

# I - SYSTEM/COMPONENT TESTS

1995 Volvo 850

1995 ENGINE PERFORMANCE  
Volvo - System & Component Testing

850

## INTRODUCTION

NOTE: In this article, Engine Control Module (ECM) may also be referred to as Engine Control Unit (ECU).

Before testing separate components or systems, perform procedures in the F - BASIC TESTING article. Since many computer-controlled and monitored components set a trouble code if they malfunction, also perform procedures in the G - TESTS W/CODES article.

NOTE: Testing individual components does not isolate shorts or opens. Unless stated otherwise in test procedure, perform all voltage tests using a Digital Volt-Ohmmeter (DVOM) with a minimum 10-megohm input impedance. Use ohmmeter to isolate wiring harness shorts or opens.

## COMPUTERIZED ENGINE CONTROLS

CAUTION: To prevent damage to Electronic Control Unit (ECU), ensure ignition switch is in OFF position before disconnecting or connecting ECU.

## ELECTRONIC CONTROL UNIT - FUEL INJECTION

NOTE: When measuring resistance and voltage at ECU, use Breakout Box (981-3190) and Adapter (981-3195). DO NOT measure resistance and voltage at ECU connector. Before disconnecting/connecting control unit connector, disconnect negative battery cable.

### Preliminary Check & Breakout Box Installation

1) Remove ECU cover located in right front engine compartment. Remove both fuel injection and distributor ignition ECUs. Press adapter into ECU base. Position adapter lead at rear of ECUs and thread through slot next to distributor ignition module.

2) Press distributor ignition ECU into position first to avoid damage to adapter lead. Press fuel injection control unit, with adapter connected, into connector in bottom of ECU box. Connect breakout box to adapter 60-pin connector.

### Power Circuit Check

Ensure ignition is off. Connect voltmeter between breakout box terminals No. 20 and 10. Battery voltage should be present. Connect voltmeter between terminals No. 20 and 30. Turn ignition on. Battery voltage should be present. If voltage is not as specified, check wiring, fuse No. 1, and electrical connections. Turn ignition off.

### Ground Circuit Check

1) Connect ohmmeter between ground and breakout box terminal No. 20, then between ground and breakout box terminal No. 29. Ohmmeter should indicate about zero ohms. If about zero ohms is not present, check control unit grounds.

2) Connect ohmmeter between breakout box terminal No. 20 and

breakout box terminals No. 8, 12, 14, and 23. Ohmmeter should indicate about zero ohms in all cases. If reading is too high, repeat test using new fuel injection ECU.

## ELECTRONIC CONTROL UNIT - IGNITION

**NOTE:** When measuring resistance and voltage at ECU, use Breakout Box (981-3190) and Adapter (981-3195). See Fig. 1. DO NOT measure resistance and voltage at ECU connector. Before disconnecting/connecting control unit connector, disconnect negative battery cable.

### Preliminary Check & Breakout Box Installation

1) Turn ignition switch to OFF position. Distributor ignition ECU is located in right side of engine compartment. Remove ECU cover. Disconnect distributor ignition ECU connector. Visually inspect all terminal connector sleeves to ensure no terminals are damaged.

2) To install breakout box, remove distributor ignition ECU. Press adapter onto distributor ignition ECU and pull lead upward through slot beside module. Press distributor ignition ECU, with adapter connected, into connector in bottom of ECU box. Connect breakout box to adapter 60-pin connector.

### Power Circuit Check

1) Connect voltmeter between breakout box terminals No. 20 and 43. Operate starter motor. Voltmeter should indicate .7-1.3 volts. If voltage is not as specified, repeat test using new ECU.

2) To check distributor ignition signal to fuel injection ECU, connect voltmeter between breakout box terminals No. 20 and 52. Operate starter motor. Voltmeter should indicate about 5-7 volts. If voltage is not as specified, repeat test using new distributor ignition ECU.

3) Turn ignition off. To check voltage supply to ECU, connect voltmeter between breakout box terminals No. 20 and 10. Battery voltage should be present. Turn ignition on. Connect voltmeter between breakout box terminals No. 20 and 30. Battery voltage should be present. If battery voltage is not present, check wiring.

