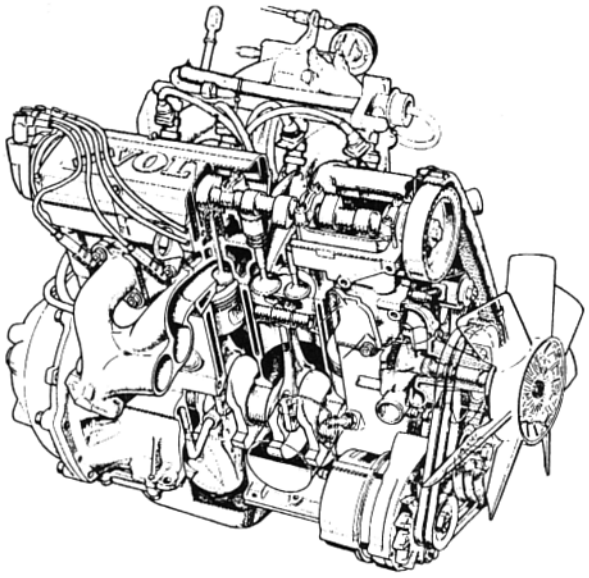
This manual deals with



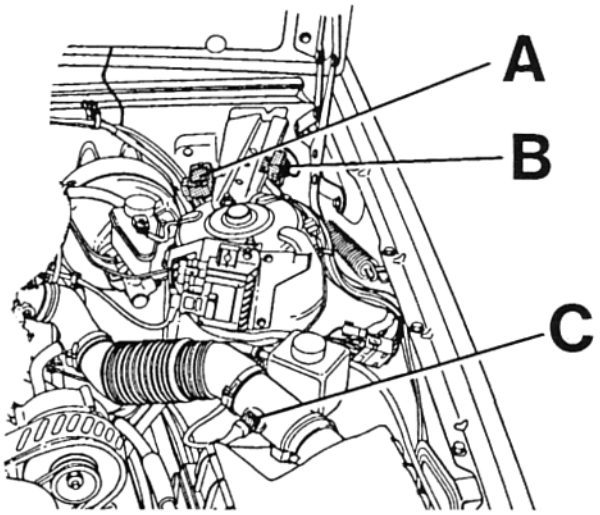
S145 805

B230F

- petrol engine.
- with fuel injection.
- 2 valves per cylinder.
- cylinder volume 2.3 litres.
- catalytic exhaust system.

Fuel system Regina and Ignition system Rex-I

Regina / Rex-I is identified most easily by the following three characteristics.



S152 462

A. Pressure sensor, intake air.

B. Diagnostic socket.

C. Temperature sensor, intake air.

Modifications to May 1991 included

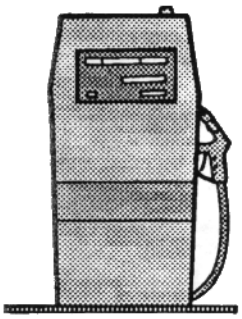
Modifications introduced after the above date are not covered in this manual. See Service Bulletins as applicable.

Volvos are sold in versions adapted for different markets. These adaptations depend on many factors including legal, taxation and market requirements. This manual may therefore show illustrations and text which do not apply to cars in your country.
Volvo owners planning to export their car(s) to another country should investigate the applicable safety and exhaust emission requirements. In some cases it may be impossible to comply with these requirements.

Specifications

Fuel system Regina

Fuel



S145 695

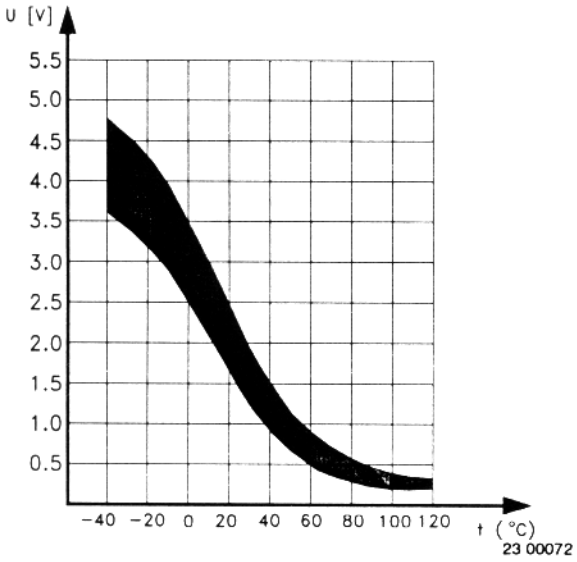
Octane requirement

- RON (Research Octane Number) = 91-95
- AKI = $\frac{RON+MON}{2}$ = 87

Unleaded fuel must always be used

Part number

Component	Part number	Remarks
Control unit 1988-1990 1991-	1 389 553-7 3 531 658-7	Replaces previous control units if current unit is faulty
Temperature sensor engine	1 346 030-8	Table resistance/temperature next page Shared with Rex-I
Temperature sensor inlet air	1 389 556-0	Table resistance/temperature next page
Pressure sensor inlet air	1 378 162-0	Table pressure/voltage next page
Throttle contact	1 389 558-6	Shared with Rex-I
Lambdasond Screw joint paste	3 517 394-7 1 161 035-9	Resistance pre-heating: 2-14 Ω (temperature dependent) Tightening torque: 55 Nm (40 ft.lbs) Applied on the sond's entire threaded section.
Injection valve	1 389 563-6	Resistance: 16 ± 1 Ω Static flow : 170 cm^3/min (10.4 in^3/min) Removed valve may only be tested using special equipment
Cold-start valve	3 517 130-5	Resistance: 10 ± 1Ω Injection quantity: 165 cm^3/min (10.0 in^3/min)
Idle speed valve	1 389 557-8	Resistance in the coil: 4 Ω
Fuel pump 1988-1989 1990-	1 389 449-8 3 531 165-3	Fuel capacity at 300 kPa (43psi), 12 V and 20 C: 2000 gr/min
Pressure regulator	1 389 564-4	System pressure: 300 ± 10 kpm(43.5 ± 1.5 psi)
Fuel filter	1 389 561-0	Tightening torque:27 Nm (20 ft.lbs)
System relay	3 523 608-3	
Interference suppression relay	1 323 592-1	
Cannister EVAP	1 276 694-5	
Diagnostic socket	1 363 923-3	Shared with Rex-I

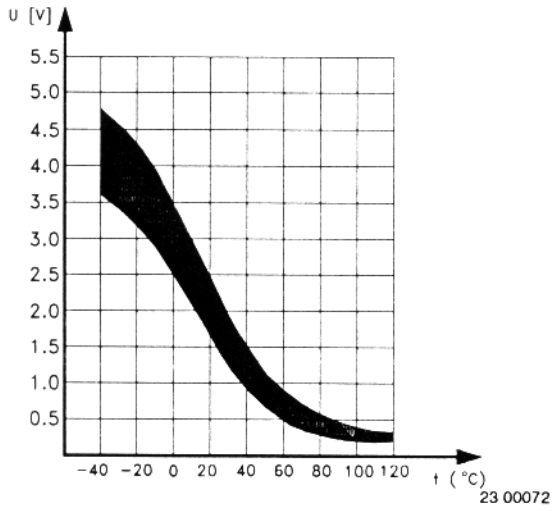


Temperature sensor, engine

Approximate resistance at various temperatures

-10°C (14F)	8200-10600 Ω
20°C (68F)	2200-2800 Ω
80°C (176F)	250-400 Ω

See Voltage / Temperature diagram.

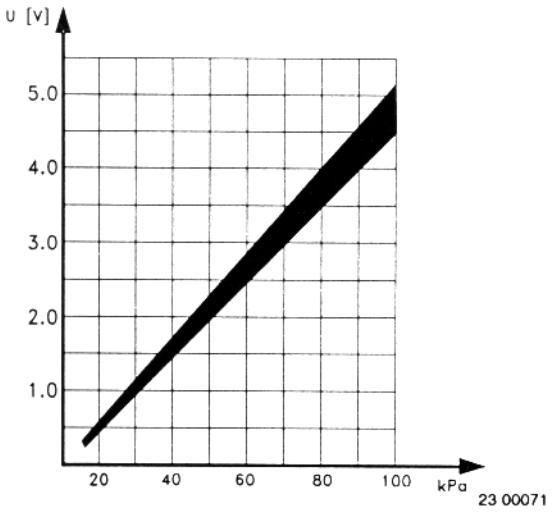


Temperature sensor, inlet air

Approximate resistance at various temperatures

-40°C (-40F)	45000 Ω
-20°C (-5F)	15000 Ω
0°C (32F)	5800 Ω
20°C (68F)	2500 Ω
80°C (176F)	330 Ω

See Voltage / Temperature diagram.



