CI Fuel Injection System (Engine B21F)

Repairs and Maintenance

Section	Group
2	24

CI System (Engine B21F)
1976–

VOLVO

Group 24

Engine Fuel System

CI Fuel Injection System

Index

Servicing

The following subgroups A to H have been arranged to constitute one continuous service of the CI System. However, separate operations can be picked to satisfy special demands.

Checks, replacements, adjustments

TP 11121/3

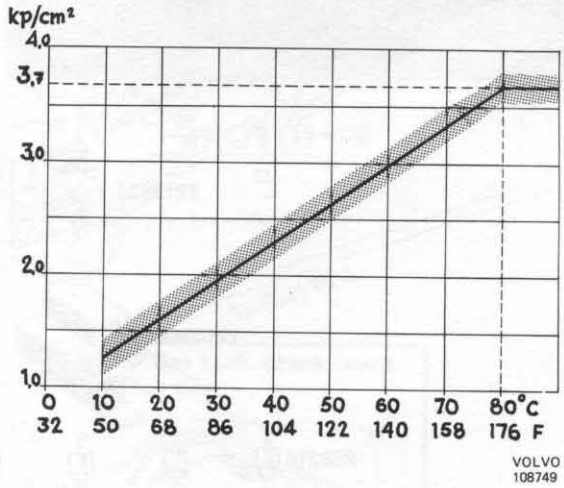
3000.4.80

Printed in U.S.A.

CI Specifications

Fuel filter	**Metric**	**US**
Type	Paper	
Replacement intervals	50,000 km	30,000 miles
Fuel pump (electric, roller type)		
Capacity	1.6 liters/minute at 5 kp/cm^2	1.6 qts/minute at 70 psi
Current draw	max. 8.5 amps	
Injectors		
Opening pressure	2.6–3.6 kp/cm^2	37–51 psi
No bleeding permitted below	2.4 kp/cm^2	34 psi
Auxiliary air valve		
Completely open at	–30°C	–22°F
Completely closed at	+70°	+158°
The air valve is controlled electrically and should be closed after 5 minutes heating-up.		
Line pressure	4.5–5.3 kp/cm^2	64–75 psi
Rest pressure		
Minimum	1.7 kp/cm^2	24 psi
Control pressure		
Hot engine	See engine specifications	

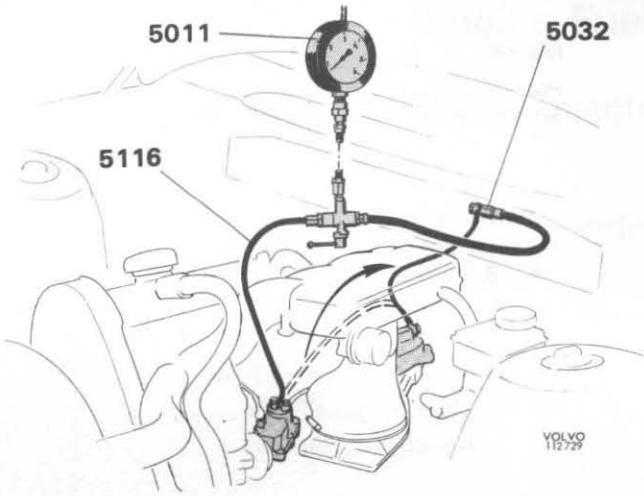
Cold engine, see diagram



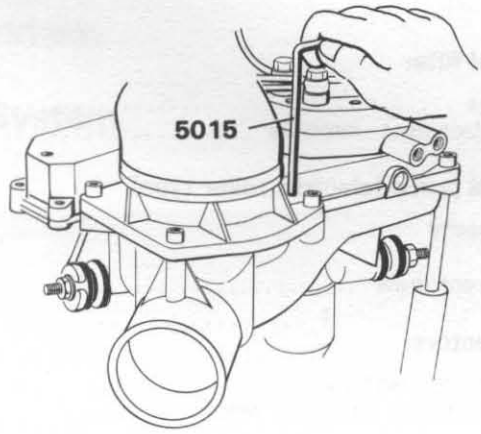
Air filter		
Type	Paper	
Replacement intervals	50,000 km	30,000 miles
CO		
Idle speed	See vehicle specification	
Measurement, engine hot, idle	See vehicle specification	

Tools

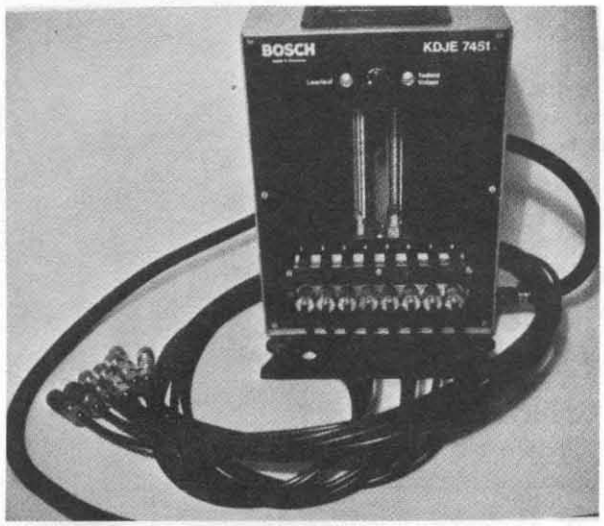
To order, put the number 999 in front of the tool number.

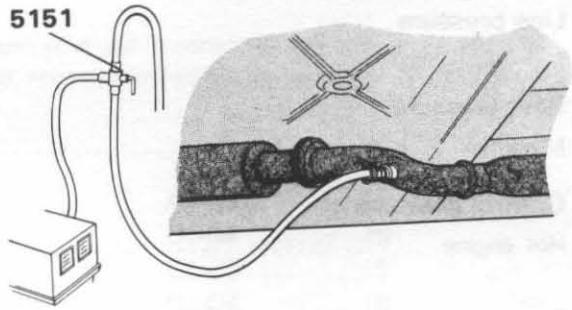


5011 Gauge assembly
5116 Hose assembly
5032 Nipple

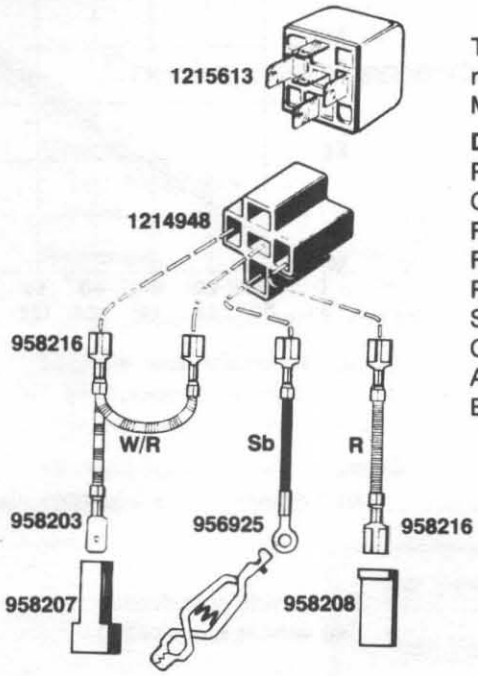


5015 CO adjusting tool



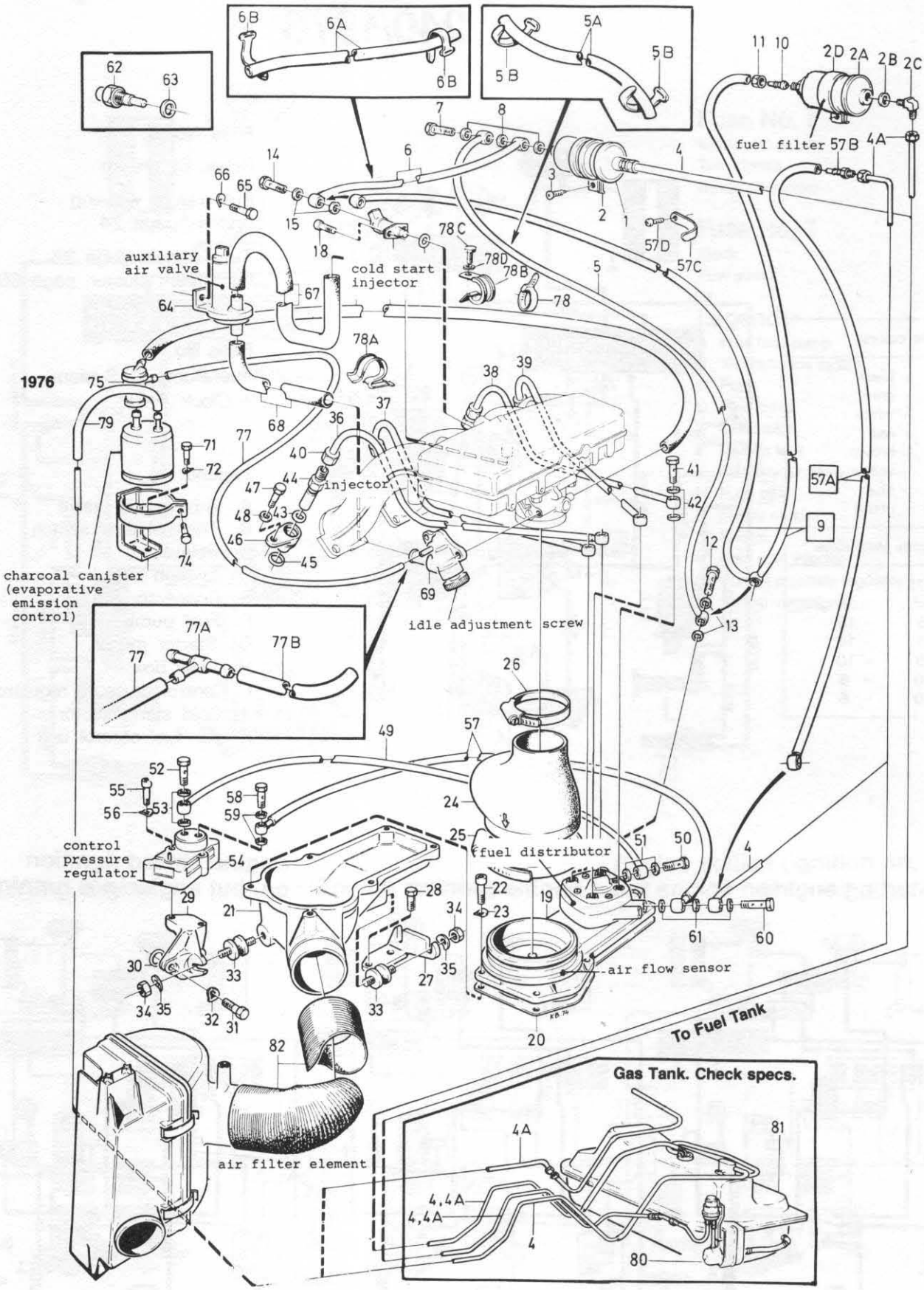


Valve and hose kit for CO-meter (California only)



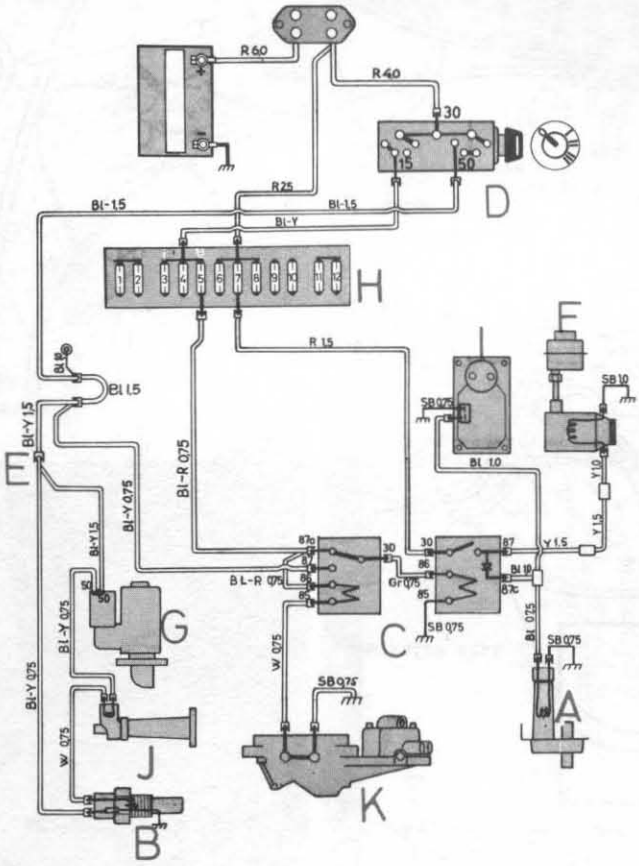
Test Relay 5170 is sold complete with electric cables. The relay and cables can also be wired up at the workshop. Materials required are the following:

Description	P/N	Qty.
Relay	1215613-9	1
Connector	1214948-0	1
Flat-pin sleeve	958216-4	5
Flat pin	958203-2	1
Pin insulation	958207-3	1
Sleeve insulation	958208-1	1
Cable shoe	956925-2	1
Alligator clamp	—	1
Electric cable	0.75 mm²	75 + 125 mm = 2⅞″ + 4⅞″ white/red
	0.75 mm²	300 mm black = 11¾″
	0.75 mm²	125 mm red = 4⅞″


1976
auxiliary air valve
cold start injector
injector
fuel filter
charcoal canister (evaporative emission control)
idle adjustment screw
control pressure regulator
fuel distributor
air flow sensor
air filter element
To Fuel Tank
Gas Tank. Check specs.

CI fuel injection system 240/1976

Wire colors:
SB – black GR – gray W – white R – red BR – brown Y – yellow BL – blue GN – green
Approx wire sizes:
0.75 mm² – 18 gauge 1.5 – 16 2.5 – 14 6.0 – 10 10.0 – 8 16.0 – 6



Fuse No. 5:

Relay, CI system

Bulb failure warning system, page 24

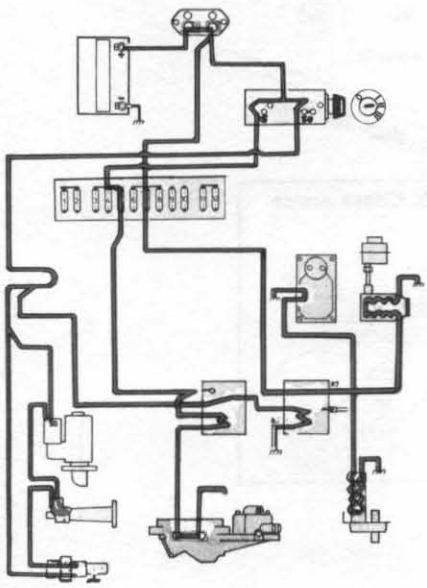
Turn signals, page 36
Instrument cluster, page 60

Fuse No. 7:
Fuel Pump, CI System + Clock

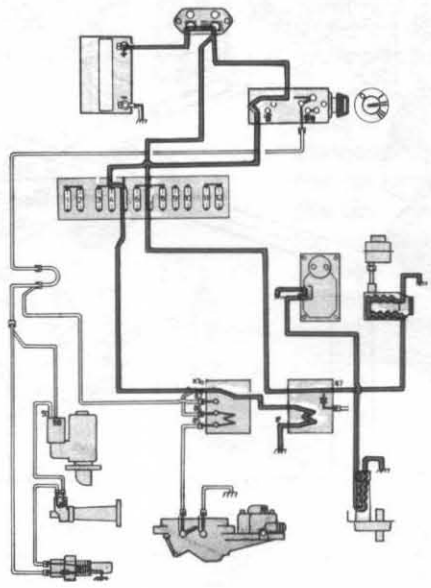
Legend:

A Auxiliary air valve
B Thermal time switch
C Relays
D Ignition switch
E Connector
F Fuel pump
G Starter motor
H Fuse box
I Control pressure regulator
J Cold start injector
K Air/fuel control unit

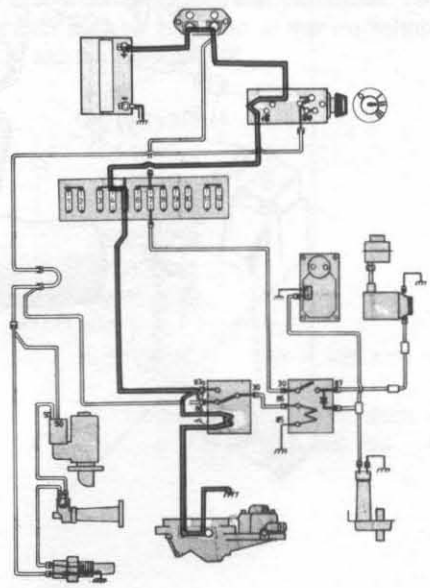
Starting engine



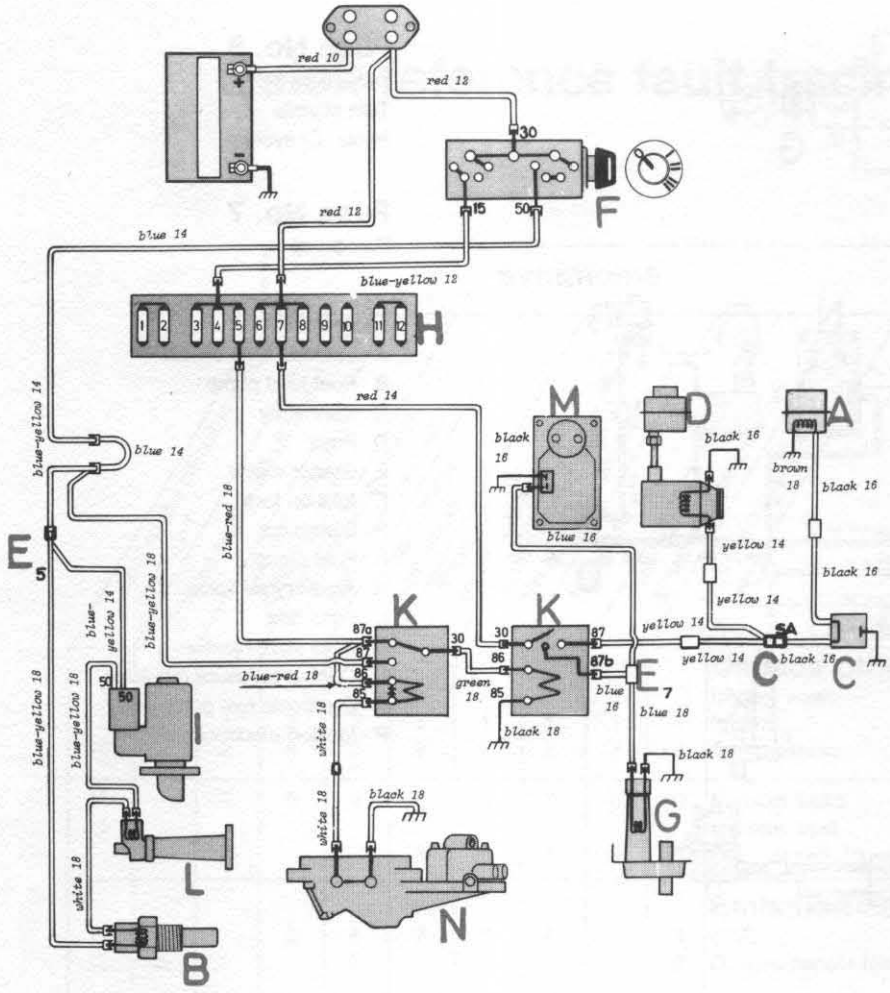
Engine running



Engine stalled (ignition on, but engine not running)