### Ground Circuit Check

Connect ohmmeter between ground and breakout box terminal No. 20, then between ground and terminal No. 29. In both cases, ohmmeter should indicate about zero ohms. Connect ohmmeter between breakout box terminals No. 20 and 2, then between terminals No. 20 and 15. In both cases, ohmmeter should indicate about zero ohms.

## ENGINE SENSORS & SWITCHES

**CAUTION:** To prevent damage to Electronic Control Unit (ECU), ensure ignition switch is in OFF position before disconnecting or connecting ECU.

### Camshaft Position Sensor

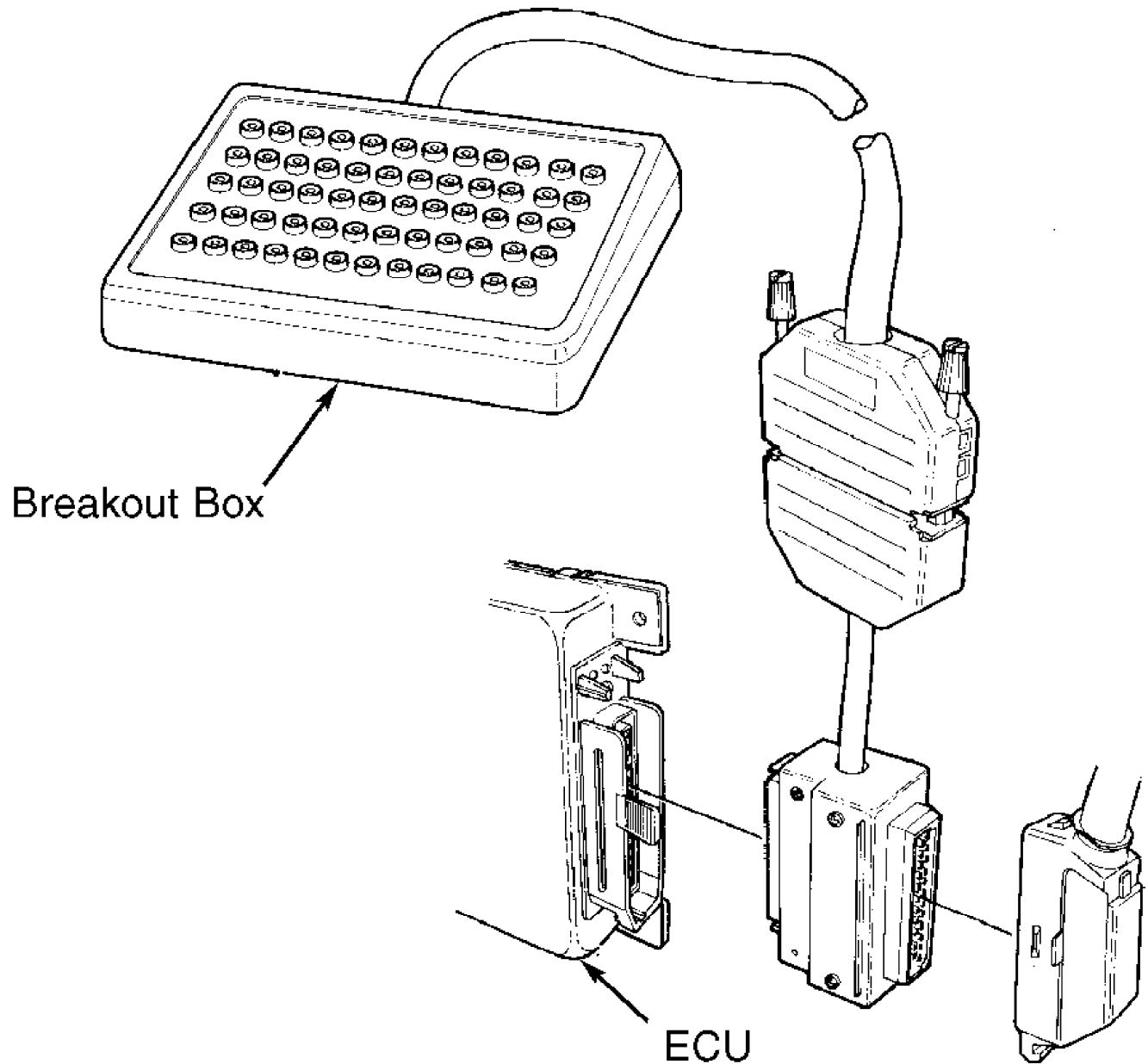
1) When measuring voltage at ECU, use Breakout Box (981-3190) and Adapter (981-3195). See Fig. 1. DO NOT measure voltage at ECU connector. Before disconnecting/connecting ECU connector, disconnect negative battery cable.

