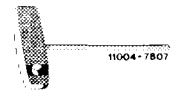
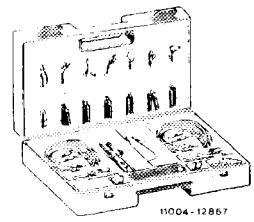
A. Standard version – NV CAT (controlled)

For complaints such as: Poor warming-up characteristics of engine, poor idle speed, engine not accelerating, or splashing during accelerating, test emission control system for function.

Test conditions: Engine at operating temperature, run engine at idle speed, electrical fuses in order. Mechanically controlled gasoline injection system and ignition system in order.

Special tools

Oil telethermometer		116 589 27 21 00
Allen wrench for hex. socket screw 3 mm, for regulating the idle exhaust emission value		000 589 14 11 00
Extractor		123 589 05 33 00
Impression mandrel		123 589 00 15 00
Electrical connection set		201 589 00 99 00

Conventional test equipment

Engine tester (speed, dwell angle, advance angle, oscilloscope, voltmeter)	e. g. Bosch MOT 001.03 or MOT 002.02
	e. g. Sun 1019
Lambda control tester	e. g. Bosch, KDJE-P 600 Hermann, L 115
Multimeter	e. g. Sun DMM 5
Twin jack	e. g. Hermann ECD 53

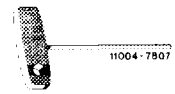
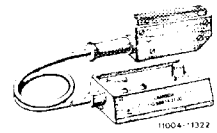
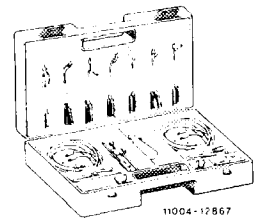
C. National version

(J) (USA) 1981–1983 (Engine 116.96)
(J) (USA) 1984/85 (Engine 117.96)

For complaints such as: On-off ratio cannot be regulated. Poor warming-up characteristics of engine, engine hunting at idle, engine not accelerating or splashing during acceleration, perform the following tests:

Test condition: Engine at operating temperature, run engine at idle speed, electrical fuses, CIS injection system and ignition system in order.

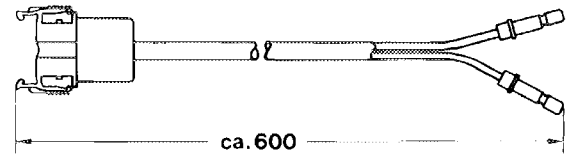
Special tools

Oil telethermometer		116 589 27 21 00
Allen wrench for hex. socket screw 3 mm for regulating the idle exhaust emission value or the lambda control		000 589 14 11 00
Adapter for testing electrical lines and components		110 589 14 21 00
Electrical connection set		201 589 00 99 00

Conventional test equipment

Engine tester (speed, dwell angle, advance angle, oscilloscope, voltmeter)	e. g. Bosch MOT 001.03 or MOT 002.02
	e. g. Sun 1019
Lambda control tester	e. g. Bosch, KDJE-P 600 Hermann, L 115
Multimeter	e. g. Sun DMM 5
Twin jack	e. g. Hermann ECD 53

Self-made test cable

Test cable (0.75 mm^2)	

