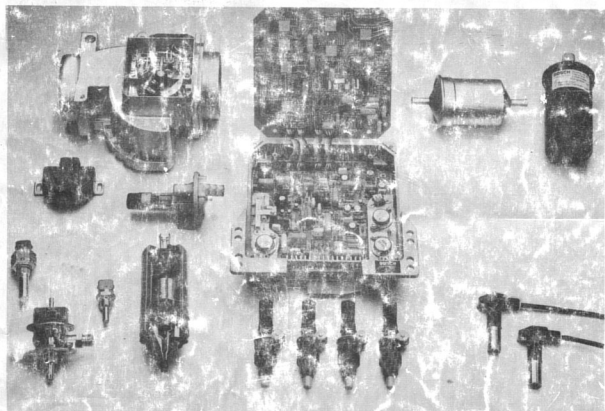


PORSCHE

944

DME- TESTING PLAN



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

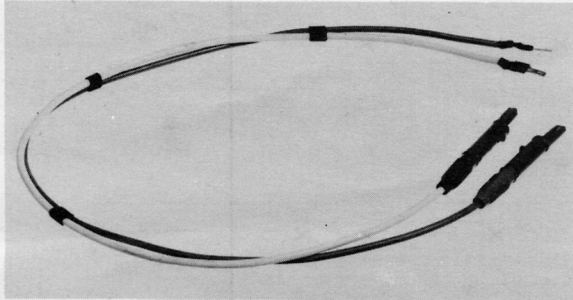
WKD 450 821

Test Requirements	Possible Causes															
Engine in good mech. condition; battery charged	Ground connections, plug connections	Power supply for control unit/fuel pump	Speed sensor	Reference mark sensor	Ignition system	Air flow sensor	Fuel pressure	Fuel injectors, injection control	Temperature sensor II (engine temperature)	Throttle switch	Cold start enrichment	CO and idle settings	Throttle bypass valve	Intake system leakage Alternator, Regulator	High altitude switch	Oxygen sensor
See Test Sheet Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Possible Conditions																
Engine will not start/hard to start	x	x	x	x	x	x	x	x			x		x	x		
Poor idling	x		x		x	x	x	x	x			x	x	x	x	x
Poor acceleration	x	x			x	x	x			x		x	x	x	x	
Engine cutout	x	x			x	x	x									x
High fuel consumpt.					x	x	x		x	x		x				x
Poor performance	x				x	x	x	x		x			x	x	x	
	x = checked with suitable tester!															

TEST REQUIREMENTS

You will need the following equipment to check the fuel and ignition systems.

- 1 Oscilloscope, e. g. SUN 1115 or equivalent
- 1 Volt and ohmmeter (internal resistance at least 20 k-ohms/V)
- 1 Test lead



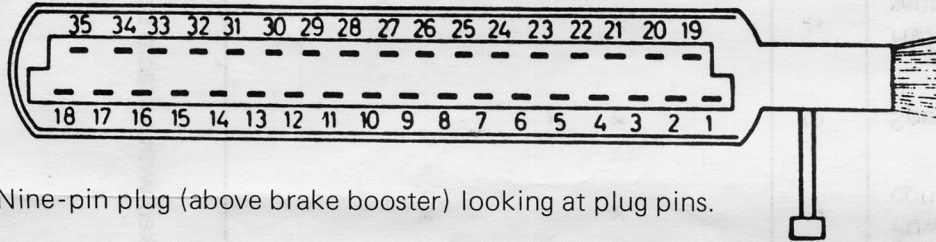
Test lead

- 1. 2 flat male plugs N 17.457.2
- 2. 2 super flexible leads, each approx. 60 cm long
- 3. 2 insulated alligator clips

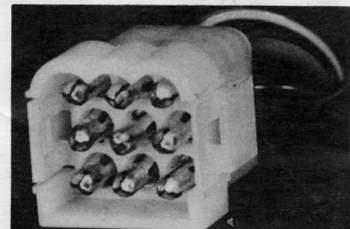
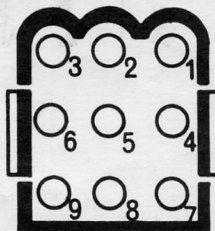
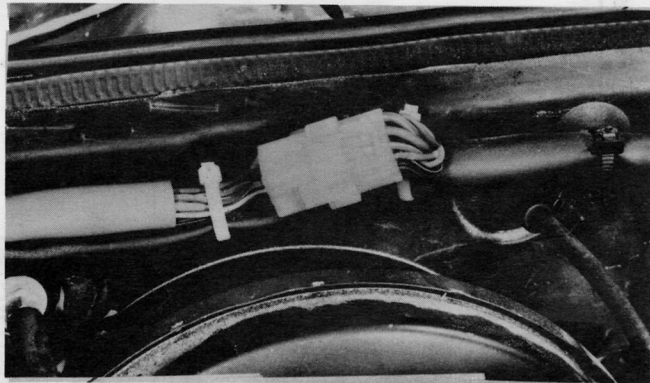
The lead must always be used for tests!
Anything else could damage the multiple pin connections

Plug Connections

Control unit multiple pin plug looking at plug terminals.