2) To install breakout box, remove distributor ignition ECU. Press adapter onto distributor ignition ECU and pull lead upward through slot beside module. Press distributor ignition ECU, with adapter connected, into connector in bottom of ECU box. Connect breakout box to adapter 60-pin connector.

3) Connect voltmeter between breakout box terminals No. 20

and 4. Operate starter motor. Voltage should vary between 0-5 volts. If voltage reading is incorrect, check camshaft position sensor supply voltage. If voltage is present, check control signal to power stage.

4) To check voltage supply to camshaft position sensor Hall Effect generator, connect voltmeter between breakout box terminals No. 20 and 14. Voltmeter should indicate about 10 volts. If voltage is present but signal is absent, repeat test using new camshaft position sensor.



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Fig. 1: Connecting Breakout Box To ECU (Typical)  
Courtesy of Volvo Cars of North America.

Engine Coolant Temperature Sensor

1) Disconnect Engine Coolant Temperature (ECT) sensor

connector. Using an ohmmeter, measure resistance between ECT sensor terminals.

2) If resistance is not as specified, replace sensor. See the ENGINE COOLANT TEMPERATURE SENSOR RESISTANCE table.

#### ENGINE COOLANT TEMPERATURE SENSOR RESISTANCE TABLE

Temperature °F (°C)	Ohms
32 (0)	7300
68 (20)	2800
176 (80)	300
212 (100)	150

#### Mass Airflow Meter/Sensor

1) Connect Breakout Box (981-3190) and Adapter (981-3195) to fuel injection ECU. See Fig. 1. DO NOT measure resistance and voltage at ECU connector. Before disconnecting/connecting control unit connector, disconnect negative battery cable.

2) Remove ECU cover located in right front engine compartment. Remove both fuel injection and distributor ignition ECUs located in right front of engine compartment. Press adapter into ECU base. Position adapter lead at rear of ECUs and thread through slot next to distributor ignition module.

3) Press distributor ignition ECU into position first to avoid damage to adapter lead. Press fuel injection control unit, with adapter connected, into connector in bottom of ECU box. Connect breakout box to adapter 60-pin connector.

4) Turn ignition on. Connect voltmeter between breakout box terminals No. 13 and 20. About 2.7 volts should be present. Start engine. About 3.5 volts should be present at idle with engine hot. Turn engine off. If voltages are okay, go to step 6) and check MAF ground circuit. If voltages are not okay, go to next step.

5) Turn ignition on. Connect voltmeter between MAF connector terminal No. 4 (White wire) and ground. Voltage should be about 2.7 volts. Start engine. Voltage should be about 3.5 volts during idle with engine hot. If voltages are correct, check voltage supply for an open or short circuit. If voltages are incorrect, go to next step and check MAF ground circuit.

6) Turn ignition off. Connect ohmmeter between MAF connector terminal No. 2 (Green/Red wire) and ground, then between connector terminal No. 1 (Brown/White wire) and ground. Ohmmeter should indicate about zero ohms in both instances. If readings are okay, go to step 8). If readings are incorrect, go to next step.

7) Ensure ignition is off. Connect ohmmeter between breakout box terminals No. 20 and 8, then between terminals No. 20 and 12. Ohmmeter should indicate about zero ohms in both instances. If readings are incorrect, repeat test using new fuel injection ECU. If readings are correct, go to next step and check MAF voltage supply.

8) Turn ignition on. Connect voltmeter between ground and MAF connector terminal No. 3 (Green wire). Voltmeter should indicate battery voltage. If voltage is not present, check for an open or short circuit in voltage supply. If voltage is present, repeat test using new MAF sensor.

#### Heated Oxygen Sensor (HO2S) & Preheater Resistor

1) Connect Breakout Box (981-3190) and Adapter (981-3195) to fuel injection ECU. See Fig. 1. DO NOT measure resistance and voltage at ECU connector. Before disconnecting/connecting control unit connector, disconnect negative battery cable.

2) Remove ECU cover located in right front engine compartment. Remove both fuel injection and distributor ignition ECUs.

