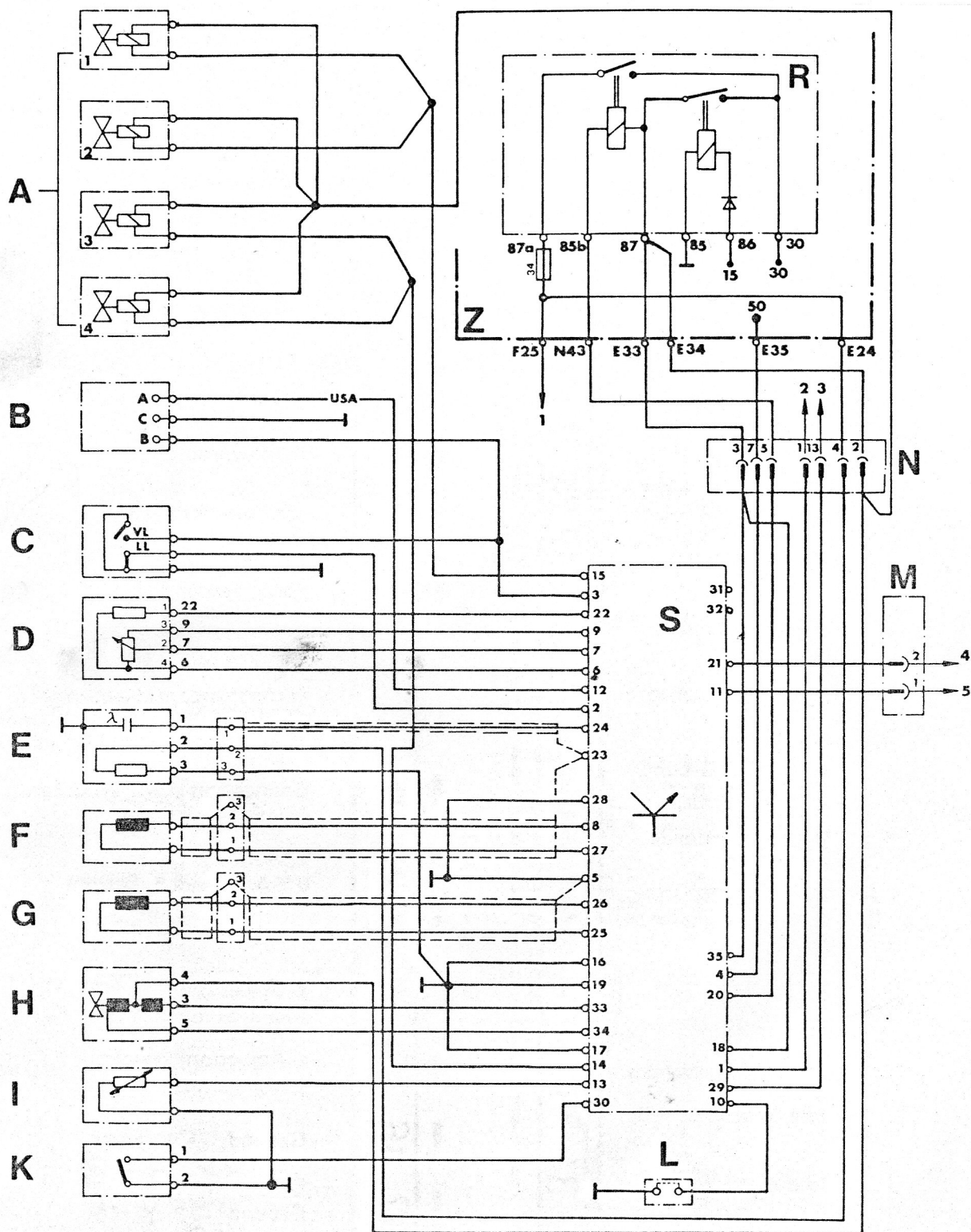
Control Unit Plug Connections

- Ground
- Ground activation relay G 5 – 85 b
- Connection point 4-pin term. 2 (tachometer – 1)
- Air flow sensor – 1 (NTC I)
- Shielding (speed sensor/oxygen sensor)
- Oxygen sensor (USA/unleaded engines)
- Reference mark sensor
- Reference mark sensor
- Speed sensor
- Ground
- A/C compressor (+)
- Altitude correction box (USA/unleaded engines)
- Idle positioner – 3
- Idle positioner – 5
- Power supply relay G 5 – 87