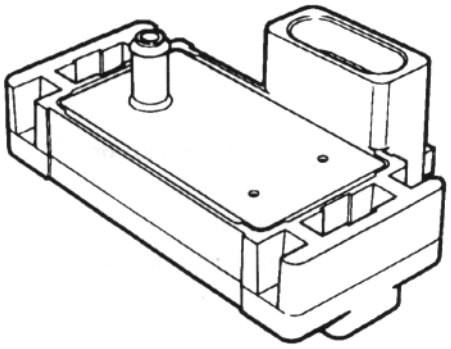
Pressure sensor

Approximate voltage at different pressure levels

100 kPa (14.5 psi)	4,4 V
80 kPa (11.6 psi)	3,2 V
60 kPa (8.7 psi)	2,1 V
40 kPa (5.8 psi)	1,1 V
20 kPa (2.9 psi)	0,5 V

See Voltage / Pressure diagram.

Regina sensor system

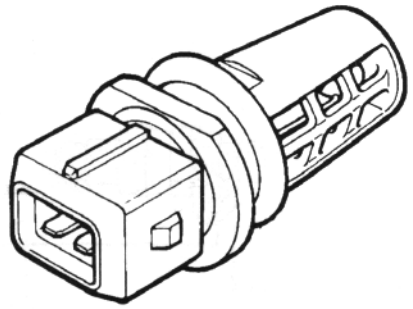


S151 515

Pressure sensor

The pressure sensor is connected via a hose to the intake manifold, so as to sense the air pressure there. Pressure is converted to an electrical signal via a piezo-electrical crystal in the sensor.
The pressure sensor is sensitive to electrical interference and is therefore sheathed in a metal casing.

When the ignition is switched on and under full load, atmospheric pressure is registered so that an adjustment can be made for changes in atmospheric pressure.

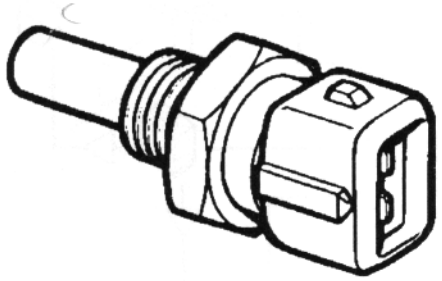


S151 514

Temperature sensor, intake air

Air in the intake manifold passes through a hole in the sensor and affects a probe. The probe's resistance reduces with increasing temperature (NTC=Negative Temperature Coefficient).

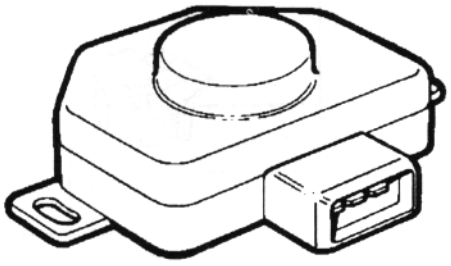
With the help of signals from the pressure sensor and temperature sensor for intake air, the control unit can calculate the volume of air which is inducted into the engine.



S151 510

Temperature sensor, engine

The sensor is mounted in the cylinder head and is immersed in coolant. The sensor has two resistors, one for the fuel and one for the ignition system. Resistance is reduced with increasing temperature (NTC=Negative Temperature Coefficient).



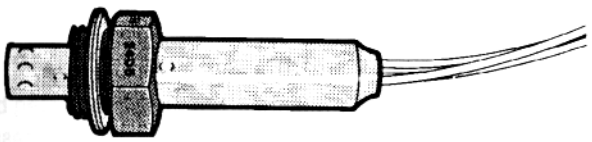
S151 508

Throttle switch

The throttle switch has two switches for idle and full throttle respectively.

It provides signals to the fuel system's and ignition system's control unit regarding shut or fully open throttle valve.

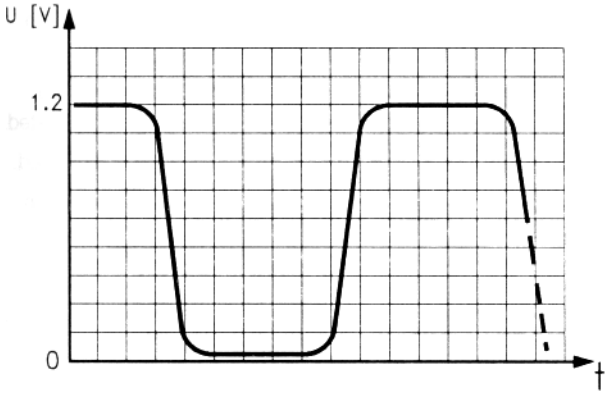
Lambdasond



S145 633

An assessment of the ratio between air and fuel is obtained by measuring the oxygen content of the exhaust gases after the combustion process, using a lambdasond.

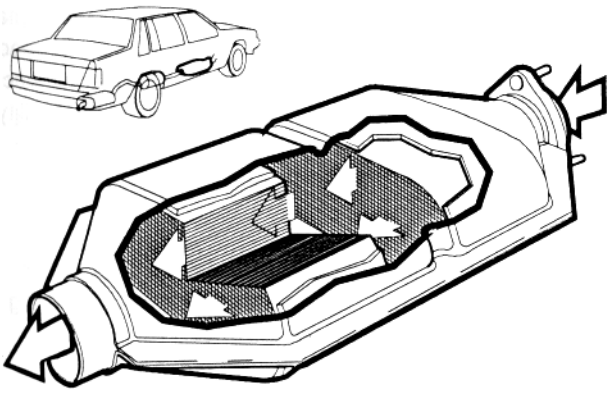
The signal from the lambdasond has a voltage whose level depends on the oxygen content of the exhaust gases. This signal varies from high (>0.9 V) to low (<0.1 V) at the ideal ratio of 14.7 kg air/1 kg fuel. A rich mixture provides a high voltage while a lean mixture provides a low voltage. Based on this signal, the control unit regulates the injection timing continuously so that the ideal ratio is maintained.



23 00074

The lambdasond only functions above a certain temperature, approx. 285°C. This is why it is electrically heated, so that it can quickly reach operational temperature. When the ignition is switched on, a PTC-resistor (PTC=Positive Temperature Coefficient) is connected, whose resistance increases with a rise in temperature. This resistor provides a short warming-up time and it keeps the sond at the correct temperature when exhaust temperature is low.

Catalytic converter 3-way



25 00001

The catalytic converter effectively reduces the levels of carbon monoxide, oxides of nitrogen and hydrocarbons in the exhaust gases

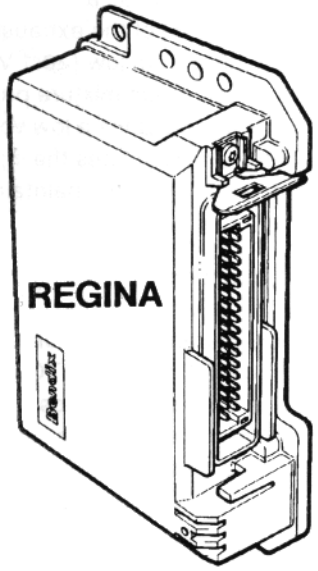
The catalyst is of the three-way type and cleans the exhaust as follows:

- Unburned hydrocarbons (HC) are oxidised to water vapor (H_2O) and carbon dioxide (CO_2)
- Carbon monoxide (CO) is oxidised to carbon dioxide (CO_2)
- Oxides of nitrogen (NO_x) are reduced to nitrogen gas (N_2)

In order for the catalyst to function as intended, it is necessary for the lambdasond to provide the correct signal so that no unburned fuel mixes with the exhaust gases. Otherwise the catalytic converter can be damaged by excessive temperature.

Regina control system

Control unit

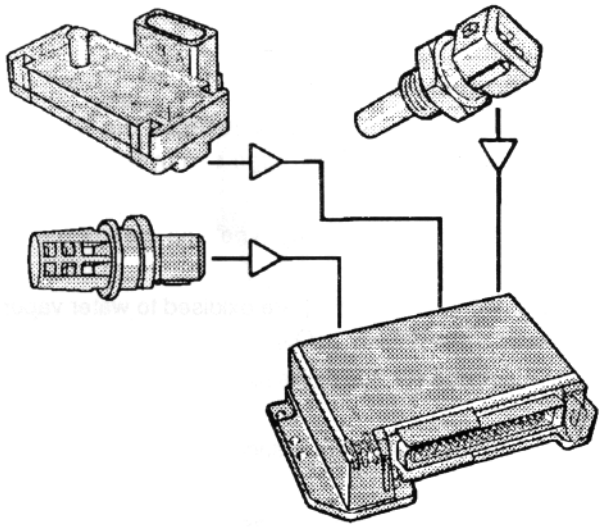


S151 509

Control of injection timing

In normal driving, a basic injection timing is calculated by the control unit based on the data relating to air mass, oxygen content of the exhaust gases, engine speed and battery voltage. The control unit then adjusts this basic timing under certain conditions to provide optimal combustion and best function.

- At start a special program is used, offering two injection cycles per engine revolution.
- At very low engine temperature (below approx. -18°C) and low engine speed the cold-start valve too is operated.
- At temperatures below 60°C a richer mixture is provided.
- When the throttle switch indicates full load, the injection timing is increased.
- The injectors are shut during engine braking.
- Fuel injection is switched off on over-run.



