Fault tracing

Oxygen Sensor Feedback System

Section	Group
2	24

Fault tracing
Oxygen Sensor
Feedback System

VOLVO

Contents

Supporting information:

Supplement

TP 11585/2
2500.4.78
Printed in USA

Check of Oxygen Sensor Feedback System

Indications of malfunctions in this system can be:
- Starting difficulties with engine at normal operating temperature, (hot)
- Erratic idle
- Poor performance, especially in lower speed ranges
- Poor mileage

These indications are common with several other engine malfunctions and there is no reason to believe that this system is more at fault than others.

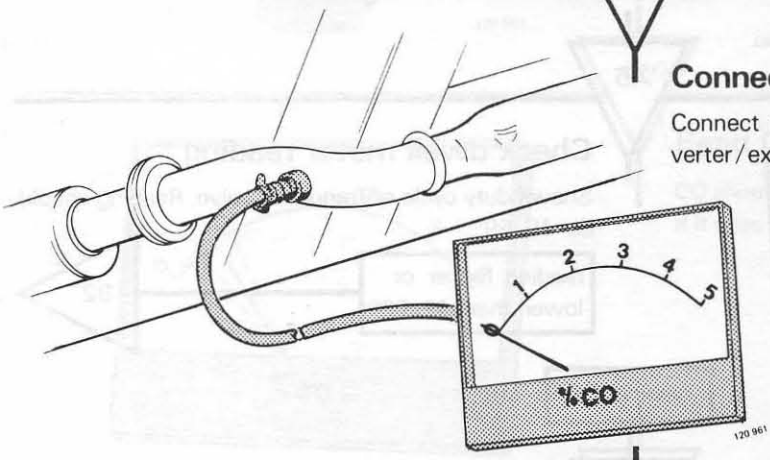
In order to separate the faults, first listen to the frequency valve. If it buzzes, something other than this system is most likely at fault.

Extremely high or low CO readings can also indicate a system fault. In this case it is better to make a complete system analysis.
Op. A1–A13 contain a complete check of the system.
Op. B1–K3 deal with system malfunctions.

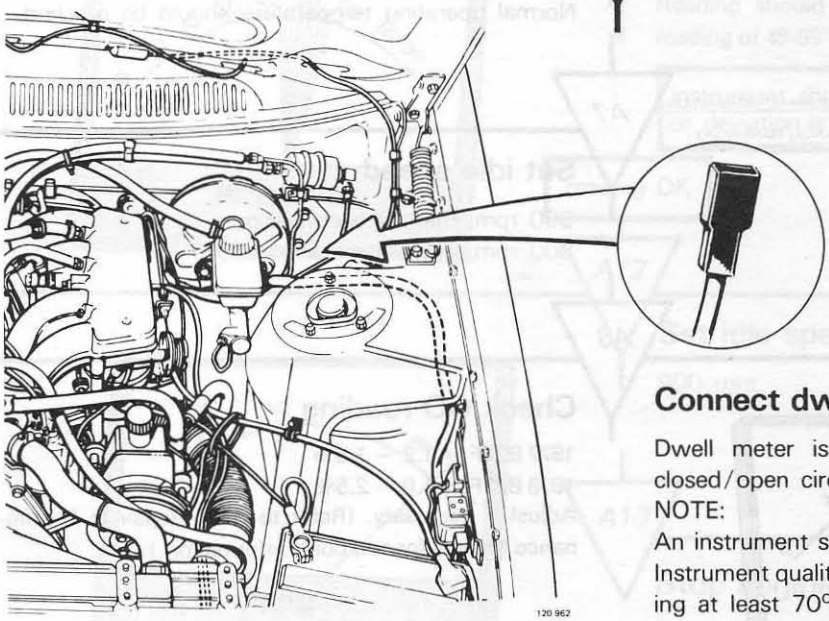
A1

Connect CO-meter

Connect to CO test point in front of catalytic converter/expansion box.



A2



Connect dwell meter

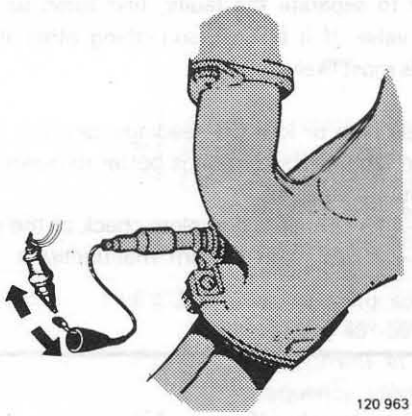
Dwell meter is used to check duty cycle (ratio closed/open circuit) of frequency valve.
NOTE:
An instrument suited for the purpose must be used. Instrument quality must be high and with a scale reading at least 70°. Examples:

Sun instruments—late models

A3

Disconnect sensor

In exhaust manifold outlet.



120 963

A4

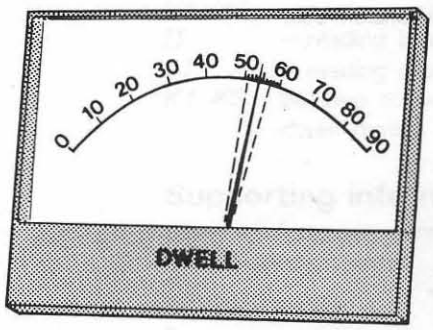
Start engine

A5

Check dwell meter reading

Shows duty cycle of frequency valve. Reading should be 49–59°.

reading higher or lower than 49–59° → B2



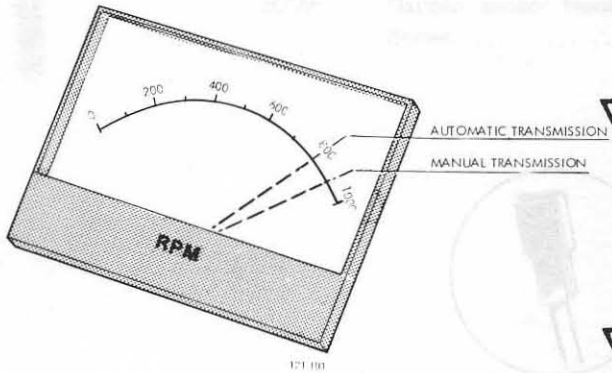
120 964

reading OK

A6

Run engine

Normal operating temperature should be reached.



121 [illegible]

A7

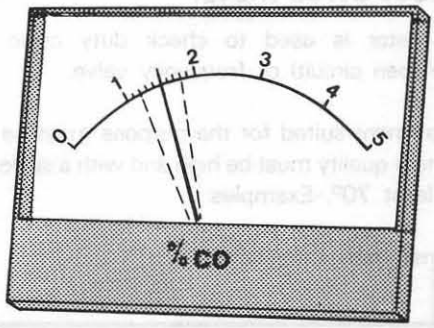
Set idle speed

900 rpm, manual transmission
800 rpm, automatic transmission

A8

Check CO reading

1977 B21F = 1.2 – 1.8%
1978 B21F = 1.0 – 2.5%
Adjust if necessary. (Refer to B21F Repair & Maintenance Manual for additional information.)

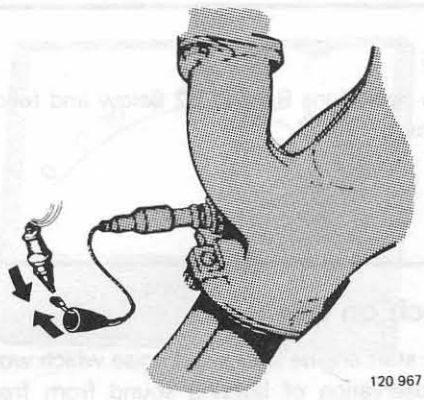


120 965

A9

Reconnect sensor

Observe CO meter and dwell meter readings, see Operations A10 and A11 below.

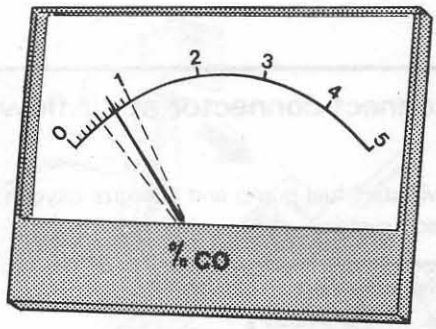


120 967

A10

Read CO meter

CO should drop below 1.0%
If it does not, refer to operation G1.