CI fuel injection system 240/1977

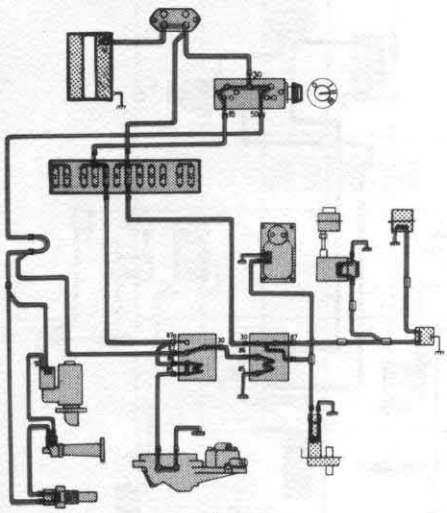


Fuse No. 5
Instrument cluster
Turn signals
Relay, CI system

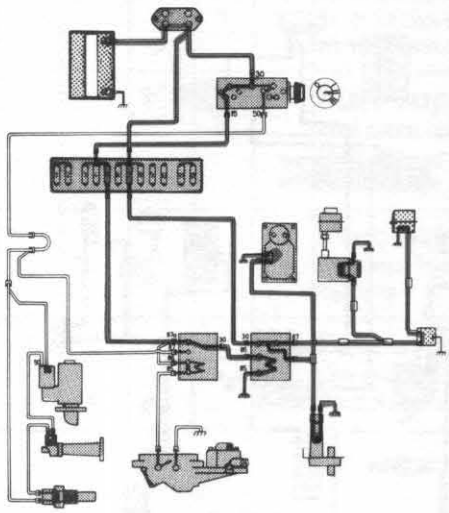
Fuse No. 7
Clock
Fuel pump

Legend:
A Fuel feed pump
B Thermal time switch
C Fuse
D Fuel pump
E Connector
F Ignition lock
G Auxiliary air valve
H Fuse box
I Starter motor
K Relays
L Cold start injector
M Control pressure regulator
N Air/fuel control unit

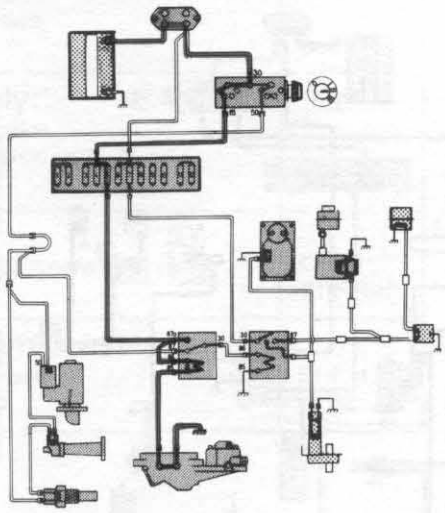
Starting engine



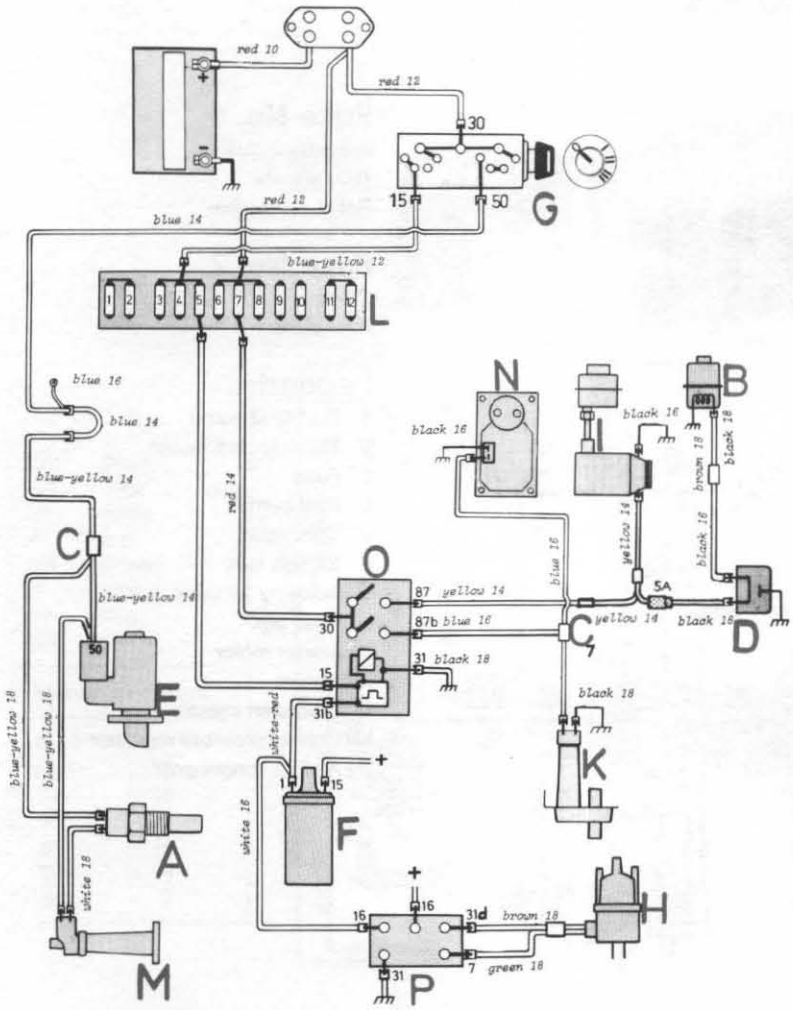
Engine running



Engine stalled (ignition on, but engine not running)



CI fuel injection system 240/1978



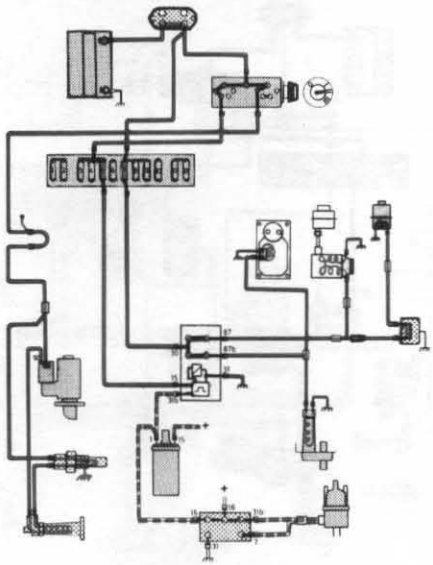
Fuse No. 5
Instrument cluster
Turn signals
Relay, CI system

Fuse No. 7
Fuel pump

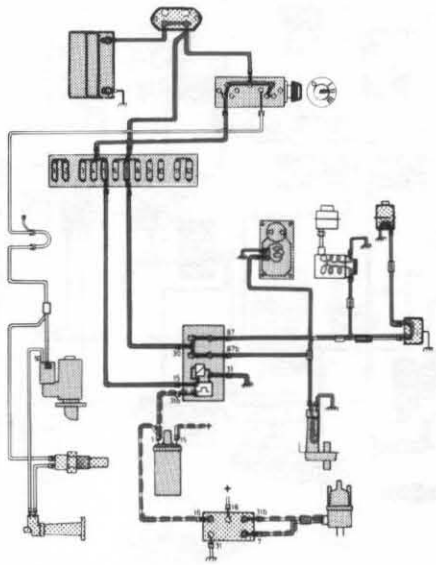
Legend:

A Thermal time switch
B Fuel feed pump
C Connector
D Fuse
E Starter motor
F Ignition lock
H Distributor
I Fuel pump
K Auxiliary air valve
L Fuse box
M Cold start injector
N Control pressure regulator
O Electronic fuel pump relay
P Ignition electronic module

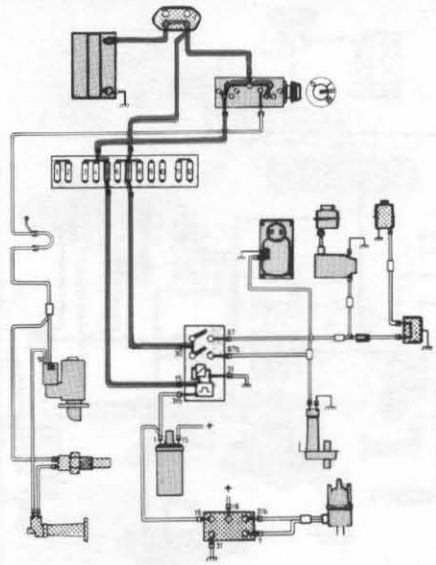
Starting engine



Engine running



Engine stalled (ignition on, but engine not running)



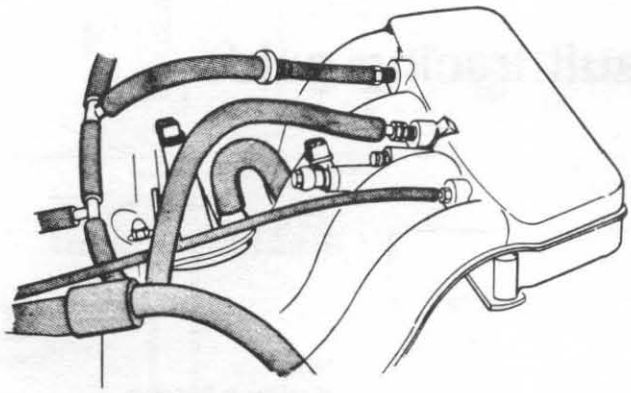
Service diagnosis

Quick reference fault tracing guide

Symptoms: Cold engine difficult to start, or no start	Warm engine difficult to start	Cold and warm engine difficult to start	Erratic running engine, cold or during warmup	Erratic running, warm engine	Erratic running, engine cold and warm	Erratic running engine and high fuel consumption	Rough idle	Low top speed (poor engine performance)	High fuel consumption	Causes	Info
										Causes other than CI fuel:	
1										Battery weak	*
2	1	1	3	2	1	1	1	1	1	Ignition	*
10	2	2	4	3	2	2	2	2	2	Compression	*
15		7	5	6	8	8	7	6	10	Vacuum leaks	*
16										Extreme cold	*
		6			6	6	3	5	8	CO	*
										Emission control systems:	
11	4		2	4	7	7	6		9	EGR	*
12	5			5	5	5			6	Oxygen sensor feedback system	*
13								7		Catalytic converter	*
14										Evaporative control	*
										Air supply:	
3									3	Air intake system	*
5		3			3		4	3		Air induction system	*
8		4					5			Air flow sensor	D1-D4
										Fuel supply:*	
4										Fuel pump operation	*
6										Main relay operation (1976-77 only)	*
									4	Fuel leakage	F9-F11
										Injectors:	
7						3			5	Cold start injector, thermal time switch	C1-C3
										Injectors	F1-F14-H1
										Fuel system pressures:	
	3	5						4		Line and rest pressures	E1-E14
			1	1	4	4			7	Control pressure	K1-K2

Note:
Numbers in Symptom columns represent order of likely occurrence.

Engine will not start



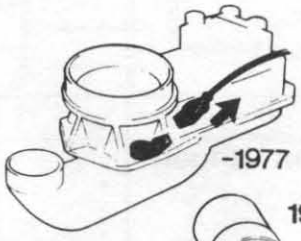
OP. 1.

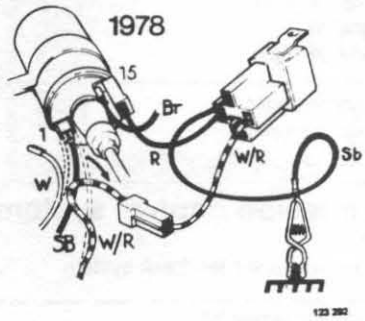
Check spark

OP. 2.

Check for intake manifold leaks

Manifold should be rigidly attached.
No connection leaks.





OP. 3.

Check fuel pump operation

Start the fuel pump

1976-1977: Disconnect the contact piece from the air flow sensor.

1978—Connect test relay 5170.

If fuel pump operates, go to Op. 4 below.
If fuel pump does **not** operate:

A. Check fuses No. 5 and 7.

Fuse blown or defective	Check circuit for shorts. Replace blown fuse.

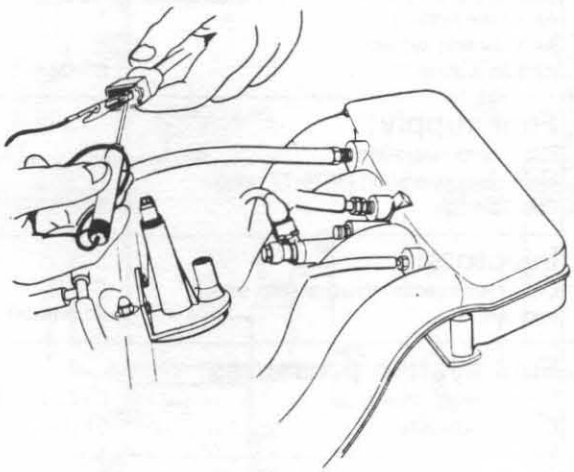
B. Check for voltage at auxiliary air valve terminals.

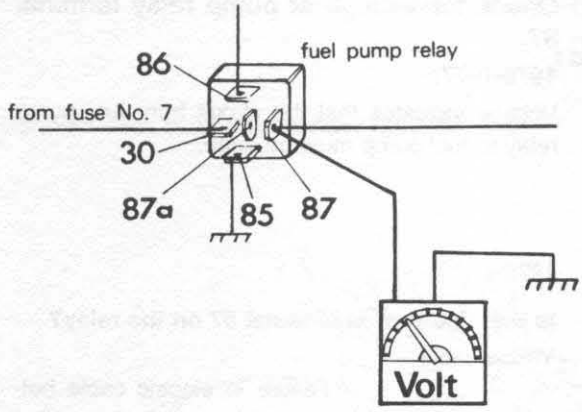
1976-1977:

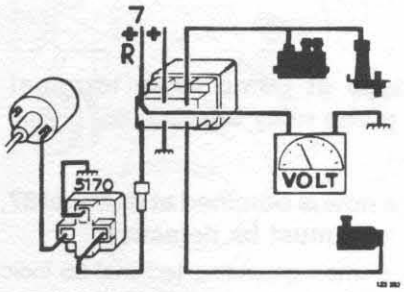
The terminals are normally live. In this condition, however, live terminals indicate defective fuel pump or fuel pump wiring.

1978—

Same as above.







C. Check for voltage at pump relay terminal 86

1976-1977:
from main relay terminal 30.

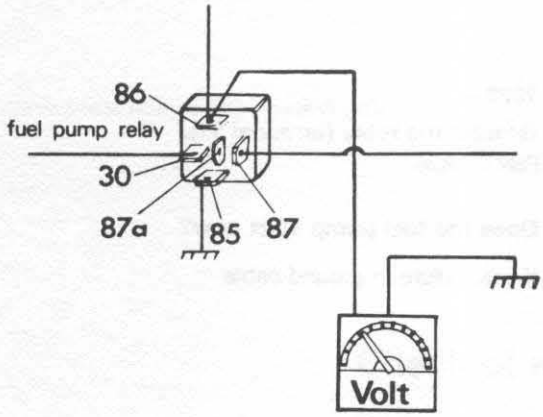
The terminal is normally live. If it is, go to Op. D. If there is **no** voltage, check for voltage at main relay terminal 87 A:

1. Voltage indicates a defective main relay.
2. No voltage indicates open circuit from ignition coil to terminal 86 on main relay.

1978—

Is there current at terminal 30 on the relay?
Red cable

Failure in electric cable between relay and fuse No. 7



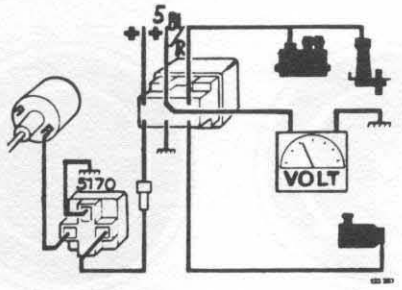
D. Check for voltage at pump relay terminal 30/51

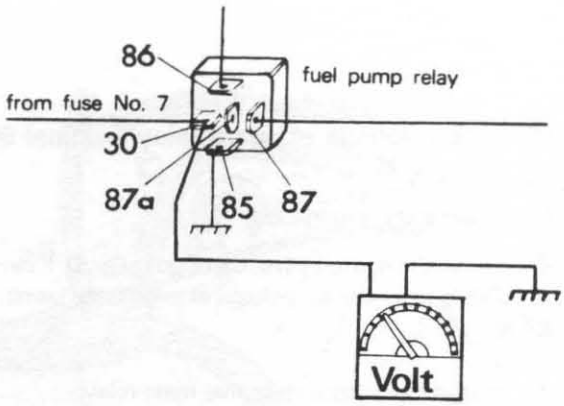
1976-1977:

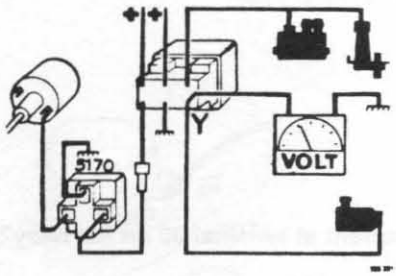
The terminal is normally live. If there is **no** voltage, the circuit from the fuse must be open.

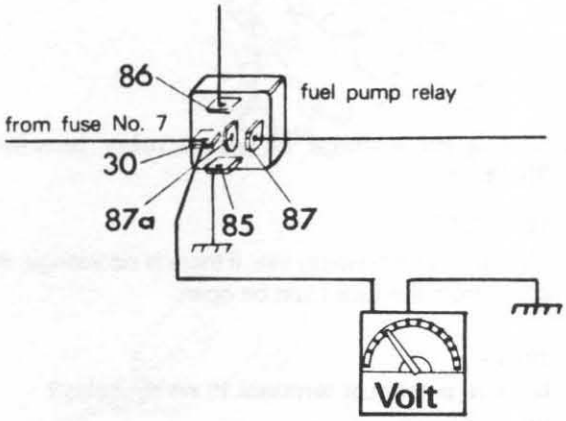
1978—
Is there current at terminal 15 on the relay?
Blue/red cable

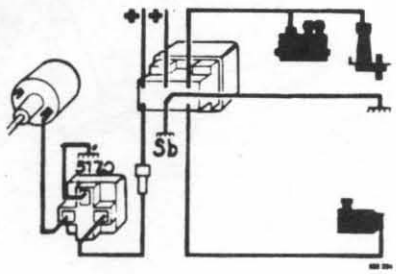
Failure in electric cable between relay and fuse No. 5











E. Check for voltage at pump relay terminal 87.

1976-1977:

Voltage indicates that the circuit from fuel pump relay to fuel pump must be open.

1978—

Is there current at terminal 87 on the relay?

Yellow cable

Failure in electric cable between relay and fuel pump

F. No voltage at pump relay terminal 87, ground pump relay terminal 85.

1976-1977:

If voltage now is obtained at terminal 87, the ground wire must be defective.

No voltage when grounding terminal 85 indicates that the pump relay is defective and should be replaced.

1978—

Ground the relay (terminal 31).

Black cable

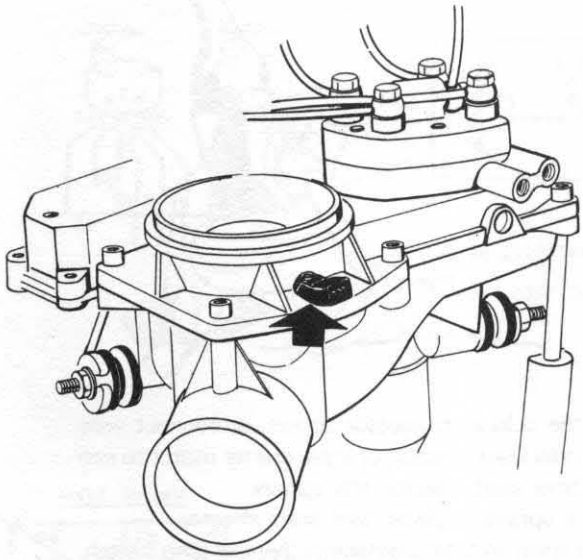
Does the fuel pump start now?