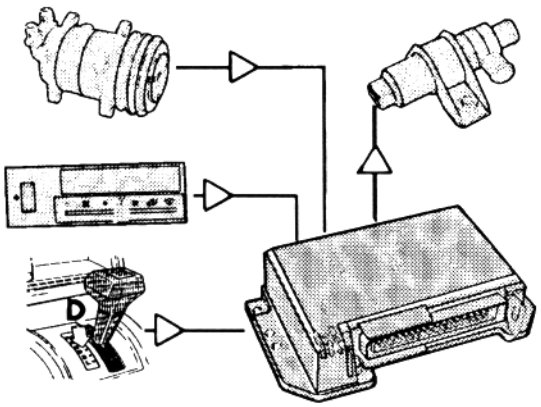
S151 517

Emergency function

The control unit has "limp-home"-functions so that the car can be driven even if a signal is missing.

The system is reversible, which means that if the signal returns with adequate values after a period of faulty readings, the control unit will utilize the measured values once again instead of continuing to use the "limp-home" facility.

- If one or both of the signals from the intake air pressure or temperature sensor fail to get through, injection timing will vary depending on the engine speed.
- If the engine temperature signal is missing, injection timing will be as for a hot engine. As a result, the lack of the engine temp. signal will be most noticeable during cold starts.



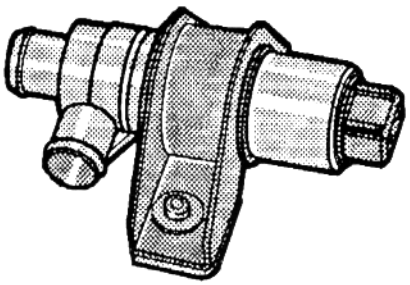
S151 518

Idle speed regulation

The control unit bases regulation of idle speed on engine temperature and whether or not the throttle valve is in the idle position. The control unit also regulates the idle valve so that constant idle speed is obtained in the following cases.

- If the AC-button is switched on.
- If the AC-compressor is operating.
- If the gear selector in an automatic car is moved from Park or Neutral.

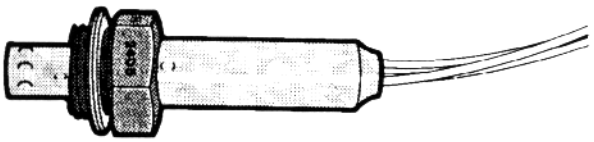
In order to avoid excessive idle speed, for example owing to an incorrectly adjusted throttle valve, the idle valve receives a signal which virtually corresponds to an opening angle of 0 %. Engine idle speed will be just over 1000 rpm.



S145 644

Adaptive idle speed control

The B 230F does not have basic engine speed adjustment. Instead, the control signal to the idle valve is based on information received by the control unit over a long period of time. The signal is adjusted to compensate for ageing, dirt accumulations or minor air leakage, so that a constant idle speed is obtained even when the engine has aged.



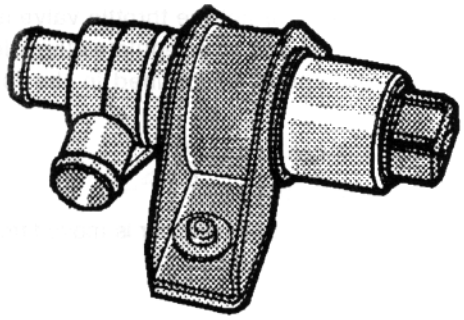
S145 633

Adaptive lambdasond regulation

With the adaptive lambdasond regulation, the control unit can adjust injection timing to compensate for engine wear, minor air leakage, clogged injectors etc. so that the lambdasond can operate under optimum conditions. The correct fuel ratio is obtained even after engine braking and before the lambdasond has been warmed up, which would otherwise not be the case.

The adaptive lambdasond regulation system consists of two phases, additive and multiplicative compensation. Additive compensation affects injection timing swiftly and mostly at low engine speeds such as when idling. Additive control corresponds to the basic CO adjustment which is made in other systems using a potentiometer. Multiplicative control has a greater effect during longer changes.

The ability to compensate is limited and in the event of major interference, the limit will be exceeded. The control unit will then set fault code 2-3-1 or 2-3-2, depending on whether it is the multiplicative or additive compensation which has been exceeded.



S145 644

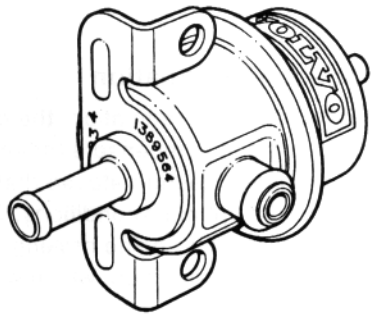
Idle valve

When the idle switch is on, the valve controls the amount of air which flows past the throttle valve. The engine's idle speed is thus kept constant irrespective of load from the automatic gearbox, AC unit, power steering or alternator.

In addition, under engine braking it supplies air to the engine so that negative pressure is maintained in the intake manifold at a permitted level. In order to control this swiftly, the idle valve assumes a monitoring setting when the idle switch is not closed.

Fuel distribution system

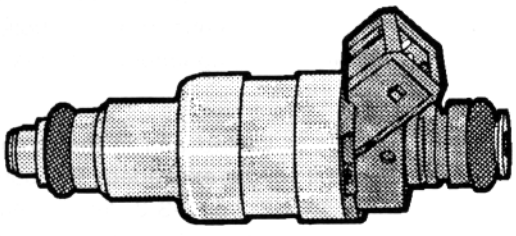
The fuel pump draws fuel from the fuel tank and passes the fuel through a filter to the distribution pipes on the engine. The distribution pipe features a pressure regulator, injectors and cold-start valve.



S151 513

Pressure regulator

The pressure regulator keeps the fuel under constant pressure in relation to the negative pressure in the intake manifold.



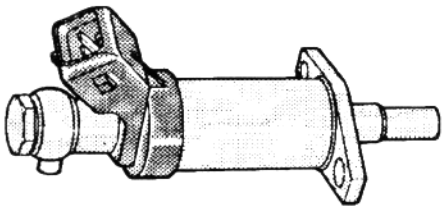
S145 640

Injectors

This is equipped with a solenoid and fuel needle which opens and shuts a nozzle.

The control unit grounds the injectors during the calculated time period so that the valves open and inject fine droplets of fuel. Injection takes place through all the injectors simultaneously, once per engine revolution during driving and twice if the engine is cold. Fuel is injected in the intake manifold near the intake valves.

An injector which has been removed may only be tested with special fluid since fuel spray is particularly volatile and explosive.



S145 640

Cold start valve

The cold start valve improves the cold starting characteristics. It has a similar design to that of the injectors.

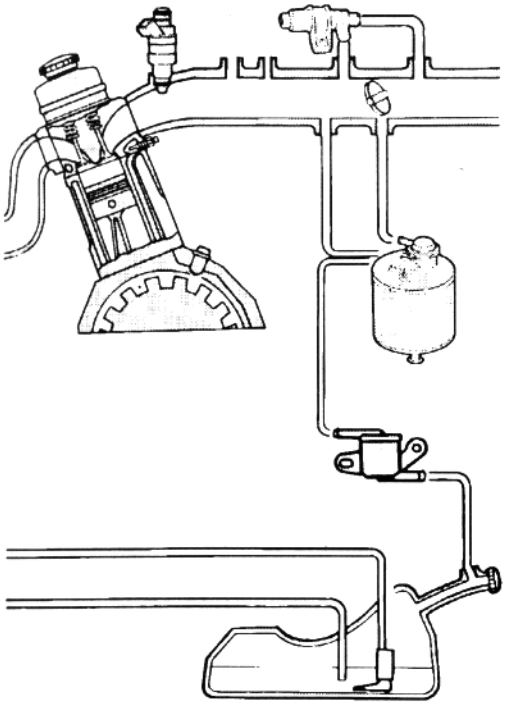
In cold starts, a lot of fuel is condensed in droplet form on the cold surfaces. The cold start valve is thus located further away from the engine than the injectors and it supplies the fuel more in gas form than in droplet form.

The cold start valve is activated at approx. -18°C and at engine speeds under approx. 600 rpm. When one of the limits is exceeded, the cold start valve is shut. On certain models, the cold start valve is connected to the starter motor so that it can only be activated when the engine is started.

On certain cars, voltage supply is connected to the starter motor so that injection can only take place when the engine is cranked. The engine speed and temperature limits are the same.

EVAP system

EVAP stands for Evaporative Control System and it is a vacuum-controlled system which deals with those gases which evaporate from the fuel in the fuel tank, preventing them from being released into the atmosphere.



S145 646

Cannister

Fuel vapor passes through a hose system from the top of the fuel tank's filler pipe to a container (cannister) featuring a coal filter which absorbs the fuel vapor.