- Ignition pulse to ignition coil – 1
- Throttle switch idle contact – 2
- Throttle switch full load contact – 3
- Start signal (ign. lock – 50)
- Ground and shielding from reference mark sensor
- Air flow sensor – 4 (NTC I)
- Air flow sensor – 2 (sensor plate potentiometer)
- Speed sensor
- Air flow sensor – 3
- Performance curve change (to –I for CH, S, AUS, NZL, California, Japan)
- Connection point 4-pin term. 1 (economy control)
- Test socket (A) (USA/unleaded engines)
- NTC II
- ti (injection) signals, fuel injectors 3 + 4
- ti (injection) signals, fuel injectors 1 + 2
- Ground
- Ground
- Power supply relay G 5 – 87

DME Wiring Diagram



A – Fuel injectors
 B – Test socket
 C – Throttle switch
 D – Air flow sensor
 E – Oxygen sensor
 F – Speed sensor
 G – Reference mark sensor

H – Idle positioner
 I – NTC II
 K – Altitude correction box
 L – Performance curve plug
 M – Four pin plug via DME control unit
 N – Fourteen pin plug (engine compartment)

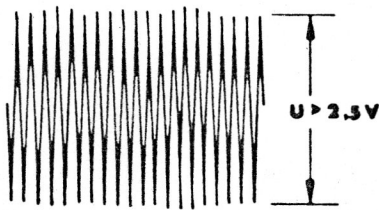
R – DME relay G 5
 S – DME control unit
 Z – Central electric
 1 – To fuel pump
 2 – On ignition coil 1
 3 – On A/C compressor +
 4 – On tachometer 1
 5 – To economy control

Speed Sensor ()

The speed sensor can only be tested with an oscilloscope.

A workshop oscilloscope will be required to have correct oscillographs. Adjust oscilloscope to supplier's instructions.

Connect control unit plug terminals 8 and 27 on oscilloscope tester via test leads.
Start engine: screen must display sine oscillation, of which the amplitude must be $> 2.5\text{ V}$!



If voltage signal is too small ($< 2.5\text{ V}$), distance between sensor and gear ring is excessive or speed sensor is defective.

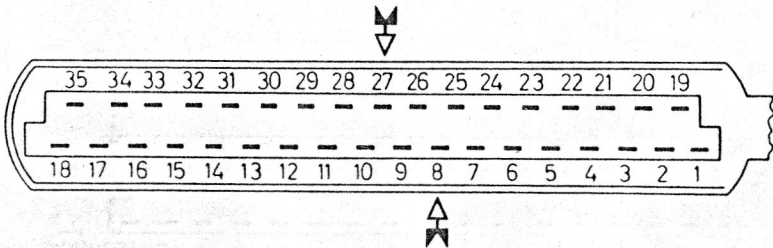
Distance between gear ring and sensor: $0.8 \pm 0.3\text{ mm}$.

No Display:

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

Connect test leads on center and outer plug pins of plug (term. 1 and 2)
(see testing requirements).

Start engine. Sine oscillation must be visible on screen.
Check sensor for power flow, spacing and dirt, replacing sensor if necessary.
Sensor adjustment: see repair manual.



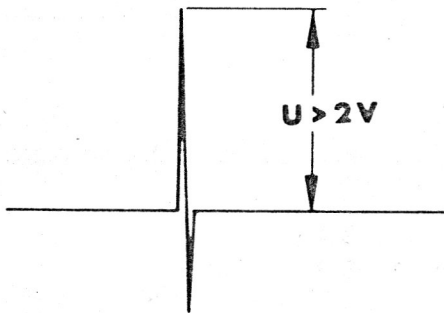
Reference Mark Sensor ($\square/\Omega$)

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

Start Engine:

A single sine oscillation should appear on the screen.

It is important that the oscillation begins with a **positive** flank and the screen scale shows $> 2\text{ V}$ with a starter speed of at least 200 rpm (amount of signal amplitude depends on the starter speed).



If the voltage signal is too small ($< 2\text{ V}$), the distance between the sensor and reference mark is excessive.

Specification: $0.8 \pm 0.05\text{ mm}$.

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.