If yes, failure in ground cable

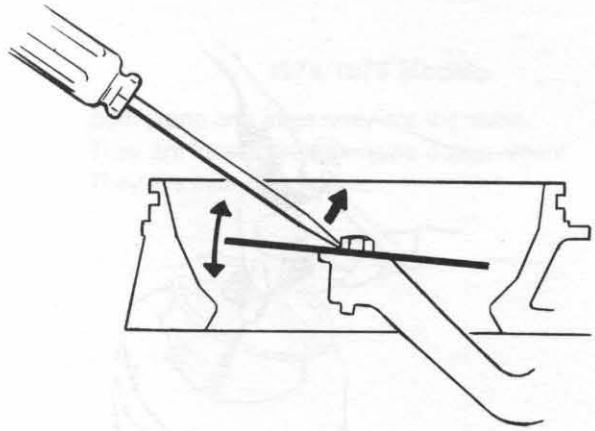
OP. 4

Check contact switch at air flow sensor
1976-1977

Connect wire at air flow sensor (ignition on).



Lift the air flow sensor plate. The injectors should buzz.



If not, check if fuel pump operates.
If fuel pump operates, check pressure.
If fuel pump does **not** operate, this indicates an incorrect ground in the air flow sensor connector.

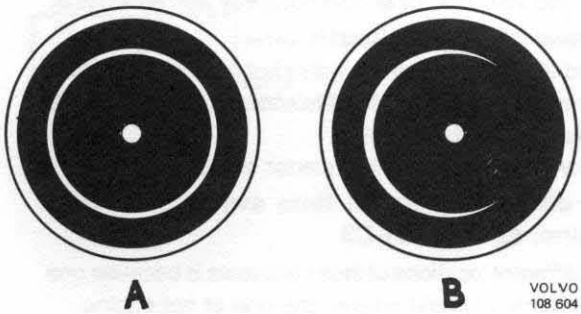
1978—

Connect test relay 5170 (ignition on).

Lift the air flow sensor plate. The injectors should buzz.

OP. 5.

Check of air flow sensor plate
1976-



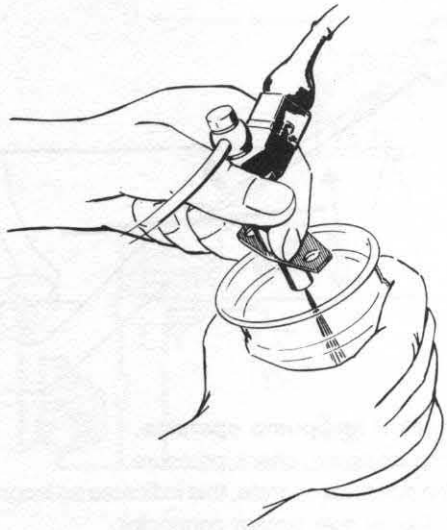
Check that the air flow sensor plate is correctly adjusted and operates without binding.

OP. 6.

Check cold start injector

Cold engine

Remove and check operation of cold start injector when starter motor is operated (inhex 5 mm).
The cold start injector should spray.



If it sprays other possible faults might be, leaks (generally), incorrect control pressure, or a defective auxiliary air valve.

If it does not spray:
Check for voltage of cold start terminals when starter motor is operated.
Voltage indicates defective cold start injector.
No voltage indicates defective thermal time switch or thermal time switch wiring.

Hot engine

Check that the cold start injector does **not** spray when the starter motor is operated.

If the cold start injector sprays, disconnect wire at cold start injector, operate starter motor to see if cold start injector still sprays.
If it sprays, replace cold start injector.
No spray indicates defective thermal time switch.

Other possible defects:
leaks, incorrect line pressure, misadjusted CO.

Thermal time switch

Check the thermal time switch—Hot engine

Disconnect the cold start injector from the manifold and place it over a container.
Run the starter motor.
The cold start injector should not spray with hot engine.

In case of malfunction:

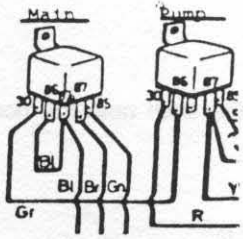
If cold start injector sprays with a hot engine, it indicates thermal time switch is defective and should be replaced.
Reinstall cold start injector.
Disconnect remote control starter switch.

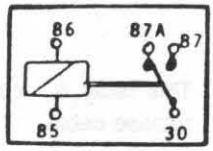
For check of thermal time switch with cold engine, see Op. C1-C3

The different locations of these two tests is because one is performed at cold engine and one at hot engine.

OP. 7.

Checking relays





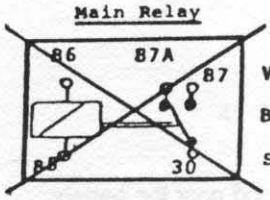
Volvo #1214764-1

Bosch #0332 204 125

1974/1975 Models

Both pump and main relay are the same.
They are located in the engine compartment.
They are interchangeable.

Main Relay

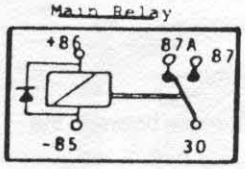


Volvo #1234750

Bosch #0332 204 102

Superseded By

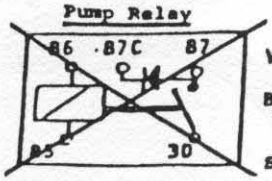
Main Relay



Volvo #1235134-2

Bosch #0332 204 110

Pump Relay

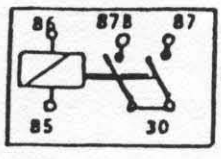


Volvo #1234751

Bosch
#0332 014 114

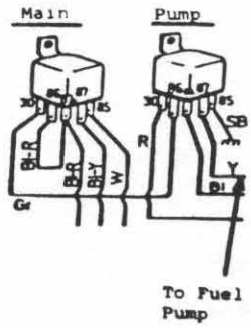
Superseded By

Pump Relay



Volvo #1235020-1

Bosch
#0332 015 009



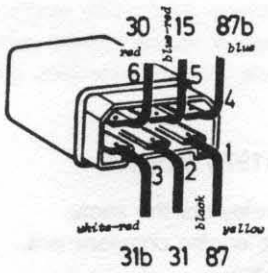
1976/1977 Models

Both the main and pump relays are located under the dash near the hood release cable.

The pump relay is easily distinguished from the main relay by a heavy gauge yellow wire in its multiplug (#87), which goes to fuel pump.

In most cases, the pump relay is fitted with a white plastic plug.

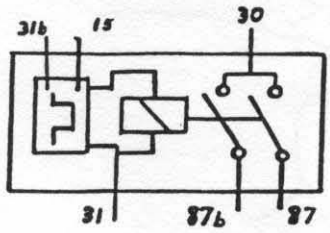
CAUTION: These two relays must never be interchanged.



1978—

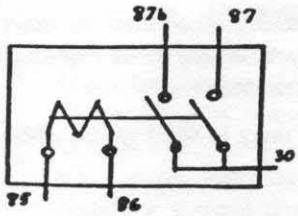
This relay is located under the dash near the hood release cable.

Pump Relay



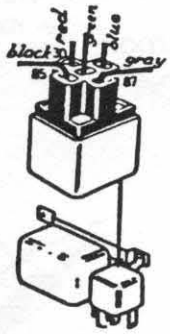
Volvo No.
1235337-1

Lambda-Sond Relay



Volvo #1235013-8.

Bosch No. 0332015 001 Early
Bosch No. 0332015 012 Late



1977—

This relay is located under the hood near the battery.

Volvo #1235013-8

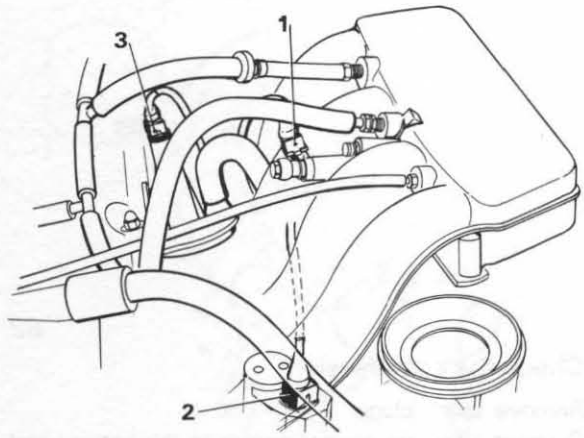
Both relays use the same Volvo number.

The mounting bracket is the only difference between the early and late version.

Servicing

The following subgroups A to H have been arranged to constitute one continuous service of the CI System. However, individual operations can be used to satisfy special demands.

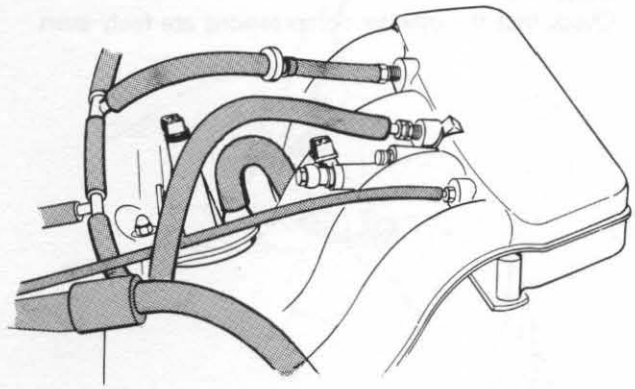
Preparations prior to servicing



A1

Disconnect electrical wires at:

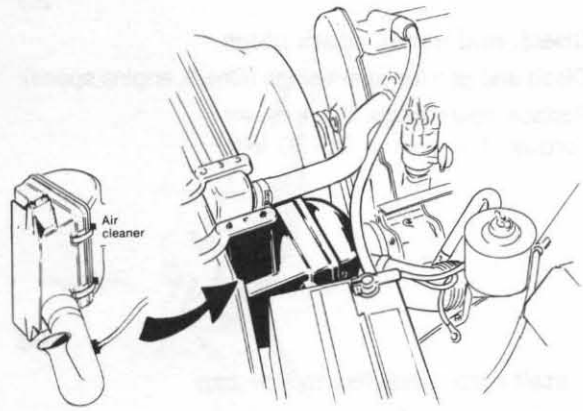
(1) cold start injector.
(2) control pressure regulator.
(3) auxiliary air valve.
These components should be disconnected as they would otherwise be heated up during the compression test and when measuring control pressure.



A2

Check air intake system for air leaks (visual inspection)

Check all of the hose connections.

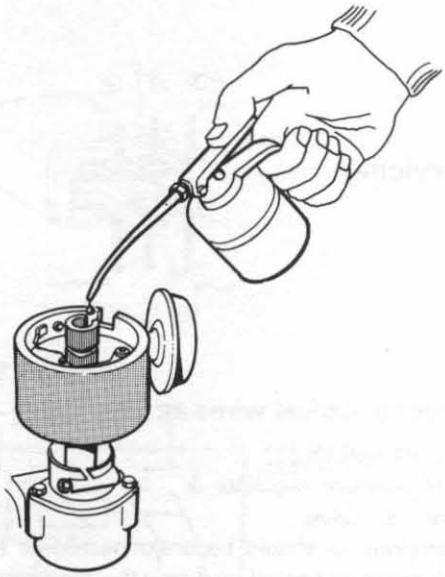


A3

Remove the air cleaner

Check filter insert, replace if necessary.

Ignition system and compression



B1

Check and lubricate the distributor

Remove distributor cap and rotor.
Lubricate the felt wick under the rotor with a couple of drops of light oil.
Check the rotor and cap for cracks and damages.
Check the high tension leads.

B2

Check the compression

Remove spark plugs.
Connect a remote control switch to the battery and starter motor.
Check that the cylinder compressions are fairly even

B3

Check and install spark plugs

Clean and gap the spark plugs (Check engine specs).
Replace spark plugs if necessary.
Torque: 3–4 Kpm = 25–30 lb.ft.

B4

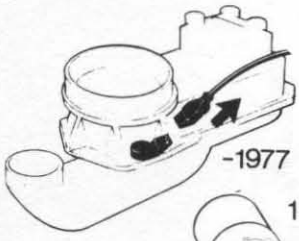
Install rotor and distributor cap

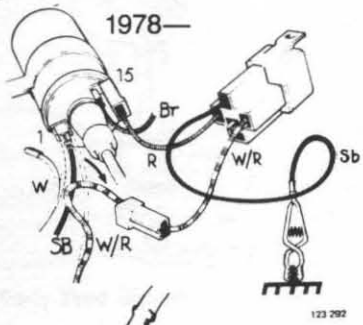
Cold start injector (cold engine)

C1

Check the cold start injector for leaks

Remove the cold start injector from the manifold.
Reconnect the connector at the injector.
Actuate fuel pump.
Check the injector for leaks. Maximum bleeding permitted: 1 drop per minute.
Replace if defective.
Reconnect connector at the air flow sensor.
1976-77 only.
Disconnect test relay 5170. 1978-





Start the fuel pump

1976-1977: Start the fuel pump by removing the contact piece from the air flow sensor.

1978-: Start the fuel pump by connecting test relay 5170.

C2

Check the cold start injector operation

Place the cold start injector over a container.
Check that it operates when the starter motor is running.
The cold start injector should operate for 7.5 seconds at $-20^{o}C$ ($-5^{o}F$). The injection duration gradually reduces in pace with rising temperatures. There is no injection at temperatures in excess of $+35^{o}C$ ($95^{o}F$).
At hot engine: test cold start injector directly on battery.
NOTE: maximum 2 seconds.

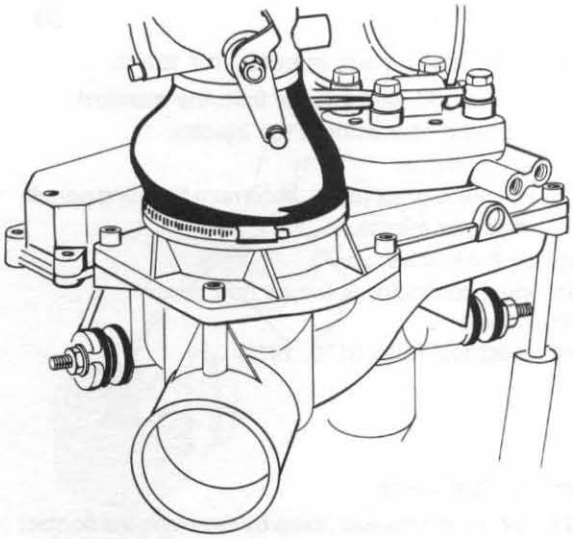
C3

Reinstall the cold start injector

If the cold start injector does not operate, use a test lamp to check for voltage across terminals when the starter motor is operating.
If there is voltage but the cold start injector does not operate, it indicates the injector should be replaced.
If there is no voltage, check wires and thermal time switch.

To check that the cold start injector does not operate at hot engine, see "Thermal time switch" op. H1.

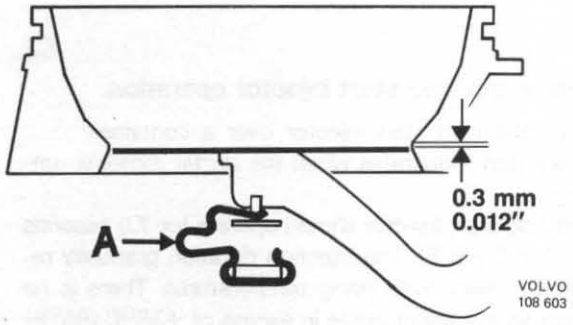
Air flow sensor



D1

Remove the rubber bellow.

Remove the upper and lower clamps



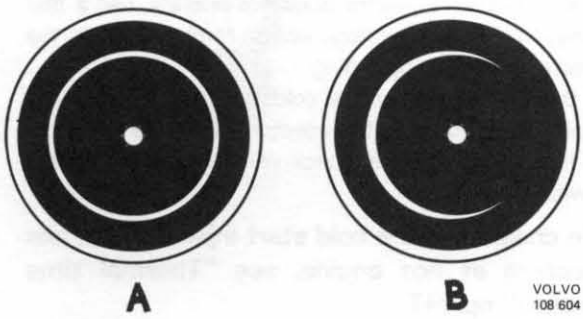
D2

Check the air flow sensor plate rest position.

The distance shown in Fig. should be 0–0.5 mm (0–0.02").

If misaligned: check the plate lever for distortion.

Adjust by bending the wire A under the sensor plate.



D3

Check that the air flow sensor plate is centered in the venturi

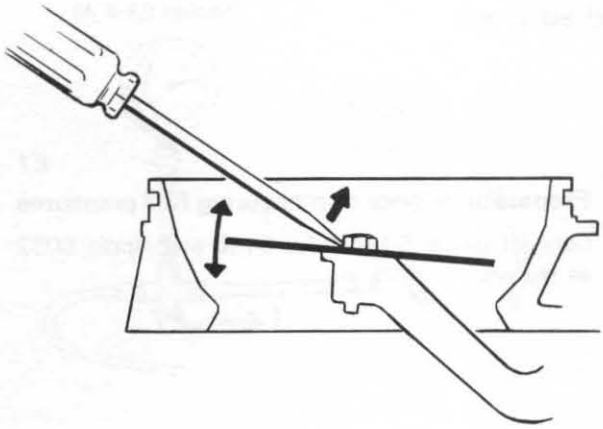
The air flow sensor plate must not touch the venturi at any point.

In case of malfunction:

Loosen the center screw and adjust plate position.

Check that the lever has no sideways play.

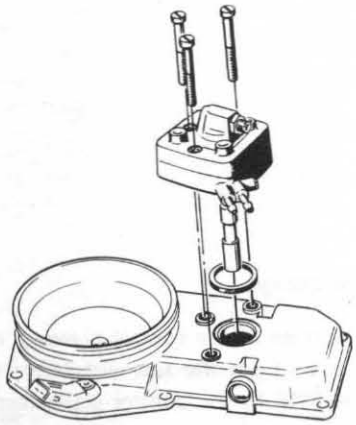
D4



Check that the air flow sensor does not seize or bind

Lift the sensor plate and release it.
The plate should return at once.
NOTE: the control pressure will cause some resistance when the sensor plate is lifted. Do not confuse this resistance with seizure.

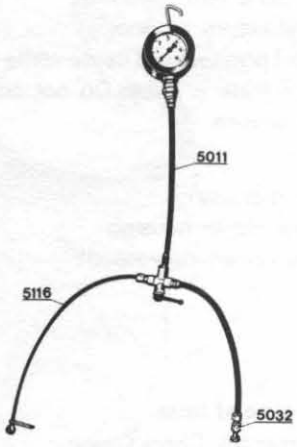
Possible faults:
a) Lever seizes in housing
b) Lever pivot seizes in housing
c) Plunger binds (when depressed).