120 968

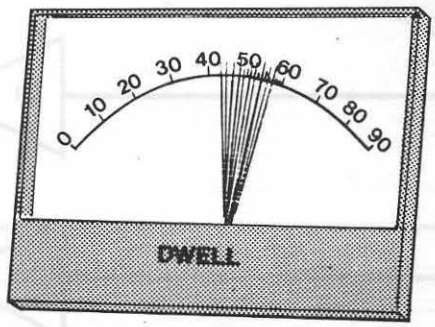
A11

Read dwell meter

Reading should be slightly lower than the previous reading of 49-59° (see illustration).

instrument shows no change, or deviation is excessive → G1

reading OK

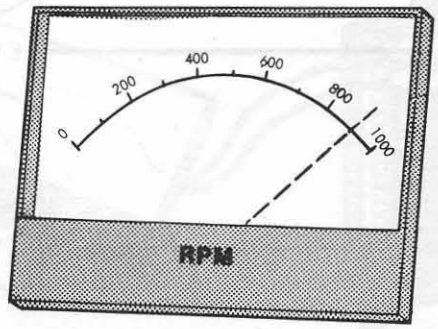


120 969

A12

Set idle speed

900 rpm.



120 965

A13

Stop engine

Disconnect instruments.

Check of **Oxygen sensor feedback system** is now completed.

System malfunctions

Reference from A5:

When testing duty cycle of frequency valve with dwell meter, reading is outside specified limits of 49–59°.

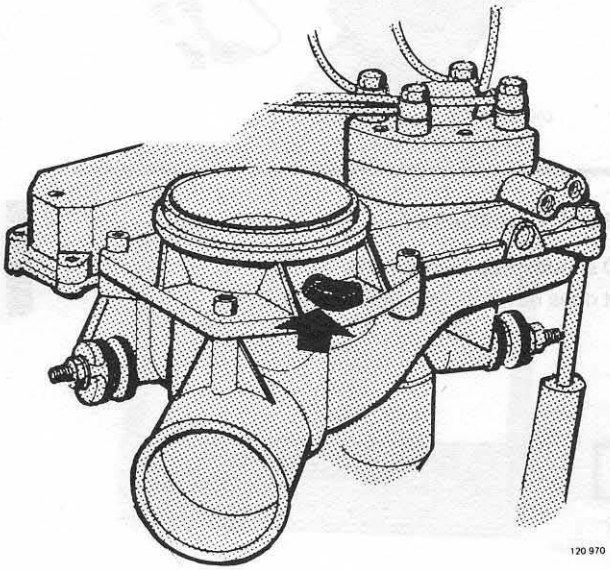
Action:

Perform operations B1 and B2 below and follow instructions.

B1

Switch on ignition

Do not start engine (and avoid noise which would impair observation of buzzing sound from frequency valve).



B2

Disconnect connector at air flow sensor

This will start fuel pump and energize oxygen sensor feedback system.

One of the following conditions should occur:

Condition 1: buzzing sound from frequency valve but dwell meter reading incorrect → C1

No buzzing sound from frequency valve

Condition 2: dwell meter reading 0° → D1

Condition 3: dwell meter reading 49–59° → E1

Condition 4: dwell meter reading 90° → E1

Condition 5: buzzing sound from frequency valve but no reading on dwell meter → K1

Condition 1 in B2: Buzzing sound from frequency valve but dwell meter reading incorrect.

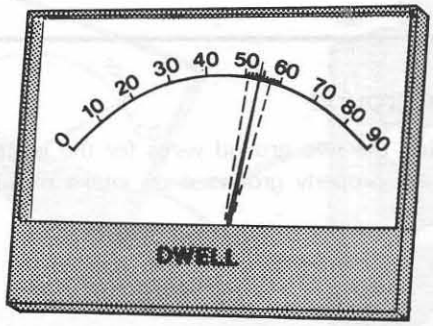
C1

Check instrument

Check that the instrument is correctly connected and suitable for the purpose.

Reading 49–59°

correct → A6

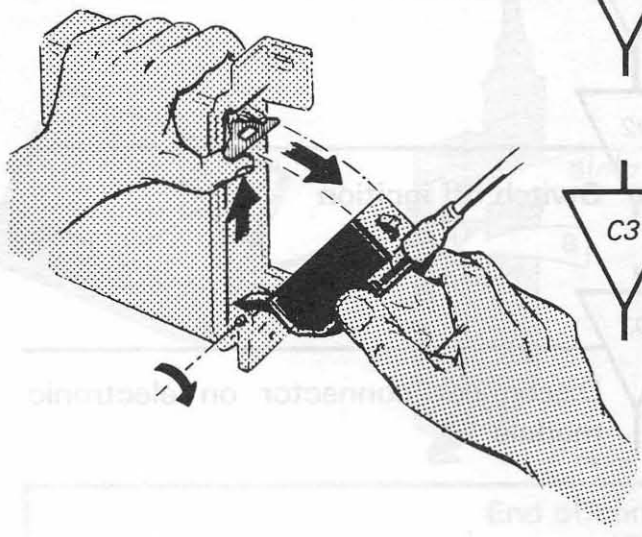


reading above 68°

Other readings: indicate that electronic module is defective

C2

Switch off ignition



120 971

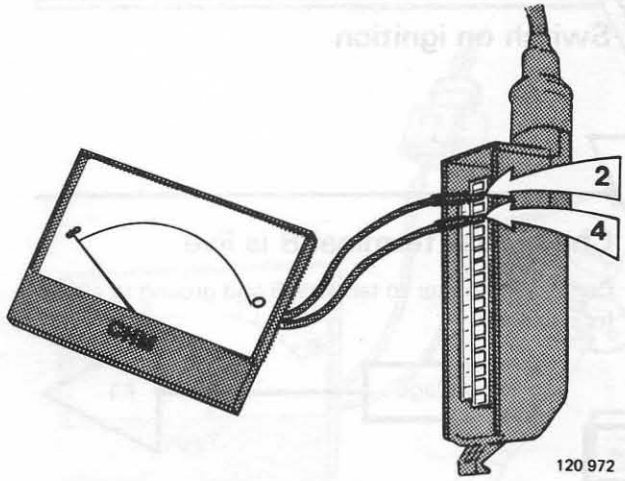
C3

Disconnect connector at electronic module

C4

Check for short circuiting

Use ohmmeter to check there is no short circuit between terminals 2 and 4 in connector.



120 972

shorted circuit → repair wire

open circuit* → indicates electronic module is defective

*This is correct reading for this check and indicates that wiring is OK.

End of condition C

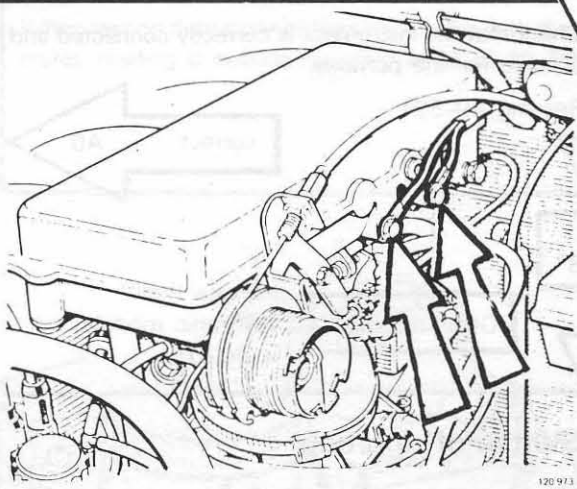
Condition 2 in B2:

No buzzing sound from frequency valve, dwell meter reading is 0°

D1

Check ground

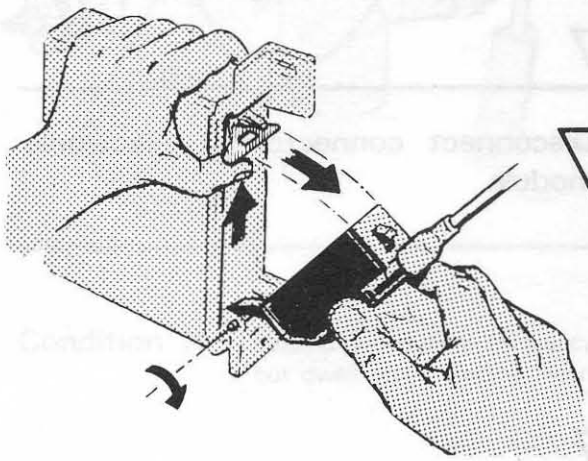
Check that the two ground wires for the electronic module are properly grounded on intake manifold.