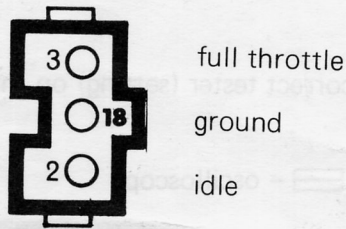


Nine-pin plug (above brake booster) looking at plug pins.

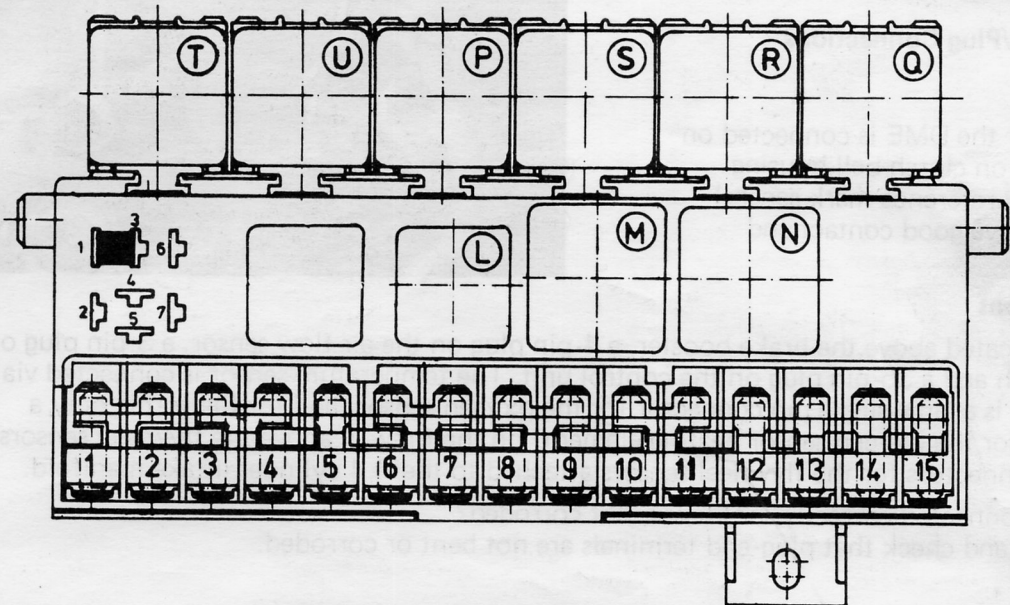


TEST REQUIREMENTS

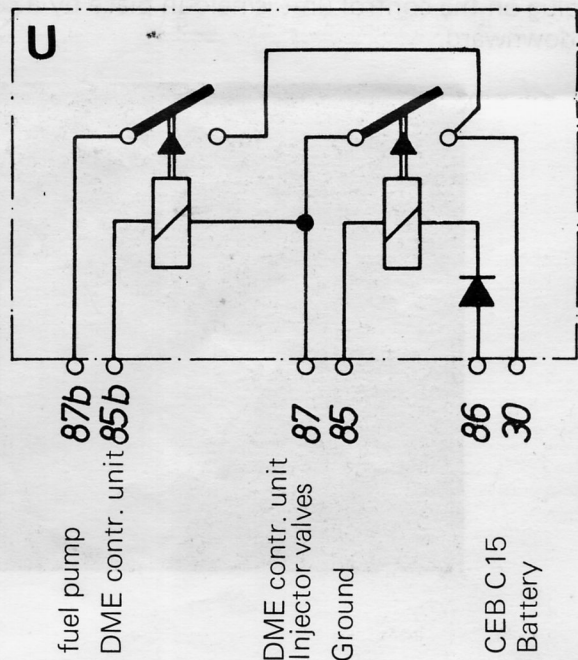
Disconnected throttle switch plug looking at plug terminals.



Central Electric Board Relay Connections



- T – Radiator fan (+ condenser blower)
- U – Fuel pump, DME control unit
- P – Air conditioner
- S – Headlight cleaners
- R – Seatbelt
- Q – Rear window defogger
- L – Two-tone horns
- M – Intermittent wiper
- N – Turn signals/hazard lights (flasher)




Note:

The test points should be carried out in the specified order, especially when the engine will not start or has a performance problem.

Test point 1 is especially important!

Make sure that you are testing with the correct tester (setting) on the correct test point with the specified requirements!

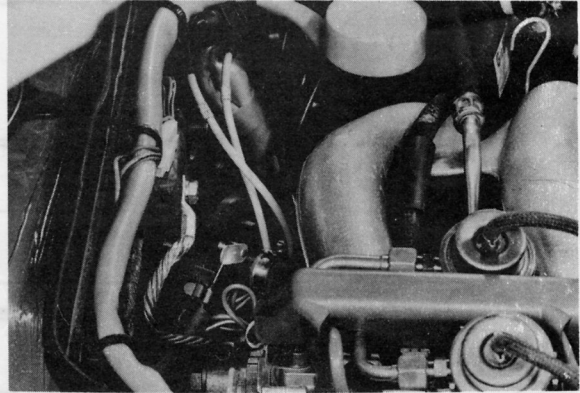
V = voltmeter Ω = ohmmeter  = oscilloscope
(< = smaller than, > = greater than)