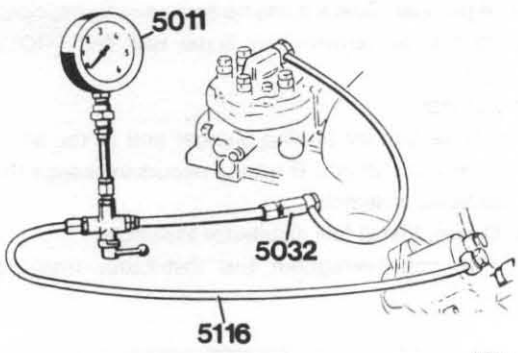


Early Type Shown

Procedures in case of fault:
Remove fuel distributor. Check O-ring.
Remove plunger. Check it has no scratches or deposits. Deposits may be removed by finger nail, NO TOOLS permitted.
Clean plunger.
Check for seizure by turning plunger and at the same time move it in and out. If seizing occurs exchange the fuel distributor assembly.
Install O-ring. Install fuel distributor assembly.
NOTE: do not overtighten fuel distributor retaining screws.

Pressures and sensors





E1

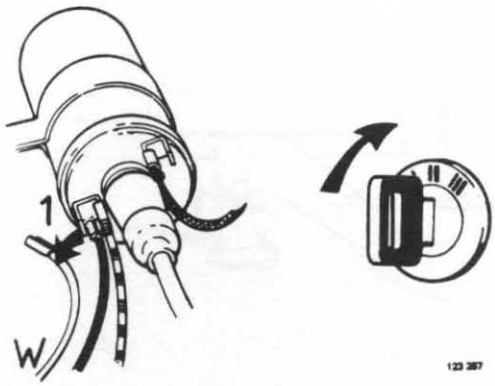
Preparations prior to measuring fuel pressures

Connect gauge 5011, hose 5116 and nipple 5032 as shown.

E2

Connect the gauge

Disconnect the hose at the control pressure regulator. Connect the hose from the fuel distributor to nipple 5032 and hose 5116 to the control pressure regulator.



E3

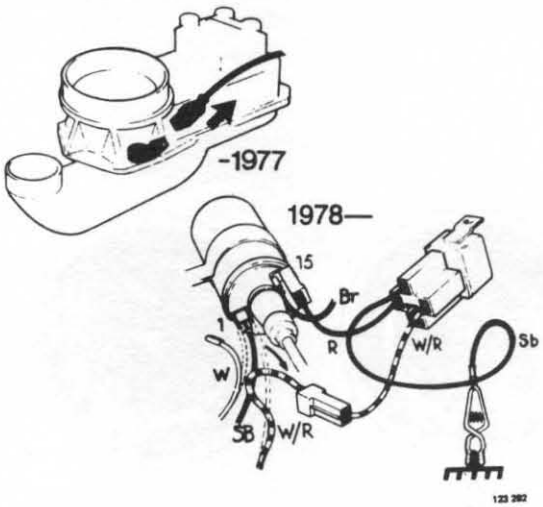
Switch on ignition

Disconnect the wire at the ignition coil terminal 15. (Important safety measure) Switch on the ignition. Disconnect the wire at the control pressure regulator terminal.
Disconnect the wire at the auxiliary air valve.

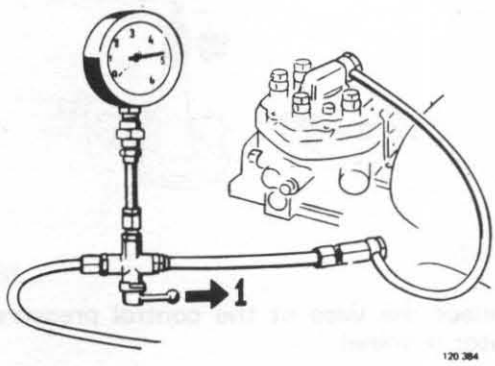
Start the fuel pump

1976-1977: Disconnect the contact piece from the air flow sensor.

1978-: Connect test relay 5170.



450-530 kPa
(4, 5-5,3 kp/cm²)



E5

Check line pressure

Pressure gauge lever towards the fuel distributor (position 1).

Correct line pressure:
4.5–5.3 kp/cm^2 = 64–75 psi.

Possible reasons for too low line pressure:

A. Fuel line leakage, check and repair.

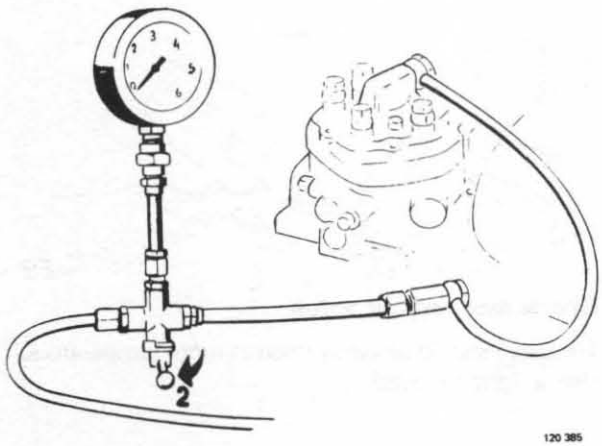
B. Insufficient pump capacity.
Procedures:
Disconnect delivery hose at fuel distributor.
Run pump for 30 seconds and check delivered fuel quantity.
Minimum 750 cm^3 (25.3 fl. oz).

C. Line pressure regulator incorrectly adjusted
NOTE:
If the fuel pump operates but there is no line pressure, the reason might be clogged fuel lines, filter or fuel distributor.

Possible reasons for too high line pressure:

A. Fuel return line clogged.

B. Line pressure regulator incorrectly adjusted.
See adjustment of line pressure, op. K–2.
NOTE:
First check rest pressure.



E6

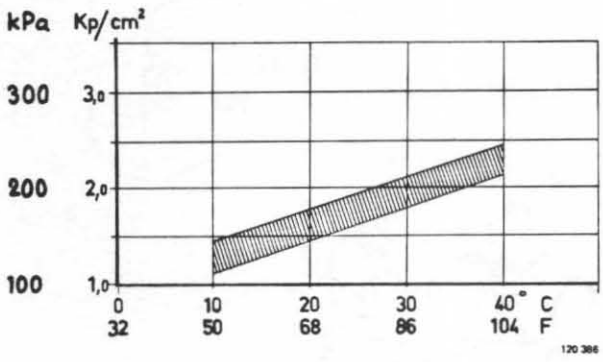
Check control pressure

Is the control pressure correct?

Set the lever on 5011 to position 2 (at right-angles to the hoses).

The control pressure regulator should have the same temperature as the ambient temperature.

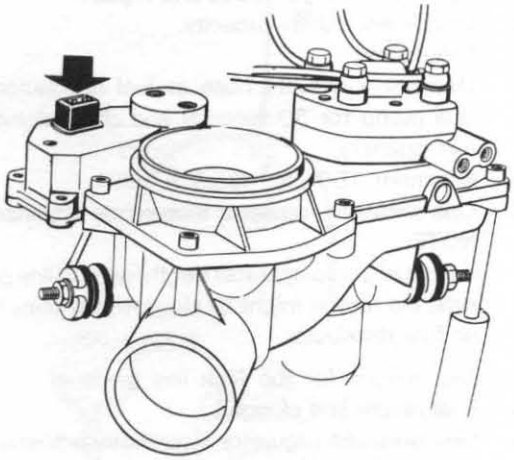
The correct control pressure at different ambient temperatures can be seen from the diagram.



In case of malfunction:

E7

Too low pressure	Test with a new control pressure regulator
Excessive pressure	Switch off the ignition.
	Remove the tank cover from the fuel tank in order to release any overpressure from the fuel tank.
	Check if the return line from the control pressure regulator is blocked. If there is no blockage, replace the control pressure regulator.
Correct pressure	Carry out a complete overhaul of the CI-system.



E8

Reconnect the wire at the control pressure regulator terminal

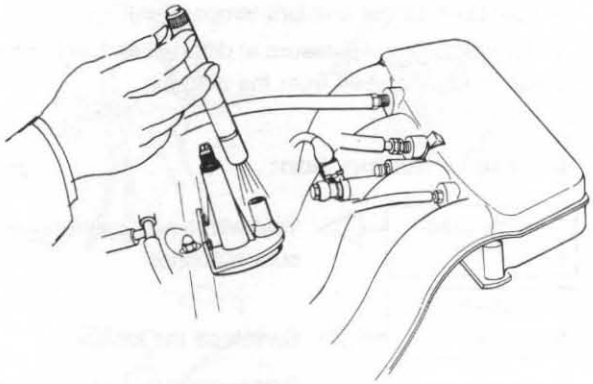
After approx. 4–5 minutes the control pressure should have increased to 3.7 ± 0.20 kp/cm^2 = 44–50 psi. If not, disconnect the wire connector. Use a test lamp to test for voltage at the wire connector.

No voltage means that the wire is defective. Voltage can mean that the control pressure regulator is defective and should be replaced.

Use an ohm-meter to check across the control pressure regulator terminals.

ohm-meter reading: the fault may be incorrect terminal contact.

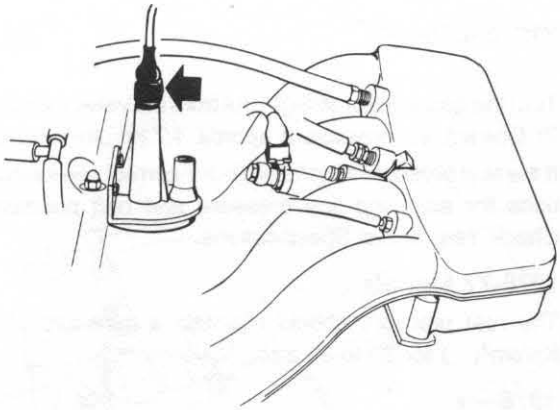
ohm-meter does not read: replace control pressure regulator.



E9

Check auxiliary air valve

The valve should be partly open at room temperature. Use a light to check.



E10

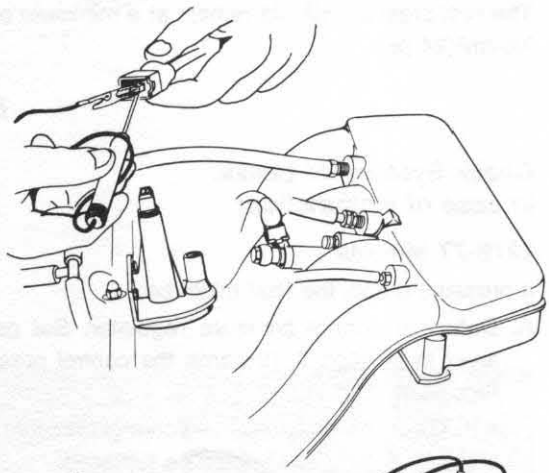
Reconnect the wire at the auxiliary air valve

The valve should be fully closed after approx. 5 minutes.
Attach the hoses.

If the valve is not closed:

A. Tap lightly on the valve

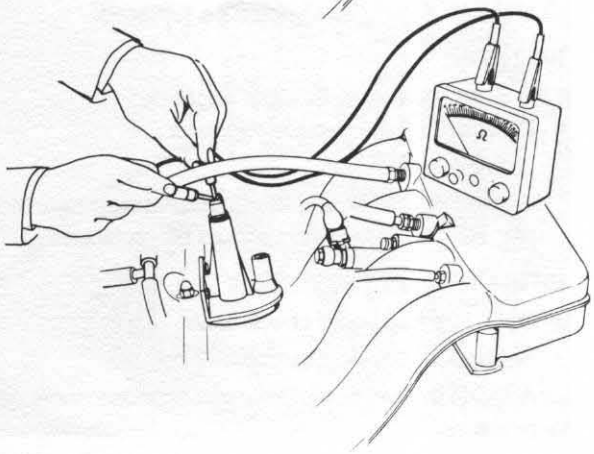
Engine vibrations normally contribute to closing.



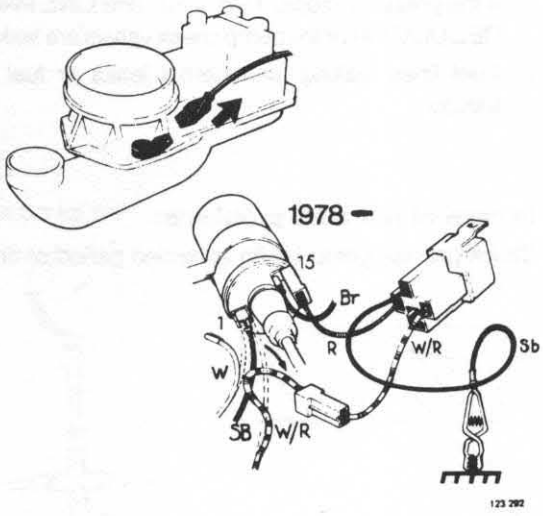
B. Check for voltage

Disconnect the wire connector.

1. Use a test lamp to check the voltage across the wire connector terminals.
   No voltage: indicates a defective wire.
   Voltage: go to "2" below.



2. Use an ohm-meter to check across the auxiliary air valve terminals. Reading may indicate bad connections. No reading indicates the auxiliary air valve is defective and should be replaced.



E11

Stop the fuel pump

1976/1977 Models

Reconnect the wire at the air flow sensor which should stop the pump.

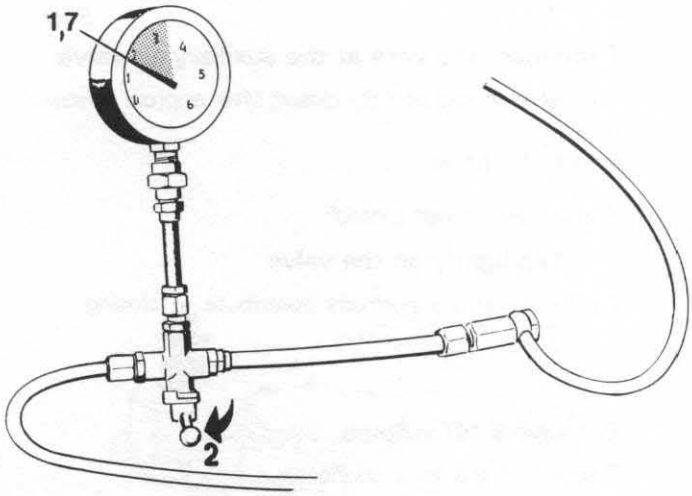
If the pump does not stop, check that it does when grounding the wire connector.

If the pump stops, this indicates that air flow sensor switch is defective and should be repaired.

If the pump does not stop when grounding the switch, the safety relay might be defective and should be replaced.

1978—

Remove test relay 5170.



E12

Turn the gauge lever straight out from the valve (position 2). Correct rest pressure is approx. 1.7 Kp/cm²=24psi.

If the rest pressure is constant but incorrect see instructions for adjusting line pressure and rest pressure. Check Year Model Specifications.

1976-77 Models

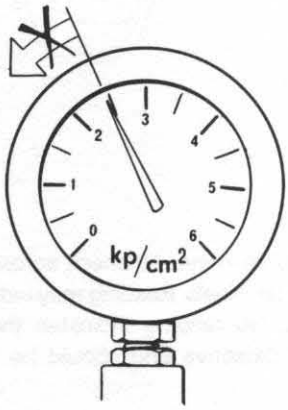
The rest pressure should maintain a minimum of 1. Kp/cm²( ) for 30 to 60 mm.

1978—

The rest pressure should remain at a minimum of 1.7 Kp/cm²(24 psi).

E13

Check System for Leaks.
In case of malfunction:



1976-77 Models

If pressure drops, the fault might be:

A. Defective control pressure regulator. Set gauge lever in position 3. (towards the control pressure regulator).

   If the pressure still drops, the control pressure regulator is leaking and should be replaced.

1978—

If the pressure drops, the fault might be:

A. Defective LINE pressure regulator.

   Set lever in position 3.

   If pressure still drops, the LINE pressure regulator "O" Ring is leaking and should be replaced.

1978—

B. Defective fuel pump check valve.

   Set gauge lever in position 1.

   Activate the fuel pump for a few seconds to increase pressure.

   If the pressure drops, it indicates THE LINE PRESS REGULATOR or the pump check valves are leaking.

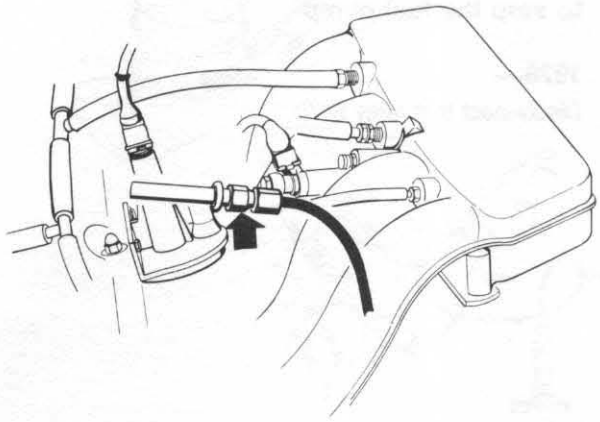
C. Fuel lines leaking, or external leaks or fuel distributor.

E14

In case of hot start problems:

Check pressure drop for an extended period of time.

Injectors and fuel distributor



F1

Remove the injectors from the cylinder head

F2

Connect the measuring tool

See special instructions for the measuring tool back of manual.

F3

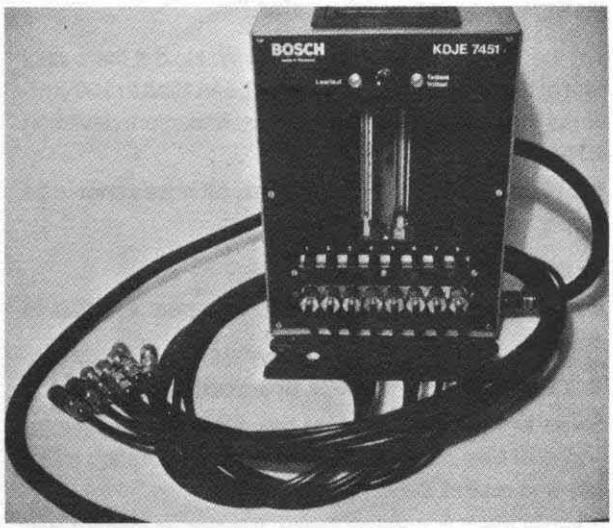
Disconnect the white electric cable from terminal 1 on the ignition coil (safety measure).

F4

Start the fuel pump

1975-1977: Start the fuel pump by removing the contact piece from the air flow sensor.

1978-: Start the fuel pump by connecting test relay 5170.



Switch on the ignition

F5

Check fuel supply

1—As per flow tester instructions and procedures.

2—If flow tester is not available, procede as follows using tester 9995094.

Gauge lever in position 1.

Lift the air flow sensor plate fully and hold it there for approx. 4 seconds. The line pressure may drop no more than 0.3 kp/cm².

If line pressure drops more than 0.3 kp/cm²:

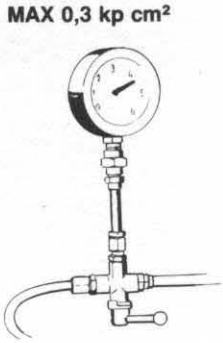
A. Low fuel level in tank.
B. Fuel lines or filters clogged.
C. Fuel line leakage or insufficient fuel pump capacity.
D. Low battery voltage.
E. Insufficient pump capacity.