Press adapter into ECU base. Position adapter lead at rear of ECUs and thread through slot next to distributor ignition module.

3) Press distributor ignition ECU into position first to avoid damage to adapter lead. Press fuel injection control unit, with adapter connected, into connector in bottom of ECU box. Connect breakout box to adapter 60-pin connector.

4) Connect voltmeter between breakout box terminals No. 22 and 23. Start engine. After about 30 seconds, voltage should vary between .1-.9 volt. If voltage does not vary but remains constant at .5 volt, HO2S or wiring is defective.

5) To check voltage supply to HO2S, turn ignition on. Connect volt-meter between breakout box terminals No. 20 and 28. If battery voltage is present, go to next step. If battery voltage is not present, check HO2S wiring.

6) If battery voltage was present in step 5), connect voltmeter between breakout box terminals No. 28 and 20. Start engine. If voltage reading falls from battery voltage to about .4 volt, go to next step. Turn engine off. If voltage reading does not fall from battery voltage to about .4 volt, ECU is probably defective.

7) Stop engine. To check preheater resistor, connect ohmmeter between breakout box terminals No. 19 and 28. Ohmmeter should indicate about 3-13 ohms, depending on resistor temperature.

#### Throttle Position (TP) Sensor

1) Connect Breakout Box (981-3190) and Adapter (981-3195) to fuel injection ECU. See Fig. 1. DO NOT measure resistance and voltage at ECU connector. Before disconnecting/connecting control unit connector, disconnect negative battery cable.

2) Remove ECU cover located in right front engine compartment. Remove both fuel injection and distributor ignition ECUs located in right front of engine compartment. Press adapter into ECU base. Position adapter lead at rear of ECUs and thread through slot next to distributor ignition module.

3) Press distributor ignition ECU into position first to avoid damage to adapter lead. Press fuel injection control unit, with adapter connected, into connector in bottom of ECU box. Connect breakout box to adapter 60-pin connector.

4) To check TP sensor signal, connect voltmeter between breakout box terminals No. 1 and 14. Turn ignition on. Voltmeter should indicate about .6 volt in idling position and about 4.2 volts in full-load position. Turn ignition off.

5) If signal is not present or not to specification, connect voltmeter between breakout box terminals No. 2 and 20. Turn ignition on. Voltmeter should indicate about 5 volts. Turn ignition off. To check ground, connect ohmmeter between breakout box terminals No. 14 and 20. Ohmmeter should indicate about zero ohms.

6) If no voltage was present or ground is faulty, check wiring for short to ground or voltage. If wiring is okay, repeat test using new fuel injection ECU. If voltage supply was present and ground is okay, go to next step and TP sensor resistance.

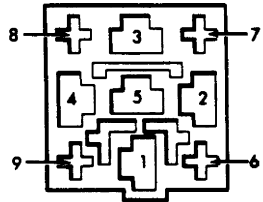
7) Ensure ignition is off. Measure resistance between breakout box terminals No. 14 and 2. Resistance should be about 1800-2200 ohms. Connect ohmmeter between terminals No. 14 and 1. Ohmmeter should indicate about 1000 ohms when throttle is at idle position and about 2600 ohms when throttle is at full load.

8) If resistance is incorrect or zero, measure directly at TP sensor connector to determine if fault is in switch or wiring. Replace sensor as necessary.