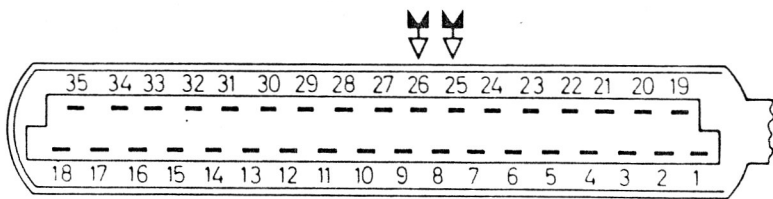
Connect test leads on center and outer pins (term. 1 and 2) of plug (see testing requirements). Start engine.

No Display:

Check tester connections on plug.

Check sensor for breaks, spacing and dirt, replacing sensor if necessary.

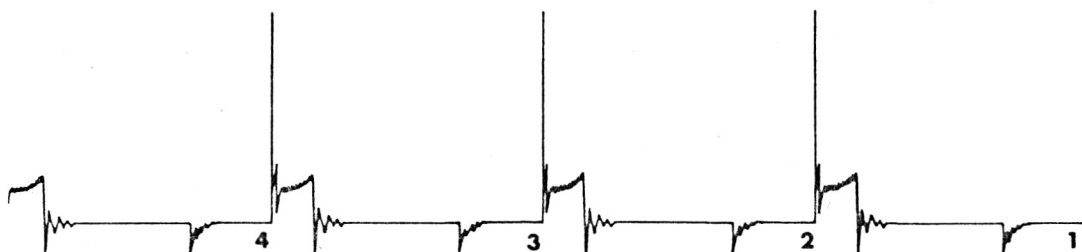
Sensor adjustment: see repair manual.



Ignition System ($\equiv/\Omega$)

a) Secondary Image

Adjust secondary image on oscilloscope. Connect tester leads to supplier's instructions.



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

Primary resistance: term. 1 + 15 = 0.4 – 0.6 Ω

Secondary resistance: term. 1 + 4 = 5.0 – 7.2 k Ω

b) Spark Plug Connectors (Ω)

Suppression resistor: 3 k Ω

Visual inspection for damage or burning.

c) Distributor (Ω)

Distributor rotor, distributor cap: suppression resistor each 1 k Ω .

Visual inspection for damage, dirt and wrong installed position.

d) Ignition Timing Check

Ignition timing is not adjusted.

Only the ignition timing at idle speed is checked.

Engine at operating temperature.

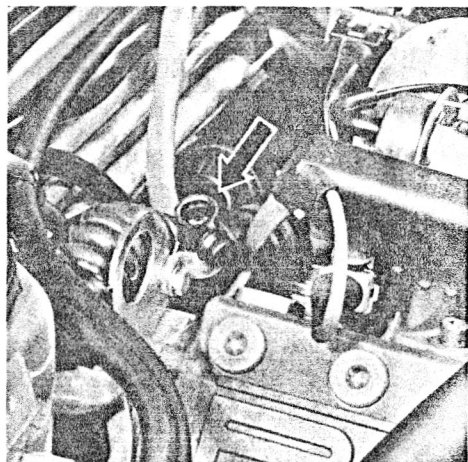
Test Value:

Ignition timing at 840 $\pm$ 40 rpm
= 10° $\pm$ 3° before TDC

USA/unleaded engines: 5° $\pm$ 3° before TDC

Control value at 3200 rpm and bridged test connections
B and C (full load contact)

ign. timing: 23 $\pm$ 3° before TDC



The speed/ignition timing test can be made by using the TDC sensor system in conjunction with an engine tester, which is suitable for this type of testing.

Air Flow Sensor (V/ Ω)

A) Power Supply (V)

Pull back plug seal of air flow sensor (plug remains connected). Connect voltmeter on terminals 3 and ground through back of plug.
Turn on ignition.
Display: 5 ± 0.5 volts

B) Voltage Drop on Sensor Plate Potentiometer (V)

Remove air cleaner. Connect voltmeter on term. 2 and ground.
Display: approx. 250 – 260 mV

Press sensor plate to full load position. Sensor plate must move easily, without hesitation.
Display: sensor plate in full load ~ 4.60 volts