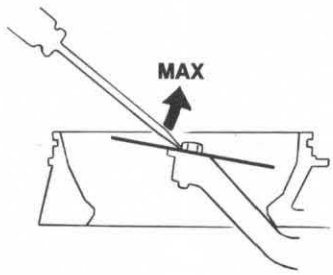
Procedures:

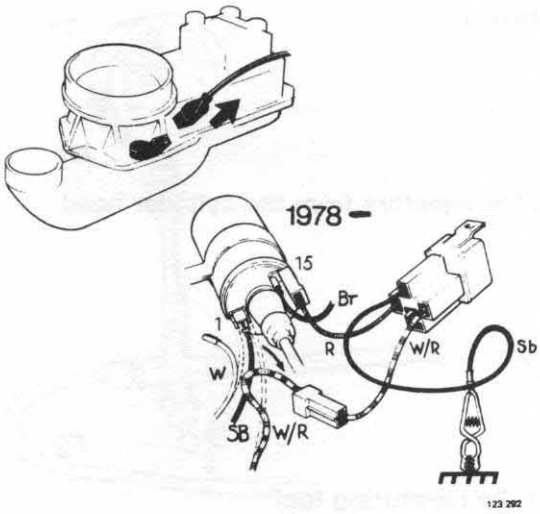
Disconnect delivery hose at fuel distributor.

Run pump for 30 seconds and check delivered fuel quantity.

Minimum 750 cm³ (25 fl. oz.)







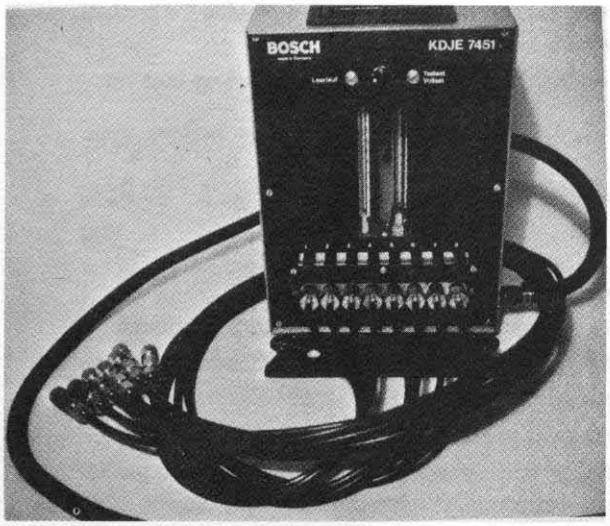
F6

1976/1977 Models

Reconnect the connector at the air flow sensor to stop the fuel pump

1978—

Disconnect test relay 5170.



F7

Check injector deviation (test only in case of definite engine malfunction)

Lift the air flow sensor plate halfway. Hold it there until one of the measuring glasses has been filled to 100 cm^3. Read the other measuring glasses. Maximum deviation 20%.

NOTE: To obtain correct readings, **all** hoses should be empty of fuel at the start of the test.

In case of malfunction:

If injector deviation exceeds 20%, repeat the test to confirm.

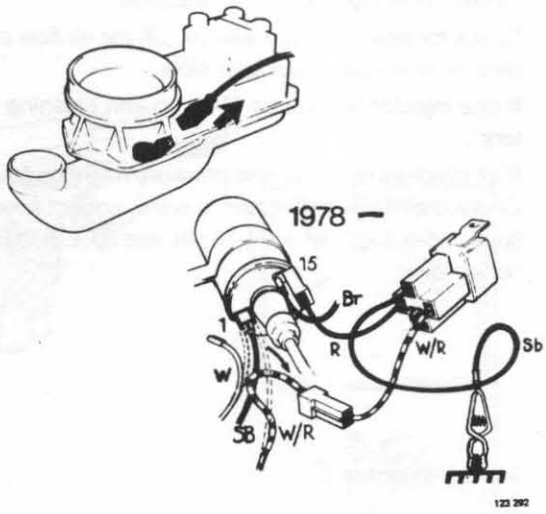
In case the test results are confirmed:

Swap two injector hoses at the distributor (exchange hoses of one incorrect and one correct operating injector) and repeat the test.

If same injector persists faulty, injector or injector fuel supply line is defective. See "Testing and cleaning injectors", operation K3-K1.

If fault changes to the other injector, the fuel distributor is defective.

F8



1976/1977 Models

Disconnect the connector at the air flow sensor to start the fuel pump

1978—

Connect test relay 5170.

F9

Check fuel distributor for internal leaks

No seepage may be observed at injector tips.

If injector leaks (drops formed), the fault might be:

1. Air flow sensor plate misadjusted
(incorrect height)

Procedures:

—Check that air flow sensor plate position is not influenced by CO adjustment screw.

—Check air flow sensor for damages.

2. Fuel distributor plunger seizes.

Procedures:

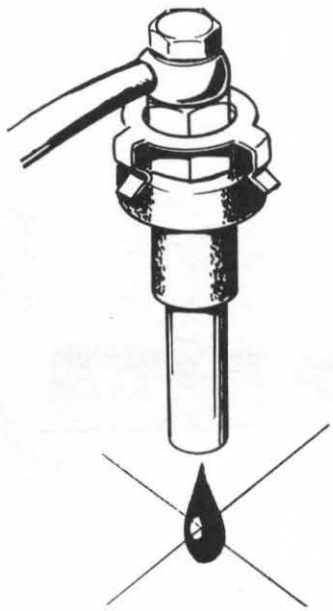
—Remove fuel distributor. Check O-ring.

—Remove plunger. Check for scratches or deposits. Deposits may be removed, with mineral spirits. NO TOOLS or abrasive cloth may be used.

—Check for seizure by turning plunger and at the same time move the plunger in and out. If seizing occurs exchange the fuel distributor assembly.

—Install O-ring. Install fuel distributor assembly.

NOTE: Do not overtighten fuel distributor retaining screws.



3. Internal leaks in fuel distributor
(Faulty seals in fuel distributor)
The fuel distributor must not be disassembled. Complete replacement is required.

F10

NOTE: A high control pressure can indicate an "O" ring leak at the top of the fuel distributor plunger.

Reconnect the connector at the air flow sensor to stop the pump. 1976-77 only.

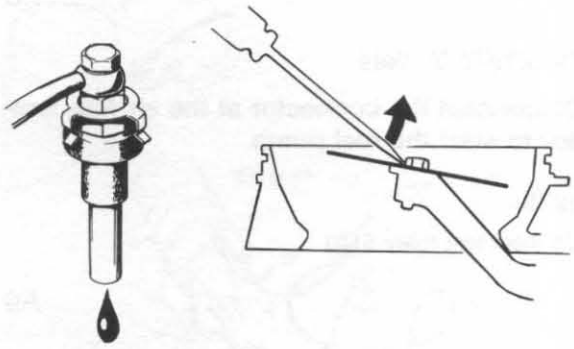
Disconnect test relay 5170

1978—

F11

Switch off the ignition

F12



Not more than one drop in 15 seconds

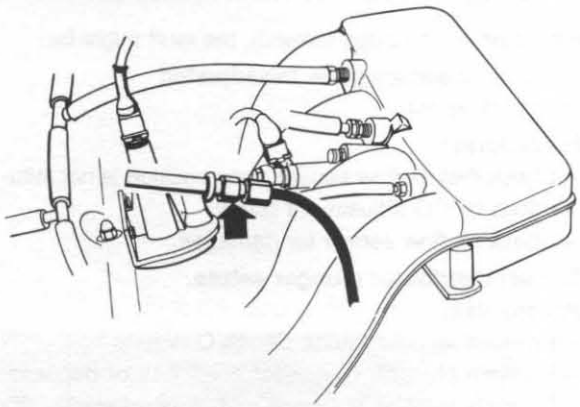
Check the injectors for leakage

Check for leaks at rest pressure. Lift the air flow sensor plate to open fuel distributor slots.

If one injector leaks, see "Testing and cleaning injectors".

If all injectors leak, the rest pressure might be too high. Check that the line pressure is within correct specifications, 4.5-5.3 kp/cm² = 64-75 psi, see op. E-5 to E-8 for corrections.

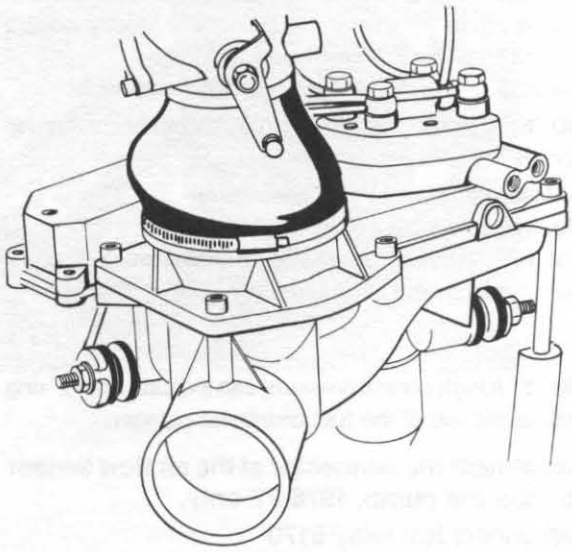
F13



Install injectors.

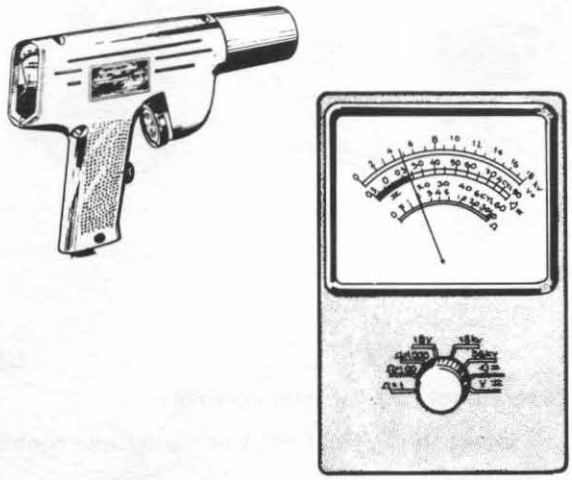
Reconnect high tension leads

F14



Install rubber bellow and clamps.

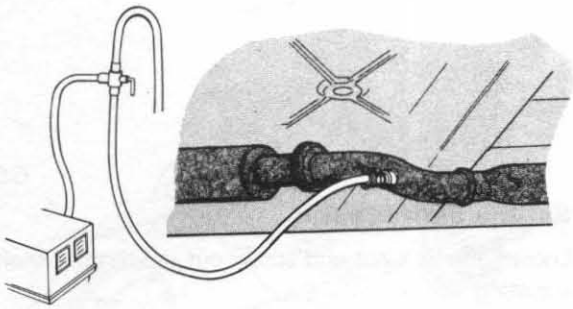
Ignition timing, idle and CO



G1

Prepare for idle adjustment and CO setting

Connect tachometer and ignition timing light.



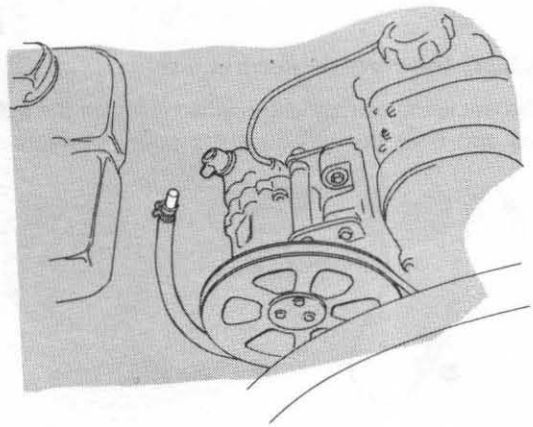
G2

Connect CO-gauge

For cars without catalytic converter the CO measurement is taken with the sensor inserted in the tail pipe a min. of 48 cm (19 inch).

For cars with catalytic converter the CO measurement is taken with the sensor inserted in a fitting on the header pipe just before the catalytic converter.

Use tool 5151.

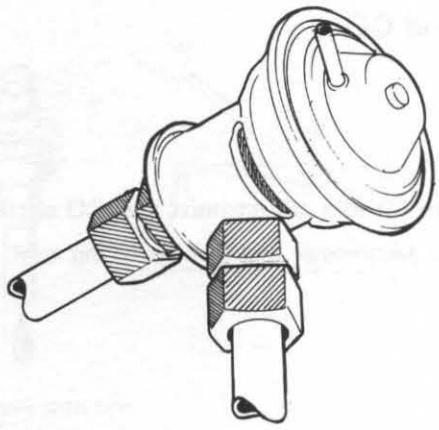


G3

Disconnect and plug AIR system

Disconnect hose at air pump.

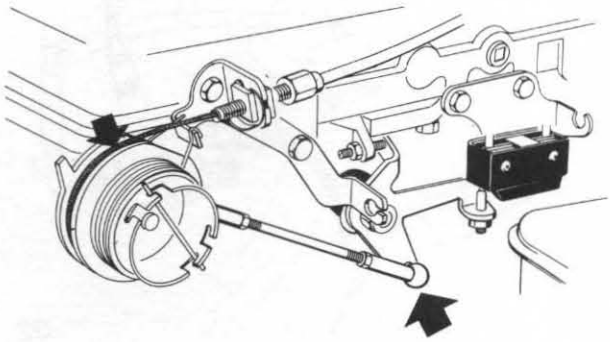
Plug the end of the hose or use tongs 999 2901 to protect the backfire valve, on vehicle so equipped.



G4

Disconnect and plug the EGR vacuum hose

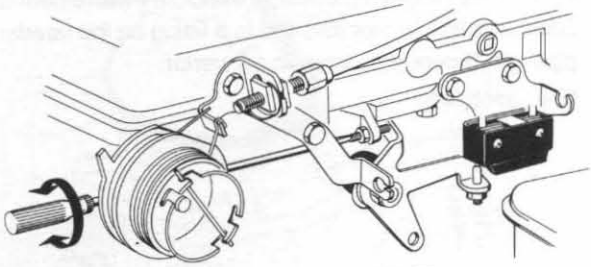
Disconnect the vacuum hose at the valve.



G5

Disconnect the throttle control

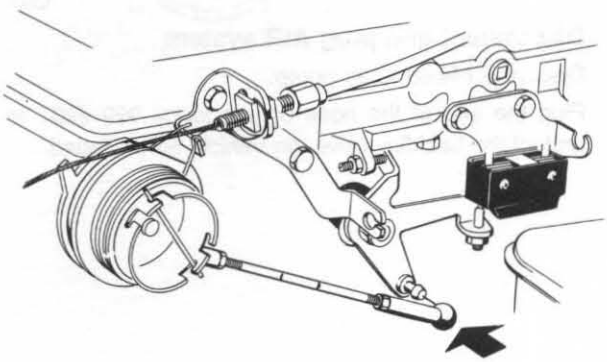
Disconnect the link and cable at the throttle control pulley.



G6

Set the throttle valve

Loosen the lock nut and screw out the throttle shaft adjusting screw.
Then turn in the screw until it just touches the boss and then 1 additional turn. Lock with the lock nut. Check that the throttle valve does not seize or bind.

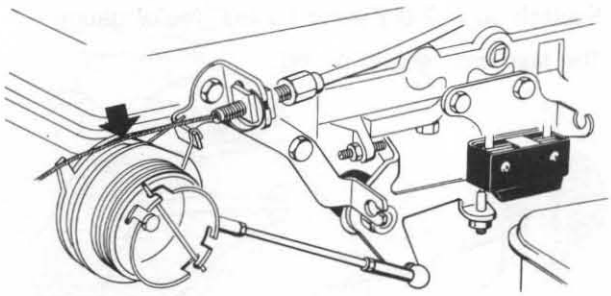


G7

Adjust the throttle control link

The link is the correct length when it fits on the pulley ball and does not influence the pulley position.

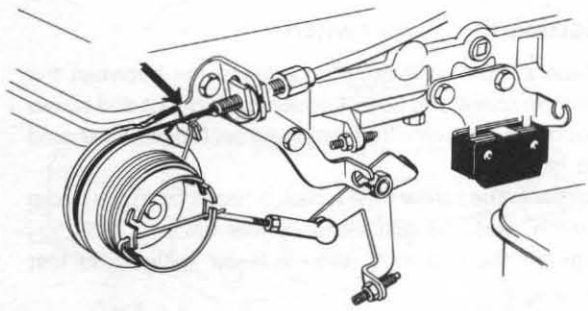
G8



Adjust the throttle cable

Attach the cable to the pulley. Adjust the cable sheath. The cable should be stretched but should not influence the pulley position.

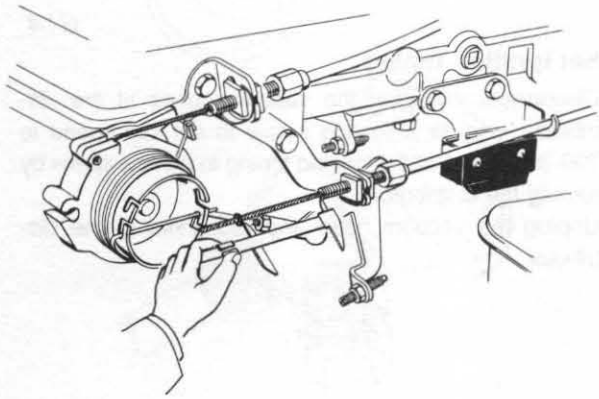
G9



Check full throttle position

Depress the throttle pedal completely.
The pulley should touch the full throttle boss.

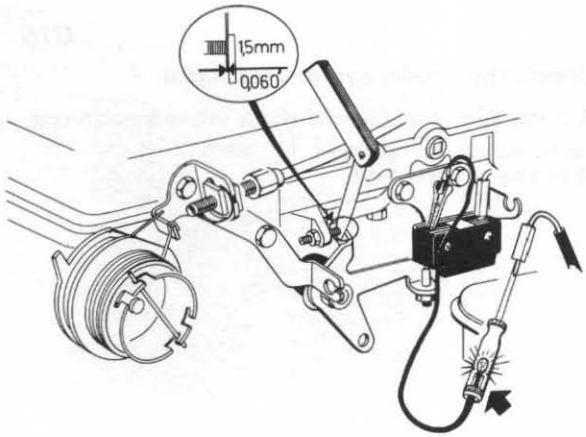
G10



Adjust the throttle cable to the automatic transmission

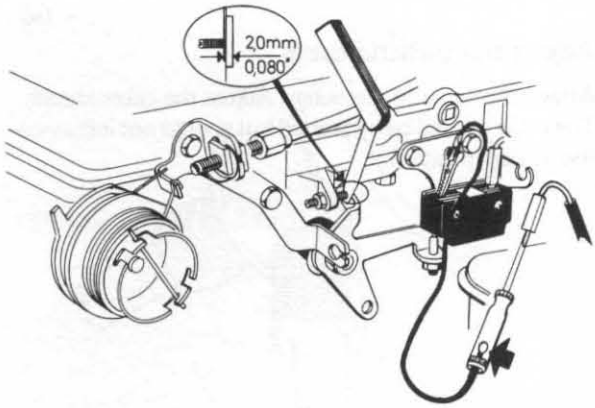
The cable clip should travel 51 mm ± 0.4 mm = 2.001" ± 0.016" from idle position to full throttle position.
At idle there should be a 1 mm = 0.040" clearance between the clip and the adjusting sheath.
The clip must not touch the adjusting sheath.

G11



Check micro switch setting (California)

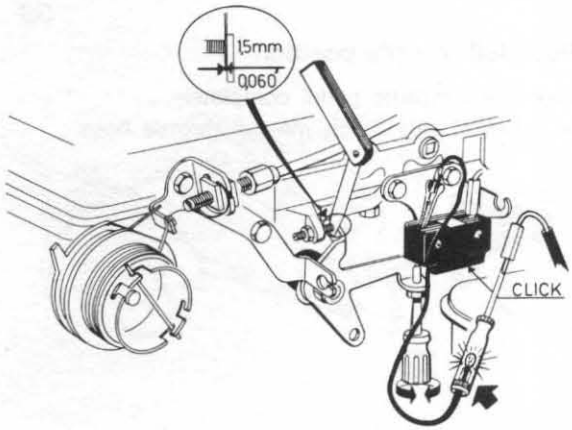
Connect a test lamp to the micro switch.
Switch on the ignition.
Place a 1.5 mm (0.060") feeler gauge between throttle screw and boss.
The light should stay on.