Test Point 1

Checking Ground/Plug Connections

a) Ground

A ground wire for the DME is connected on engine flange and on clutch bell housing (area of speed and reference mark sensor). Do connections have good contact and are they tight.



b) Plug Connections

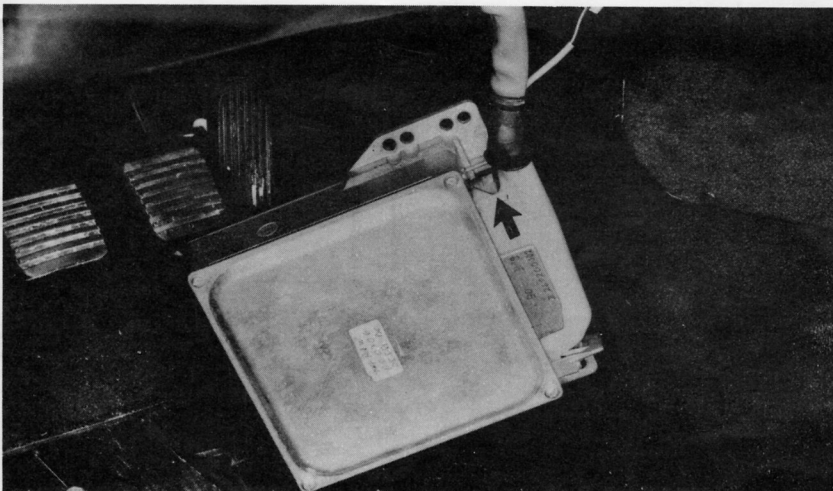
A 9-pin plug is located above the brake booster, a 4-pin plug on the air flow sensor, a 3-pin plug on the throttle switch and a 35-pin plug on the control unit. The temperature sensor is connected via a 2-pin plug. There is a large single pin connector for the oxygen sensor (and, for California only, a 2-pin connector for the oxygen sensor heating element) on the firewall above the flywheel sensors and two 3-pin connectors for the flywheel sensors attached to the #4 cylinder intake manifold.

Are these plugs connected correctly, not loose, not corroded?

Disconnect plugs and check that plug-end terminals are not bent or corroded.

Note:

The plug on the control unit is held in place by a catch. Push catch to the right and then pull off plug downward.



Test Point 2**Power Supply for Control Unit and Fuel Pump****A) Control Unit (V)**

Turn on ignition after connecting voltmeter.

- a) Pull off plug on control unit. Connect term. 35 and term. 5 with voltmeter as well as term. 18 and term. 5 with voltmeter.

Display: = battery voltage

No display, then check:

Pull off power supply relay U. Bridge term. 30 and 87 on socket.
Repeat test a).

- b) Connect voltmeter between term. 3 of 9-pin plug and ground.

Display: = battery voltage

- c) Pull off plug of one fuel injector; connect voltmeter with ground.

Display: = battery voltage

B) Ignition Circuit

Connect voltmeter between term. 1 of control unit plug and ground.

Turn ignition on.

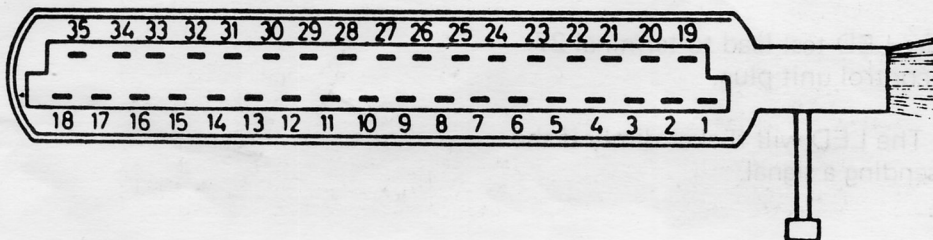
Display: = battery voltage

C) Fuel Pump (Connect control unit plug)

Start engine — fuel pump must run during starting procedures.

If not, check:

Fuse 2 (16 amp.) in extra fuse box, — relay U, bridge term. 30 and term. 87b in socket,
— fuel pump must run.



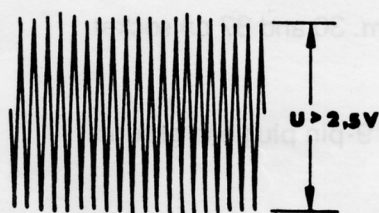
Test Point 3

Speed Sensor (\square/Ω)

The preferred method of testing the speed sensor is by using an engine oscilloscope. See the oscilloscope manufacturers operating instructions to determine the correct control positions and tester connections for "Special Tests".

- a) Connect the "+" tester lead to terminal 8 of the disconnected control unit plug. Connect the "-" tester lead to terminal 27 of the disconnected control unit plug.

Operate starter. Screen should display harmonic oscillation with **an amplitude of ~ 8 V (nominal > 2.5 volts)**.



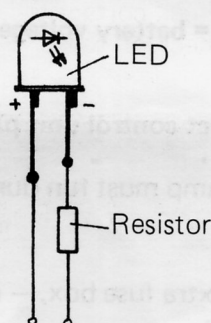
If voltage signal is too small $< 2.5\text{ V}$, distance between sensor and flywheel is too large.
Distance between sensor and flywheel: **nominal $0.8 \pm 0.05\text{ mm}$** (0.0315 in.)