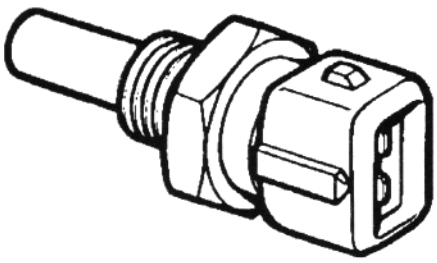
EVAP valve

The EVAP valve is located on the cannister and it is connected to the intake manifold. This valve ensures that fuel vapor does not get to the engine if the engine is switched off or is operating at idling speed.

Roll-over valve

The Roll-over valve shuts off the system if the car leans more than 45 degrees, thus preventing fuel from leaking in the event of an accident.

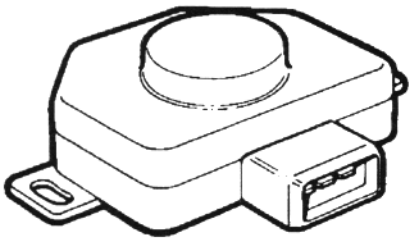
Rex-I sensor system



S151 510

Engine temperature sensor

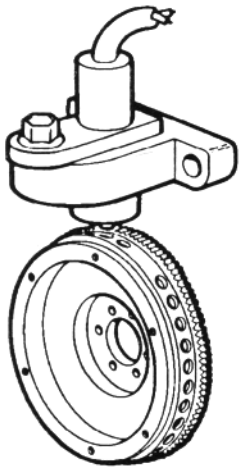
The ignition system uses the same temperature sensor for engine temperature as does the fuel system. The temperature sensor has two NTC-resistors (Negative Temperature Coefficient), one for Rex-I and the other for Regina.



S151 508

Throttle switch

The ignition system uses the same throttle switch as the fuel system. Rex-I uses only the idle speed switch.

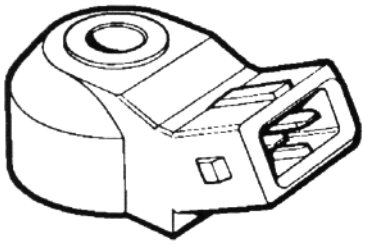


S151 506

Impulse sensor

The impulse sensor provides information about engine speed and crankshaft position and it is the most important sensor signal to the control unit. Without it, the control unit will not supply any signal to the power stage/ignition coil and the engine cannot be started.

When the holes in the flywheel pass the sensor, the magnetic field is altered thus providing a signal whereby voltage varies as a sine wave signal. Since the flywheel does not have holes in two places, the control unit can read off its position in relation to TDC. By measuring the time between two voltage peaks, the control unit can calculate engine speed.

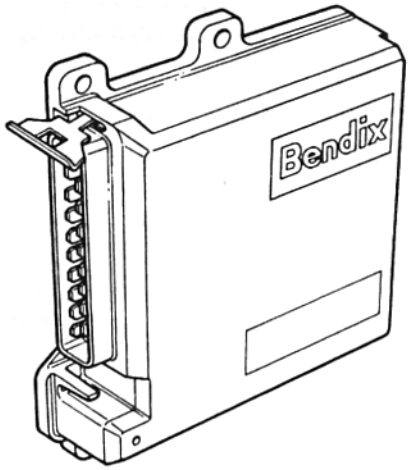


S151 507

Knock sensor

The knock sensor consists of piezo-electrical crystals which are sensitive to the vibrations which arise in the engine block when the engine knocks.

Rex-I control system



S151 516

Control unit

Control of ignition setting

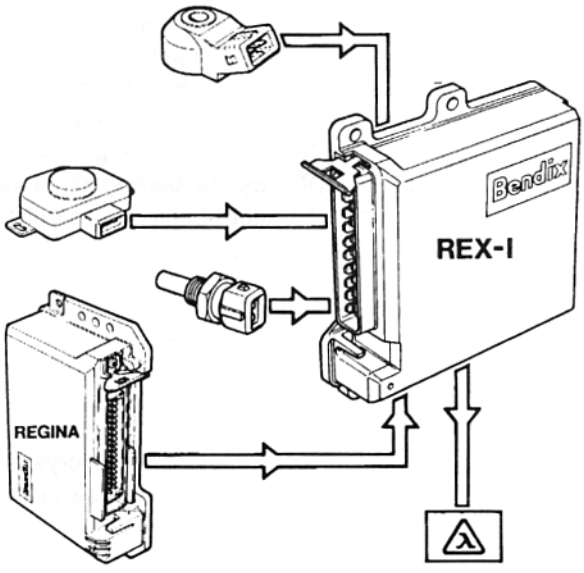
The ignition system's control unit calculates the ignition setting twice per engine revolution, once per ignition cycle. The general ignition setting is based on engine speed and the load signal issued by the fuel system's control unit.

The control unit then adjusts the basic ignition setting under certain circumstances to provide optimal combustion and function.

- When the engine is started, the ignition setting is only dependent on engine speed and engine temperature.
- At idle speed the ignition setting is only dependent on engine speed.
- At temperatures below 55°C ignition is retarded depending on temperature.
- Below 60°C no attention is paid to the knock sensor's signal.
- On over-run, the ignition coil's recharging time is reduced so that engine speed does not increase.
- Ignition is retarded in the case of engine knocking.

Control of ignition voltage

The control unit regulates ignition energy so that it is independent of battery voltage and engine speed. At low battery voltage the control unit sends a signal to the power stage to begin recharging earlier, thus extending the recharging time.



S151 511

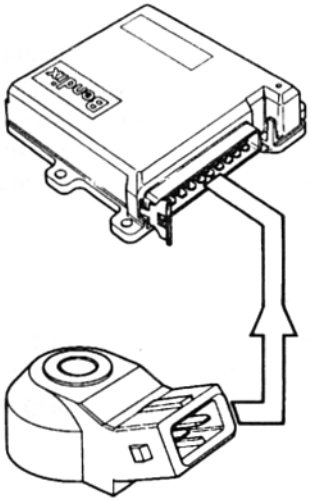
Emergency operation

The control unit has a "limp-home" function which is reversible. This means that if the signal resumes satisfactory levels after a faulty reading, the control unit will utilize these values instead of continuing to use the limp-home function.

- If there is no signal from the knock sensor, the ignition is retarded 10° .
- If there is no load signal from Regina the ignition setting is calculated as for full load except when the throttle switch indicates idle speed.
- If there is no engine temperature signal, the ignition setting is calculated as for a hot engine.
- If there is no throttle signal the control unit will react to load even at idle speed.

Load-related information

Rex-I receives information regarding load from Regina's control unit. At high load (a large volume of fuel/air) the ignition is retarded. If the load is subjected to rapid change, the ignition setting is retarded significantly for all cylinders to prevent knocking.



S151 512

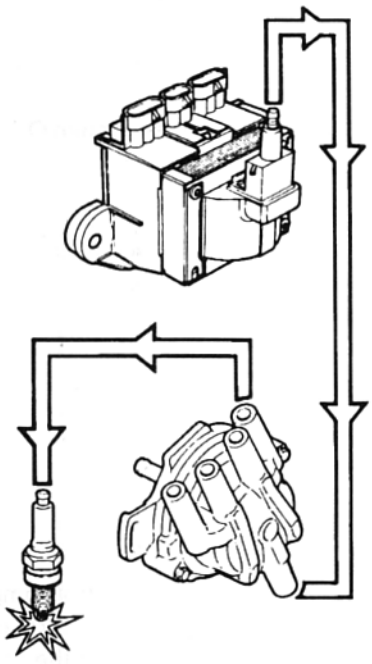
Knock control

If engine knock arises in any cylinder, the cylinder's ignition is retarded at the next ignition cycle until the knock disappears. Once the knock disappears, ignition is advanced in small increments. The speed of this incremental phase depends on engine speed. It is quicker at low than at high engine speed.

Adaptive knock control

If the engine is subject to a heavy load under a long period, the knock-regulated ignition retardation will be activated often. The control unit will retard ignition by 1° on all cylinders as long as the engine is subjected to higher than normal load, to avoid knocking.

High-tension system



S151 505

Power stage/ignition coil

In Rex-I the power stage and the ignition coil are integrated. The function, however, is the same as for those systems which feature separate units.

The power stage closes and breaks the supply of current through the ignition coil's primary winding. When the supply of current to the primary winding is interrupted, a 30-35 kV high-tension is produced in the secondary winding.

Ignition coil, distributor and spark plugs

The high-tension system consists of the ignition coil which generates high tension which is then transmitted to the distributor.

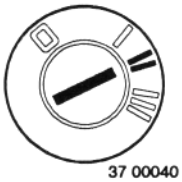
The distributor allocates this voltage to the spark plugs via the ignition cables.

CC. Symbols

Diagrams and symbols are sometimes used in certain sections of the troubelshooting section to simplify this process and to make the manual easier to read.