120 973

D2

Switch off ignition



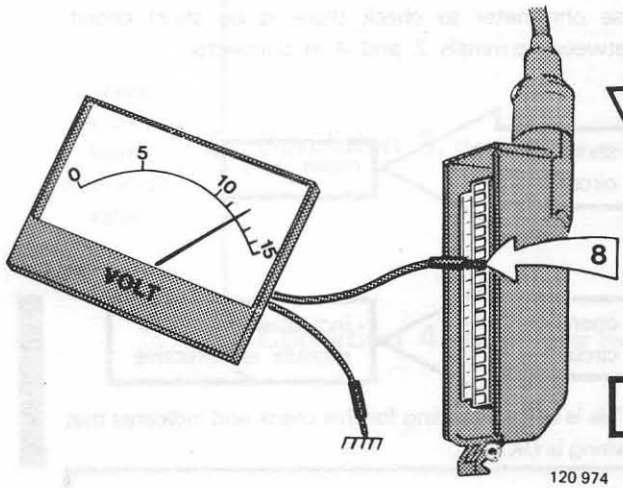
120 971

D3

Disconnect connector on electronic module

D4

Switch on ignition



120 974

D5

Check that terminal 8 is live

Connect voltmeter to terminal 8 and ground to check for voltage.

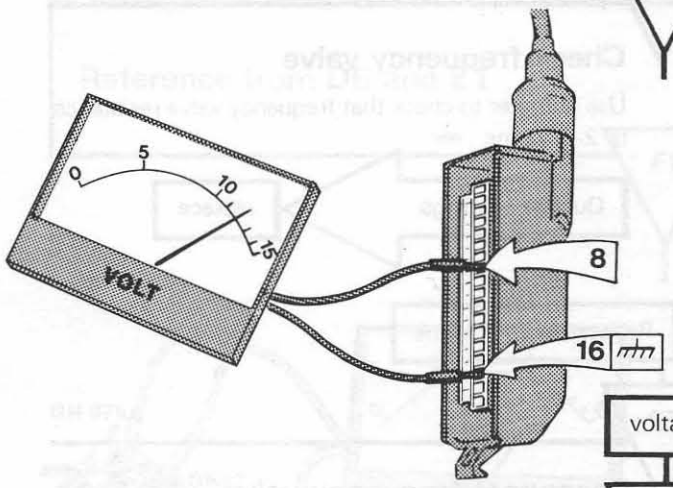
no voltage: → F1

voltage:

D6

Check for voltage

Connect voltmeter to terminals 8 and 16. Read battery voltage (control of proper grounding)



no voltage → repair wire from terminal 16 to ground at intake manifold. See check at D1.

voltage

D7

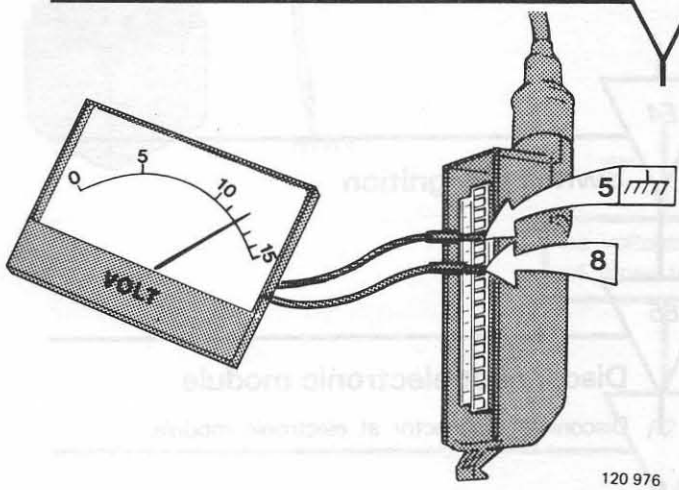
Check for voltage

Connect voltmeter to terminals 8 (+) and 5 (−) and check for battery voltage.

A reading of +12 VDC assures that terminal 5 is properly grounded at the intake manifold.

Conclusion:

If voltmeter indicates 12 volts the electronic module is defective.



120 976

End of condition D

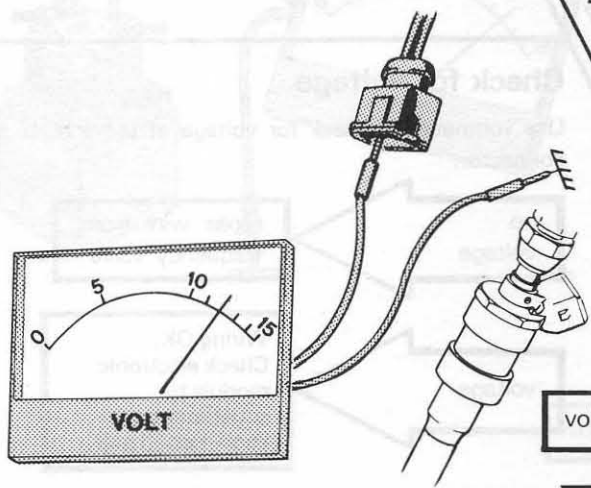
Conditions 3 and 4 in B2:

No buzzing sound from frequency valve.
Dwell meter readings 49–59° or 90°.

E1

Check for voltage at frequency valve

Disconnect connector at frequency valve. Use voltmeter to check that one of the terminals is live (battery voltage)



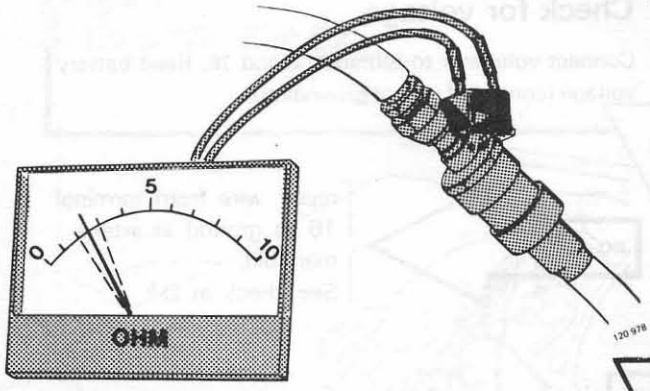
no voltage → F1

voltage

E2

Check frequency valve

Use ohmeter to check that frequency valve resistance is 2–3 ohms.

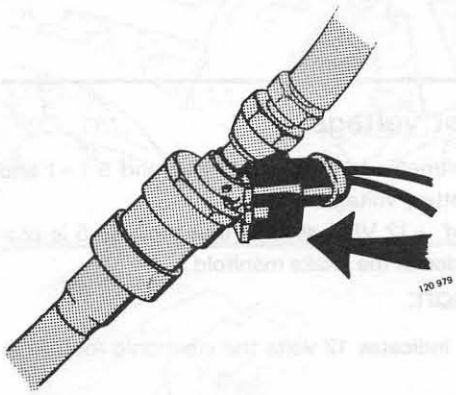


Outside readings → replace

Resistance 2–3 ohms

E3

Reconnect frequency valve



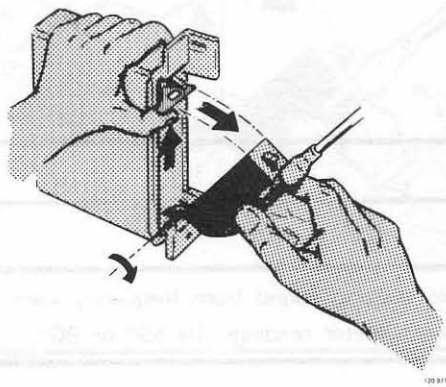
E4

Switch off ignition

E5

Disconnect electronic module

Disconnect connector at electronic module.



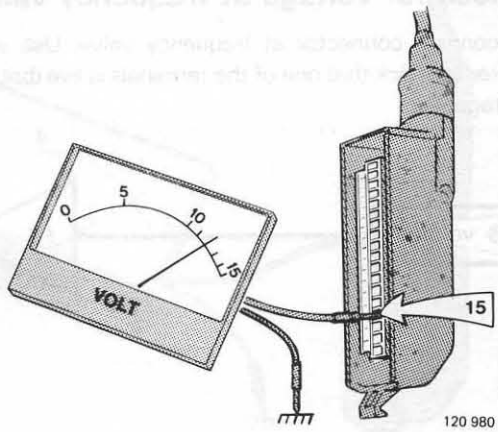
E6

Switch on ignition

E7

Check for voltage

Use voltmeter to check for voltage at terminal 15 in connector.



no voltage → repair wire from frequency valve

voltage → Wiring OK. Check electronic module by substituting with known good unit.

End of condition E

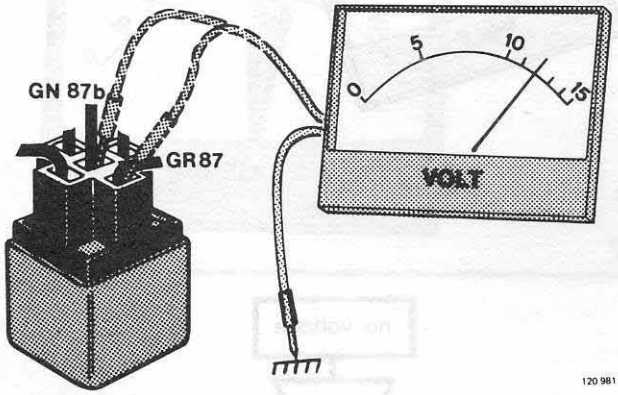
Reference from D5 and E1

Conditions:
D5: no current at module terminal 8.
E1: no current at frequency valve

F1

Check for voltage

Use voltmeter to check for voltage at terminals 87 and 87b on sensor system relay.