No display, check: Wire connection from control unit plug to sensor plug, check correct oscilloscope connection and switch range, check on sensor plug itself – No display – replace sensor.

Alternate Test

If an oscilloscope is not available, a LED can be used to check the speed sensor signal.

Use a Fresnel Lens Front LED available from an electronics store, or use part $\neq 171\ 919\ 061\text{ B}$ (the fresnel LED's are brighter). Connect a resistor (220 ohm, 1/4 watt) in series with one of the LED terminals.




Connect one LED test lead to terminal 8 of the removed control unit plug.

Connect the other LED test lead to terminal 27 of the removed control unit plug.

Operate starter. The LED will flicker dimly if the speed sensor is sending a signal.

Test Point 4

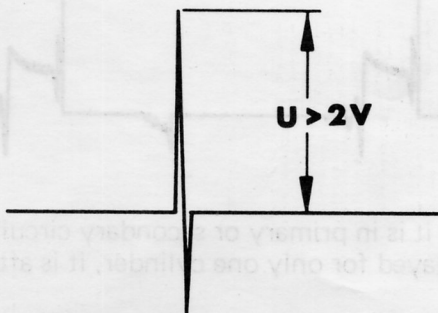
Reference Mark Sensor ( /Ω)

Set oscilloscope as in test point 3. If oscilloscope is not available, use L. E. D. as in test point 3.

Connect “+” tester lead to terminal 25 and “-” tester lead to terminal 26.

Operate Starter:

Screen should display a single harmonic oscillation. It is important that oscillation begins with a positive flank and screen scale shows > 2 V with a starter speed of at least 200 rpm (signal amplitude depends on starter speed).

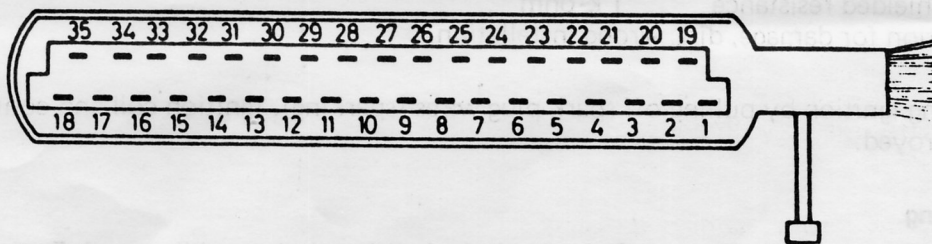


If voltage signal is too small < 2 V, distance between sensor and reference mark is excessive (nominal 0,8 ±0,05 mm—0,0315 in.))

If an L. E. D. is being used the L. E. D. should flicker dimly, when the starter is operated if the reference mark sensor is sending a signal.

No display, check: Wire connection from control unit plug to sensor plug,
check correct oscilloscope connection and switch range,
check on sensor plug itself.

No display — replace sensor.



Sensor Adjustment

Procedures for checking sensor clearance with installed engine:

1. Remove speed sensor.
2. Measure distance from top of holder to top of one starter gear ring tooth with a depth gauge.
3. Measure speed sensor length.
4. Subtract distance of point 3 from distance of point 2, whereby difference should be 0.8 mm (0.0315 in.). If difference is greater or smaller, turn holder until calculated difference is correct.
5. Install sensor.

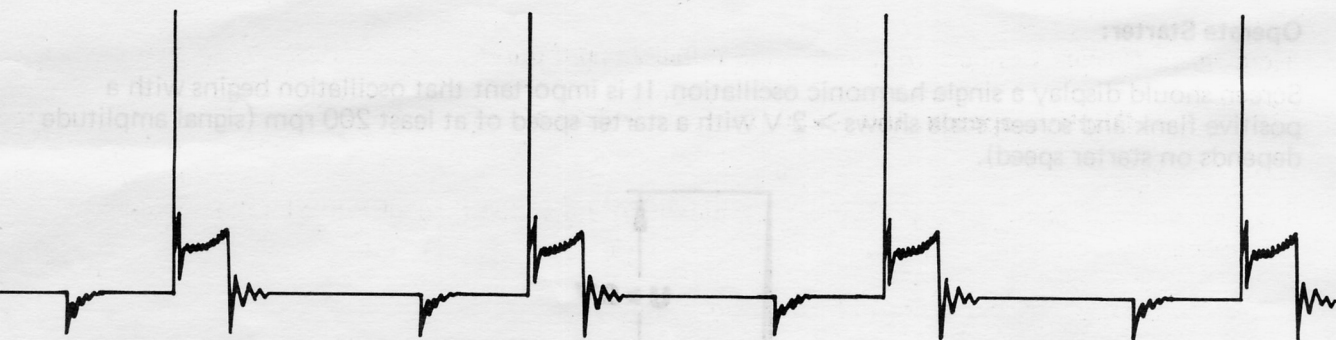
The reference mark sensor is adjusted together with the speed sensor, i. e. it cannot be adjusted separately.