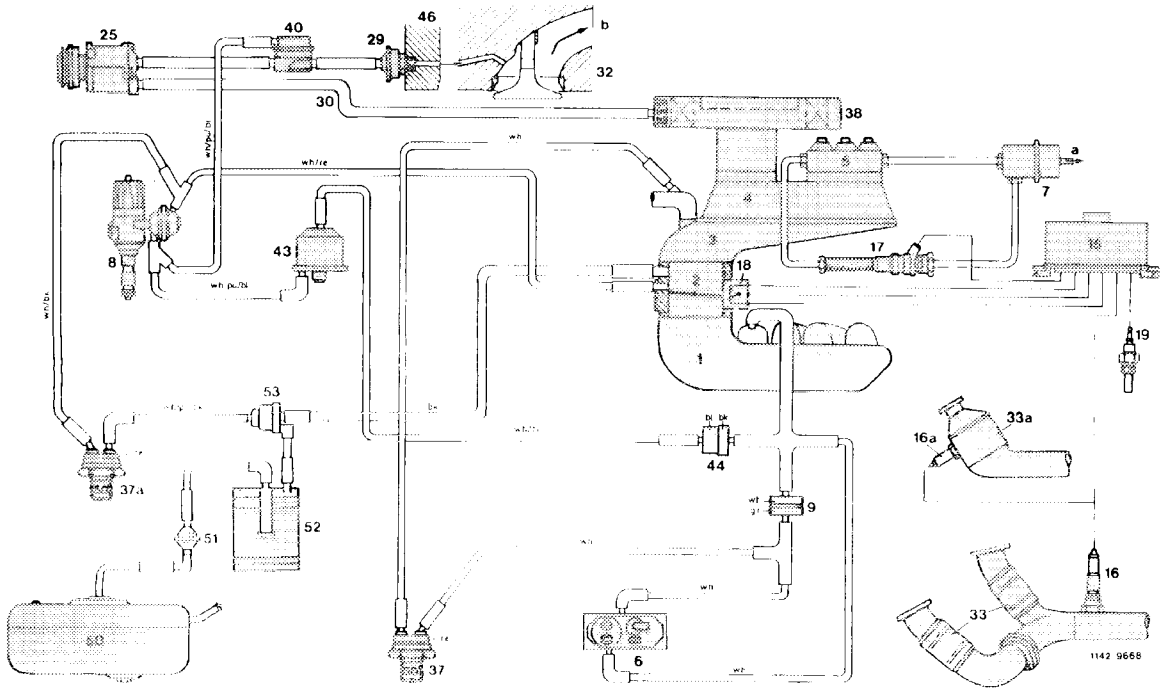
Test program

a) Quick test with lambda control tester

b) Quick test with adapter

c) Component testing with adapter

d) Testing air injection

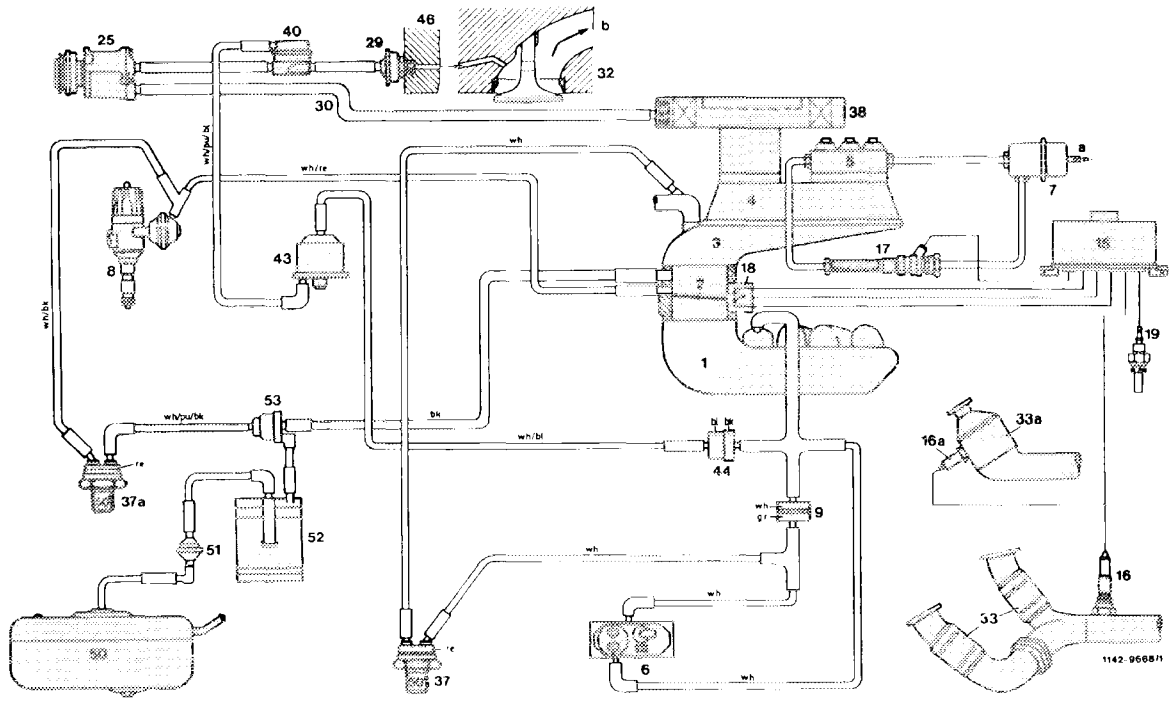


Function diagram engine 116 model year 1981

1 Intake manifold
2 Throttle valve housing
3 Air guide housing
4 Air flow sensor
5 Fuel distributor
6 Warm-up compensator
7 Damper
8 Ignition distributor
9 Throttle (orifice)
15 Control unit
16 O_2 probe (model 107)
16a O_2 probe (model 126)
17 Frequency valve
18 Throttle valve switch
19 Temperature switch 16 °C oil
25 Air pump
29 Check valve (injected air)
30 Intake line
32 Cylinder head
33 Primary catalyst (model 107)
33a Primary catalyst (model 126)
37 Thermovalve 50 °C
37a Thermovalve 50 °C
38 Air cleaner
40 Air shutoff valve
43 Switchover valve
44 Check valve (vacuum)
46 Timing housing cover
50 Fuel tank
51 Vent valve
52 Charcoal canister
53 Purge valve

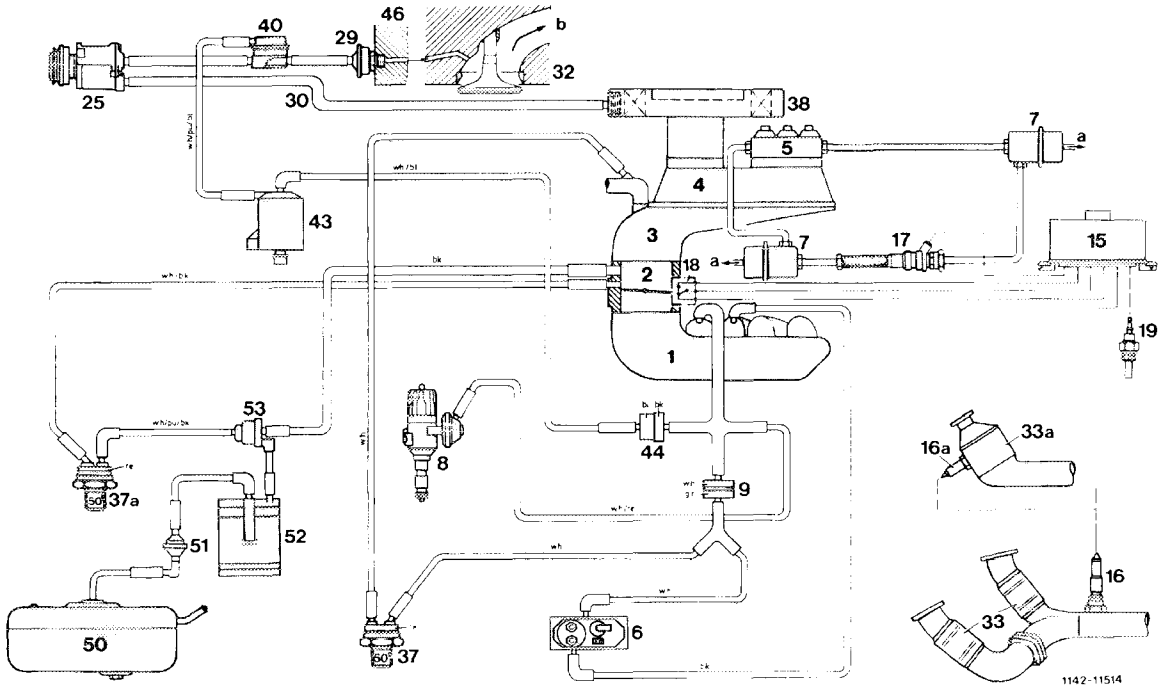
a Leak connection
b To exhaust manifold

bk = black
bl = blue
gr = green
pu = purple
re = red
wh = white



Function diagram engine 116 model year 1982

1	Intake manifold	32	Cylinder head	bk	= black
2	Throttle valve housing	33	Primary catalyst (model 107)	bl	= blue
3	Air guide housing	33a	Primary catalyst (model 126)	gr	= green
4	Air flow sensor	37	Thermovalve 50 °C	pu	= purple
5	Fuel distributor	37a	Thermovalve 50 °C	re	= red
6	Warm-up compensator	38	Air cleaner	wh	= white
7	Damper	40	Air shutoff valve		
8	Ignition distributor	43	Switchover valve		
9	Throttle (orifice)	44	Check valve (vacuum)		
15	Control unit	46	Timing housing cover		
16	O_2 probe (model 107)	50	Fuel tank		
16a	O_2 probe (model 126)	51	Vent valve		
17	Frequency valve	52	Charcoal canister		
18	Throttle valve switch	53	Purge valve		
19	Temperature switch 16 °C oil				
25	Air pump	a	Leak connection		
29	Check valve (injected air)	b	To exhaust manifold		
30	Intake line				