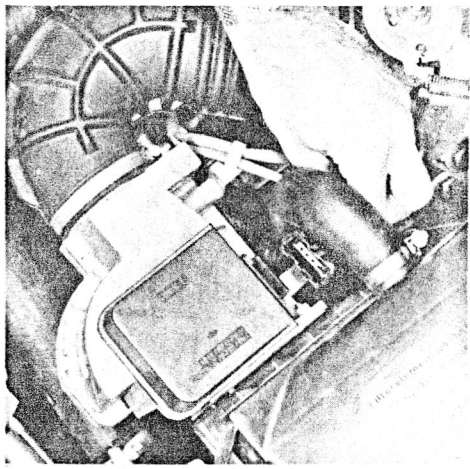
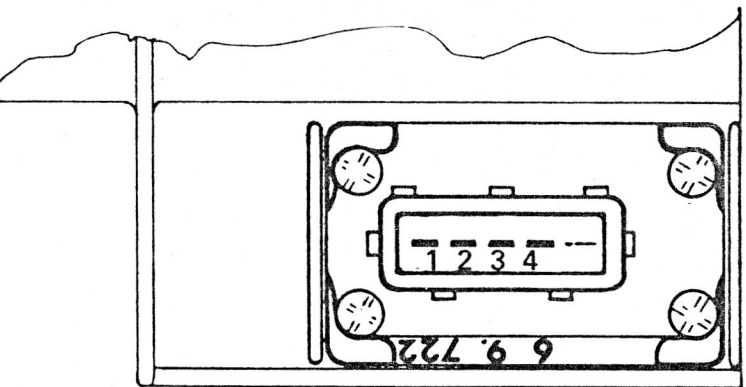
Turn off ignition. Pull off plug and install plug seal.

C) NTC I (Intake Air Temperature)

Air flow sensor plug pulled off.
Connect ohmmeter on terminals 1 and 4 of air flow sensor (terminals 6 and 22 on control unit, air flow sensor plug connected!).
Display: $0^{\circ}\text{C} = 4.4 - 6.8 \text{ k}\Omega$
 $15 - 30^{\circ}\text{C} = 1.4 - 3.6 \text{ k}\Omega$
 $40^{\circ}\text{C} = 1 - 1.3 \text{ k}\Omega$

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

Air Flow Sensor Plug Connections:



Fuel Pressure (Pressure Tester P 378)

There is a cap nut on the end of cyl. no. 1 injection line. Unscrew cap nut, being careful that sealing ball does not fall out!

Connect pressure tester P 378 on adapter.

Start engine and run at idle speed.

Test pressure: 2.0 bar

Pull off vacuum hose on pressure regulator.

Test pressure: 2.3 – 2.7 bar

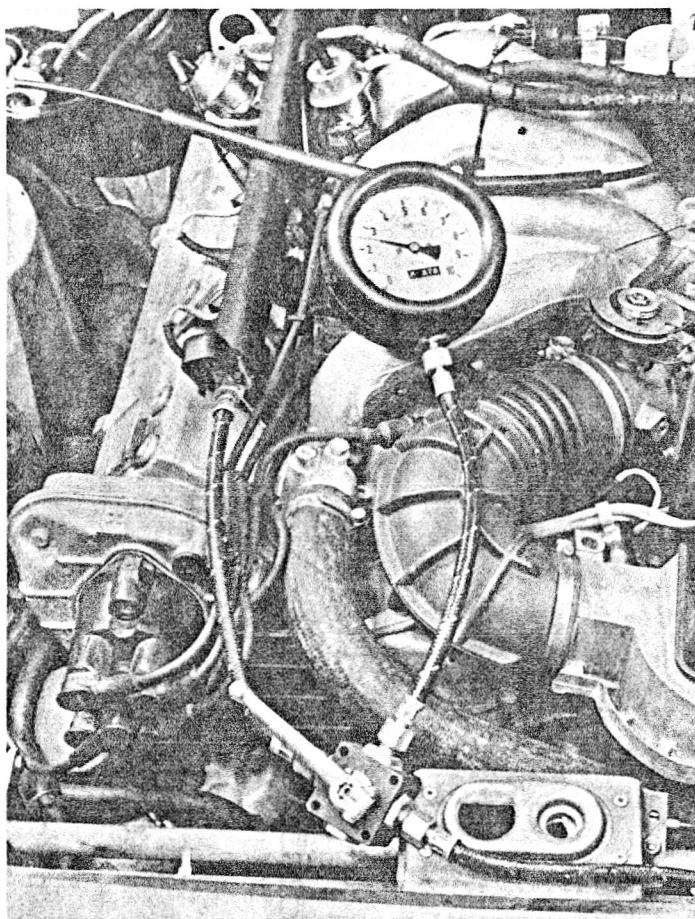
Squeeze return hose of pressure regulator tight slowly with a hose clamp.