Test Point 5

Ignition System (\square/Ω)

a) Secondary Image

Secondary image
(set on oscilloscope)
term. 1 and 15, trigger clip on cyl. 1



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

Ignition Coil

Primary resistance (ohmmeter): 0.4 – 0.6 ohm term. 1 + 15
Secondary resistance: 5 – 7.2 k-ohm term. 1 + 4

b) Spark Plug Connectors (ohmmeter)

Shielded resistance: 3 k-ohm
Visual inspection for damage, burns.

c) Distributor (ohmmeter)

Distr. cap (all connections): 1 k-ohm
Distr. rotor, shielded resistance 1 k-ohm
Visual inspection for damage, dirt, wrong installation.

Important!

Avoid checking ignition by pulling off spark plug wires (sparking). Ignition coil and control unit could be destroyed.

d) Ignition Timing

The ignition timing is not adjustable. Only check the ignition timing at idle speed. Engine at operating temperature.

Test value:

Ignition timing at **900±50 rpm = 5°± 2° before TDC:**

If timing is out of tolerance, check air-flow sensor (Test Point 6) and throttle switch (Test Point 10), before replacing DME control unit.

Test Point 6**Air Flow Sensor (V/ Ω)**

Full back seal of air flow sensor plug. Plug still connected. Connect voltmeter on terminal 9 (back of plug) and ground. Turn on ignition.

Display: $> 8 \text{ V}$

Remove air cleaner. Connect voltmeter on terminal 7 and ground.

Display: approx. 150 – 250 mV (0.15 – 0.25 V)

Push sensor plate to full throttle with a non-metallic rod inserted through filter intake opening. Sensor plate must move easily and not stick.

Display: $\geq 8 \text{ V}$ at full throttle position

Temperatur sensor II (intake air)

Disconnect air flow sensor plug

Connect ohmmeter on term. 6 and 22 of air flow sensor.

Display at	0 °C = 5 – 6.2 k-ohms] ± 10 %
	20 °C = 2.2 – 2.8 k-ohms	
	30 °C = 1.5 – 1.9 k-ohms	

Note: Temp. sensor short circuit = fuel mixture lean
 Temp. sensor disconnected = fuel mixture rich

Test Point 7**Fuel Pressure (P 378)**

A cap nut can be seen on end of injection line.
Unscrew cap nut – be careful that inserted sealing ball doesn't fall out.
Connect P 378 test pressure gauge on adapter.

Start engine, at idle speed:

Test pressure: 2.0 bar

Disconnect vacuum hose on pressure regulator.

Test pressure: approx. 2.3 – 2.7 bar

Pinch return line of pressure regulator slowly with a hose clamp.

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

If engine will not start:

Pull off relay (U) and bridge term. **30 and 87b** in socket.
Fuel pump must run (fuse 2 (16 amps) extra fuse box – okay?).

Test pressure: 2.3 – 2.7 bar

Test Point 8**Fuel Injectors – Injection Control (V/ Ω / \square)****a) Fuel Injectors**

If engine runs, pull off injector plugs separately.
If Injectors are okay, engine speed will drop.
If engine will not start:

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

Display: ~ 10 V

Check coil resistance at plug pins of fuel injector with an ohmmeter.

Display: 2 – 3 ohms

b) Injection Rate (\square)

Follow oscilloscope manufacturers instructions to set oscilloscope for a "primary ignition" test, however make sure ignition coil polarity is set at "-".

Pull back rubber boot on an injector plug (plug still connected).

Connect oscilloscope coil "-" lead to the grey/black wire connection.

Connect oscilloscope coil "+" lead, if required, to red/black wire connection.

Note: Do not allow either test lead to touch ground!

Start engine:

See page 12 for the correct injection signal patterns.

If oscilloscope is not available, use L. E. D. from test point 3 and 4 **with** resistor (220 ohm, 1/4 watt)

Start engine:

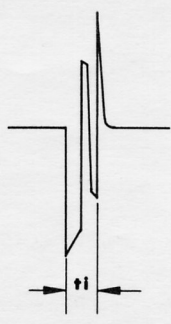
L. E. D. should flash during starting and at idle.

L. E. D. should glow at high engine speeds.

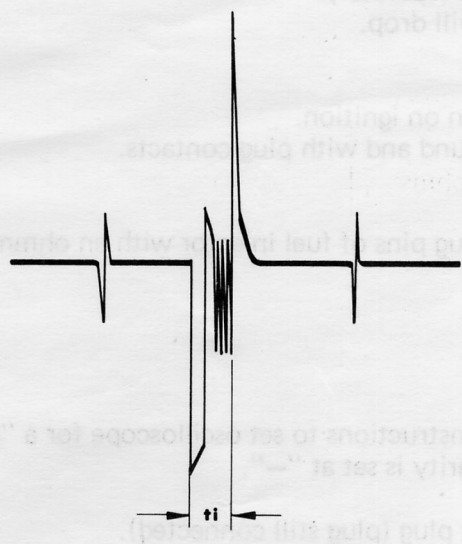
L. E. D. should go out momentarily when throttle is closed again. If not, see Test Point 10.