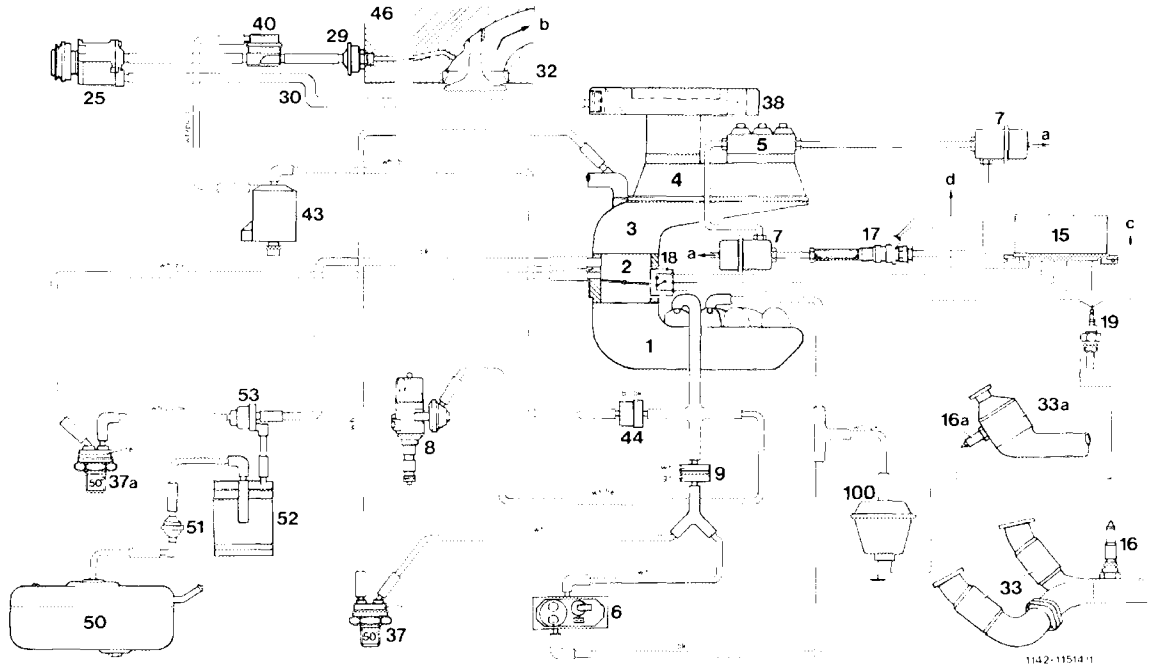


Function diagram engine 116 starting model year 1983, engine 117 starting model year 1984

1 Intake manifold
2 Throttle valve housing
3 Air guide housing
4 Air flow sensor
5 Fuel distributor
6 Warm-up compensator
7 Damper
8 Ignition distributor
9 Throttle (orifice)
15 Control unit
16 O_2 probe (model 107)
16a O_2 probe (model 126)
17 Frequency valve
18 Throttle valve switch
19 Temperature switch 16 °C oil
25 Air pump
29 Check valve (injected air)
30 Intake line
32 Cylinder head
33 Primary catalyst (model 107)
33a Primary catalyst (model 126)
37 Thermovalve 50 °C
37a Thermovalve 50 °C
38 Air cleaner
40 Air shutoff valve
43 Switchover valve
44 Check valve (vacuum)
46 Timing housing cover
50 Fuel tank
51 Vent valve
52 Charcoal canister
53 Purge valve

a Leak connection
b To exhaust manifold

bk = black
bl = blue
gr = green
pu = purple
re = red
wh = white



Function diagram with acceleration enrichment by sudden change of pressure switch national version (USA) engine 116, 117 starting model year 1985

1 Intake manifold
2 Throttle valve housing
3 Air guide housing
4 Air flow sensor
5 Fuel distributor
6 Warm-up compensator
7 Damper
8 Ignition distributor
9 Throttle
15 Control unit (lambda control)
16 O_2 probe (model 107)
16a O_2 probe (model 126)
17 Frequency valve
18 Throttle valve switch
19 Temperature switch 16 °C oil
25 Air pump
29 Check valve (injected air)
30 Intake line
32 Cylinder head
33 Primary catalyst (model 107)
33a Primary catalyst (model 126)
37 Thermovalve 50 °C
37a Thermovalve 50 °C
38 Air cleaner
40 Air shutoff valve
43 Switchover valve
44 Check valve (vacuum)
46 Timing housing cover
50 Fuel tank
51 Vent valve
52 Charcoal canister
53 Purge valve
100 Sudden change of pressure switch

a Leak connection
b To exhaust manifold
c Control unit idle control
d Plug connection reverse light cable set (jacket 2)

bk = black
bl = blue
gr = green
pu = purple
re = red
wh = white

a) Quick test with lambda control tester

The lambda control tester can be used for adjusting on-off ratio at idle speed, as well as for a quick diagnosis of lambda control.

Test equipment	Lambda control tester	
Model	KDJE-P 600 Bosch	L 115 Hermann
Button/switch	100 %	100 % 

Connect lambda control tester to diagnosis socket and revolution counter. Connect oil telethermometer.

Note: If the specified nominal value is not attained, refer to quick test with adapter.

Test scope	Actuation	Readout/nominal value
Cold run control		
a) Engine oil temperature < 13 °C	Engine at idle	Constant between 56–64 %
b) Simulation	Pull coupling from temperature switch 16 °C and connect to ground.	Readout as above
Warm run control		
a) Engine oil temperature > 20 °C, O_2 probe not yet operational (< approx. 300 °C)	Engine at idle	Constant between 46–54 %
b) Simulation	Separate coupling O_2 probe	Readout as above
Control of operating temperature		
Engine oil temperature approx. 80 °C O_2 probe operational (> approx. 300 °C)	Engine at idle	Model year 1981: 50 % ± 10 % Starting model year 1982: between 30–70 % Light deflection of needle[1])
Idle speed contact closed	Throttle valve at idle speed stop	Deflection of needle approx. 8–12 % around nominal value[1])
Idle speed contact opened	Slightly open throttle valve	Deflection of needle approx. 13–23 % around nominal value[1])
Full throttle contact closed	Apply full throttle for a short moment	Constant between 56–64 %
Lean stop control unit	Separate coupling O_2 probe **Temporarily** connect plug to control unit with 2-V output of tester.	Constant < approx. 20 %
Rich stop control unit	Separate coupling O_2 probe, **temporarily** connect plug to control unit with ground.	Constant > approx. 87 %
Sudden change of pressure switch (only for (USA) model year 1985)	Engine at idle Separate coupling O_2 probe, apply full throttle for a short moment.	On-off ratio constant 50 % Readout temporarily 60 %, drops again to 50 % ± 10

[1]) Lambda control and O_2 probe are in order if needle of measuring instrument is not hunting, but position of needle can be changed by short acceleration.

b) Quick test with adapter

Connect adapter to coupling of control unit and multimeter to adapter.

Note: Only disconnect and connect the coupling to the control unit when the ignition is switched off.