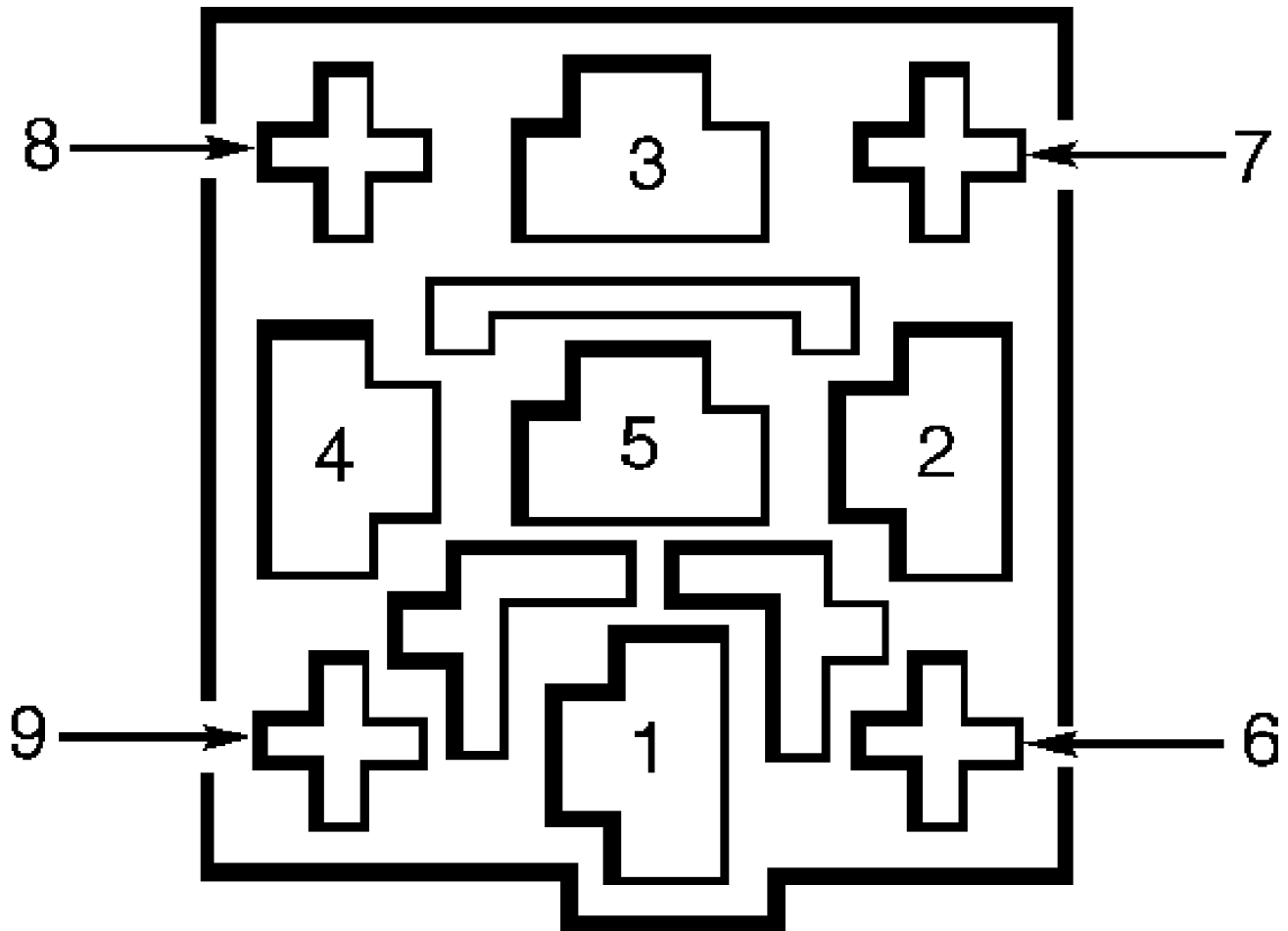
## RELAYS

### Fuel Pump Relay

1) Remove fuel pump relay. See Fig. 2. Connect jumper wire between fuel pump relay terminals No. 1 and 3. See Fig. 3. Turn ignition on. If fuel pump does not start, go to next step. If fuel pump starts, replace fuel pump relay.



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 Fig. 2: Locating Fuel Pump Relay & Fuse  
 Courtesy of Volvo Cars of North America.



### 93G78481

Fig. 3: Identifying Fuel Pump Relay Base Terminals  
 Courtesy of Volvo Cars of North America.

2) Turn ignition off. To check relay ground, connect ohmmeter between ground and fuel pump relay terminal No. 2. See Fig. 3.

Ohmmeter should indicate about zero ohms. If ohmmeter does not indicate about zero ohms, check wiring between fuel pump relay and ground.

3) To check fuel pump relay voltage supply, connect voltmeter between ground and fuel pump relay terminal No. 1. See Fig. 3. Turn ignition on. Battery voltage should be present. If battery voltage is not present, check wiring between fuel pump relay and fuse No. 2.

4) Turn ignition off. Connect ohmmeter between ground and relay terminal No. 3. See Fig. 3. About 1.5 ohms should be present. If about 1.5 ohms are not present, check resistance at fuel pump connector to determine whether fault is in pump or wiring.