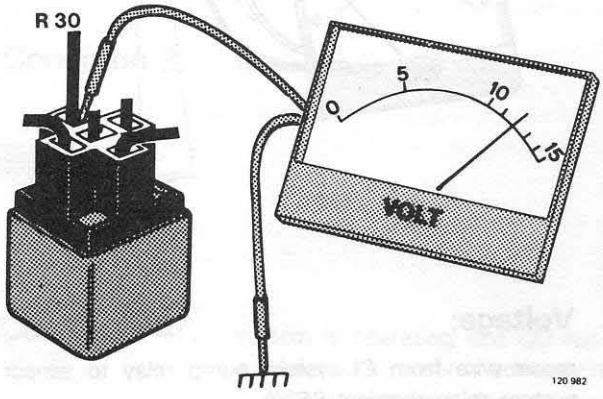
voltage at both terminals → repair wire from sensor system relay to frequency valve (electronic module)

voltage at one terminal only → sensor system relay defective, try a new relay

no voltage at any of those terminals

F2

Check for voltage at terminal 30

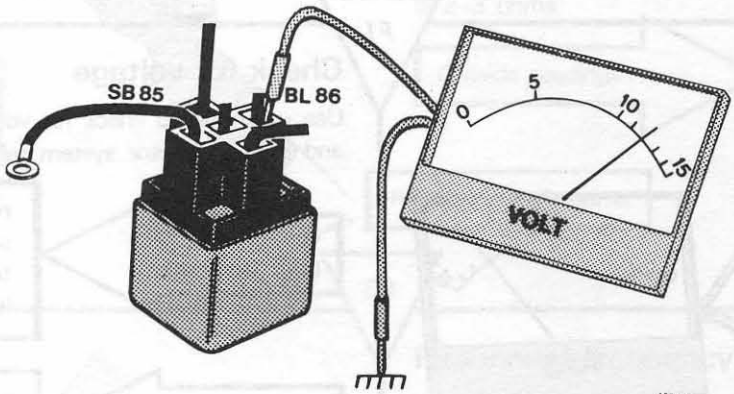


no voltage → repair wire to relay from main joint

voltage

F3

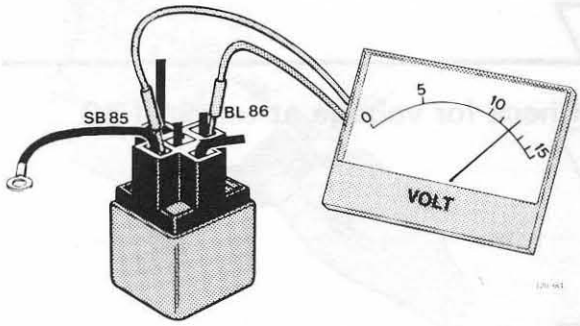
Check for voltage across terminal 86 and ground



voltage

F4

Check for voltage across terminals 86 and 85



Voltage:

indicates sensor system relay is defective. Try a new relay.

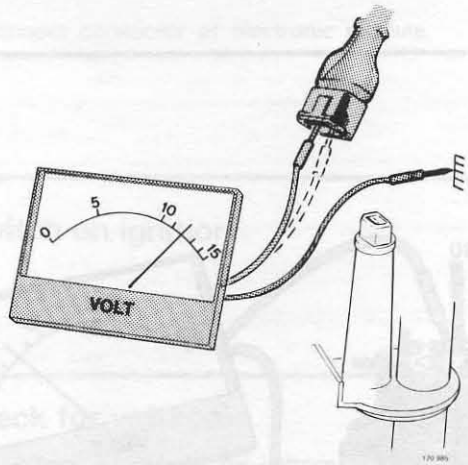
No voltage:

repair ground wire.

no voltage

F5

Check for voltage at one terminal of auxiliary air valve connector



Voltage:

repair wire from CI system pump relay to sensor system relay terminal 86.

No voltage:

use diagnosis instructions for CI system (in separate Manual).

End of Condition F

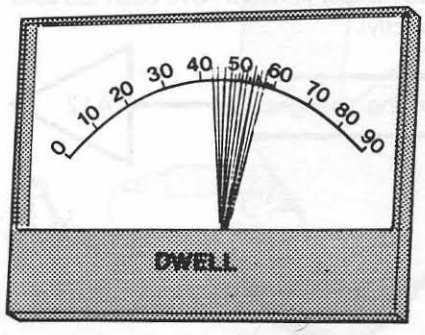
Reference from malfunction in A11:

- No deviation in reading when checking duty cycle of frequency valve (= dwell meter reading)

or

- excessive deviation

G1



Check reading and select appropriate condition below:

Condition 1: reading unchanged → H1

Condition 2: reading below 23° → I1

Condition 3: reading more than 68° → J1

Condition 4: system is operating, but CO not below 1 %:

a. Make sure sensor is correctly mounted and there are no leaks in the exhaust manifold close to the sensor.

b. Increase rpm to 1500 and check that CO drops.
If CO does not drop, check for mechanical problem in CI fuel system.

c. System in order.

End of condition G

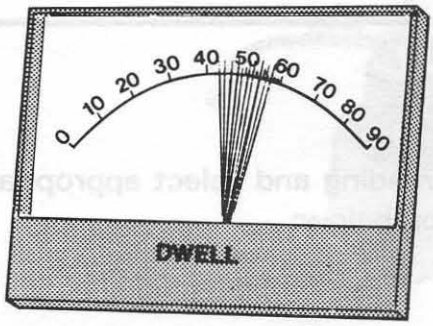
Reference from G1:

Condition 1:
reading unchanged

H1

Check reading with hot sensor

Raise rpm to heat sensor (it might have been too cold to operate correctly).



120 969

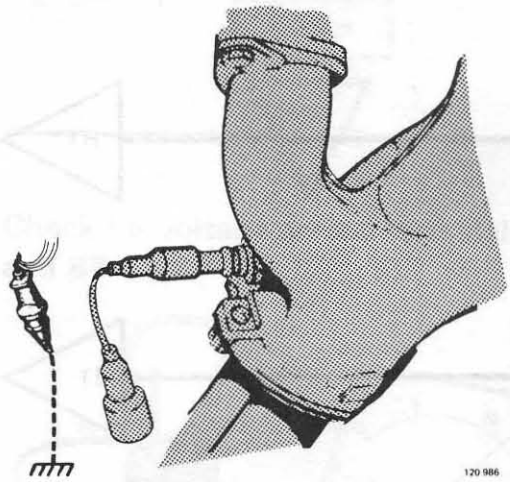
reading changes: → A12

reading still steady and unchanged.

H2

Disconnect sensor

Disconnect wire at oxygen sensor. Ground the disconnected wire (emerging at the electronic module). This should normally increase duty cycle of frequency valve (= dwell meter reading) to 68° or more. This indicates oxygen sensor is defective and should be replaced.



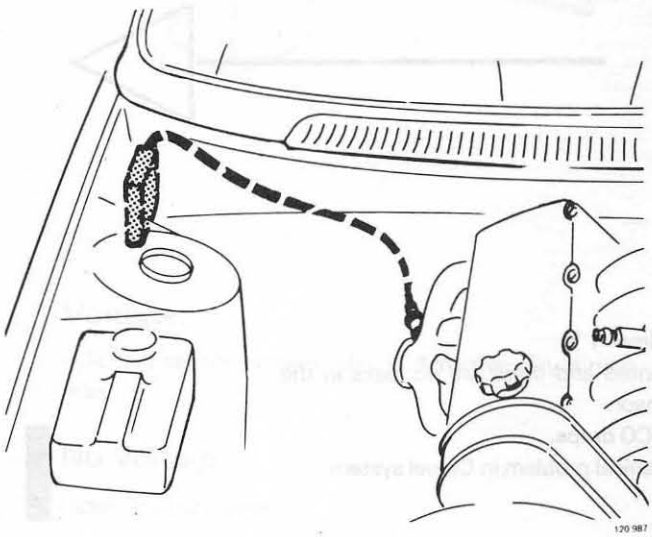
120 986

reading does not increase:

H3

Check wire

Check wire from oxygen sensor to terminal # 2 in electronic module connector.
If wire is in order, it indicates the electronic module is defective. Try a new electronic module.