Test layout	Test scope	Actuation	Nominal value . . . . *In the event of deviations refer to component test program sections*
Adapter to position 1 with voltmeter	Voltage supply	Ignition on	U = 12 ± 2 V LED lighting up *Deviation section I.*
Adapter on position 2 with ohmmeter	Throttle valve switch	Ignition off Idle speed stop . . . Full throttle stop . . .	R = ∞ Ω R = 0 Ω *Deviations sections IV. and V.*
	Switch 16 °C	Ignition off	< 13 °C R = 0 Ω > 19 °C R = ∞ Ω *Deviations sections II. and III.*
Adapter to position 3 with ohmmeter	Throttle valve switch	Ignition off Idle speed stop . . . Lightly actuate regulating linkage . . .	R = 0 Ω R = ∞ Ω *Deviations sections IV. and V.*
Adapter to position 4 with voltmeter	Frequency valve	Ignition on Actuate starter	U = 12 ± 2 V *Deviations sections VI. and IX.*
Adapter on position 5 with ohmmeter	O_2 probe cable and plug control unit	Ignition off . . . . Pull off O_2 probe coupling and bridge plug to control unit . . .	R = ∞ Ω R = 0 Ω *Deviations sections VII. and VIII.*
Remove adapter and plug coupling on control unit. Connect lambda control tester.	Lambda control	Start engine and run up to operating temperature.	On-off ratio Model year 1981: 50 % ± 10 %[1]) Starting model year 1982: between 30–70 %[1]) *Deviation section X.*
	Sudden change of pressure switch (only (USA) model year 1985)	Engine at idle Separate coupling O_2 probe. Depress accelerator for a short moment.	On-off ratio constant 50 % Readout temporarily 60 %, drops again to 50 % ± 10 *Deviation section XI.*

[1]) Lambda control and O_2 probe are in order if needle of measuring instrument is not hunting, but position of needle can be changed by short acceleration.

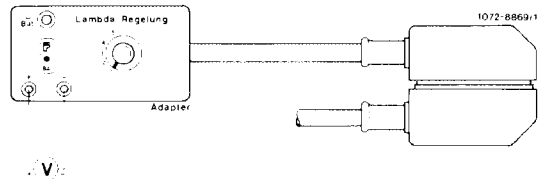
c) Components testing with adapter

Test section A

Test conditions:

Connect adapter to coupling of control unit and multimeter to adapter.

Connect oil telethermometer.



I. Testing voltage supply of control unit

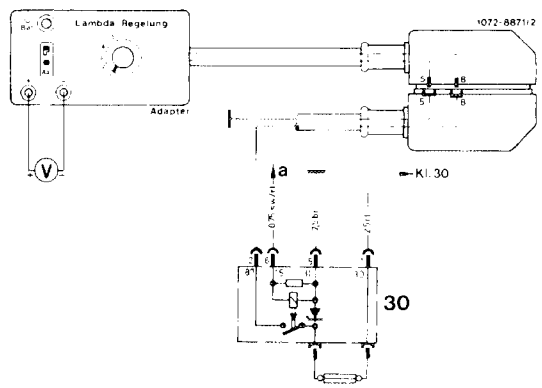
Rotary switch on adapter to position 1, multimeter to measuring range 0—30 volts, ignition switched on, read readout.

Indicator lamp of adapter:

Lighting up. | Not lighting up.

Readout

approx. 12 volts | 0 volt

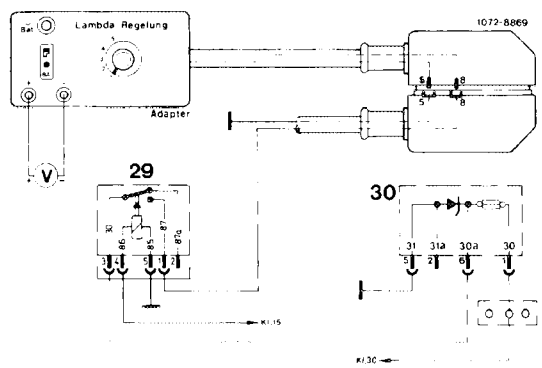


starting 1982

Power supply to electronic control unit interrupted.

Possible faults:

a) Overvoltage protection (30) defective.
b) Relay for voltage supply defective.
c) No ground connection.
d) Line to relay voltage supply or to control unit lambda control interrupted.
e) If no fault has been found, continue with diagnosis according to electric wiring diagram until readout of approx. 12 volts shows up.



End of test

1980/81

II. Testing temperature switch 16 °C oil (engine oil temperature < 13 °C)

Rotary switch-on adapter to position 2, multimeter to measuring range 0—∞ ohm, ignition switched off. Separate coupling of throttle valve switch, read readout.

Readout

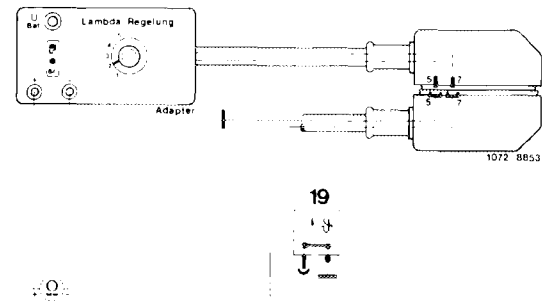
0 ohm | ∞ ohm

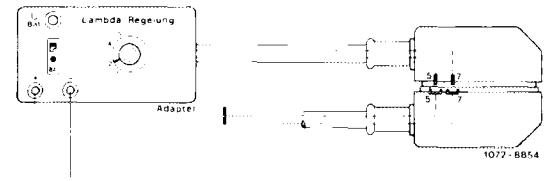
Pull off coupling of temperature switch (19) and connect to ground.

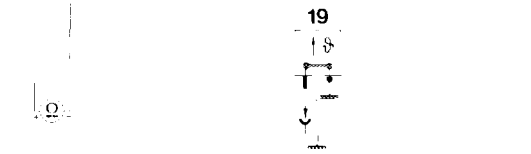
If readout is 0 ohm, renew temperature switch.

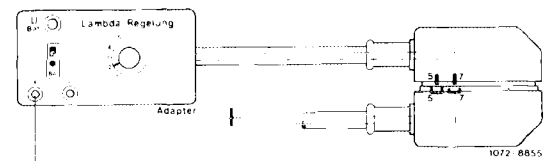
If readout is ∞ ohm, test line from coupling of control unit (terminal 7) to temperature switch for interruption.