5) To check fuel injection control signal to fuel pump relay, connect voltmeter between ground and fuel pump relay terminal No. 4. See Fig. 3. Operate starter motor. If voltmeter indicates about 3 volts, replace relay. If voltage is not to specification, check wiring between fuel pump relay and ECU. If wiring is okay, see procedures under ELECTRONIC CONTROL UNIT - IGNITION under COMPUTERIZED ENGINE CONTROLS.

## FUEL SYSTEM

NOTE: For fuel system pressure testing, see the F - BASIC TESTING article.

WARNING: Always relieve fuel pressure before disconnecting any fuel injection-related component. DO NOT allow fuel to contact engine or electrical components. Cover fuel line connector with shop towel to absorb any fuel spray.

## FUEL DELIVERY

### Fuel Pressure Regulator

1) Install Connector (998-9725) to Fuel Pressure Gauge (999-5011). Using Adapter (999-5479), connect pressure gauge to valve on fuel distribution manifold. Turn valve in direction of adapter. Connect other gauge connection to Fuel Drainage Unit (981-2270, 2273 and 2282).

2) Remove electrical distribution unit cover in engine compartment. Remove fuel pump relay. See Fig. 2. Connect jumper wire between fuel pump relay terminals No. 1 and 3. Turn ignition on. Fuel pump should start. If system pressure is 43.5 psi (300 kPa), go to step 5).

3) If system pressure is too high, remove jumper wire. Disconnect pressure regulator return and vacuum lines and blow through lines. If both lines are okay, replace regulator and recheck pressure.

4) If system pressure is too low, squeeze return line and ensure pressure rises. Do not allow pressure to exceed 87 psi (600 kPa). If pressure rises quickly, pump and line are okay. Replace pressure regulator and recheck system pressure. If pressure rises slowly, check for blocked fuel filter, fuel pump strainer or fuel lines. If pressure does not rise, replace pump.

5) If system pressure was 43.5 psi (300 kPa) in step 2), check operation of pressure regulator by connecting Vacuum Pump (999-5843) to pressure regulator. Apply vacuum to regulator. Ensure system pressure falls by same amount as regulator pressure.

6) Turn ignition off. Remove jumper wire between fuel pump relay terminals No. 1 and 3. Reinstall fuel pump relay. Check fuel system residual pressure. Pressure should not fall below 20 psi (200 kPa) in less than 20 minutes. If fuel pressure falls faster, check injectors, pressure regulator, and fuel pump. Disconnect Pressure Gauge (999-5011).

## FUEL CONTROL

### Fuel Injectors

1) Remove fuel injector cover. Connect an ohmmeter between injector terminals. Injector resistance should be 15.6-16.2 ohms. If resistance is not as specified, replace injector. If resistance is as specified, disconnect injector connector. Connect voltmeter between connector terminals. Operate starter motor. Voltmeter should indicate 300-700 millivolts, depending on engine temperature.

2) If voltage not to specification, connect voltmeter between injector connector terminal No. 1 (Green wire) and ground. If battery voltage is present, see ELECTRONIC CONTROL UNIT - FUEL INJECTION under COMPUTERIZED ENGINE CONTROLS.

3) If battery voltage is not present, remove main relay from engine compartment relay base. Connect voltmeter between ground and relay connector terminal No. 4, then between ground and relay connector terminal No. 2. If battery voltage is present in both instances, go to next step. If battery voltage is not present, check relay voltage supply from battery.

4) Turn ign. on. Reinstall relay in base. Relay should click. If relay does not click, see ELECTRONIC CONTROL UNIT - FUEL INJECTION under COMPUTERIZED ENGINE CONTROLS.

## IDLE CONTROL SYSTEM

### Idle Air Control (IAC) Valve

Ensure ignition is off. Disconnect IAC valve connector.

Connect an ohmmeter between connector terminals No. 1 (Blue/Black wire) and No. 2 (Blue/White wire), then between terminals No. 2 (Green wire) and No. 3 (Green wire). If resistance is not 9-14 ohms, replace IAC valve. If resistance is 9-14 ohms, IAC valve is okay. Check IAC circuits. See the G - TESTS W/CODES article.

## IGNITION SYSTEM

NOTE: For basic ignition checks, see the F - BASIC TESTING article.