120 987

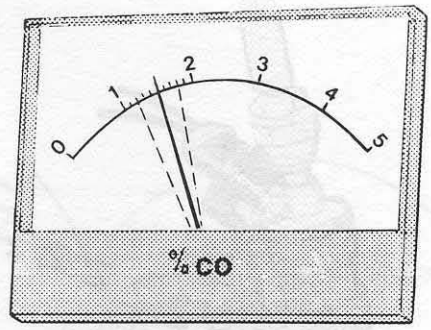
End of condition H

Reference from G1

Condition 2:
reading below 23°

I1

When reconnecting sensor (in Op. A9), the CO reading does not drop:
Indicates a defective frequency valve. Try a new one.



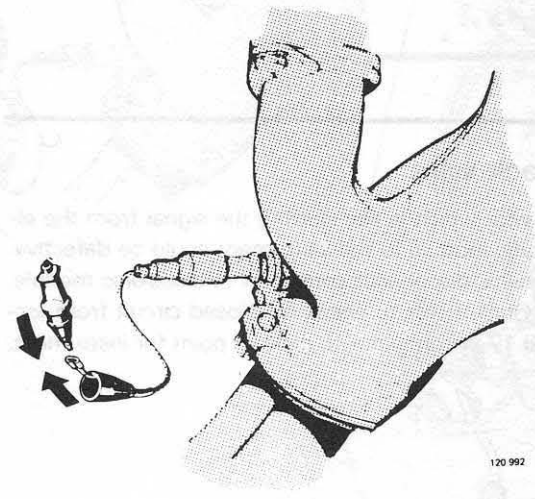
End of condition 1

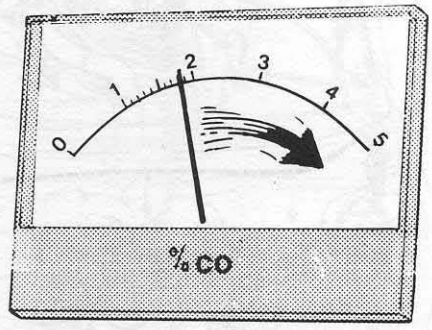
Reference from G1:

Condition 3:
reading more than 68°

J1

When reconnecting sensor (in Op. A9), the CO reading increases:
Indicates a defective oxygen sensor (short circuited). Try a new oxygen sensor.





End of condition J

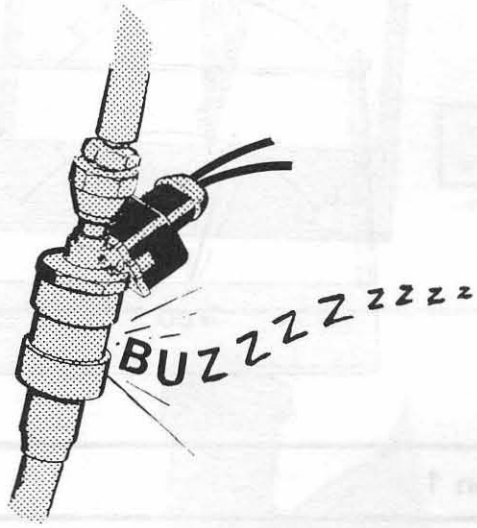
Reference from B2:

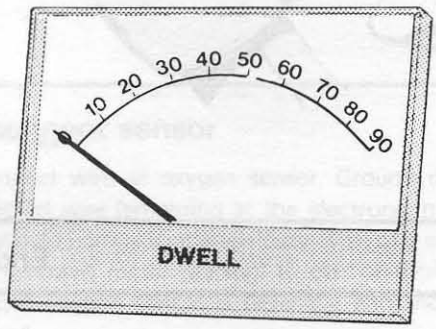
Condition 5:
Buzzing sound from frequency valve, but no reading on dwell meter (measuring frequency valve duty cycle):

K1

Something causes the instrument not to read

See K2 and K3 for possible reasons.

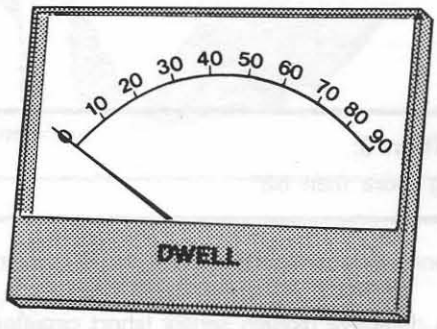




K2

Check instrument

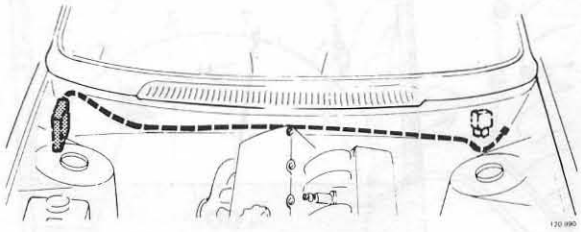
Check that the instrument is properly connected and suited for the purpose.
- This is very important, not all instruments can be used, see Op. A2.



K3

Check wire

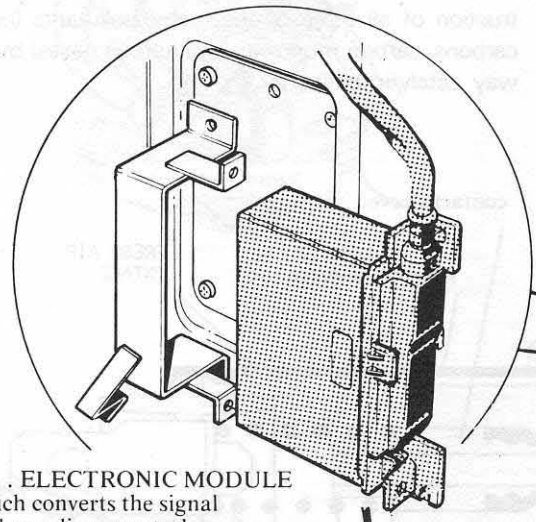
The wire which is transferring the signal from the electronic module to the instrument could be defective. To check: disconnect connector at electronic module. Use Ohm-meter to check for closed circuit from terminal 17 in connector to pick-up point for instrument.



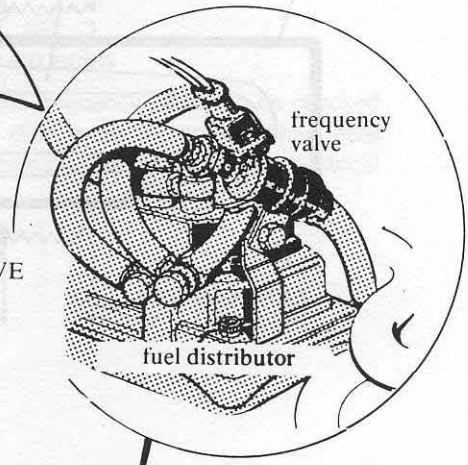
End

Description of Oxygen Sensor Feedback System

General idea



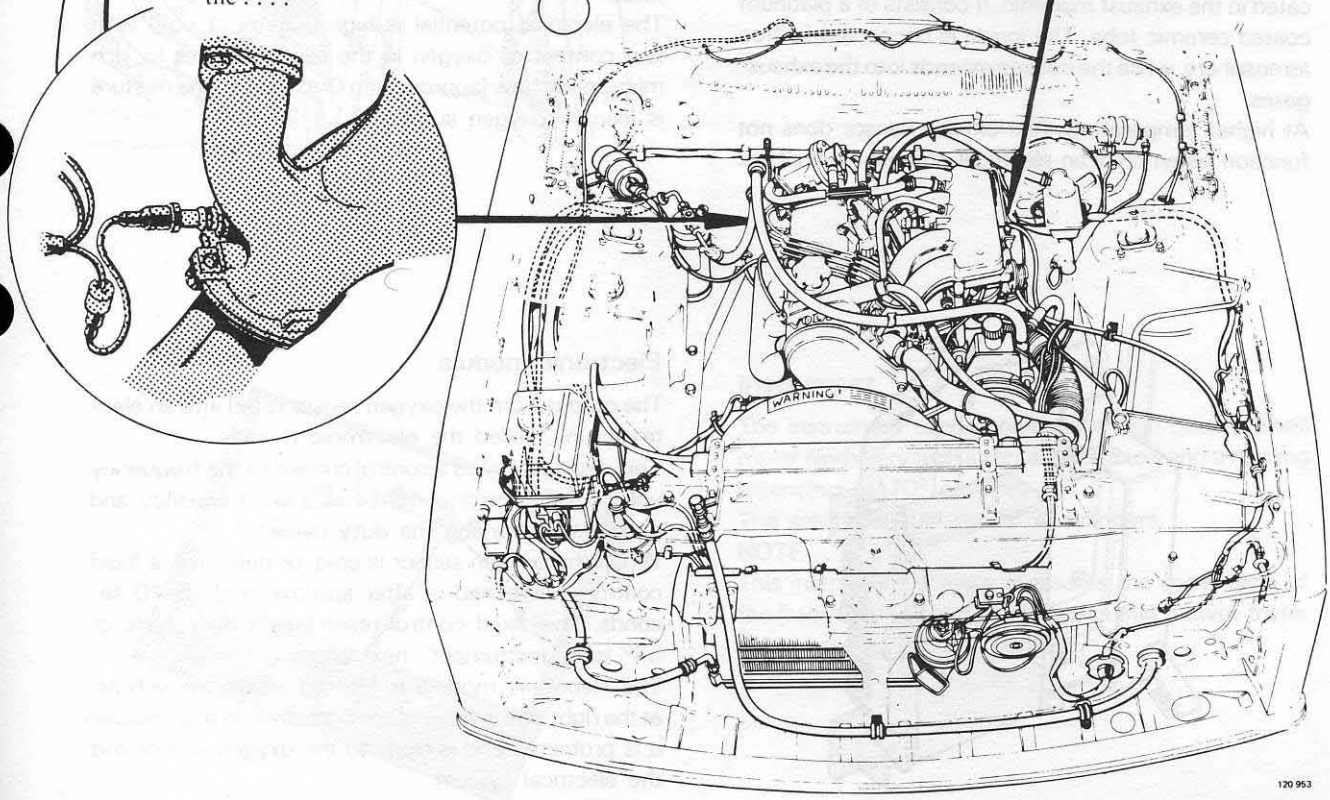
. . . . ELECTRONIC MODULE
which converts the signal
and supplies a control
current to the . . .