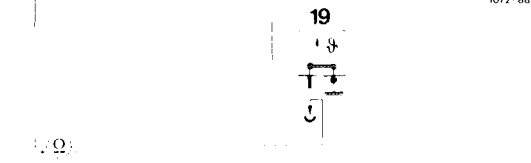
End of test



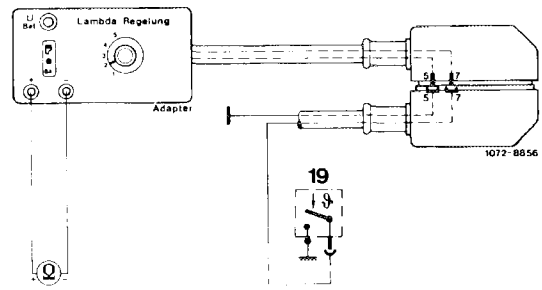








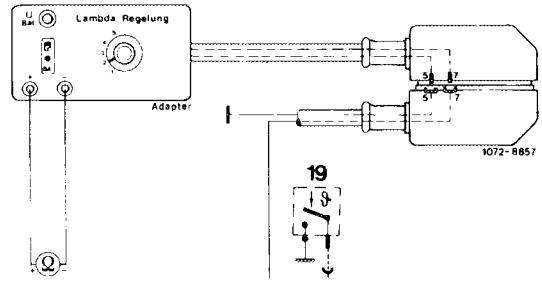
III. Testing temperature switch 16 °C oil (engine oil temperature > 20 °C)



Rotary switch on adapter to position 2, multimeter to measuring range 0— ∞ ohm, ignition switched off.

Separate coupling of throttle valve switch, read readout.

Readout	
∞ ohm	0 ohm



Pull coupling from temperature switch (19).

If readout is ∞ ohm, renew temperature switch.

If readout is 0 ohm, test line from coupling of control unit (terminal 7) to temperature switch for ground connection.

End of test

IV. Testing throttle valve switch (18) (idle speed stop), engine oil temperature > 20 °C

Rotary switch on adapter to position 3, multimeter to measuring range 0—∞ ohm, ignition switched off.

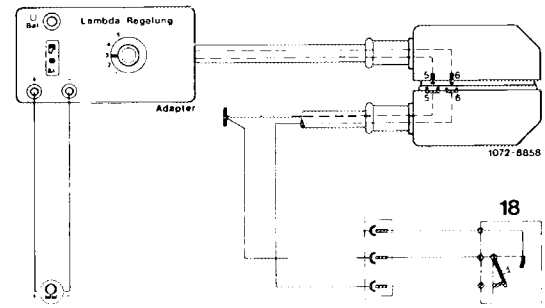
Regulating linkage against idle speed stop, read readout.

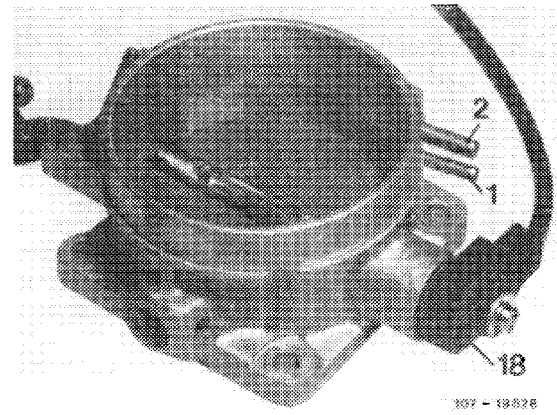
Readout	
Idle speed stop 0 ohm	∞ ohm
Lightly operate regulating linkage ∞ ohm	0 ohm

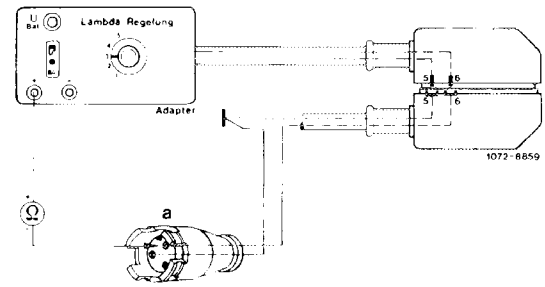
Separate coupling of throttle valve switch. Test lines from coupling (a) to coupling of control unit (terminal 6 or 5) according to wiring diagram for interruption.

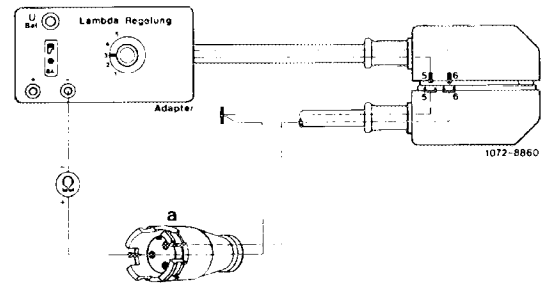
If lines are in order, renew throttle valve switch.

End of test









V. Testing throttle valve switch (18)
(full throttle stop, engine oil temperature > 20 °C)

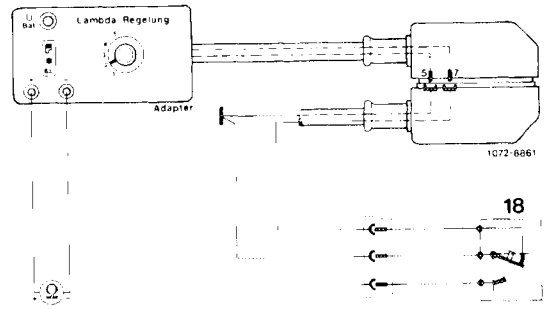
Rotary switch on adapter to position 2, multimeter to measuring range 0—∞ ohm, ignition switched off.

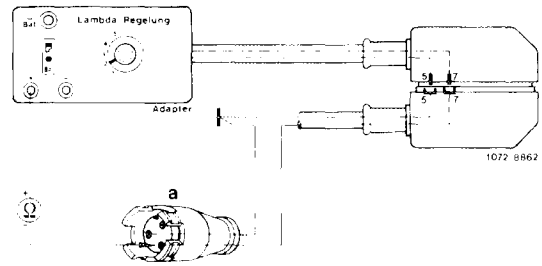
Regulating linkage to full throttle stop. Read readout.

	Readout
Full throttle stop	∞ ohm
0 ohm	
Let regulating linkage slightly move back	∞ ohm

Separate coupling of throttle valve switch. Test line from coupling (a) to coupling of control unit (terminal 7) for interruption. If line is in order, renew throttle valve switch.

End of test





VI. Testing frequency valve (17)

Rotary switch of adapter to position 4, multimeter to measuring range 0–30 volts, ignition switched on, actuate starter. Read readout.