For test point 8 b)

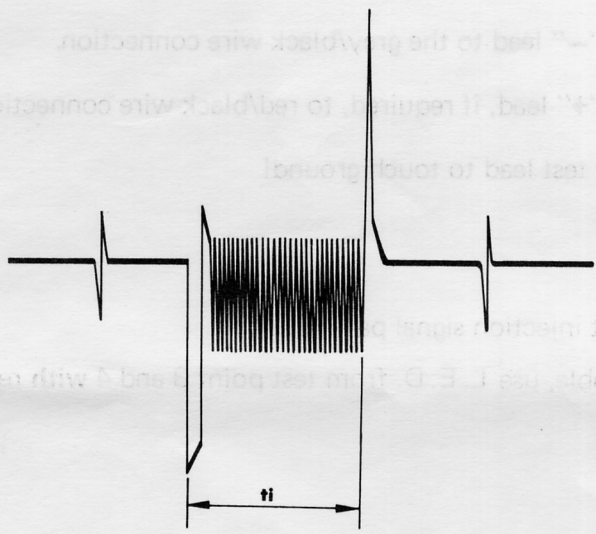
Starter speed



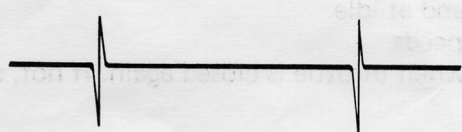
Idle speed



Acceleration



Deceleration



If injection signal „ti“ is not cut off during deceleration, see test point 10.

Test Point 9

Engine Temperature Sensor II (Ω)

Check fit and contact of plug connection on temperature sensor.

Pull off control unit plug. Connect ohmmeter between term. 13 and ground.

Test values at	10 °C =	3.3 – 4.1 k-ohms] ± 10 %
	20 °C =	2.2 – 2.8 k-ohms	
	40 °C =	1.0 – 1.3 k-ohms	
	80 °C =	290 – 350 ohms	
	100 °C =	160 – 210 ohms	

Note: Temp. sensor short circuit = fuel mixture lean
 Temp. sensor disconnected = fuel mixture rich.

Test Point 10

Throttle Switch (Ω)

Pull off control unit plug. Connect ohmmeter between terminal 2 and ground.

Throttle sw. at idle stop: **display 0 ohms**
Throttle sw. open: **display ∞ ohms**
Idle contact must open immediately (max. 1°)!

Connect ohmmeter between terminal 3 and ground.

Throttle sw. at idle stop: **display ∞ ohms**
Throttle sw. open — display must go back **to 0 ohms**
shortly before full throttle.

If not check:

Connect ohmmeter between ground and the removed throttle switch plug center pin (terminal 18). Should read "0" ohms.

Repeat throttle switch tests by connecting ohmmeter directly to throttle switch. Connect ohmmeter to center pin (terminal 18) and right or left pin (terminal 2 or 3).

a) Injection Pulse Cutoff

Pull off throttle switch plug.

Connect term. 2 (idle contact) of disconnected plug with term. 18 (center pin) with a test lead. Increase engine speed to 2000 r.p.m. Engine begins to surge. In test 8b the injection time signal (ti) will not be displayed on screen briefly.

Connect term. 3 (full throttle contact) of disconnected plug with term. 18 (center pin) via a test lead.

Engine speed should decrease (retarded ignition).

Note: With the full throttle contact closed, the D. M. E. control unit will switch off the oxygen sensor.

b) Throttle Switch Adjustment

Set throttle against idle stop.

Unscrew bolts of throttle switch and turn throttle switch until idle contact closes.

Tighten bolts.

Idle contact must open when opening throttle in range of $< 1^\circ$ throttle angle.

Test Point 11

Cold Start Enrichment

Set and connect your oscilloscope as in test point 8b.

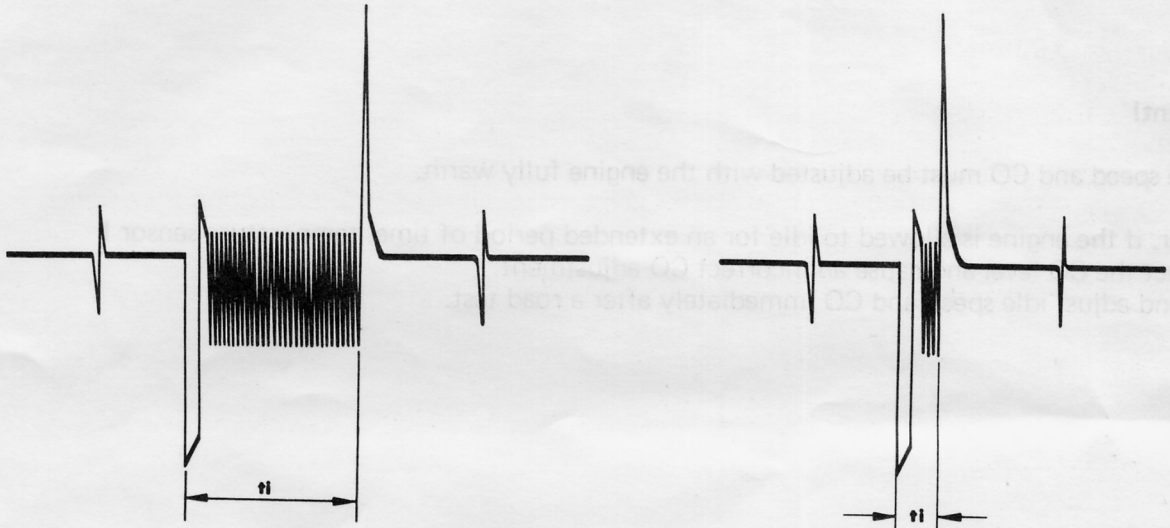
Start engine

Oscilloscope should show a very wide spread "ti" signal at first, which immediately wanders back to the idle signal.