Pressure below 4 bar = check fuel filter, replace fuel pump.

If engine cannot be operated: Bridge terminals 30 and 87 b on DME relay G 5.

Fuse no. 34 okay.

Specified test pressure value: 2.3 – 2.7 bar



NTC II (Ω) (Engine Temperature)

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

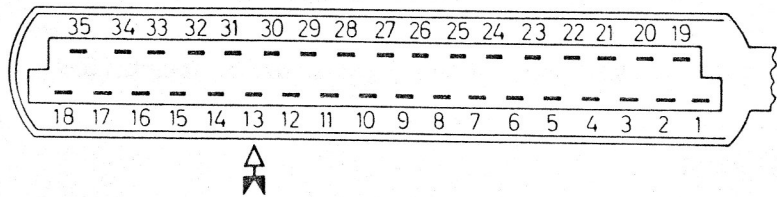
Sensor Test Values at:	0 °C = 4.4 – 6.8 kΩ
	15 – 30 °C = 1.4 – 3.6 kΩ
	40 °C = 1 – 1.3 kΩ
	80 °C = 250 – 390 Ω
	100 °C = 160 – 210 Ω

If values are not reached, check direct on temperature sensor.

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

Control Unit Function Test

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



CO Level and Engine Idle Speed Adjustments

It is important that the engine have operating temperature for the following tests, in particular checking or adjusting engine idle speed as well as CO level adjustments. On the other hand the intake pipes must not be heated excessively, since this would produce wrong test values or make it impossible to adjust the engine.

Operating temperature means: Engine temperature = approx. 90 °C
 Intake air temperature = approx. 15 – 35 °C
 All equipment switched off.

CO Level: **1 ± 0.5 %** at idle speed (840 ± 40 rpm) and with equipment switched off.
 0.6 ± 0.2 % for **USA** cars or cars with unleaded gasoline engines,
 measured in front of catalytic converter.

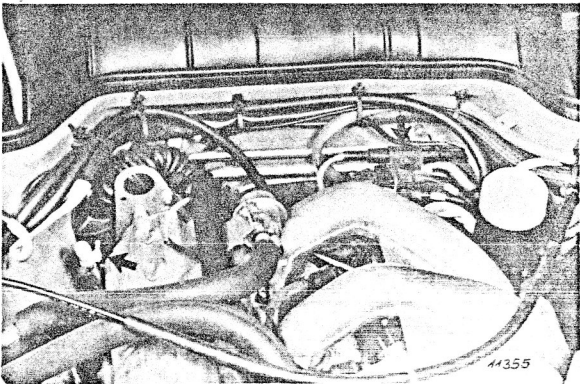
Idle Speed: **Bridge** test socket term. **B** and **C** on regulator plate.
 Adjust idle speed to **840 ± 20 rpm** on bypass air screw of throttle housing,
 with equipment switched off.

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

Adjusting Procedures:

Rest of World Cars	USA Cars/Unleaded Engines M 298/M 299
Exhaust gas tested in tailpipe.	Exhaust gas tested in front of catalytic converter on test pipe in engine compartment, on right hand side. Pull off plug on oxygen sensor.
Check or adjust idle speed CO level. Specification: 1 ± 0.5 % CO (at 840 ± 40 rpm). Accelerate engine briefly after each adjustment.	Check or adjust idle speed CO level. Specification: 0.6 ± 0.2 % CO (at 840 ± 40 rpm). Accelerate engine briefly after each adjustment. Connect plug on oxygen sensor.
Bridge term. B and C on test socket of regulator plate. Check/adjust engine idle speed. Specification: 840 ± 20 rpm . Adjust idle speed on bypass air screw of throttle housing.	Bridge term. B and C on test socket of regulator plate. Check/adjust engine idle speed. Specification: 840 ± 20 rpm . Adjust idle speed on bypass air screw of throttle housing.
Remove bridge on test socket. Accelerate engine briefly. Check CO level and engine idle speed.	Remove bridge on test socket. Accelerate engine briefly. Check CO level and idle speed. Plug exhaust test pipe.

Note:
A defective standard relay (911.615.109.01), of which term. 30 and 87 pins have been soldered together, is suitable for bridging the test socket! **It is not necessary to check the CO level after test driving the car.**
Reason: The air flow sensor temperature (temperature sensor I) will be the same as the outside air temperature, i. e. the temperature will be different than that during adjustments. The control unit is programed to change the engine via temperature sensor signal changes.