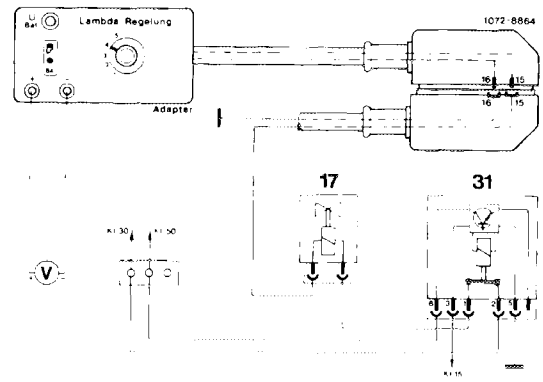
Readout	
approx. 12 volts	0 volt

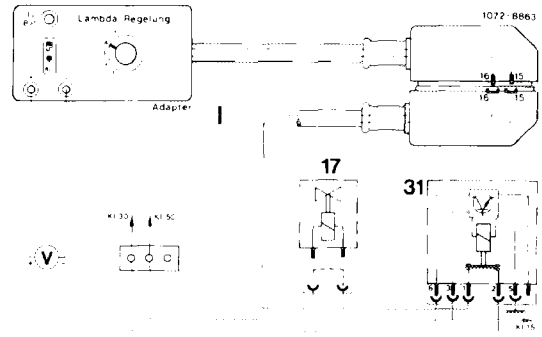
Pull coupling from frequency valve and bridge. Operate starter. Readout 12 volts: renew frequency valve.

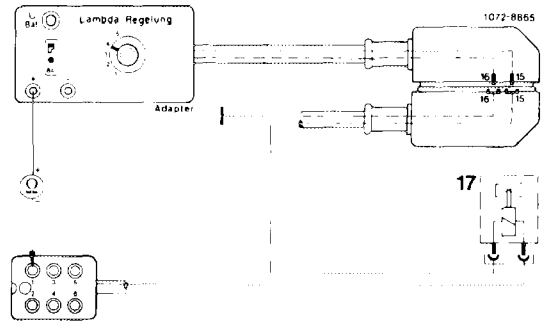
Readout 0 volt: switch off ignition, multimeter to measuring range 0 – ∞ ohm.

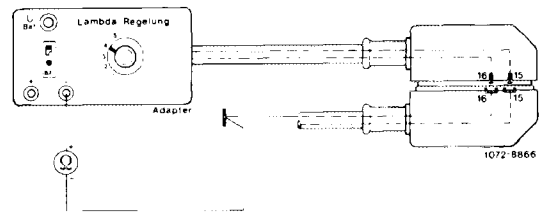
Test line from coupling of control unit (terminal 15) to coupling of electronic fuel pump relay (31, terminal 1), as well as line from coupling of control unit (terminal 16) to grounding point in leg-room right under instrument panel for interruption.

End of test









VII. Testing supply line to O_2 probe (16)

Rotary switch on adapter to position 5, multimeter to measuring range 0—∞ ohm, ignition switched off, coupling of O_2 probe separated. Read readout.

Readout

∞ ohm | 0 ohm

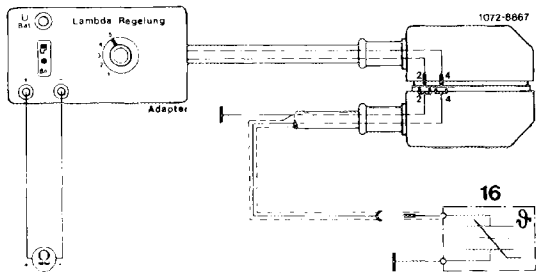
Short-circuit in line from coupling of O_2 probe to coupling of control unit.

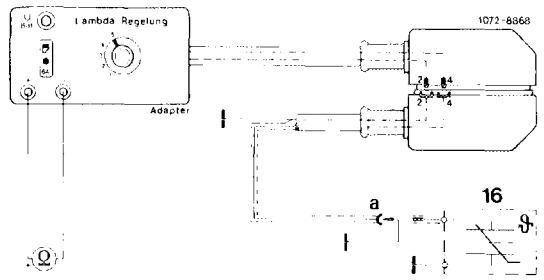
Connect coupling member (a) to ground.

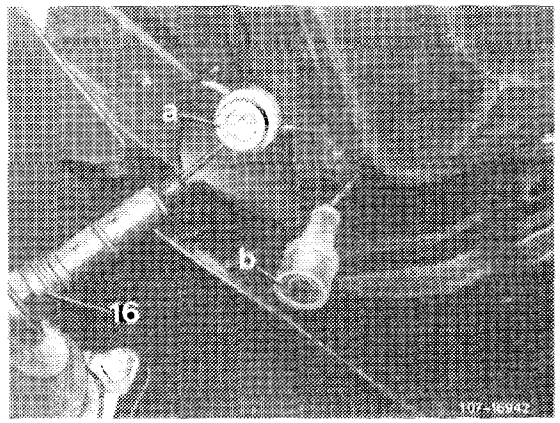
Readout 0 ohm, line in order.

Readout ∞ ohm, line interrupted.

End of test.







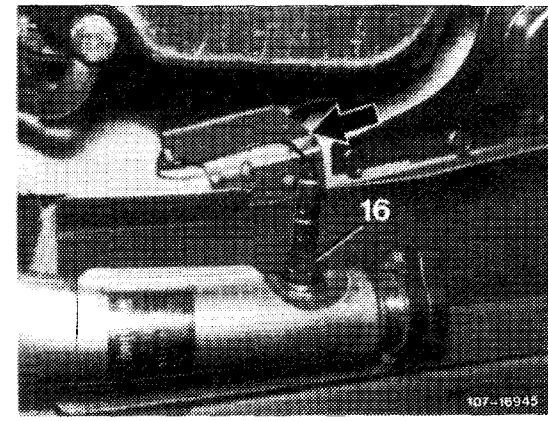
Test section B

Test conditions:

Remove adapter, connect coupling to control unit.

Connect tester on-off ratio to test socket. Start engine (coupling of O_2 probe connected).

VIII. Testing O_2 probe (16)



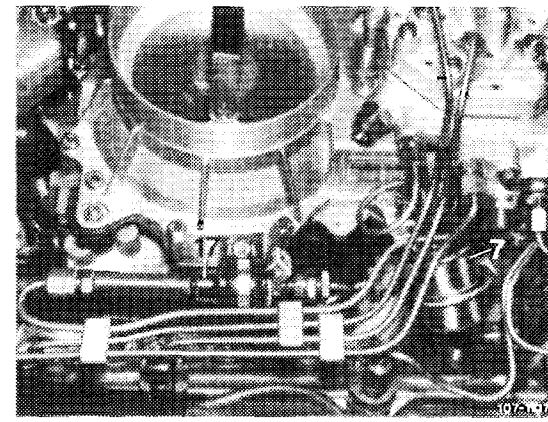
Temperature of O_2 probe below + 300 °C.
Read readout on-off ratio.

Readout	
Constant between 46–54 %	Constant 92 %

Short-circuit in O_2 probe, renew O_2 probe.