. . . .FREQUENCY VALVE
which influences the
fuel flow and thereby
the ratio of oxygen
in the exhaust gases

The ratio of oxygen
in the exhaust gases
determines the strength
of the output signal
from the

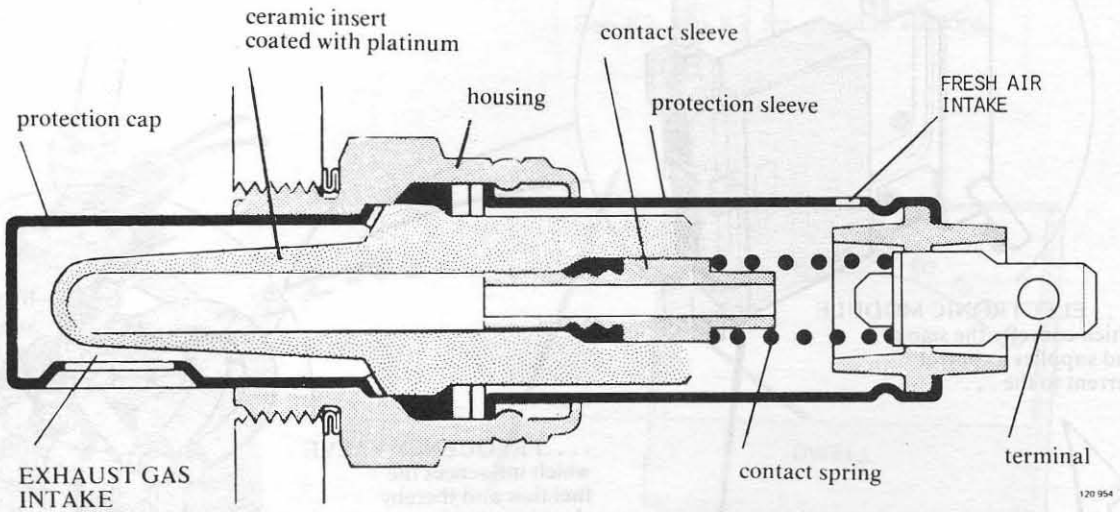
OXYGEN SENSOR
This signal is fed into
the . . . .



120 953

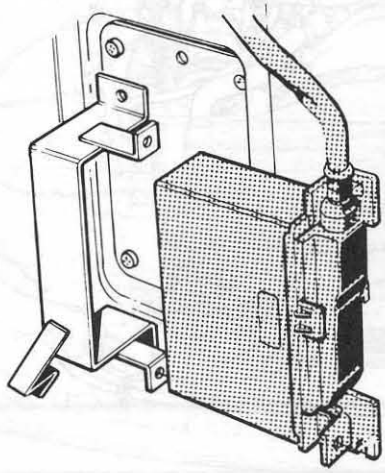
Oxygen sensor feedback system

This is a self-tuning engine control system designed to reduce emissions and improve fuel economy.
An **exhaust gas sensor,** (oxygen sensor, also called lambda sensor) monitors the composition of the exhaust gases leaving the engine. The exhaust gas analysis is fed into a closed loop feedback system. This continuously adjusts the air-fuel ratio to provide optimum conditions for combustion and efficient destruction of all three of the major pollutants (hydrocarbons, carbon monoxide and nitrous gases) by a 3-way catalytic converter.



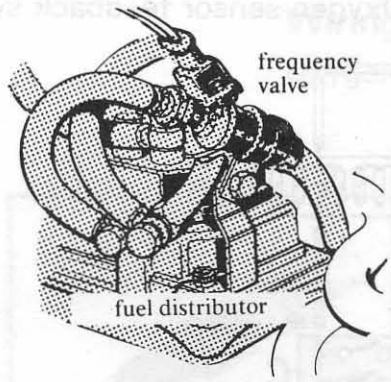
Oxygen sensor

The exhaust gas sensor, called **oxygen sensor,** is located in the exhaust manifold. It consists of a platinum coated ceramic tube. The inside is connected to free atmosphere, while the outside extends into the exhaust gases.
At higher temperatures (the oxygen sensor does not function when cold) an electrical potential is built up. This is a function of the air-fuel ratio. There is a steep transition just at the point where the air-fuel ratio is ideal.
The electrical potential is high (approx. 1 volt) with low content of oxygen in the exhaust gases (= rich mixture) and low (approaching 0 volt) when the mixture is lean (= oxygen surplus).



Electronic module

The output from the oxygen sensor is fed into an electronic unit, called the **electronic module.**
This device supplies a control current to the **frequency valve.** The control current has a set frequency and operates by varying the **duty cycle.**
When the oxygen sensor is cold, or defective, a fixed control is switched in after approximately 5–10 seconds. This fixed control resembles a duty cycle of 54° (see "Instrument" next page).
The electronic module is located inside the vehicle, at the right side in front of the right door. In this position it is protected and is close to the oxygen sensor and the electrical system.

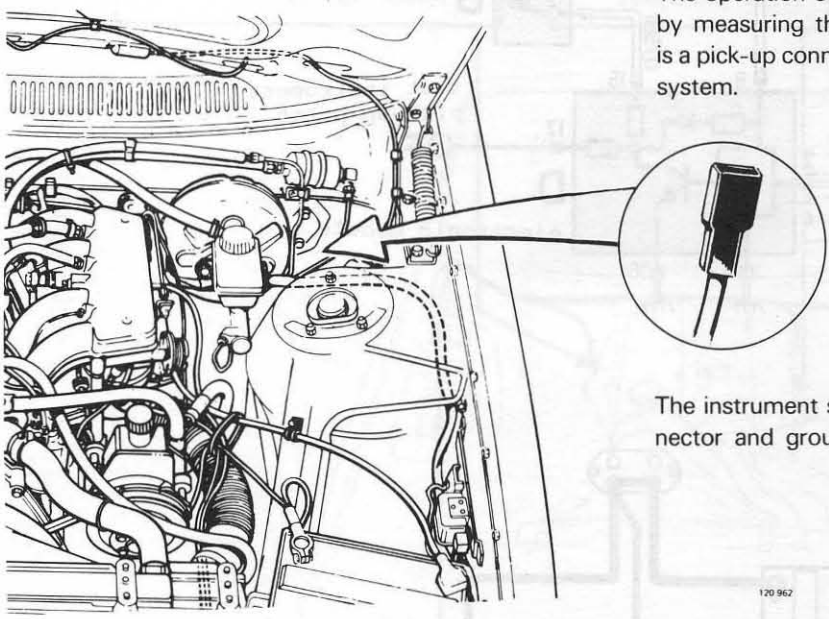


Frequency valve

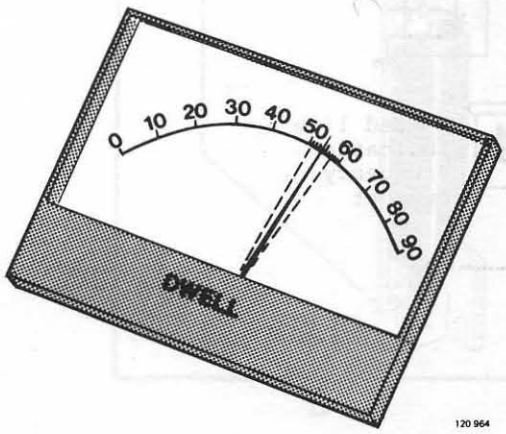
This device influences the fuel flow by influencing the pressure on the underside of the diaphragm in the pressure regulating valves in the CI System.
It is located on a bracket behind the fuel distributor on the left side of the engine.
The frequency valve operates on a set frequency and by varying the duty cycle (ratio of closed / open circuit).