Important! Spread signal will only be displayed briefly while starting.

Enrichment

Idle



Test Point 12**CO Setting**

Idle speed adjustments are made on throttle housing.

CO adjustments are made on air flow sensor.

Adjusting values: Idle speed = **900 ± 50 rpm**
CO level = **$0,6 \pm 0,2\%$** (Measured before catalyst with oxygen sensor disconnected)

After adjusting C. O., check oxygen sensor operation.

Disconnect vacuum hose from pressure regulator and plug hose

CO level goes rich!

Reconnect oxygen sensor

CO level goes to $0.6 \pm 0.2 \%$

Important!

The idle speed and CO must be adjusted with the engine fully warm.

However, if the engine is allowed to idle for an extended period of time, temperature sensor I will effect the CO level and cause an incorrect CO adjustment.
Check and adjust idle speed and CO immediately after a road test.

Test Point 13

Throttle Bypass Valve (V/ Ω)

Throttle bypass valve will be closed when heated (warm).
When pinching air hose at idle speed, engine speed may drop only slightly.

Pull off plug on throttle bypass valve and connect voltmeter (or test lamp) on plug terminals, with engine running.

Display: **battery voltage (or test lamp on)**

Connect ohmmeter to throttle bypass valve terminals.

Test value: **20 – 55 ohms**

Test Point 14

Leak in intake System

Check all connections after air flow sensor for tight fit and leaks.

Alternator, Regulator

Engine cutout could be caused by voltage peaks from the alternator. Remove drive belt from alternator, start engine. If defects have been eliminated, check alternator and regulator.

Test Point 15

High altitude switch (below dash board-driverside)

A) Disconnect altitude switch plug

Connect on Ohmmeter to the switch terminals — **the Ohmmeter should indicate $\infty \Omega$ (switch open)**

Important: The switch is closed in areas above 1000 mtr. (3280 ft.) —
Ohmmeter shows $\sim 0 \Omega$

B) Warm up engine, disconnect oxygen sensor, disconnect high altitude switch, remove vacuum hose from fuel pressure regulator and plug hose.

Run engine at 2,000 R.P.M. and note C. O. level.

Bridge terminals in high altitude switch plug.

C. O. level at 2,000 R.P.M. should now be leaner.

If not, check high altitude plug connections. (One terminal should go to ground, one terminal should go to control unit plug terminal 28).

Test Point 16**Oxygen Sensor****Oxygen Sensor Quick Test**

Connect C. O. tester, warm up engine, disconnect oxygen sensor.

Disconnect vacuum hose from fuel pressure regulator and plug hose:

CO increases

Reconnect Oxygen sensor:

CO decreases to $0,6 \pm 0,2\%$

If not, check D.M.E. control unit.

DME Control Unit Test

Reconnect fuel pressure regulator vacuum hose. Disconnect oxygen sensor. Connect oxygen sensor connector (control unit side) to ground.