End of test

IX. Testing frequency valve (17)



Engine oil temperature > 20 °C.
Engine at idle.

Place one hand on frequency valve.

Frequency valve should noticeably operate.	Frequency valve not operating.

Renew frequency valve.

End of test

X. Testing lambda control

Note: Lambda control and O_2 probe are in order if needle of measuring instrument is not hunting, but position of needle can be changed by short acceleration.

Model year 1981

Engine oil temperature approx. 80 °C.
Engine at idle (500 ± 50/min).
Read on-off ratio readout.

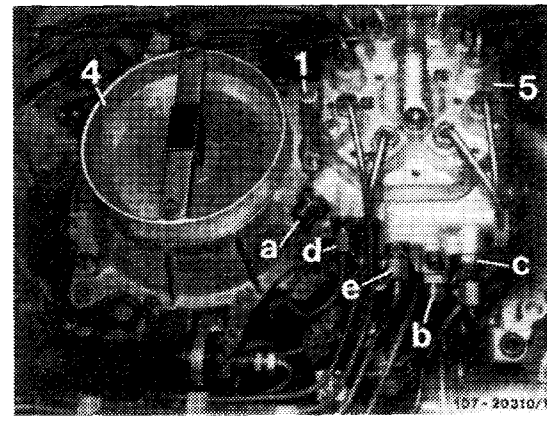
Readout	
Between 40—60 %	40 % or 60 % Constant 50 %

On mixture regulating screw (1), adjust on-off ratio in such a manner that readout is around 50 ± 5 %.

Note: For distance of protective lock refer to 07.3—105.

If on-off ratio cannot be regulated, renew control unit.

If readout is constantly approx. 50 %, renew O_2 probe.



End of test

Starting model year 1982

1. Engine oil temperature approx. 80 °C.
2. Pull purge line to throttle valve housing from purge valve and close.
3. At engine speed 2500/min, read mean value of on-off ratio.
4. Run engine at idle and adjust to on-off ratio read under item 3.

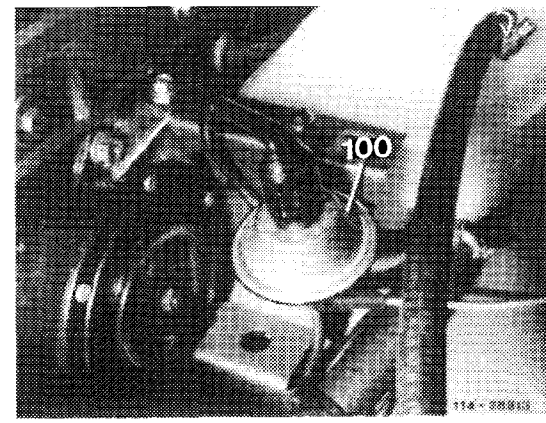
   Note: For distance of protective lock refer to 07.3—105.
5. Repeat item 3 and 4 and readjust, if required, until mean value of the deflections at both points is less than 10 apart.
6. Connect purge line.

On-off ratio	
in order	not in order

Renew control unit.
Readout constant approx. 50 %
Renew O_2 probe.

End of test

XI. Testing sudden change of pressure switch (100)
(only for national version (USA) model year 1985)



Connect lambda control tester to diagnosis socket. Button 100 % ⌐w¬. Separate coupling from O_2 probe. Start engine. Engine at idle (operating temperature).	
On-off ratio display	50 % constant
Yes	No

Test step VII

Depress accelerator.	
On-off ratio display goes temporarily to 60 % and then immediately drops back again.	
Yes	No

Test vacuum line to sudden change of pressure switch in accordance with function diagram.

Test green/white line to control unit in accordance with electric wiring diagram.

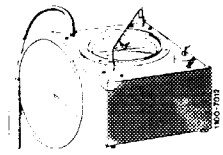
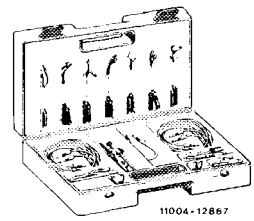
Renew sudden change of pressure switch.

End of test

d) Testing air injection

Note: CIS injection system and ignition system in order, engine at operating temperature.

Special tools

Test equipment 0—1000 mbar for vacuum		116 589 25 21 00
Electrical connection set		201 589 00 99 00

Conventional test equipment

Engine tester (speed, dwell angle, advance angle, oscilloscope, voltmeter)	e. g. Bosch, MOT 001.03 or MOT 002.02
	e. g. Sun 1019
Multimeter	e. g. Sun DMM 5
Lambda control tester	e. g. Hermann L 115

Visual testing	Start engine. Operating temperature	Magnetic clutch switched off
Pull off coupling from temperature switch (42 °C) and bridge. Place one hand on switchover valve. Observe magnetic clutch.	Switch ignition on and off.	Switchover valve must switch noticeably, magnetic clutch switches audibly and visibly.
Separate connection to air pump and connect test cable with plug for magnetic clutch, as well as terminal 30 to cable connector and ground. Pull off vacuum lines at the switchover valve and connect with each other.	Start engine.	On-off ratio Model year 1981: 50 % ± 10 %[1]) Starting model year 1982: between 30—70 %[1]) On-off ratio > 80 %

[1]) Lambda control and O_2 probe are in order, if the needle of the measuring equipment is not hunting, but position of needle can be changed by short acceleration.

Visual checkup magnetic clutch

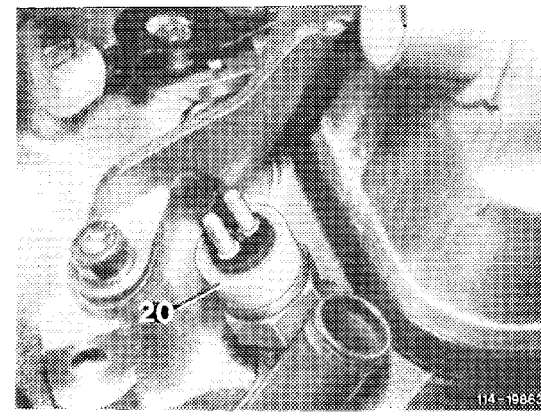
Engine at idle
Coolant temperature > approx. 42 °C

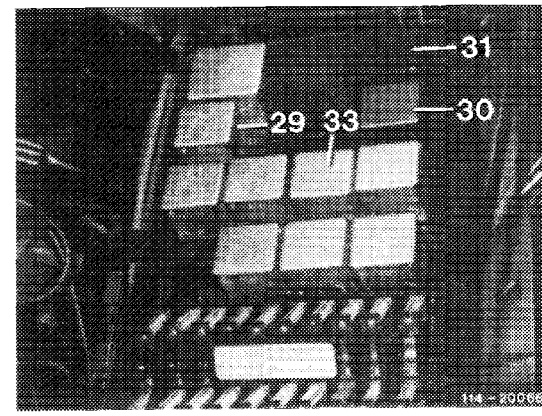
Magnetic clutch switched off.	Magnetic clutch switched on.