Instrument pick-up point

The operation of the frequency valve can be checked by measuring the duty cycle. To achieve this, there is a pick-up connector provided in the vehicle electrical system.



The instrument should be connected to pick-up connector and ground.

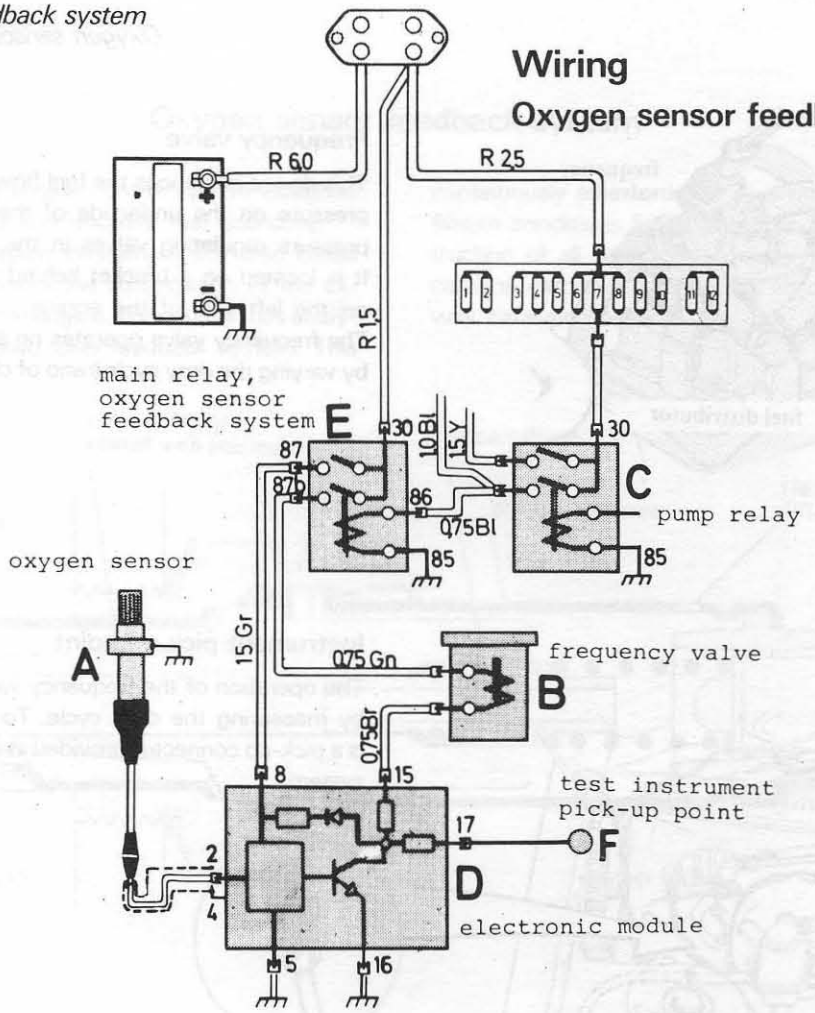


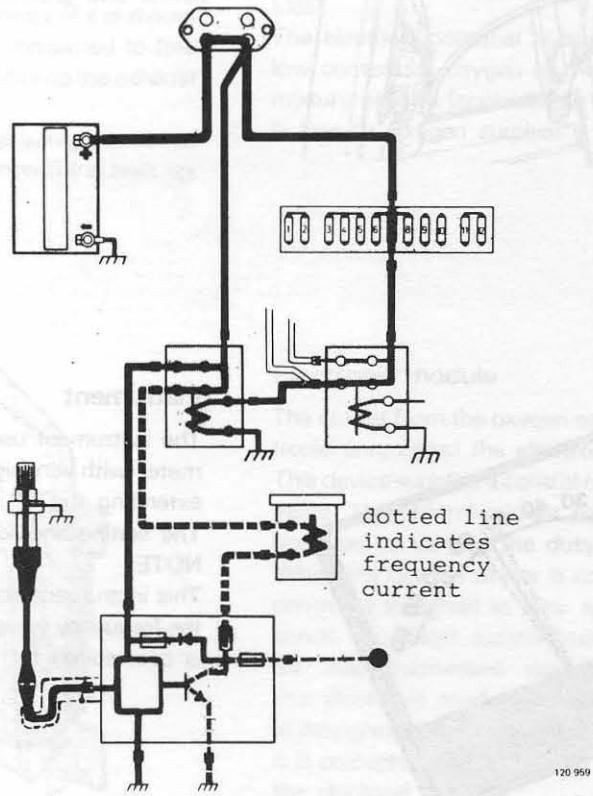
Instrument

The instrument used should be a high quality dwell meter (with very high internal resistance) and a reading extending to 70° or more.
The setting should be for **4 cylinders.**
NOTE:
This instrument actually measures the **duty cycle** of the frequency valve. It just happens that a dwell meter is best suited for this purpose.