30 000372

Ignition off



37 00040

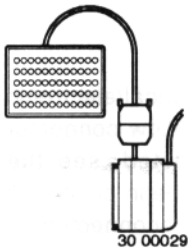
Ignition on

30 00039

Starter motor on

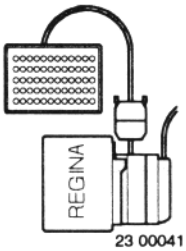
30 00020

Engine operating



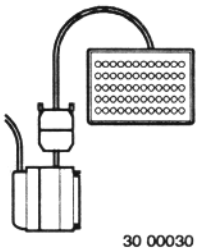
30 00029

Regina meas. box connector



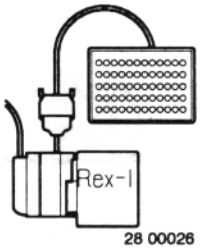
23 00041

Meas. box between Regina control unit and connector



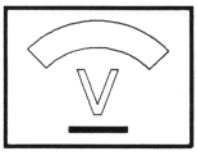
30 00030

Rex-I meas. box connector



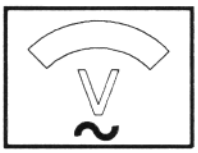
28 00026

Meas. box between Rex-I control unit and connector



30 00031

Voltmeter DC



30 00032

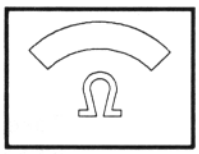
Voltmeter AC

30 00033

Voltmeter DC millivolt

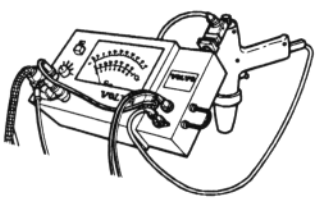
30 00034

Voltmeter AC millivolt



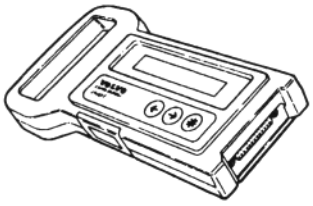
30 00036

Ohmmeter



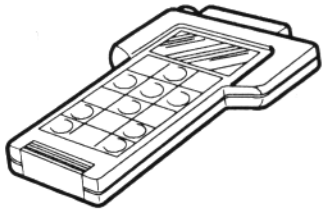
08 00020

Volvo Mono Tester



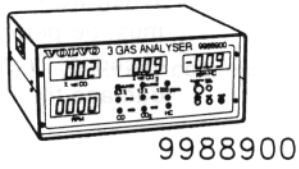
S148 685

Volvo Diagnostic Key



08 00023

Volvo System Tester



08 00019

3-gas meter

ED. Fault code 2-3-1 and 2-3-2 Regina

2-3-1 Adaptive lambda control too lean / rich in part load range

Conditions for fault code:

The adaptive system has compensated for slow changes in the fuel/air ratio.

The control unit receives information from the lambdasond if the fuel/air mixture is too rich or too lean in the partial load area. The adaptive system compensates by enrichening or diluting the mixture to maintain $\lambda=1$, which is the correct fuel/air ratio. When the adaptive system has compensated almost as much as it can, this is interpreted as abnormal and fault code 2-3-1 is set.

Causes of fault:

1. Engine runs too lean:

Air leakage.
Low fuel pressure.
Faulty sensor signals

2. Engine runs too rich:

High fuel pressure.
Contaminated engine oil.
Leaking injector.
Leaking EVAP valve.
Faulty sensor signals.

Fault symptom:

Engine dies at cold starts.
Possible high fuel consumption.
Various driveability problems.

2-3-2 Adaptive lambda control too lean / rich when idling

Conditions for fault codes:

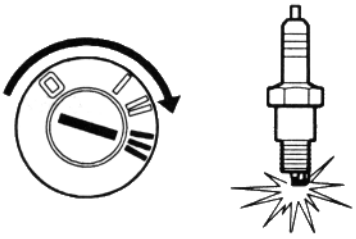
The adaptive system has compensated for swift changes in the fuel/air mixture.

The control unit receives information from the lambdasond if the fuel/air mixture is too rich or too lean at idling speed. The adaptive system compensates by enrichening or diluting the mixture to maintain $\lambda=1$, which is the correct fuel/air ratio. When the adaptive system has compensated almost as much as it can, this is interpreted as abnormal and fault code 2-3-2 is set.

Fault causes and fault symptoms:

See above.

GE. Checking Rex-I



30 00011

GE1

Checking the spark from the ignition coil

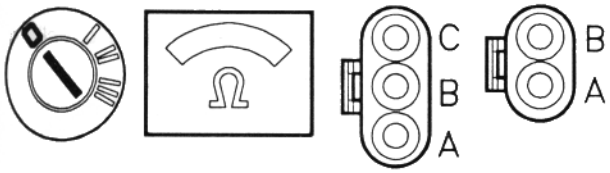
– Disconnect the wire from the distributor cover and place it agains the engine block.
– Operate the starter motor.

If there is a spark:

- Check the spark plug, rotor and distributor cover.

If there is no spark:

- Check the chassis connection to the power stage/ignition coil GE2.



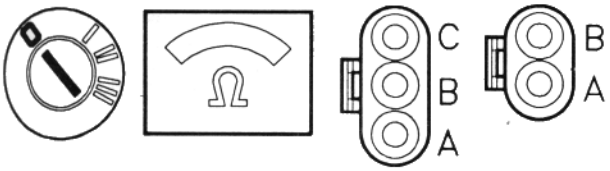
28 00026

GE2

Checking the chassis connection to the power stage/ignition coil

– Ignition off.
– Release both the connectors on the power stage/ignition coil.

Connect an ohmmeter between B on the 3-pole connector and the engine block (ground).



28 00026

Connect an ohmmeter between A on the 2-pole connector and the engine block (ground).

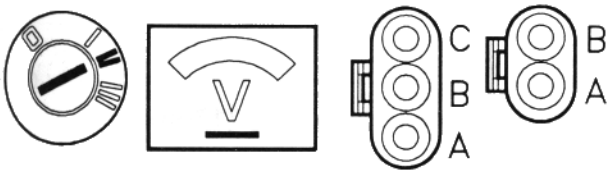
The ohmmeter should show approx. 0 Ω in both measurements.

If the value is correct:

- Checking the voltage supply to the power stage/ignition coil GE3.

If the value differs:

- Check the wires and chassis connection at the intake manifold for breakage according to CD.



28 00027

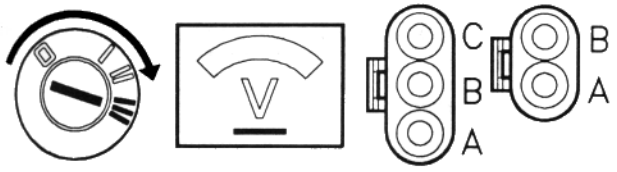
GE3

Checking the voltage supply to the power stage /ignition coil

– Ignition on.

Connect a voltmeter between A on the 3-pole connector and the engine block (ground).

The voltmeter should show battery voltage.



28 00028

Check that voltage is still registered even when the starter motor is operated.

If the values is correct:

- Checking the control signal to the power stage/ignition coil GE4.

If the value differs:

- Check the wire between A (3-pole) and the ignition lock via fuse 13 for breakage or short circuit to ground according to CD.

HD. Engine falters or dies when A/C is used

HD1

S145 885

Mode 2
– Start the engine
Activate mode 2 according to
D. Troubleshooting via the diagnostic socket.

- Continue with Checking the A/C controls HD2.

HD2

Checking the A/C controls

– Disconnect the pressostat connector which is located on the reservoir.
– Switch on the fan.
– Move the A/C control to the A/C position.

1-1-4

S152 548

The diagnostic system should respond with code 1-1-4.

If code 1-1-4 is received:

- Checking the pressostat HD7.

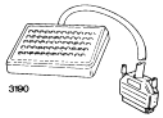
If no code is received:

The control unit does not receive any signal from the A/C control when it is moved to the A/C position.

- Connection of measurement box HD3.

HD3

Connection of measurement box



3190

S151 183

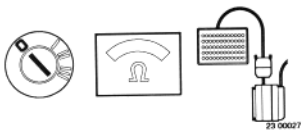
Connect the measurement box to Regina and check the chassis connections according to N1-N2.

- Continue with Checking of the A/C control and wires HD4.

HD4

Checking of A/C controls and wires

– Ignition off.
Connect an ohmmeter between #15 and #5 (ground).



23 00027

The ohmmeter should show approx. 35 Ω when the A/C control is on and infinite resistance when the AC control is off.

If the value is OK:

- Checking the signal from the A/C control HD5.

If the value differs:

- Check the wiring for breakage and connector resistance according to CD.

HD6

23 00053

Checking the signal from the A/C control

– Connect the control unit to the measurement box.
– Insert fuse no. 1.
– Start the engine.
– Switch on the fan.

Connect a voltmeter between #15 and #5 (ground).

The voltmeter should show battery voltage when the A/C control is on and approx. 0 V when the A/C control is off.