G12

Switch to a 2.0 mm = 0.080" feeler gauge

The test lamp should go off.



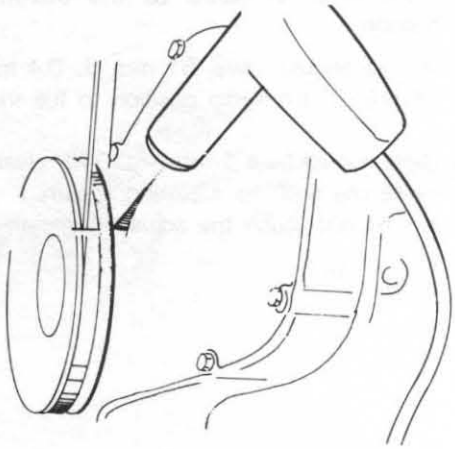
G13

Setting the micro switch

Place a 1.5 mm = 0.060" feeler gauge between the throttle screw and boss. Loosen the lock nut and screw out the micro switch adjusting screw (test lamp should go off).

Screw in the screw until a click is heard from the micro switch, and the test lamp comes on.

Tighten the lock nut, remove feeler gauge and test lamp.



G14

Set ignition timing

Disconnect and plug the vacuum hoses at the distributor. Use air adjusting screw to set idle speed to 700-800 rpm. Set the ignition timing to vehicle specs by turning the distributor.

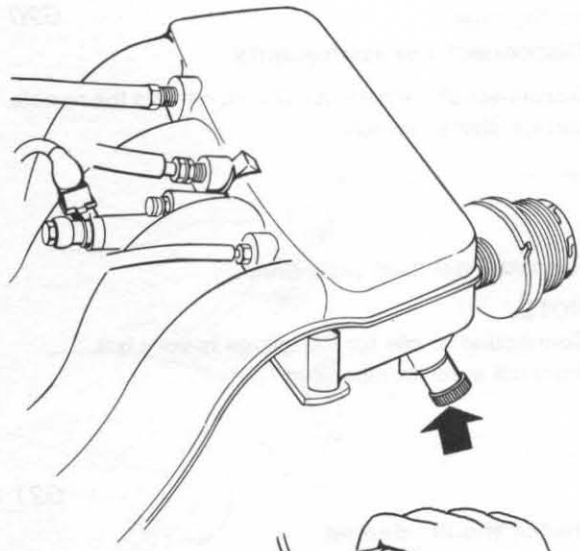
Unplug the vacuum hose and reconnect to the distributor.

G15

Check the intake system for leaks

Run the engine at idle and check intake system connections and components for leaks.

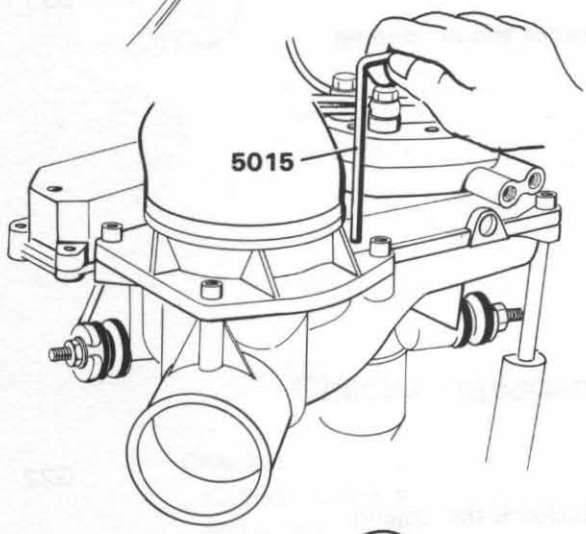
Run the engine hot



G16

Adjust idle speed

Screw out air adjusting screw until the idle speed is 900 rpm manual, 800 rpm automatic.



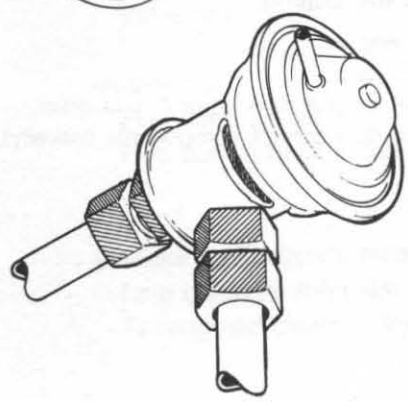
G17

Make the final CO adjustment

Adjust CO to engine specifications.
(Engine idling.)

Stop the engine

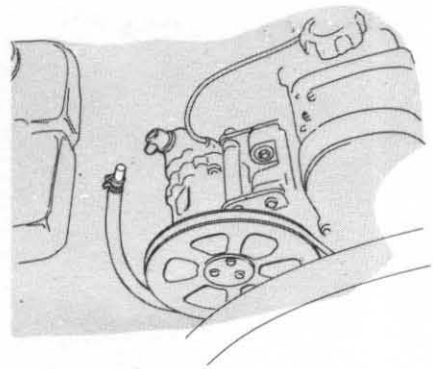
NOTE: CO should be set within approximately 8 minutes after thermostat opens.



G18

Reconnect the EGR valve

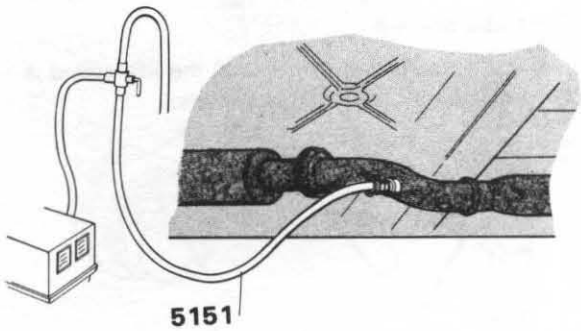
Reconnect the vacuum hose at EGR valve.



G19

Reconnect the AIR System

Remove the plug or tongs.
Reconnect the hose to the air pump on cars so equipped.


5151

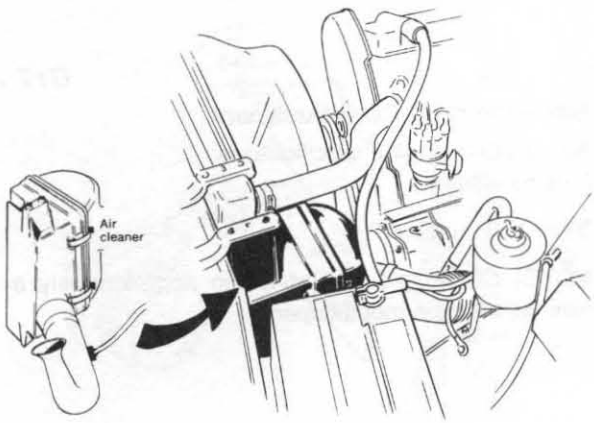
G20

Disconnect the instruments

Disconnect all instruments. Do not remove the remote control starter switch.

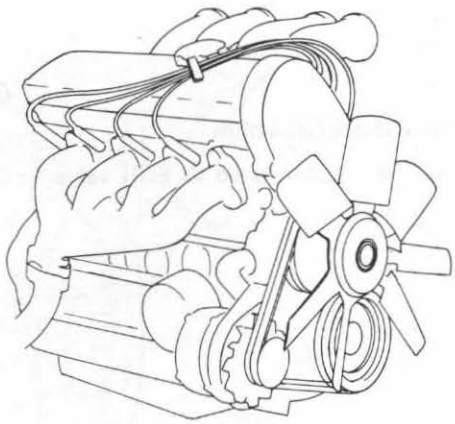
Reinstall exhaust pipe plug

NOTE:
Connecting nipple for CO gauge is very hot.
Reinstall exhaust pipe plug.



G21

Install the air cleaner

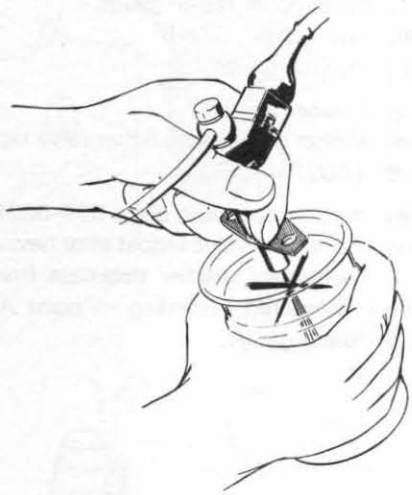


G22

Recheck the engine

Start the engine
Check for leaks.
Check that engine runs smooth and quiet.
Check emission control components (visually).

Thermal time switch



H1

Check the thermal time switch – Hot engine

Disconnect the cold start injector from the manifold and place it over a container.
Run the starter motor.
The cold start injector should not spray with hot engine.

In case of malfunction:

If cold start injector sprays with a hot engine, it indicates thermal time switch is defective and should be replaced.
Reinstall cold start injector.
Disconnect remote control starter switch.

For check of thermal time switch with cold engine, see Op. C1–C3

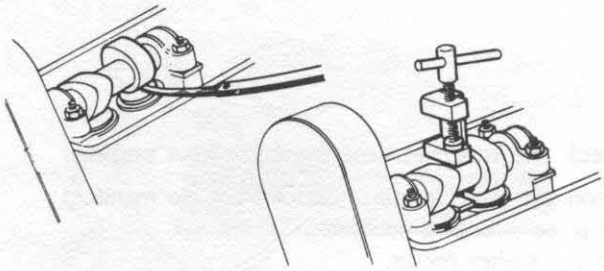
The different locations of these two tests is because one is performed at cold engine and one at hot engine.

Checks, replacements, adjustments

I1

Check cylinder balance

Connect tachometer. Short one cylinder at a time and read rpm drop.
If one cylinder fails, check high tension leads and spark plugs.
If necessary, swap injectors and see if fault remains with injector.



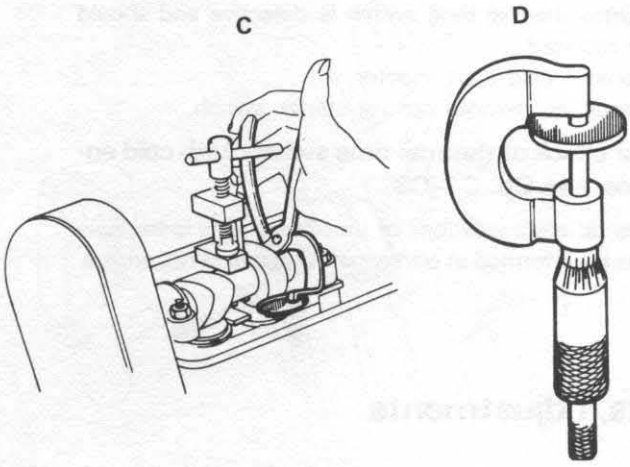
I2

Adjust valve clearance

Adjust the valves with each valve in firing position.
A. Measure clearance with feeler gauge.
Cold 0.35–0.40 mm, 0.014"–0.016"
hot 0.40–0.45 mm, 0.016"–0.018"

B. If adjusting is necessary:
Expose adjusting washer by pressing down valve tappet with tool 999 5022.

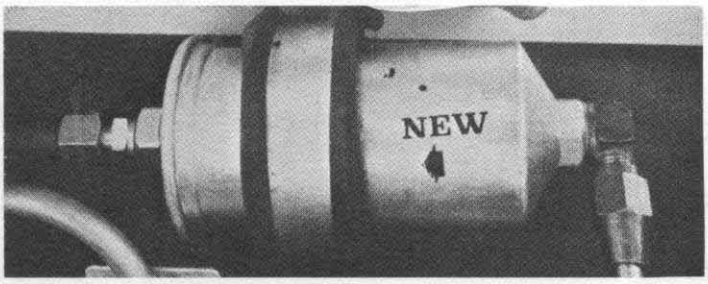
C. Remove adjusting washer with pliers 999-5026.
D. Fit a new washer on the valve tappet after having assessed the necessary washer thickness from the clearance measured according to point A.
Final-check with feeler gauge.
Fit the valve cover.



Replacements

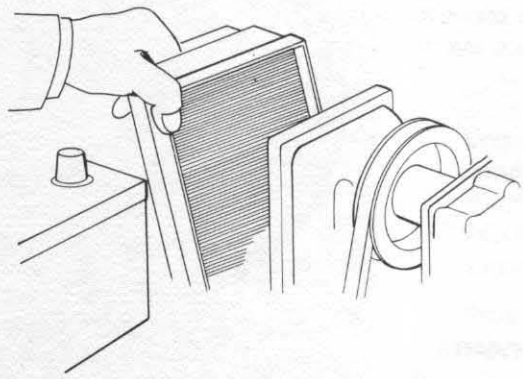
J1

Replacing fuel filter



(30,000 miles-50,000 km).
Loosen the fuel cap.
Clean the filter connections carefully.
Disconnect nipples and remove seals.
Remove filter and clamp.
Transfer nipples and clamp to new filter.
NOTE: Fuel flow direction arrow on filter.
Install filter. Install nipples and copper seals.

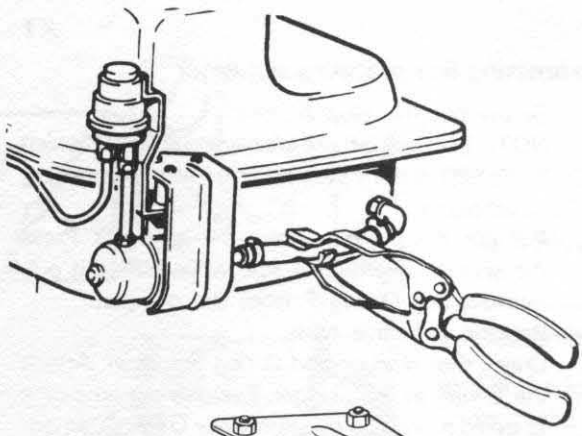
Replacements



J2

Replacing air filter cartridge

(30,000 miles-50,000 km)
Remove air filter, snap open and replace cartridge.



1976-77 *J3*

Replacing fuel pump

Use tongs 999 2901 to block the fuel line from tank.
Clean all connections carefully.
Remove pump and pressure accumulator assembly.
Replace the pump.
Install pump and pressure accumulator assembly.
Disconnect tongs 999 2901.

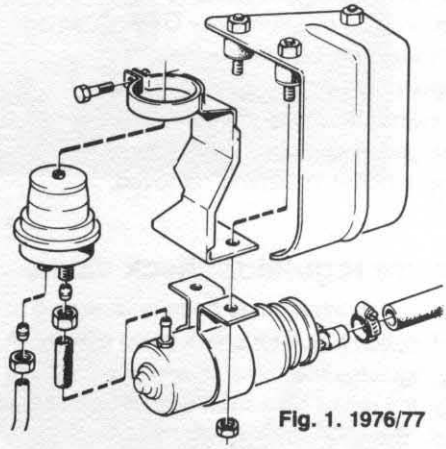
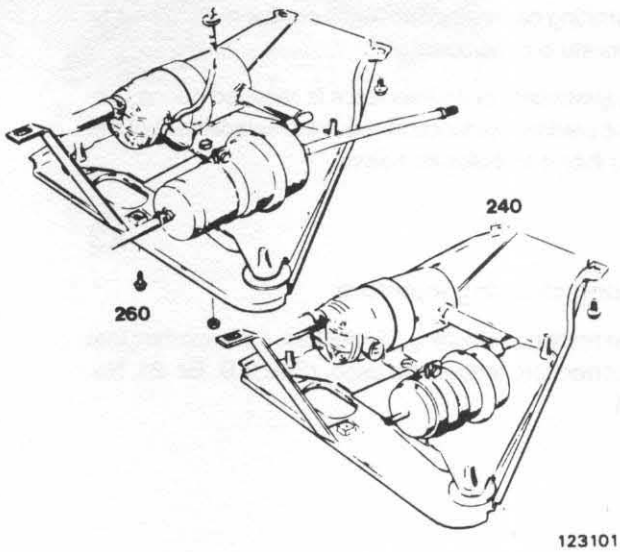


Fig. 1. 1976/77

Replacing fuel pump check valve

Remove check valve and hose from pump.
Remove cone and cap nut from hose.
Attach new check valve to fuel pump.
Torque to 16–20 Nm (12–15 lb.ft.)
Attach hose to check valve. Install cap nut and cone.

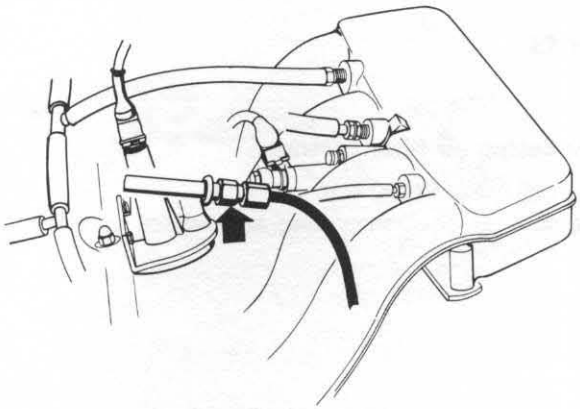


J4

1978—

Fuel pump and accumulator

Location changed from the fuel tank to the cross member under the floor of the vehicle (beneath rear seat).



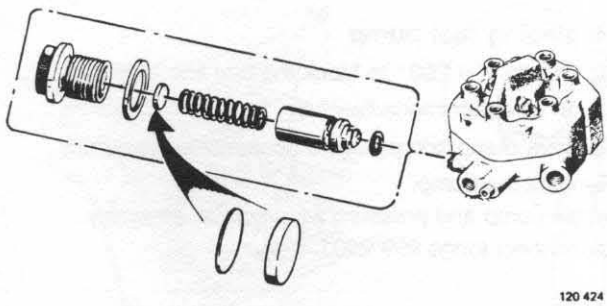
J5

Replacing injector

Clean connections carefully.
Replace injector.

Checks and adjustments

Line pressure regulator

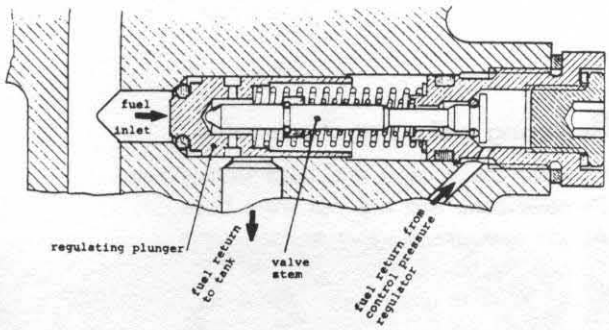


120 424

K1

Examining line pressure regulator

1. Screw out the plug A.
   NOTE: In the plug there are several shims C, which easily fall out if the plug is turned with the opening downwards.
2. Pull out the plunger E and the spring D. Press the spring towards one side while pulling it out.
3. Remove the O-ring F from the plunger.
4. Replace defective parts.
5. Check that plunger and O-ring are clean. Attach the O-ring to the plunger. Exercise extreme care to avoid damaging the plunger or O-ring. Damaged parts must not be installed.
   The plunger may not be exchanged, as plungers and fuel distributors are paired.
6. Install plunger, spring, plug with copper washer B and the amount of shims removed.