Exhaust Test Pipe (USA)

Oxygen Sensor Function (USA Cars and Unleaded Engines M 298/M 299)

A) Fast Test

(Engine at Operating Temperature, Correct Idle Speed)

Connect CO tester on test pipe in engine compartment on right-hand side. Disconnect oxygen sensor plug. Note CO value.

Pull off and plug vacuum line on fuel pressure regulator.

CO level must rise!

Connect oxygen sensor plug.

CO level must drop to specified value: $0.6 \pm 0.2 \%$.

If there is no CO level change, the oxygen sensor or DME control unit is faulty.

B) Checking DME Control Unit

(Engine at Operating Temperature, Correct Idle Speed)

Connect CO tester on test pipe in engine compartment on right-hand side. Disconnect oxygen sensor plug. Check CO level.

Bridge oxygen sensor plug term. 1 (green) – sleeve contact – (wire harness to control unit) and ground with a piece of wire.

CO level must rise!

If CO level does not change, check power flow from wire plug term. 1 (green) to control unit term. 24 before replacing the DME control unit.

C) Checking Oxygen Sensor (V)

(Engine at Operating Temperature, Correct Idle Speed)

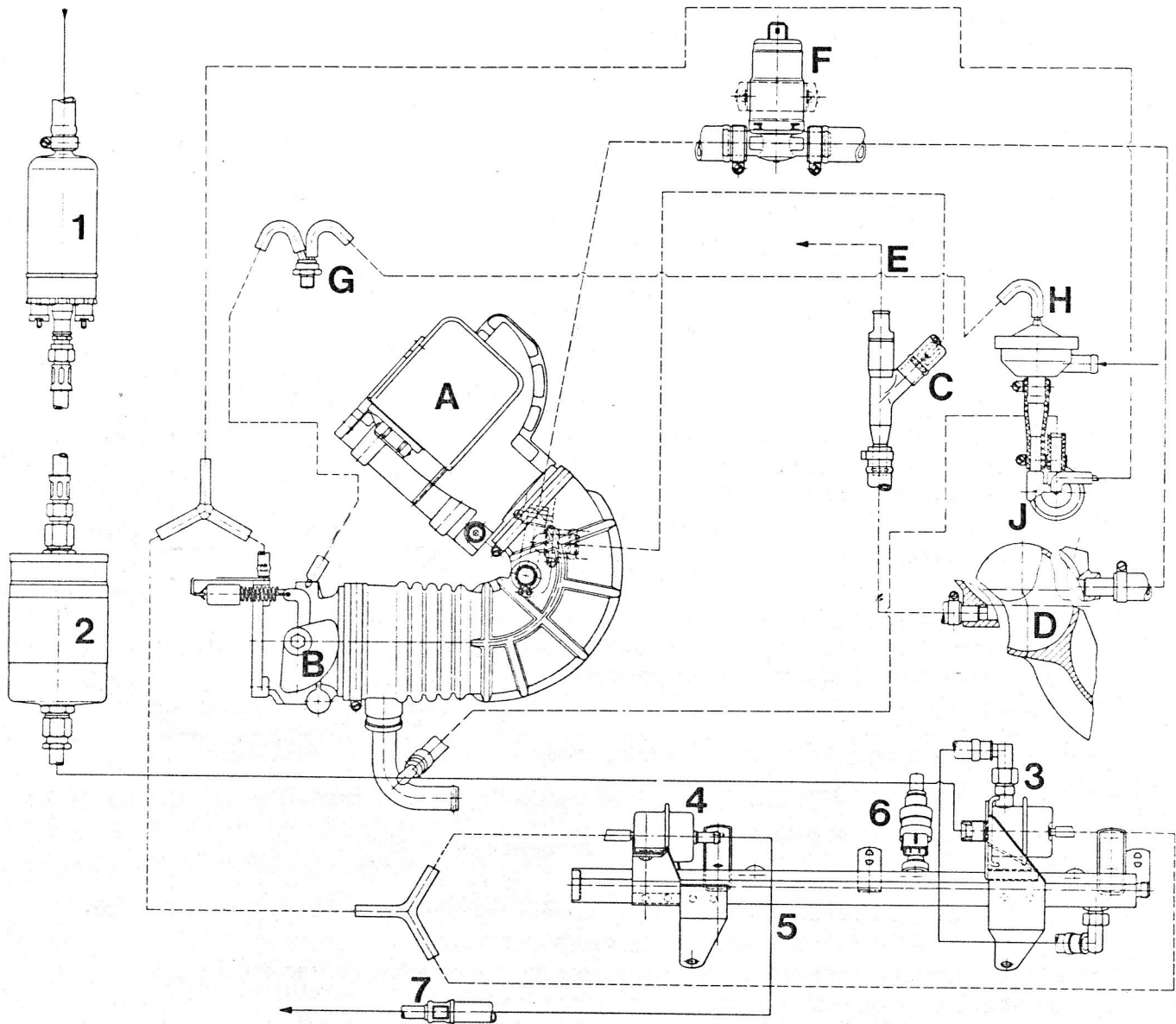
Disconnect oxygen sensor plug. Connect digital voltmeter between ground and term. 1 (pin contact) of sensor plug.