Check temperature switch 42 °C (20) for passage.

If passage exists, renew temperature switch.

No passage, renew relay (33).





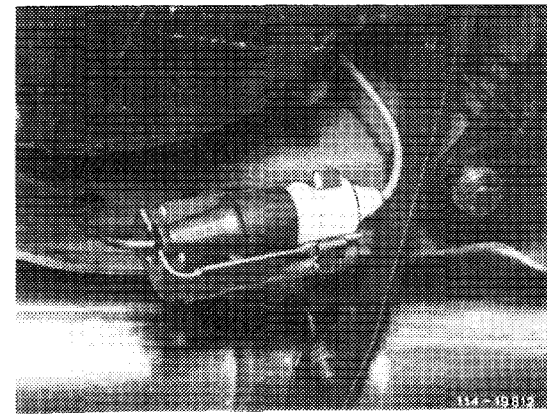
Testing magnetic clutch

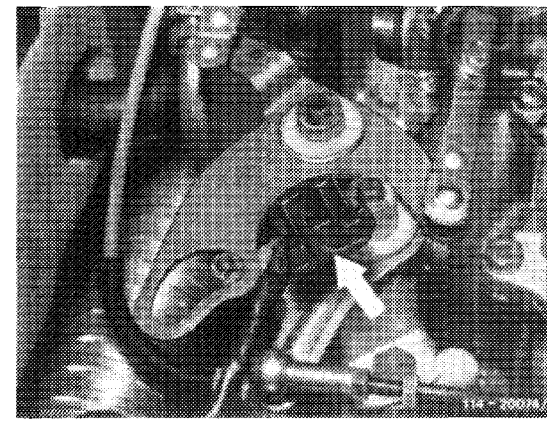
Coolant temperature approx. 100 °C
Engine at idle, separate coupling of O_2 probe, pull off coupling of temperature switch 42 °C (20) and bridge (arrow).

Magnetic clutch switched on.	Magnetic clutch not switched on.

Check whether coupling of temperature switch (20) is energized.

If not, check voltage supply according to electric wiring diagram and renew defective parts, if required.





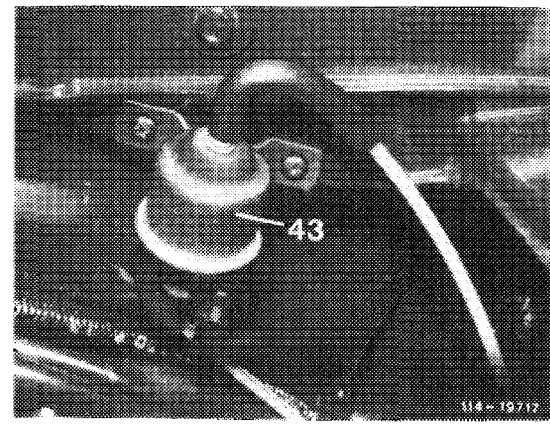
Testing temperature switch (20), relay (33) and switchover valve (43)

Engine at idle, coolant temperature approx. 100 °C.

Pull vacuum line from air shutoff valve (40) and connect vacuum tester to vacuum line.

Separate coupling of O_2 probe.

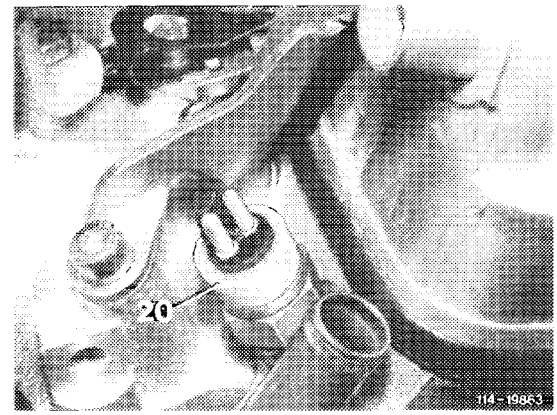
Vacuum readout	Vacuum
0 mbar.	available.



Pull coupling from temperature switch (20).

If vacuum drops to 0, renew temperature switch.

If vacuum is not dropping, test voltage supply relay (33) and switchover valve (43) according to electric wiring diagram and renew defective parts, if required.



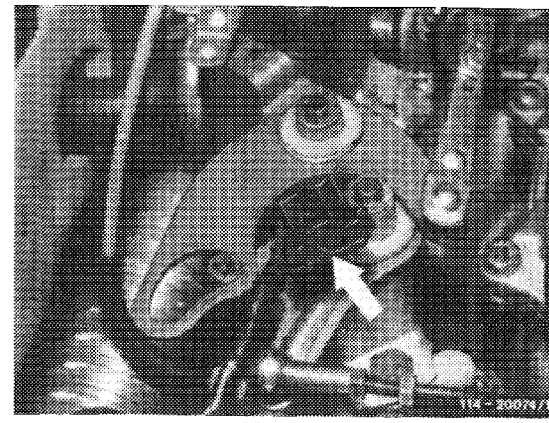
Testing vacuum control

Pull coupling from temperature switch (20) and bridge (arrow).

Vacuum should be available.

No vacuum indicated.

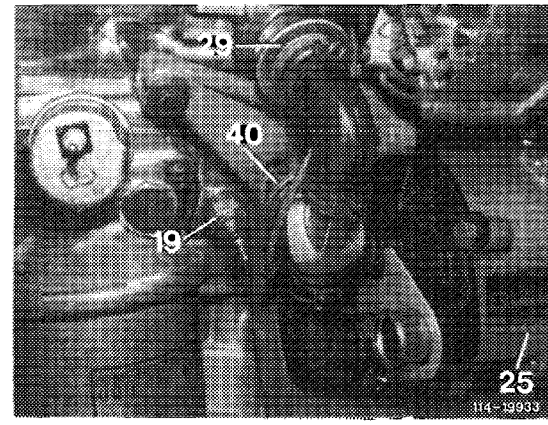
Test vacuum lines for correct connection, also test check valve and switchover valve for passage.



Testing air shutoff valve (40)

Connect vacuum tester to air shutoff valve (40) and test for leaks.

If leaking, renew valve.



Testing air shutoff valve (40) and air pump (25)

Pull contour hose from air cleaner and keep lightly closed with finger.

Heavy air intake noticeable.	No or weak air intake noticeable.

No air intake noticeable.

Check contour hoses for correct connection and for leaks.

Check V-belt for tension and renew air pump, if required.

Weak air intake noticeable.

Pull white/purple/blue vacuum line from switchover valve (43) and check for presence of vacuum.

If vacuum is present, renew air shutoff valve.

End of test