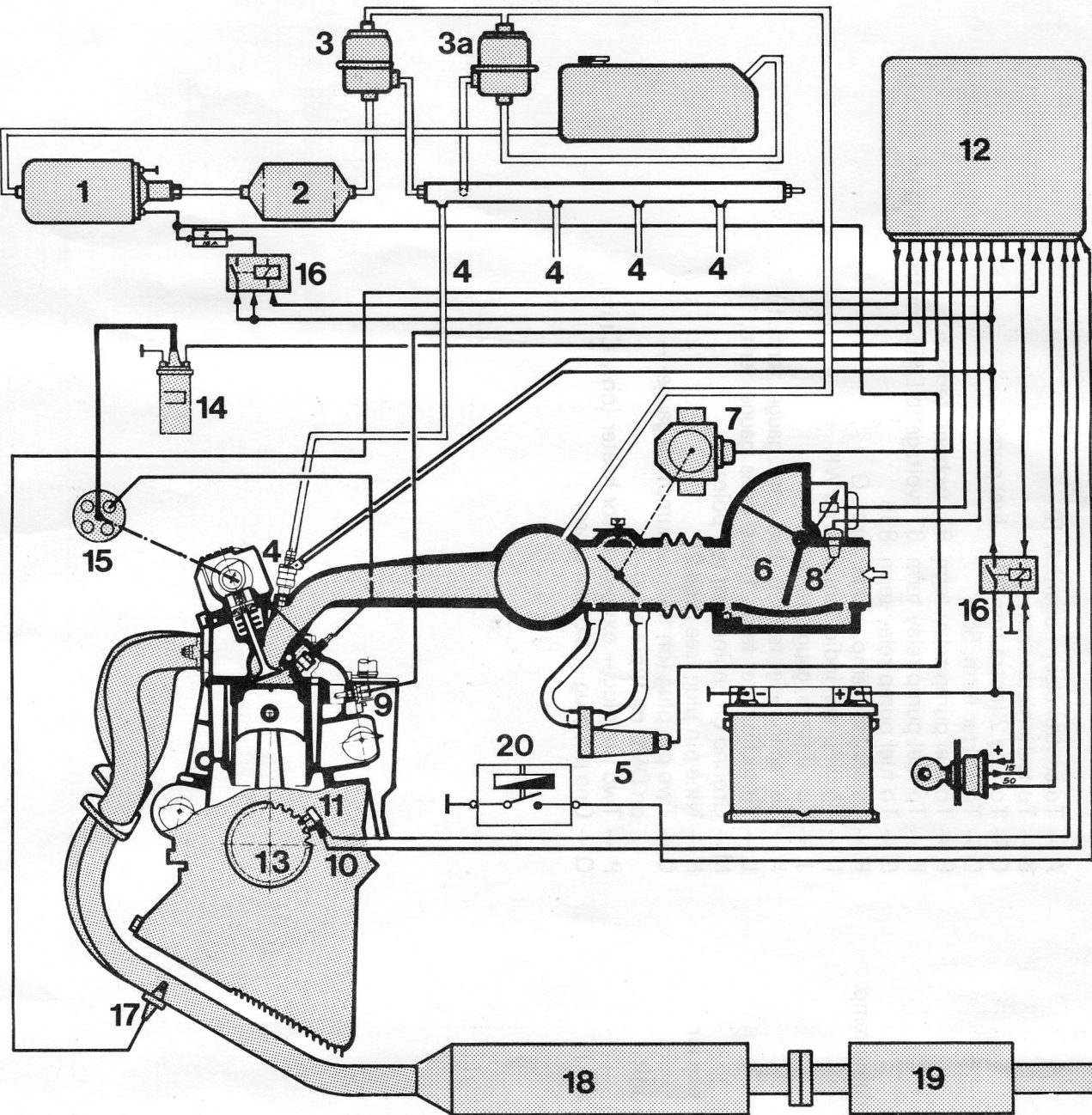
CO should increase

- If not, check wire from oxygen sensor to control unit plug terminal 24 before replacing D.M.E. control unit.
- If C.O. did increase, then oxygen sensor is defective.

Note:

The D.M.E. control unit will switch the oxygen sensor off under any of the following conditions.

1. Coolant temperature less than 15 °C (60 °F)
2. Coolant temperature less than 45 °C (113 °F) and engine idling.
3. Idle switch closed (idle position) and engine above 1000 R.P.M.
4. Full throttle switch closed (Full throttle).



Explanations of Layout:

- 1 – Fuel pump
- 2 – Fuel filter
- 3 – Pressure damper
- 3a – Pressure regulator
- 4 – Fuel injectors
- 5 – Throttle bypass valve
- 6 – Air flow sensor
- 7 – Throttle switch
- 8 – Intake air temp. sensor
- 9 – Engine temperature sensor

- 10 – Speed sensor
- 11 – Reference mark sensor
- 12 – Control unit
- 13 – Starter ring gear
- 14 – Ignition coil
- 15 – Distributor
- 16 – Double relay: fuel pump/control unit
- 17 – Oxygen sensor
- 18 – Catalyst
- 19 – Muffler
- 20 – High altitude switch

Wiring Diagram Descriptions

- 1 — DME control unit
- 2 — Throttle switch
- 3 — Reference mark sensor
- 4 — Speed sensor
- 5 — Air flow sensor
- 6 — Auxiliary air valve
- 7 — Ignition coil
- 8 — NTC temperature sensor II, engine temp.
- 9 — Fuel injector — cyl. no. 4
- 10 — Fuel injector — cyl. no. 3
- 11 — Fuel injector — cyl. no. 2
- 12 — Fuel injector — cyl. no. 1
- 13 — Oil pressure sending unit
- 14 — NTC temperature sensor I, intake air
- 15 — High voltage distributor
- 16 — Coolant temperature sending unit
- 17 — Oxygen sensor
- 18 — Heater oxygen sensor (only Calif.)
- 19 — High altitude switch

- A — To central electr. board A 12
- B — To tachometer term. 6
- C — To fuse 2 (extra fuse box), fuel pump
- D — To starter term. 50
- E — To fuel pump relay term. 87, tachom. term. 5
- F — To fuel pump relay term. 87 (voltage to DME control unit)
- G — To fuel pump relay term. 85b
- H — To coolant temp. gauge, term. G
- I — To oil press. indic. lamp. term. WK
- J — To oil press. gauge, term. G
- K — To tachometer term. 5 (fuel cons. gauge, term. 5)
- L — To tachometer term. 1 (fuel cons. gauge, term. 1)
- M — Ground on engine (see test point 1)
- N — Nine pin plug (see page 2)
- O — Two pin plug (on fuel consumption gauge) — on DME multiple plug
- P — Two pin plug — oxygen sensor heater (only Calif.)
- Q — One pin plug — oxygen sensor