Wiring

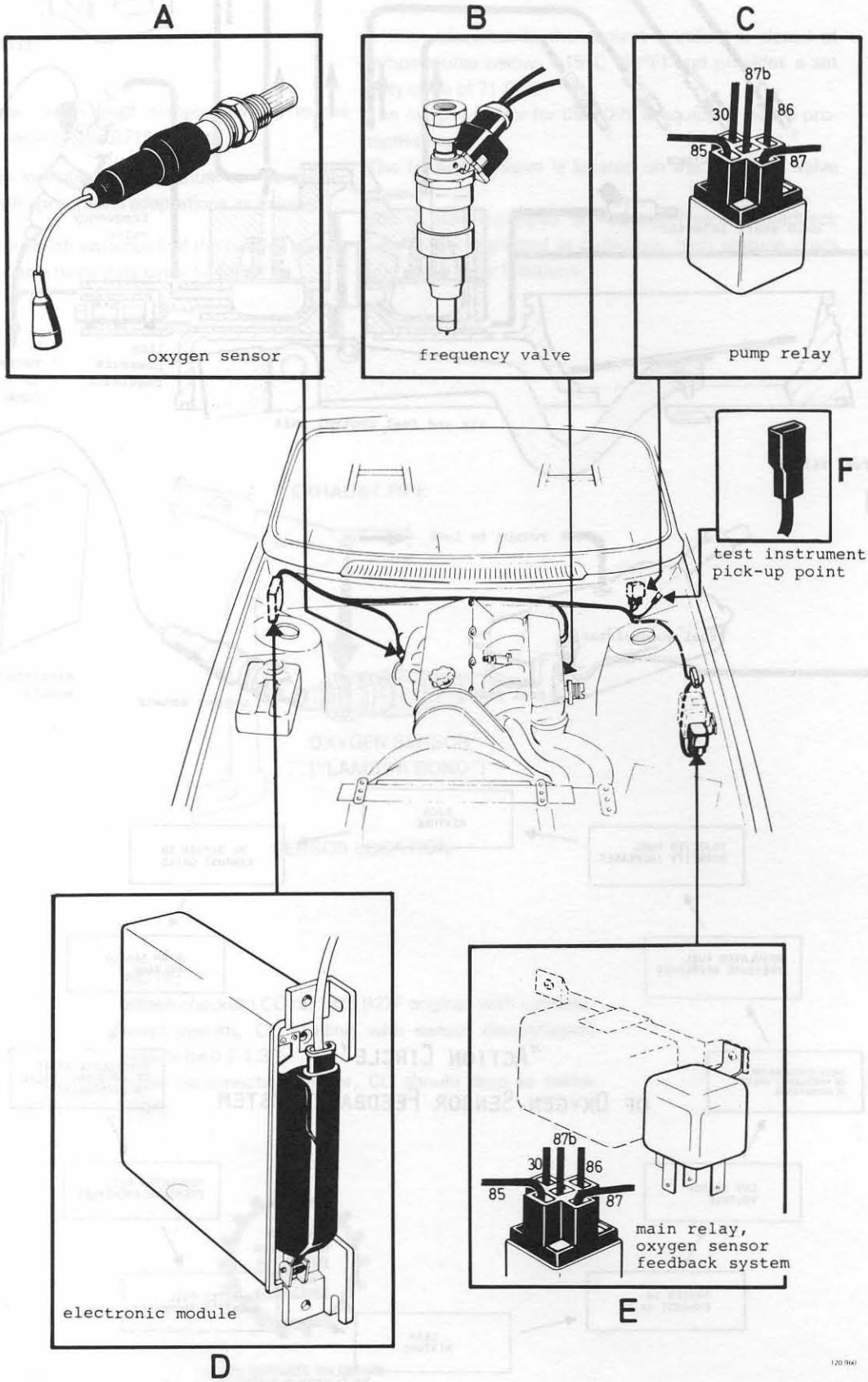
Oxygen sensor feedback system



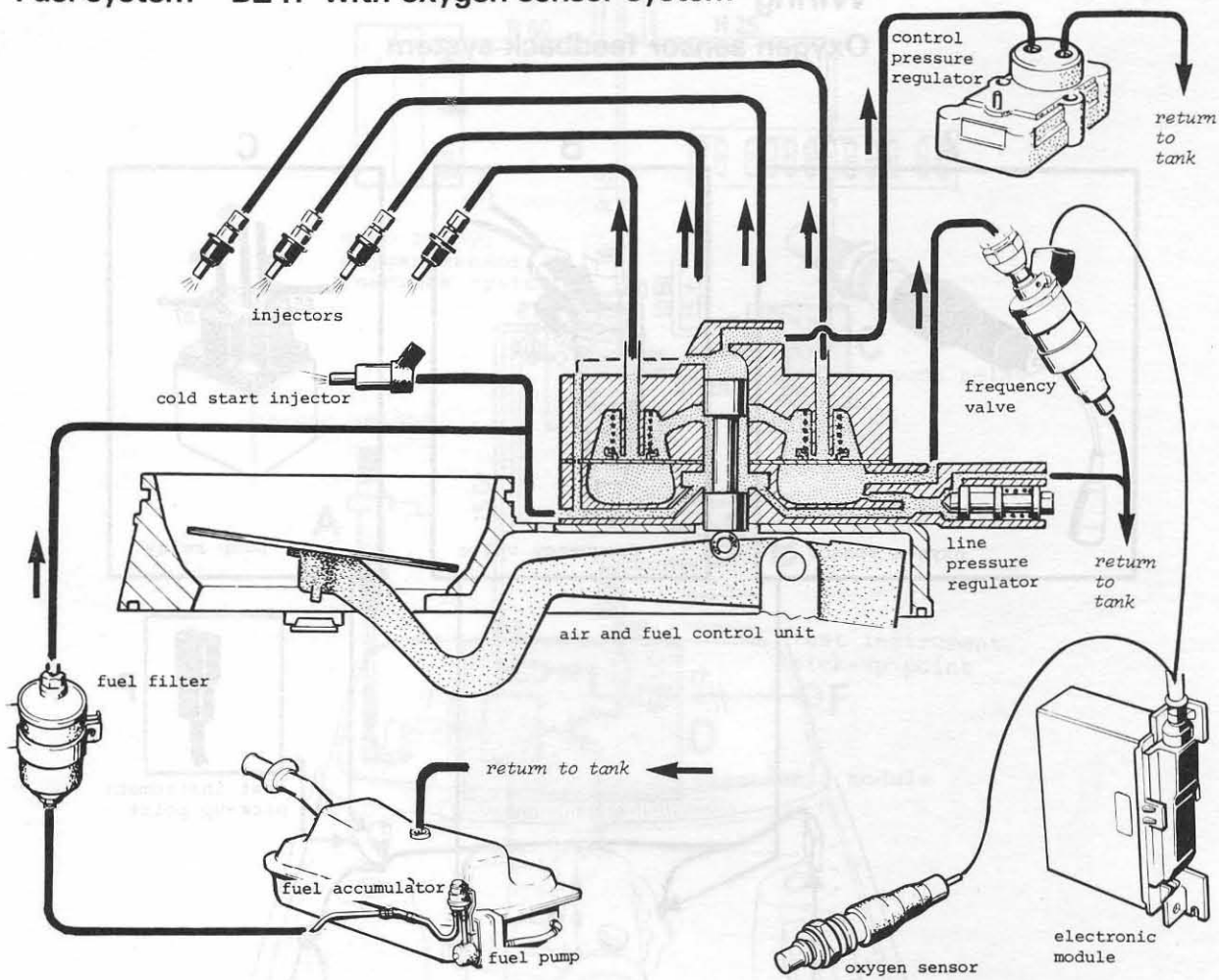


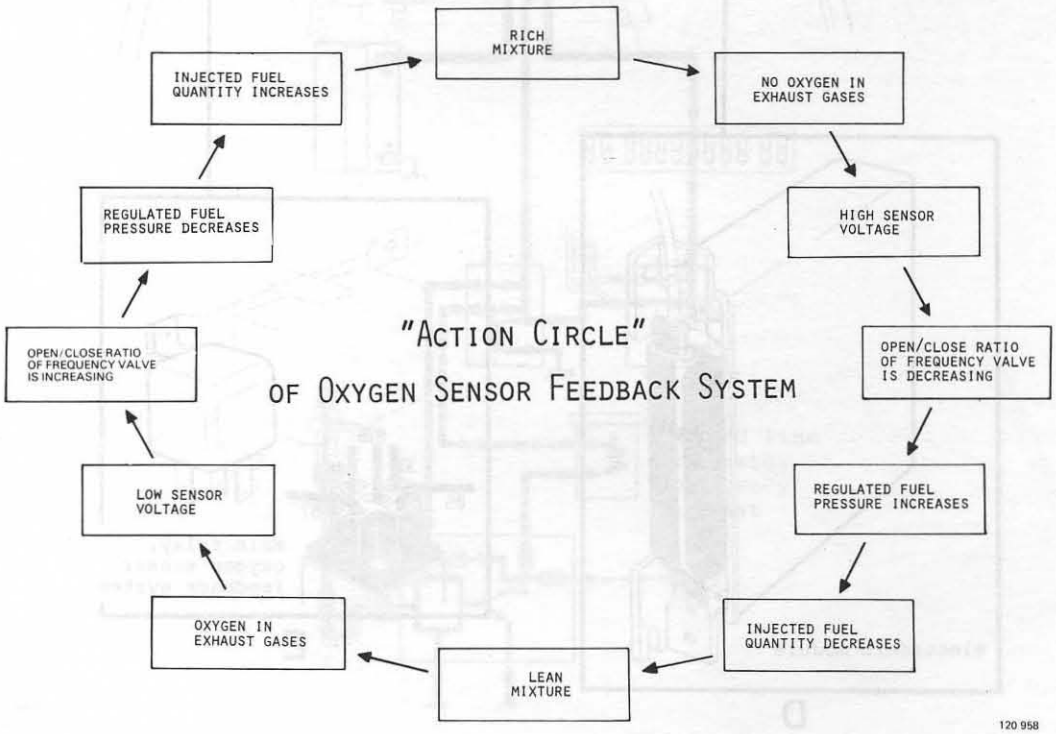
Wiring

Oxygen sensor feedback system



Fuel system – B21F with oxygen sensor system





SUPPLEMENT

Oxygen sensor feedback system for B27F introduced 260 Series

B27F system:

The B27F system is in most respects similar to the system already used on the B21F engine.

The information available in this manual can be applied for the B27F with appropriate adaptations as follows.

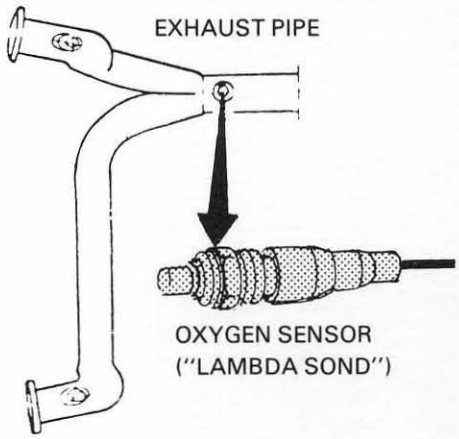
The fixed control which switches in if the oxygen sensor becomes inoperative has a duty cycle of 40-50°.

A thermal switch in the coolant manifold is closed at temperatures below +15°C (60°F) and provides a set duty cycle of 71-81°.

The oxygen sensor for the B27F is equipped with a protective cap.

The frequency valve is located on the left bank valve cover.

260 models equipped with oxygen sensor feedback system are marketed in California, high altitude areas and some other locations.



SENSOR LOCATION

NOTE:
When checking CO on 1978 B27F engines with Lambda-sond system, CO reading with sensor disconnected should be 0.7-1.3%.
After reconnecting sensor, CO should drop to below 1.0%.

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