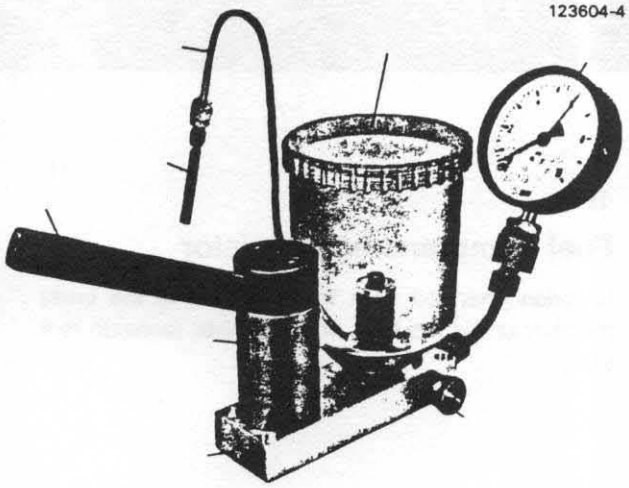
123604-4

K2

Line pressure regulator/check valve

The CI system fuel distributor has been re-designed to include a two function regulator/check valve assembly. The assembly regulates line pressure and also prevents fuel from returning to the tank from the charged lines after the engine has been shut down. Rest pressure is thus maintained in the fuel system which provides positive starting capabilities under all environmental/engine temperature conditions.

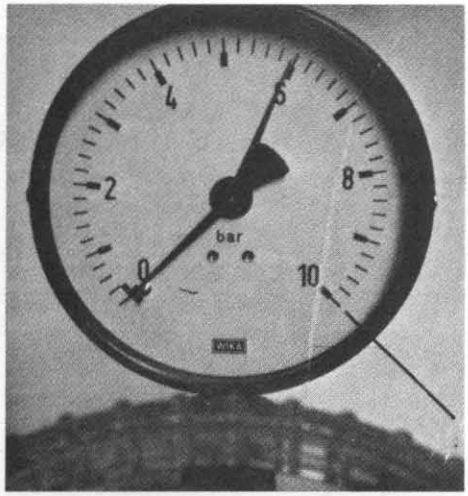
No adjustments or maintenance is required during normal operation. Malfunction requires replacement of the entire fuel distributor as before.



K3

Testing/cleaning injectors

When testing or cleaning CI injectors, it is important that the correct procedures be used. (See S.B. Gr. 24, No. 106.)

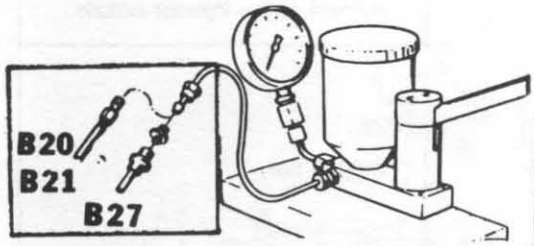


K4

Under normal operating conditions, the gauge reading should not approach full scale pressure. At no time should the fluid pressure be manually pumped higher than the maximum gauge reading of 10 bar. If this pressure is exceeded, the gauge can be damaged.

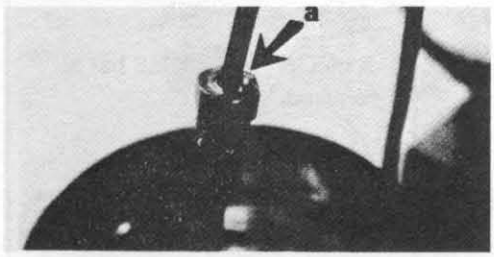
Pump gauges damaged by overpressure due to misuse will not be given warranty consideration.

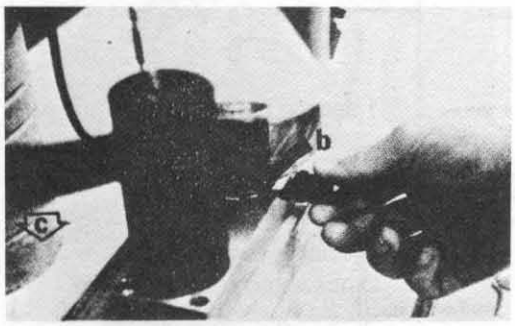
DO NOT EXCEED

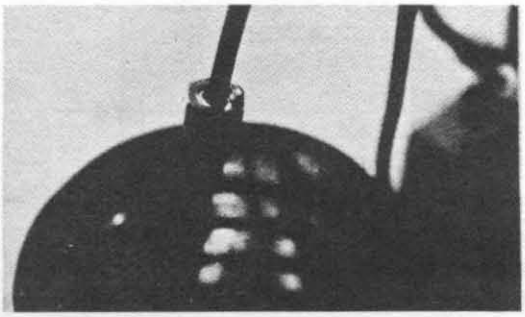


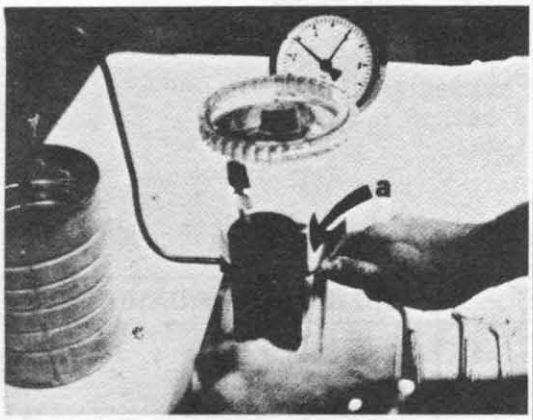
K5

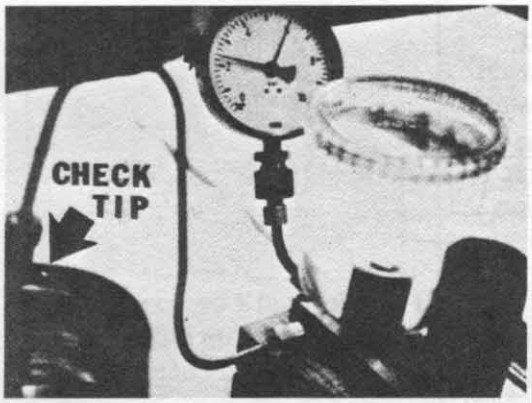
TEST DESCRIPTION	NOTES/SPECIFICATIONS
1. Test Fluid	Shell Mineral Spirits 135 or equivalent.
2. Contamination Test	
a) Fill the injector with test fluid from the hand test stand. Attach the injector loosely to the tester. Pump the lever several times to clear air bubbles from the line. Tighten the injector connection.	
b) Open Pressure Valve	
c) Slowly depress pump lever. The injector is malfunctioning if the pressure doesn't build up and the injector leaks excessively.	Pump lever at 2 sec. per stroke. When pumping up pressure, do not exceed 1-1.5 bar.
CONTINUE WITH TESTING & CLEANING, STEP 3 THROUGH 6.	

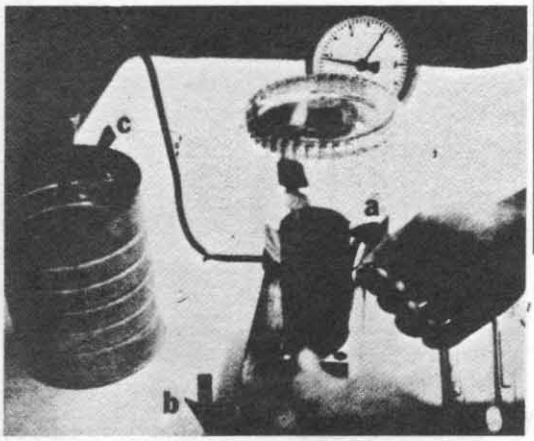








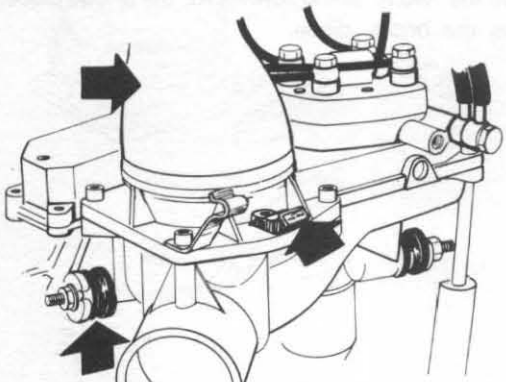




K6

TEST DESCRIPTION	NOTES/SPECIFICATIONS
3. **Bleeding the System** Before further testing, the injector and line must be bled with the **Pressure Valve Closed.**	
a) CLOSE PRESSURE VALVE	
b) Pump fluid thru line and the injector.	Bleed until **no** bubbles are evident at the injector nozzle.
4. **Opening Pressure**	
a) Open pressure valve.	
b) Pump up pressure to determine if injector opens within tolerance.	2.5-3.6 bar.
5. **Leakage Test**	
a) Increase the pressure slowly until 0.5 bar below the opening pressure obtained in Step 4 is reached.	A min. pressure of 2.3 bar is required.
b) Hold pressure constant at this value and check injector tip for leakage.	NOTE: Within 15 sec. the injector tip is allowed to become damp, but may not drip.
6. **Injector Cleaning**	
a) Close Pressure Valve	
b) Pump lever and check injector operation for at least 10 sec. A correctly operating injector should produce an **audible chattering noise.**	1 second per stroke.
c) Check spray pattern. See S.B., Gr. 24, No. 102.	Injector is bad if: Drops accumulate on the tip. Straight stream is present. Streaky stream is present.

Air-fuel control unit

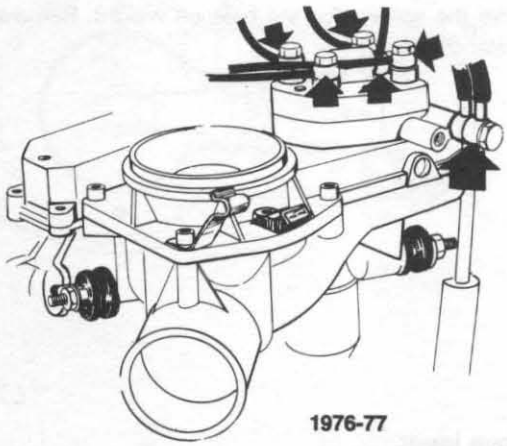


1976-77

L1.

Air flow sensor overhaul.

Remove GAS cap.
Remove the rubber bellow. Disconnect front attachment and lower the air-fuel control unit slightly.
Disconnect the wire at the air flow sensor.

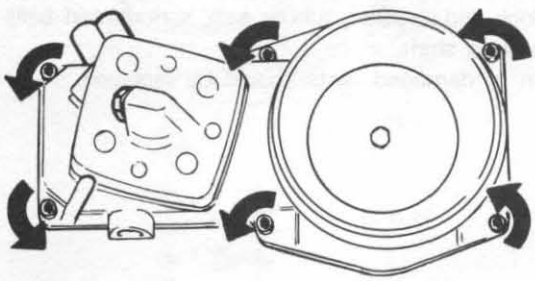


1976-77

L2

Disconnect.

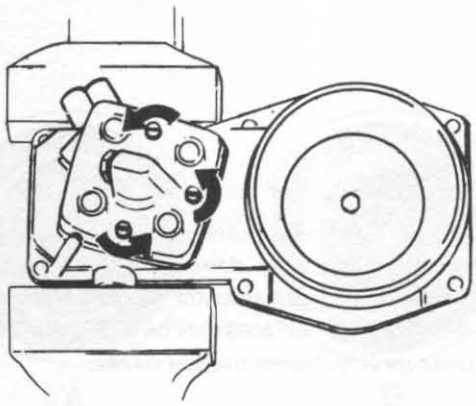
NOTE: Always clean the fuel line connections carefully before the liners are removed.
Disconnect the fuel lines at the fuel-distributor.



L3

Remove air-fuel control unit

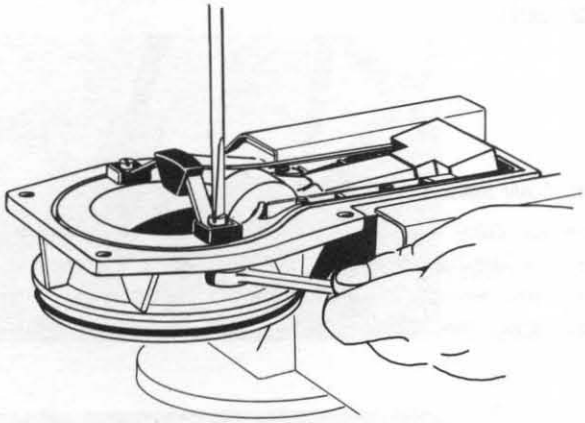
Remove the screws for the air-fuel control unit and lift it out.
Disconnect the remaining hoses (fuel supply and cold start valve). Check the gasket. Replace damaged gaskets.



L4

Fuel distributor disassembly

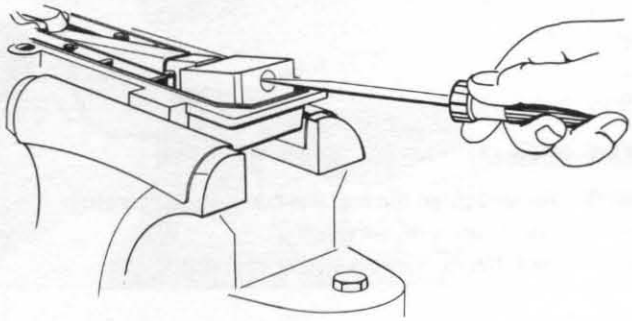
Put the fuel distributor in a vise, but lightly as forces may damage it.
Remove the three screws and carefully lift off the fuel distributor. Watch that the control plunger does not fall out and get damaged.
Check the gasket. Replace a damaged gasket.



L5

Remove the bridge piece

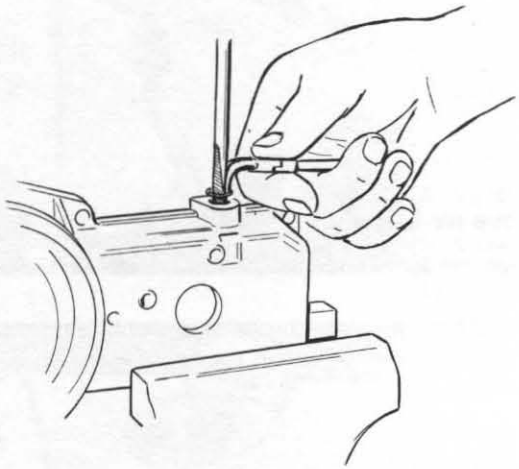
Remove the two retaining screws for the bridge piece. Remove the bridge piece.



L6

Remove the balance weight

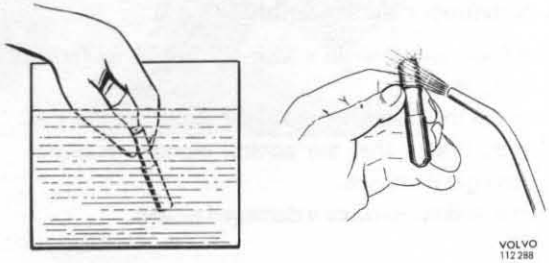
Remove the screws for the balance weight. Remove the balance weight.



L7

Remove lever

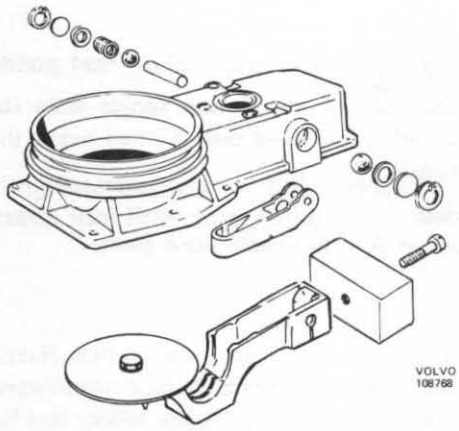
Remove the lever with the adjustment arm by removing lock ring, washer, rubber seal, springs and balls as well as shaft.
Worn or damaged parts should be replaced.



L8

Clean control plunger

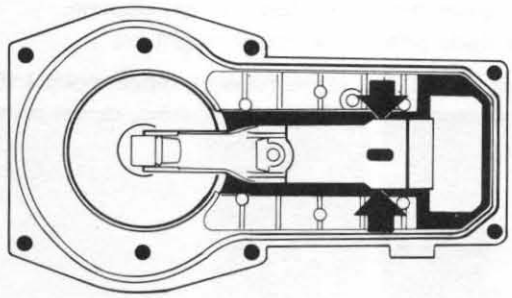
Wash the control plunger and clean it with compressed air. Check the plunger for damage. If the plunger is worn or scored, the fuel distributor should be replaced. Spots on the plunger surfaces may be cleaned by using finger pressure only. **Never use abrasives.**



L9

Assemble fuel distributor

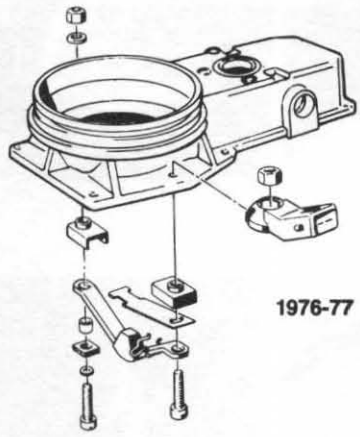
Position lever and adjustment arm. The adjustment arm should be positioned so that the roller for the control plunger is toward the fuel distributor. Position in order: shaft, balls, spring, rubber seals, washers and lock rings.



L10

Install balance weight.

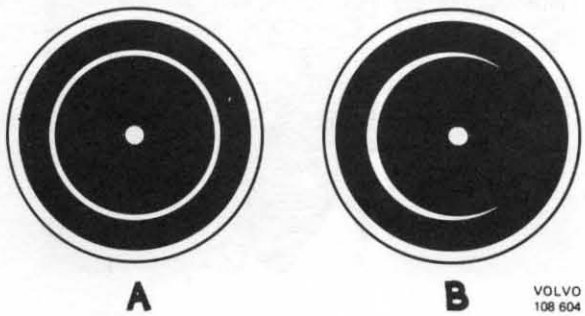
Install the balance weight and center the lever. Tighten the balance weight.



L11

Install the sensor plate stop.

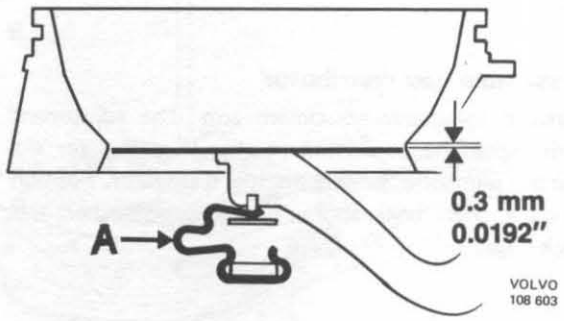
Install the sensor plate stop so that the spring and contact are on the right side.



L12

Center the air flow sensor plate.

Center the air flow sensor plate. (The sensor plate may not touch the air venturi at any point).
If adjustment is needed: Loosen the plate screw, move the plate to the right position and tighten the screw again.



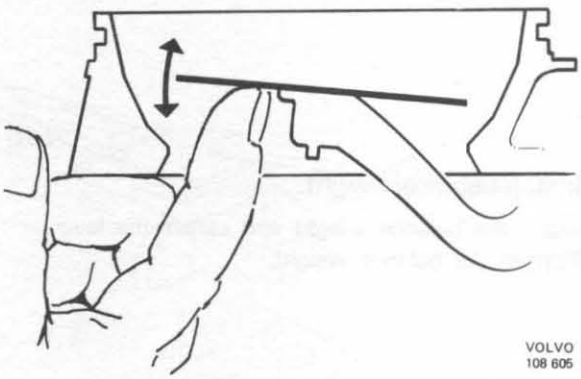
L13

Check the air flow sensor plate rest position

The upper part of the air flow sensor plate should be level with or no more than 0.5 mm below the air venturi edge.