Display: approx. 0.1 – 1.0 V.

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

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

Fuel System Line Routing, Applicable for USA, Canada, Japan and FRG with M 298/M 299



- 1 — Fuel pump
- 2 — Fuel filter
- 3 — Pressure damper
- 4 — Pressure regulator
- 5 — Injection line
- 6 — Fuel injector
- 7 — Fuel return

- A — Air flow sensor
- B — Throttle housing
- C — Ejection pump
- D — Intake pipe
- E — To brake booster
- F — Idle positioner

- * G — Temperature valve
(open above 58 °C)
- * H — Shutoff valve
- * J — Regulating valve
- * Not for R. o. W. cars

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

1. Speed > 880 rpm

The jolt from coasting shutoff cutting in becomes stronger the greater the deviation in speed from specified value.

2. Speed < 800 rpm

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

B) Maladjusted CO Level

1. CO Level $<$ Specified Value (% by Vol.)

Erratic idling is caused by insufficient CO. Moving off problems (much too lean) in extreme cases.

C) Temperature Sensor II

Temperature sensor II is very important for engine warm-up. Coolant temperature is used for reference to the engine temperature state. With increasing resistance (cold) there is an increase in mixture richness.

1. Specified Resistance Value (Ω)

Engine $\approx 20^\circ\text{C}$ (room temp.) = $2.2 - 2.8\text{ k}\Omega$

Engine at operating temp. $\sim 250\ \Omega$

Measure resistance on sensor in engine compartment with engine stopped.

2. Defect on Temperature Sensor II

The engine will stall briefly in overriched state if plug falls off (is disconnected) or wire has a break, since the resistance = $\infty\ \Omega$ (equal to -30°C outside temperature) would be excessive.

The engine will run again when the plug is bridged. However, cold start behavior will not be correct with a bridged plug.

Consequently bridging must only be used in an emergency situation.

3. Ground short — e. g. wire insulation rubbed off (resistance = $0\ \Omega$). The engine will not have rich mixtures = 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 for cold engine = longer starting time, greater number of starts, perhaps starting not possible at freezing outside temperatures, engine runs normally during warm-up.

Sensor distance can be larger as engine temperature increases. Ignition starts to jump because of interconnection between reference mark sensor signals and speed sensor signals.

Engine runs unmotivatedly high in idle sometimes.

For example, 3 mm sensor distance on cold engine = strong misfiring and poor moving off behavior (engine stops spontaneously).

E) Fuel Return Line

If the return line is bent, fuel pressure will rise and engine runs with an excessively rich mixture or stops due to overrichness.

Indications: CO level cannot be adjusted to specified value (with correct intake air and engine temperature).
Fuel consumption too high.
Car hesitates.

Remedy: Check fuel pressure → route line correctly.
Tank vent line clamped shut.
→ same indication, since fuel pressure too high.

F) Hot Start Problems

Leak Test

Fuel pressure must not drop by more than max. 0.5 bar in 30 minutes when engine is warm.

1. Causes for poor hot starting.

2. Pressure regulator leaks (→) – disconnect return line to troubleshoot.

3. Check valve of fuel pump defective (→) – disconnect pressure line to troubleshoot.

4. Fuel injectors leak (→) – check by disconnecting pressure and return lines.

G) Idle Switch

Defective switch (break) will cause excessively high fuel consumption and poor transition.

H) Spark Plug Wear Limit

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