If the value is OK:

Intermittent fault.

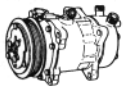
- Check the connectors for loose connection according to CD.

If the value differs:

- Check the wiring for breakage and connection resistance according to CD.

HD7

1-3-4


S152 550

Checking the pressostat

– Reconnect the pressostat.

The diagnostic system should respond with code 1-3-4 when the compressor is activated or deactivated.

If code 1-3-4 is received:

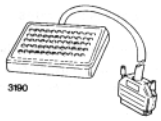
- Adjust according to RE. Adjustment for insufficient A/C compensation.

If no code is received:

The control unit does not receive any signal from the pressostat when the latter activates the compressor.

- Connection of measurement box HD8.

HD8



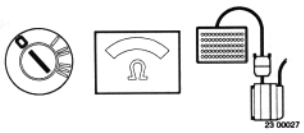
S151 183

Connection of measurement box

Connect the measurement box to Regina and check the chassis connections according to N1-N2.

- Continue with Checking of signal from A/C compressor HD7.

HD9



Checking the wires to the A/C compressor

– Ignition off.

Connect an ohmmeter between 14 and 5 (ground).

The ohmmeter should show approx. 3 Ω.

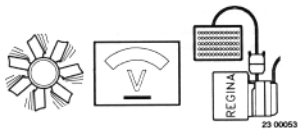
If the value is OK:

- Checking the signal from the A/C compressor HD10.

If the value differs:

- Check the wire for breakage and connection resistance according to CD.

HD10



Checking the signal from the A/C compressorn

– Connect the control unit to the measurement box.

– Insert fuse no. 1.

– Start the engine.

– Switch on the fan and the A/C.

Connect a voltmeter between 14 and 5 (ground).

The voltmeter should show battery voltage when the A/C compressor is on and approx. 0 V when the A/C compressor is off.

If the value is OK:

- Repeat Mode 2 HD1

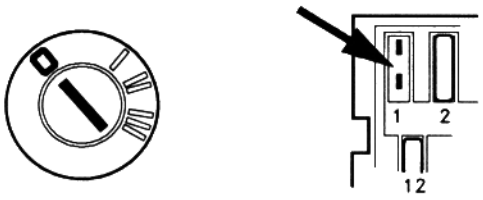
If the value differs:

- Checking the wires leading to the A/C compressor HD8.

Rex-I

N3

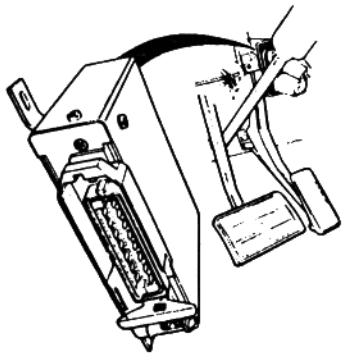
Connection/disconnection of the measurement box



30 00068

Important!
When the measurement box is connected/disconnected, voltage to the control unit must be cut so as to avoid the risk of damaging it.

– Ignition off.
– Remove fuse no. 1.

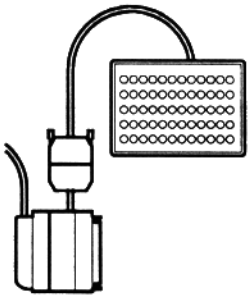


S143 258

– Remove the panel under the left section of the instrument panel.

The control unit is located above the steering column.

– Disconnect the connector from the control unit.



30 00030

Connect the measurement box to the control unit's connector.

- Continue with Checking of the chassis connections N4

N4

Checking the chassis connections

– Ignition off.

Measure with an ohmmeter between 20 and ground.

The ohmmeter should show approx. 0 Ω.

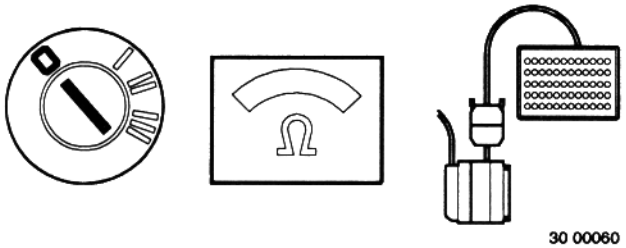
If the value is OK:

- Return to the troubleshooting process.

If the value differs:

- Check the chassis connection on the intake manifold and the wire leading to it for breakage and connection resistance according to CD.

  Check the ground connection between the engine and the chassis.



30 00060

NB. Signal description Regina

Important! All the values which are shown are between the connector in column 1 and #5; if not, the correct parameters are stated within brackets. Make sure therefore that this chassis connection is porperly attached to the battery's negative terminal before measurements are undertaken.

Values at idle speed are for a hot, unloaded engine.

Connection	Type of signal Function	Ignition on	Idling	Engine speed higher than idling
1	Engine speed signal Information from Rex-I (# 17) that the engine is operating. Used to calculate injection timing	U= 10-12V	U= 7-8 V f=25 Hz	f increases with engine speed
2	Idle switch Information that the idle switch is on. Used for a special idle programme for idling speed, injection timing etc. Also used for fuel shut-off	U= U_{low}		U≈5 V
3	Full-load switch Information that the throttle valve is fully open. Used for full-load fuel enrichment.	U≈5 V		U= U_{low} at max. valve opening
4	Battery voltage (+30) Voltage supply to diagnostic system memory and adaptive functions	U= U_{bat}		
5	Signal ground Signal ground on intake manifold for control unit's electronics	U= U_{low}		
6	Ground pressure and temperature sensors intake air	U= U_{low}		
7	Pressure sensor Information about intake air pressure; together with temperature data, used to calculate load	U=4.5-5 V (#6)	U= 1.2-1.4 V (#6)	U increases with load, max. 5V (#6)
8	–	—		
9	Voltage supply Voltage supply to control unit via system relay	U= U_{bat}		
10	Temp. sensor intake air Information about intake air temperature; together with pressure data, used to calculate load	U≈2 V at 25°C U≈1 V for hot engine (#6)		
11	Voltage supply pressure sensor	U≈5V		
12	Diagnostic link Communication with diagnostic socket	U≈5V		
13	Temp. sensor engine Information about motor temperature. Used by the control unit to calculate injection timing during warming-up	U≈0,3 V for hot engine U≈2 V at 20°C, Voltage increases when engine is colder		
14	A/C compressor working Information that A/C compressor is operating. Used to maintain constant idling speed when the A/C starts up	U= U_{low}	AC off:U= U_{low} AC on:U= U_{bat}	
15	A/C control Information that A/C control is on. Used to prepare the CIS valve before the A/C compressor starts up	AC off:U= U_{low} AC on:U= U_{bat}		
16	—	—		

U_{bat}= Battery voltage, U_{low}= Voltage near 0 V U= voltage in volts (V)
f= frequency in hertz (Hz) %= pulse quotient, duty cycle n%

Connection	Diagnosis Mode System Tester	If there is not signal
1	Mode 1 and 2 Running Test Monitor Test	Engine does not start
2	Mode 1 and 2 Running Test Monitor Test	Idling speed drops so low that the engine stops or does not start. No fuel shut-off with engine braking.
3	Mode 1 and 2 Running Test Monitor Test	Poor acceleration
4	Running Test	Adaption and diagnostic system lose memory.
5	Running Test	Grounding takes place internally via # 17 power ground
6		Grounding takes place internally via #5
7	Mode1, Running & Monitor Test	
8		
9	Running Test	Engine does not start.
10	Mode1 Running & Monitor Test	
11	Running Test	
12		Diagnostic system cannot be used
13	Mode 1 Running Test Monitor Test	Control unit uses a replacement value which corresponds to a hot engine. The engine starts with difficulty when cold.
14	Mode 2 Monitor Test	Idling speed drops when A/C compressor is engaged.
15	Mode 2	Idling speed drops when A/C compressor is engaged.
16		—