If needed:

Adjust at A with needle nose pliers.



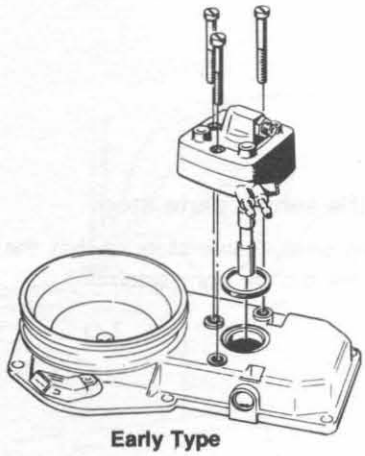
L14

Check the lever.

Check that the lever does not seize by lifting the air flow sensor plate from low to high position.

If the lever seizes, the reason might be:

A. The lever seizes in the housing, repeat point L10
B. The lever pivot seizes in the housing, repeat point L9.

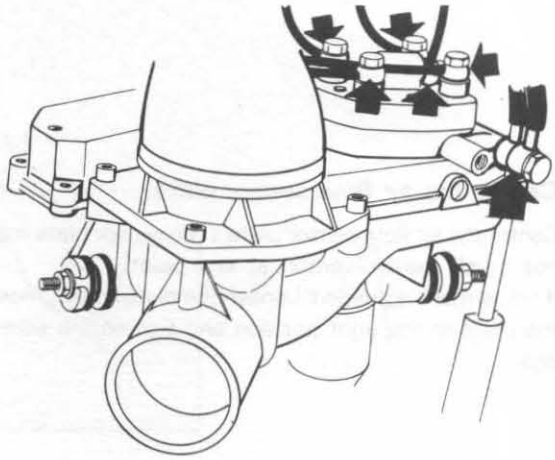


Early Type

L15

Install the air-fuel control unit

Install the fuel distributor carefully. Avoid damaging control plunger and O-ring.



L16

Air-fuel control unit installation

Install all fuel lines and connect wire connector.
Install rubber bellows.

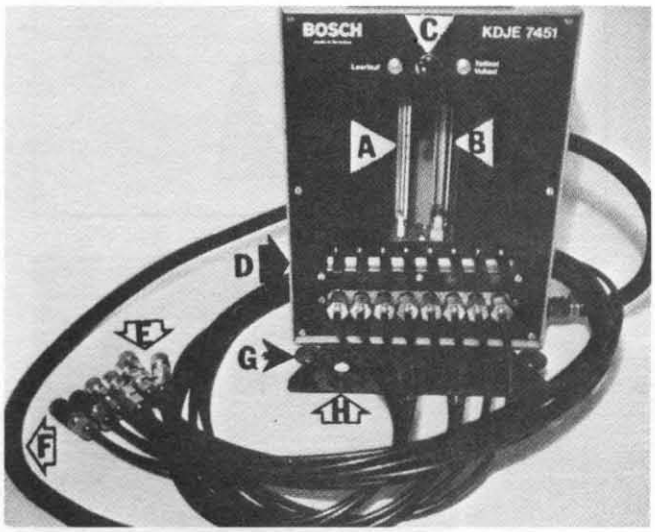
Additional information

Operating instructions for flow tester. Diagnostic fuel flow comparison.

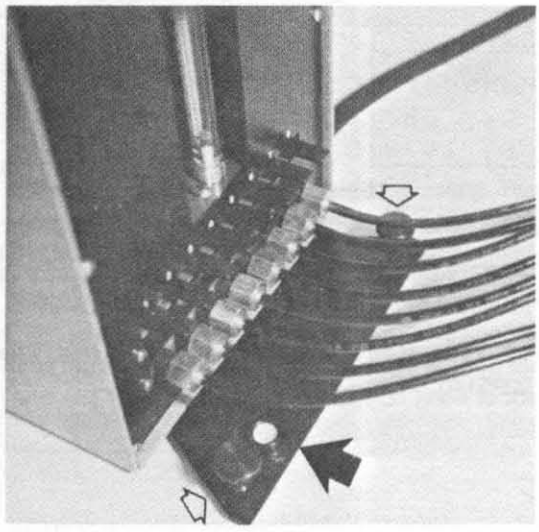
M1

The Bosch Fuel Flow Comparison Tester has been designed to perform precision flow testing on the vehicle. A variety of test modes including idle, part-load injector delivery comparison permit direct trouble shooting. This unit has a number of distinct advantages over earlier test methods, such as closed loop operation (allows system flushing) and rapid comparison monitoring.

Before attempting to perform any of the test procedures, familiarize yourself with the location and function of the operating controls listed on the illustration below. Please note that the following diagnostic operations are excluded from separate warranty consideration.



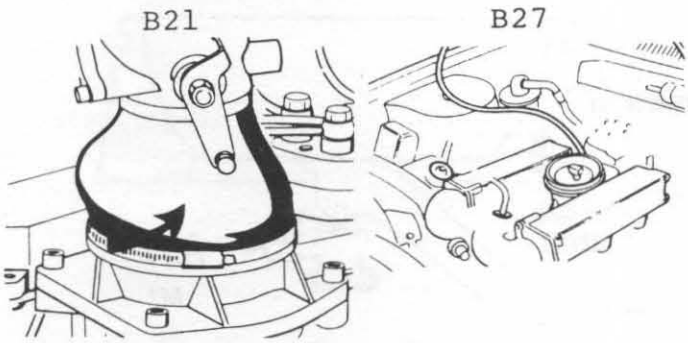
A. Rotameter Tube 2-30 cm^3
B. Rotameter Tube 15-200 cm^3
C. 3-Way Valve For Rotameter Tube Selection
D. Push-button Valves One Per Cylinder
E. 8 Fuel Hoses With Check Valve and Quick Connector
F. Fuel Return Line
G. Level Adjustors
H. Bubble Level



M2

Instrument and Vehicle Preparation

1. Place tester on a flat level surface in front of the car being tested. Use the three adjustment knobs to level the instrument. Check bubble level to verify correct adjustment.



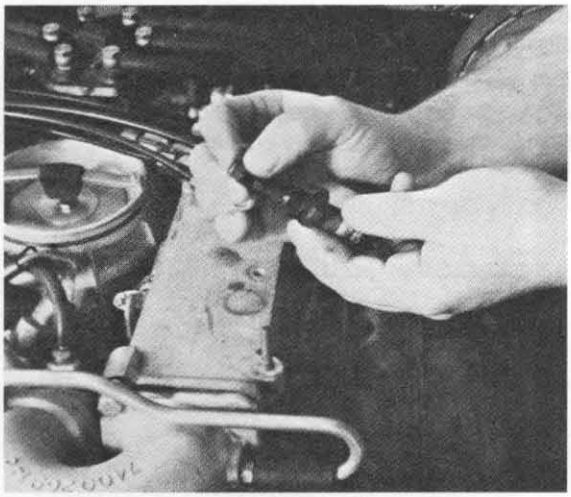
M3

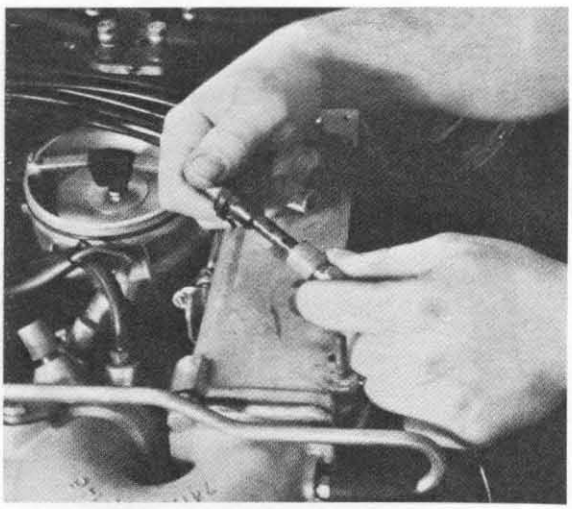
2. For 140 series, remove connection bellow at air flow sensor. On 240 series with B21 loosen lower clamp and push rubber bellow inward so you can reach the plate with special tool for adjusting the air flow sensor plate.

M4

3. Remove injectors from engine. Lubricate injector barrel with ATF to insure a good seal in the quick connector.

   Loosen knurled end of quick connector by turning counterclockwise. Insert injector into quick connector. Lock injector by tightening knurled end (clockwise rotation).



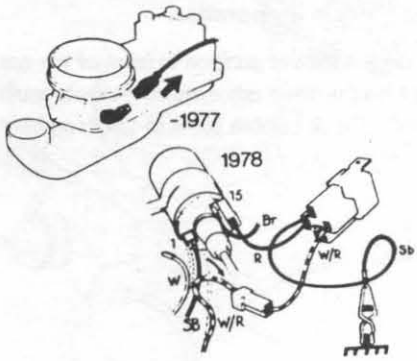


M5

4. Prepare connections to activate fuel pump.

   74-77 Year Models—Remove connector from air flow sensor.

   78 Year Models And On—Install test relay 9995170.



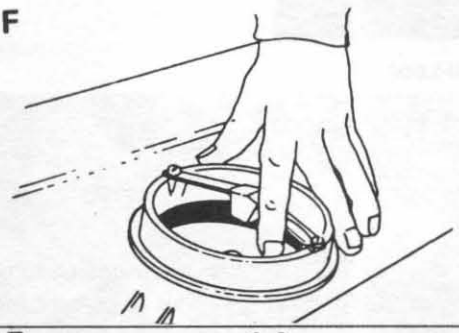
M6

5. Bleed the rotameter tubes.

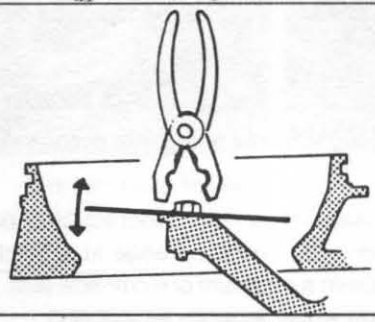
   a. Ignition **on** to activate fuel pump.

   b. Move the sensor plate to full load position (open).
   Note: Since the B21F rubber bellow is only partially removed, it is recommended to remove the air intake hose and with the assistance of a welding rod, shaped as illustrated in Alt. 2, lift the sensor plate.

B27F

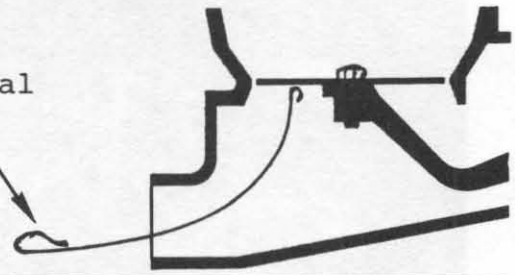


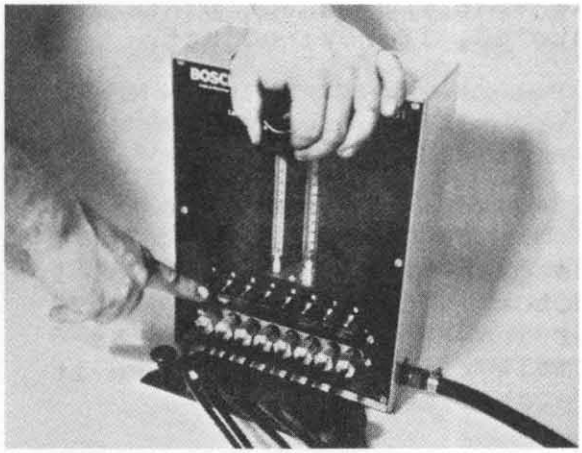
B21F
ALT. 1



ALT. 2

Shaped Metal Rod





c. Press the eight keys, one after the other, while simultaneously switching the 3-way valve. Continue until both tubes are bled and free from air bubbles.

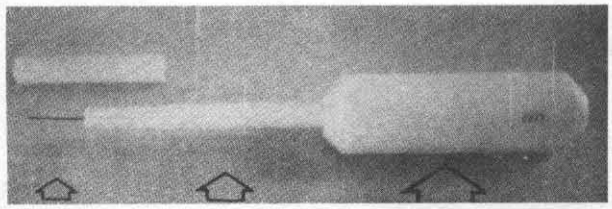
The instrument has now been prepared for testing. The flow comparison measurement is checked in the IDLE, PART-LOAD and FULL-LOAD ranges.

The thinner rotameter tube is used for idle measurement. The white dot on the 3-way selector valve knob is turned to the left. The large rotameter tube is used for part-load and full-load tests. White dot on knob to the right.

A special tool 9990977-2 has been developed to ensure ease of obtaining recommended flow rates (Set points).

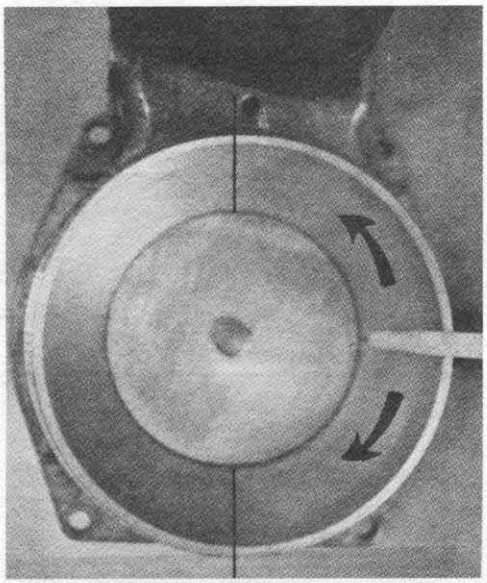
The tool is inserted between the sensor plate and venturi cone edge to the proper step depending on engine type and load range.

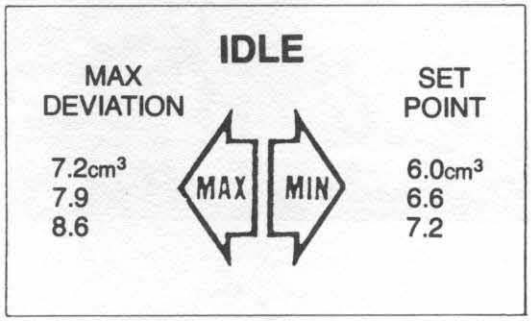
Recommended Use of Tool Step Positions



Idle Part-Load Full-Load

FLOW RATE COMPARISON TESTING





NOTE: The fuel pump must be running to perform the following tests. Therefore, in order to prevent battery drain, a battery charger should be used during the testing period.

M7

6. **Test of IDLE flow rate** (White dot on selector knob to left).

   a. Insert wire portion of tool 9990977 between sensor plate and cone edge at a point where you obtain a minimum of 6 cm^2 flow rate. See illustration where tool can be inserted.

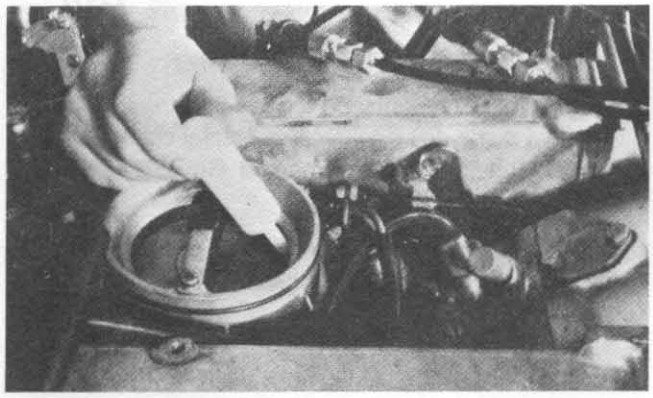
      NOTE: Make sure the sensor plate is centered, if not, adjust.

   b. Press push-button tab for No. 1 injector. Note flow value by observing top edge of pointer in small rotameter tube when it has stabilized.

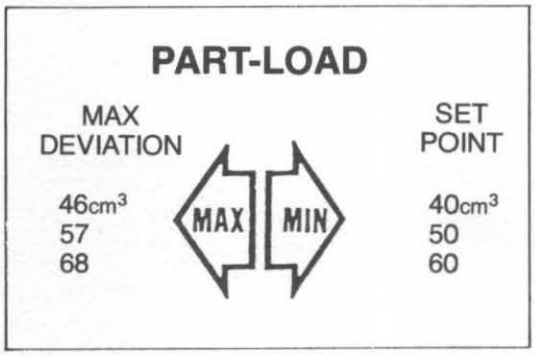
   c. Continue with each injector in turn; note values obtained. Tool 9990977 should be positioned in such a manner that the lowest reading obtained (set point) is 6.0, 6.6, or 7.2 cm^2. See label affixed to the tester for deviation specifications for each set point.

d. In case of exceptionally low fuel delivery, see Page 6, Point 9.

DIAGNOSING OF FUEL DISTRIBUTOR OR INJECTOR



B27 Part-Load Position



To isolate the problem area if there is an individual injector deviation beyond specification, proceed as follows:

Exchange the questionable injector line at the fuel distributor with a line that produced a flow rate within specs. Prior to retesting, bleed the two lines by opening the sensor plate to full-load position. Depress each of the valves for the two affected lines until all air bubbles are purged. Retest and check flow rates for each injector. If the same injector line remains out of specification, then either the injector or line is faulty. If the fault switches over to the previously good injector, then the fuel distributor is faulty.

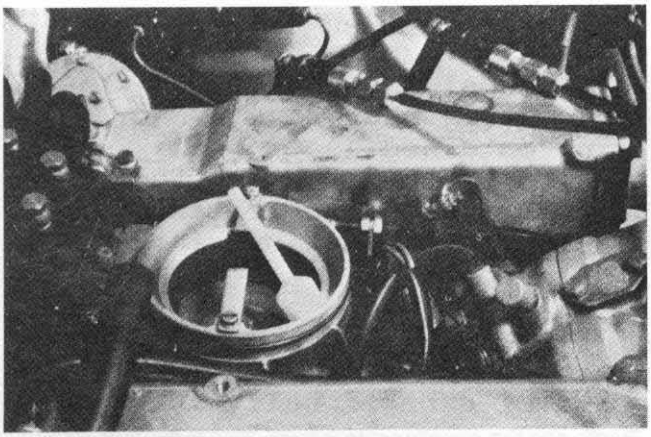
7. **Test at Part-Load Range** *M8*

   a. Rotate selector knob to the right.

   b. Insert tool 9990977-2 to the proper step (See tool illustration) and position so a set point of 40, 50, or 60 cm^2 is obtained as the lowest reading between injectors.

   c. Depress push-button tabs one by one and compare flow rates. Refer to the flow deviation chart affixed to the tester.

M9



8. **Test at Full-Load Range**

   NOTE: Tool 9990977 must be inserted in such a manner that full-load plate is obtained. The tool position will vary depending on engine type.

   A set point of 120, 140, or 160 cm^2 must be obtained as the lowest reading.

   Refer to deviation label for allowable differences.

M10

9. In case of exceptionally low fuel delivery:

   a. Battery voltage may be too low causing insufficient pump delivery (connect battery charger).
   b. Consult fault tracing manual Group 24, TP 12044/1, Page 29.

   NOTE: Fuel flow deviation percentage can be calculated using the following formula.

$$\frac{\text{High - Low} \times 100}{\text{Low}} = \% \text{ Deviation}$$

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