Connection	Signal type Function	Ignition on	Idle	Engine speed higher than idle
17	Power ground Power ground connected to intake manifold. Used for power-intensive components such as injectors and idle valve	U= U_{low}		
18	Control of injectors Grounded when the injectors are to open.	U= U_{bat} (#5)	U= 200-350 mV (#35)	U increases with engine speed
19	Signal ground Ground connected to intake manifold, grounds the control unit internally	U= U_{low}		
20	Control of pump relay Grounded when the engine speed signal comes to # 1. Used to activate the pump relay	U= U_{bat}	U= U_{low}	
21	Control of system relay Grounded when voltage is supplied to #35. Used to activate system relay	U= 0.8-1.0 V		
22	Check engine LED	LED lights:U= U_{low} ,LED off:U= U_{bat}		
23	—			
24	Lambdasond signal Information from lambdasond regarding oxygen content in exhaust gases. Adjusts injection timing so that λ=1	U= U_{low}	U= 0.1-1.2 V	
25	Load signal Digital output signal to Rex (# 8) about engine load	U_{AC}= U_{low} f≈ 0 Hz	U_{AC}≈60 mV f ≈25 Hz	U increases with increased load f increases with engine speed
26	Gear change indicator (USA/Calif, manual)	Lamp on:U= lo , Lamp off:U= Ubat		
27	—			
28	—			
29	—			
30	Start detent contact (automatic) Information about gear selector position. Used to maintain constant idling speed when a gear is engaged.	P N-position:U= U_{low} D 1 2 3 R-position:U= U_{bat}		
31	—			
32	Ground cold-start injector Grounded when temperature is below -18°C (0F) and activates the cold-start injector	U= U_{bat} Valve connected to starter motor: U= U_{low}		U reduced when the valve is activated
33	Idle valve Grounded output signal. Control unit adjusts the idle valve opening so that idling speed is maintained constant irrespective of load. In the event of engine braking the signal is used together with engine speed and load signals to maintain a constant pressure in the intake manifold so as to regulate crankcase ventilation.	U= U_{bat}	U= 11-12V %duty= 20%	U reduced with load at idling %duty< 25 % up to 2500 rpm thereafter increased
34	Speedometer signal Information about the car's speed from the speedometer. Used to adjust the idling speed with engine braking and idling adaption	U= U_{low}/U_{bat}		U= 6-7 V (speed higher than 10 km/h)
35	Voltage supply (+15) Voltage supply to certain of the control unit's internal functions.	U= U_{bat}		

Connection	**Diagnosis Mode System Tester**	If there is no signal
17	Running Test	If #19 also is missing the engine does not start.
18	Mode 3 Running Test Monitor Test	No injection pulses
19		If #19 also is missing the engine does not start.
20	Running Test	Pump relay does not engage; as a result the fuel pump does not function and the lambdasond pre-heating does not function. Engine does not start
21	Running Test	System relay does not engage. No voltage supply to pressure sensor and temperature sensor for intake air
22	—	—
23	—	—
24	Mode 1 Running Test Monitor Test	Control unit cannot compensate injection timing and engine runs either too rich or too lean.
25	Running Test	Ignition angle set for engine under full load except when idle switch is on.
26	—	Control lamp for gearchange does not light up.
27	—	—
28	—	—
29	—	—
30	Mode 2	Idling speed drops when a gear is engaged.
31	—	—
32	Mode 3	Difficult to start engine when temperature is below – 18°C (0°F)
33	Mode 1 and 3 Running Test Monitor Test	Idling speed will be higher than normal roughly 1100 rpm. Idle valve function will be inactive.
34	Mode 1	Idling speed will be higher than normal roughly 1100 rpm. Idle valve function will be inactive. Gearchange control lamp never lights up.
35	Running Test Monitor Test	System relay does not engage. No voltage supply to pressure sensor and temp. sensor for intake air, suppression relay and idle valve. Engine does not start.

NC. Signal description Rex-I

Important! All the values shown are between the connection in column 1 and connector 20. Check therefore that this chassis connection is correctly attached to the battery's negative terminal before carrying out the measurement.

Values at idle speed are for a hot, unloaded engine.

Connection	Signal type Function	Ignition on	Idle	Engine speed higher than idling
1	Diagnostic link Two-way communication between control unit and diagnostic socket	U≈5 V		
2	Temperature sensor engine Used to adjust ignition angle when the engine is not hot	U≈ 0.9 V hot engine, voltage increases with a colder engine		
3	Environment lamp	Lamp on:U= U_{low}, Lamp off:U= U_{bat}		
4	—	—	—	—
5	Voltage supply (+30) Voltage supply for diagnostic system memory and the adaptive function	U= U_{bat}		
6	Voltage supply (+15) Voltage supply to control unit	U= U_{bat}		
7	Idle switch Grounded if the throttle valve is at idle setting.	U= U_{low}		U≈5 V
8	Load signal Digital input signal from Regina (# 25) for adjustment of ignition angle depending on load	U= U_{low}	U_{AC}≈ 60 mV f≈ 25 Hz	U reduced with increased load f increases with engine speed
9	—	—	—	—
10	Impulse sensor signal Engine speed increasees and position in relation to TDC	UAC= Ulow f= 0 Hz (#23)	U_{AC}=1-2 V f ≈500 Hz (#23)	U and f increase with engine speed 11
12	Knock sensor ground Internally connected to # 20 in the control unit	U= U_{low}		
13	Knock sensor signal Information about whether the engine is knocking or not	U= U_{low}		
14	—	—	—	—
15	—	—	—	—
16	Triggering signal for power stage Gives a signal to the power stage when ignition should take place	U≈50 mV	U≈ 550 mV f ≈25Hz	U and f increase with engine speed
17	Engine speed signal Engine speed signal to Regina (# 1)	U= 10-12 V f= 0 Hz	U= 7-8 V f ≈25Hz	f increases with engine speed
18	—	—	—	—
19	—	—	—	—
20	Signal ground Signal ground connected to intake manifold	U= U_{low}		
21	—	—	—	—
22	—	—	—	—
23	Impulse signal Engine speed and position in relation to TDC	U_{AC}= U_{low} (#10)	U_{AC}=1-2 V f≈500 Hz (#10)	U and f increase with engine speed
24	—	—	—	—
25	—	—	—	—

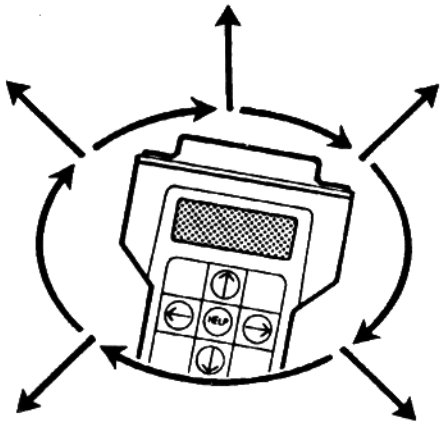
U_{bat}= Battery voltage
U_{low}= Voltage near 0 V
U= voltage in volts (V)
f= frequency in Hertz(Hz)
%= pulse quotient, duty cycle in %

Connection,	**Diagnosis Mode System Tester**	**If there is no signal**
1	—	Diagnostic systemet does not function
2	Mode 1 Running Test	Control unit uses a pre-programmed value
3	—	Environment lamp does not light up
4	—	—
5	Running Test	Memory for adaption and diagnostic system deleted. Time for deletion varies considerably between different control units.
6	Running Test Monitor Test	Engine does not start
7	Mode 1 och 2 Running Test	
8	Mode 1 Running Test	Ignition angle regulated as if the engine operates under full load except when the idle switch is on
9	—	—
10	Mode 1 Running test	Engine does not start
11	—	May result in interference at # 23 at certain vulnerable engine speeds
12	Mode 1	Control unit cannot detect knock. The control unit retards ignition to protect the engine. The engine feels sluggish.
13	Mode 1	Control unit cannot detect knock. The control unit retards ignition to protect the engine. The engine feels sluggish.
14	—	—
15	—	—
16	Running Test	Engine does not start
17	Running Test Monitor Test	Engine does not start
18	—	—
19	—	—
20	Running Test	Engine does not start
21	—	—
22	—	—
23	Mode 1 och 2 Running Test	Engine does not start
24	—	—
25	—	—

P. Running test Volvo System Tester

Sphere of operations

The Running Test registers and stores data about faults. Since the Volvo System Tester stores not only long-term faults but also faults which only appear in the short term, the Volvo System Tester is particularly suitable for use with intermittent faults.



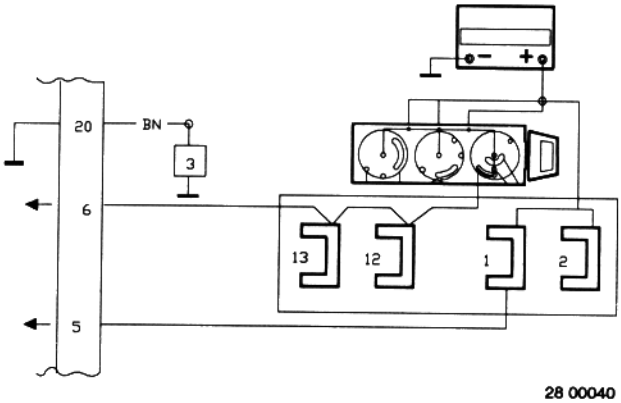
S148 136

Test description

The System Tester performs tests of signals in a particular sequence and then starts all over again. Certain tests are conducted in parallel while other tests require that the microprocessor works on only one test.

In certain circumstances, different fault messages can be provided for one and the same fault. This is because the System Tester first discovers the secondary fault before measurement of the deviant signal is carried out. One such example is a break in the impulse sensor signal which may provide a variety of different fault messages depending on when the fault occurs.

Several tests require that the System Tester carries out measurements of another value in order to determine whether a fualt has arisen or the measured value is normal. As a result, a test may take such a long time that the System Tester cannot complete the entire test procedure before engine speed drops below the relevant lower engine speed limit.



28 00040

Example, voltage supply from the ignition lock.

If voltage drops below 6 V at #35 for Regina, a test is carried out to determine whether voltage is under or over 6 V at #6 before a fault message is stored.

If voltage is below 6 V at Rex-I the System Tester interprets it as though the ignition has been set at the 0 position and the test is terminated.

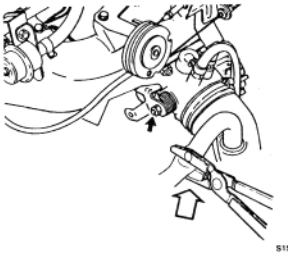
If instead the voltage is above 6 at Rex-I the System Tester must wait a while and repeat the Rex-I measurement before a fault measurement at #35 Regina can be stored. This delay is necessary because voltage drops at different rates at #6 Rex-I and #35 Regina when the ignition lock is in the 0-position. If engine speed has dropped below the lower limit during this period, no fault message is stored and the system interprets the situation as though the ignition lock is in the 0-position.

See also End of test, no faults found.

Repairs

RA. Checking the throttle housing setting

RA1


S150 544

Checking the need for adjustment

- Warm up the engine.
- Connect an accurate tachometer.
- Engine idling
- Gear selector in the P position.
- A/C off
- Pinch the IAC valve hose with a hose clip.

Engine speed should be below 500 rpm. It is not a fault if the engine stops.

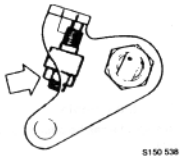
If this value is OK:

- Remove the hose clip.
- Return to fault tracing where it was interrupted.

If the reading is incorrect:

- Adjustment of idling speed *RA2*.

RA2

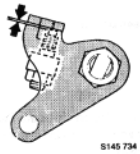

S150 538

Adjustment of idling speed

- Undo the lock nut for the adjustment screw on the throttle spindle.
- Turn the adjustment screw until idling speed is 480 -520 rpm.
- Switch off the engine.
- Tighten the lock nut. Grip the adjustment screw so that it does not rotate.

- Continue with Follow-up checking RA3.

RA3


S145 734

Follow-up checking

- Open the throttle and check the distance between the lever and the adjustment screw with a feeler gauge.

With a 0.45 mm feeler gauge **there should not be** any clicking sound from the idling switch when the throttle is closed.

With a 0.15 feeler gauge **there should be** a clicking sound from the idling switch when the throttle is closed.

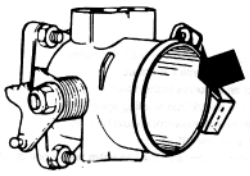
If the distances are OK:

- Return to faulttracing where it was interrupted.

If there was any deviation in any of the dimensions:

- Adjust the throttle switch according to RC.Adjustment of throttle switch.

RB. Adjustment of throttle valve



S139 912

RB1

Preparations

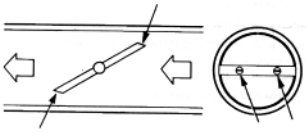
– Remove the throttle switch from the throttle housing.
– Remove the throttle housing.

Clean the throttle housing and throttle valve.

– Undo the adjustment screw so that the valve closes completely.
– Undo the screws on the throttle valve so that the valve is held loosely in place.

Check that the throttle valve is facing the right way.

- Continue with Adjustment of throttle valve.



S150 539

RB2

Adjustment of throttle valve.

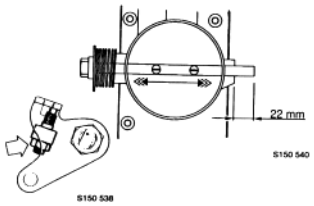
– Hold the throttle housing with the valve in a horizontal position.

Open and shut the throttle valve with the lever a few times so that the throttle valve centres in the throttle neck (open to about 1/3 aperture every time).

– Hold the throttle housing against the light.

Turn the valve with your fingers so that the opening is as uniform and small as possible

- Continue with Adjustment of throttle spindle RB3.



S150 540

S150 538

RB3

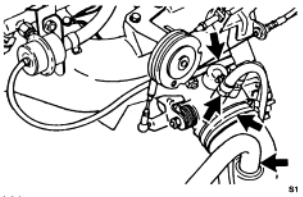
Adjustment of throttle spindle

Check that the throttle spindle can be pushed back and forth with little resistance.

Adjust the throttle spindle so that it protrudes max. 22.5 mm (0.86 in) as in the illustration.

> NOTE!
> The indicated maximum measurment, 22.5 mm, may not be exceeded. Otherwise there is a risk that the throttle spindle may hit the TP switch.

– Tighten the throttle valve fixing screws 0.6 ± 0.1 Nm (5 ± 1 in. lbs).
– Tighten the adjustment screw until it touches the link arm.
– Screw in a further QUARTER turn.
– Tighten the lock nut while holding the adjusting screw, 0.6 ± 0.1 Nm (5 ± 1 in. lbs).
- Continue with Assembly *RB4*.



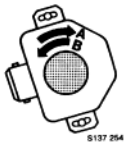
S1

RB4

Assembly

– Install the throttle housing on the intake manifold.
– Install the link rod and lock with the clamps.
– Connect all the hoses.
– Continue with RC. Adjustment of throttle switch.

RC. Adjustment of throttle switch



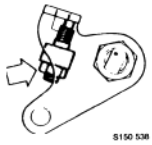
S137 254

RC1

Assembly, disassembly of throttle switch

– Disconnect the throttle switch.
– Unscrew and remove the throttle switch. Replace screws with new ones with red threads (P/N 977 762-4). Alternatively, use looking fluid on existing screws.
– Do not tighten the screws; let the throttle switch sit loosely.
– Rotate the throttle clockwise.

• Continue with Adjustment of throttle switch RC2.

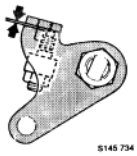

S150 538

RC2

Adjustment of

– Place a 0.25 mm feeler gauge between the lever and the adjustment screw.
– Rotate the throttle switch slowly until it "clicks".
– Screw tight the throttle switch in this position (1.2-2.0 Nm).

• Continue with Follow-up check RC3.


S145 734

RC3

Follow-up check

– Open the throttle and check the gap between the lever and adjustment screw with a feeler gauge.

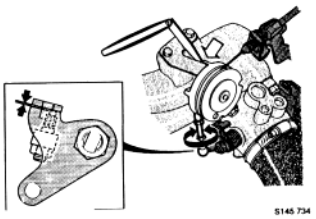
With a 0.45 mm feeler gauge **there should be no** clicking sound when the throttle closes.

With a 0.15 mm feeler gauge **there should be** a clicking sound when the throttle closes.

– Connect the connector to the throttle switch.

• Continue with RD. Adjustment of throttle control

RD. Adjustment of throttle control


S145 734

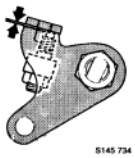
RD1

Adjustment of link rod

– Insert a 2.5 mm feeler gauge at the control puller stop.
– Rotate the middle section of the link rod until the lever comes away from the adjustment screw and the idling switch clicks.
– Rotate the link rod back until the idling switch clicks once more.
– Tighten the lock nuts in this position, first manually using a spanner (0.45-0.75 Nm). Grip tight so that the link rod does not rotate.

• Continue with Follow-up check RD2.

RD2


S145 734

Follow-up check

– Check with a feeler gauge the gap between the lever and the adjustment screw.

A 0.1 mm feeler gauge **should** fit between the lever and link rod.

A 0.5 mm feeler gauge **should not** fit between the lever and link rod.

If the gap is OK:

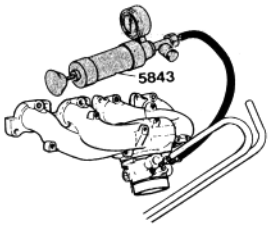
- Return to troubleshooting where you left off.

If the gap is incorrect:

- Repeat adjustment according to Adjustment of link rod RD1.

RE. Adjustment for insufficient A/C compensation

RE1



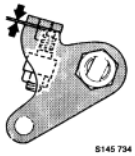
S152 545

Adjustment of throttle opening

– Disconnect cannister control (thin hose) and connect a vacuumpump to the nipple.
– Let the engine run at idling speed.
– Measure the pressure leading to the cannister control (it should normally be at atmospheric pressure app. 14.7 psi).
– Open the throttle with the adjustment screw until the meter indicates a negative pressure.
– Turn back the adjustment screw until the negative pressure disappears.
– Tighten the lock nut. Grip the adjustment screw so that it does not rotate.

- Continue with Follow-up check RE2.

RE2


S145 734

Follow-up check

– Insert a 2.5 mm feeler gauge at the control puller stop.
– Use a feeler gauge to check the gap between the lever and adjustment screw.

A 0.1 mm feeler gauge **should** fit between the lever and adjustment screw.

A 0.5 mm feeler gauge **should not** fir between the lever and adjustment screw.

If the gaps are OK:

- Return to troubleshooting where you left off.

If any gap is incorrect:

- Adjust the throttle switch according to RC.Adjustment of throttle switch.