## TIMING CONTROL SYSTEMS

### Detonation (Knock) Sensors

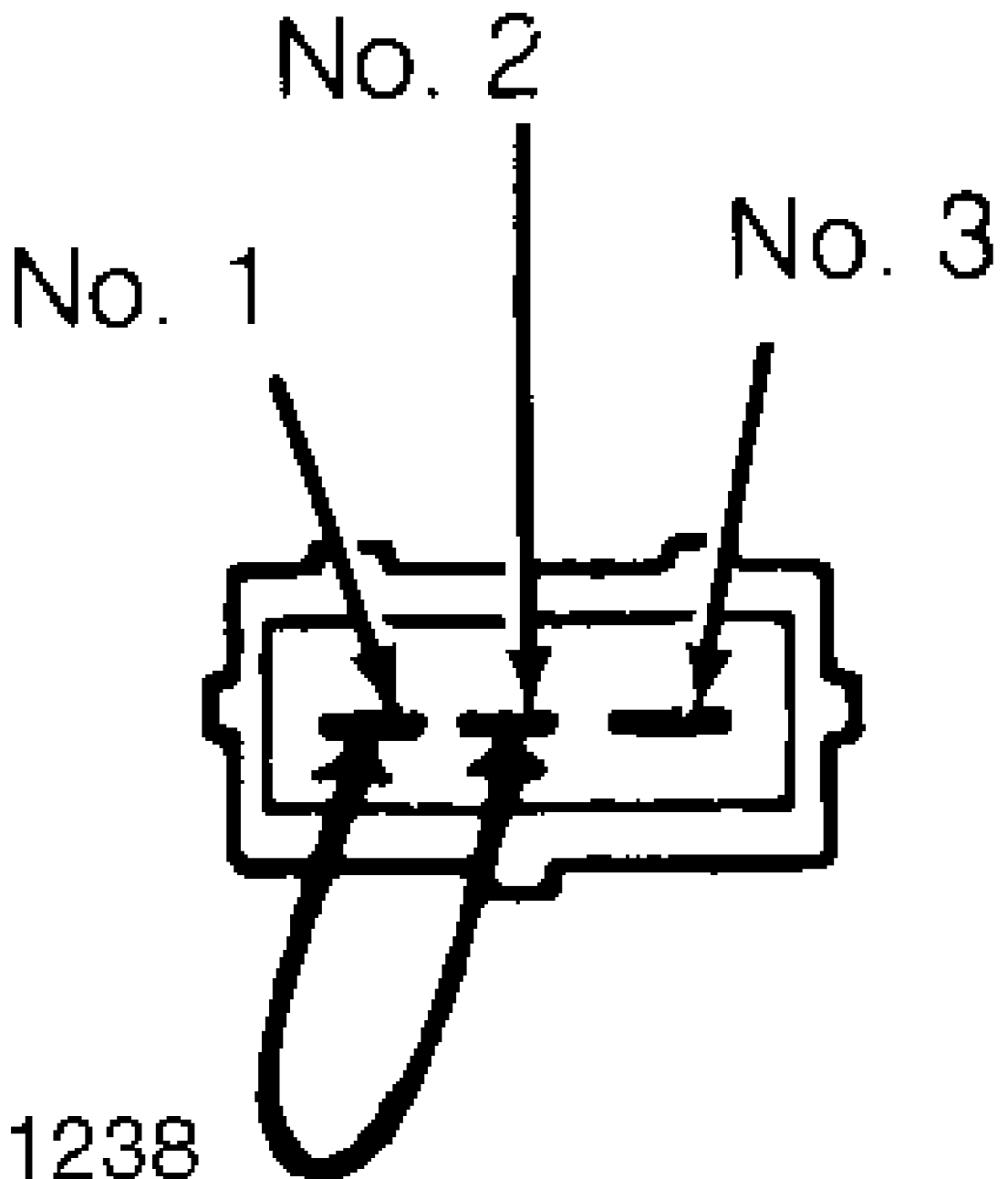
1) Connect Breakout Box (981-3190) and Adapter (981-3195) to distributor ignition ECU. Disconnect negative battery cable. Remove ECU cover located in right front engine compartment. Remove distributor ignition ECU.

2) Press adapter onto ECU and pull lead upward through slot beside module. Press ECU, with adapter connected, into connector in bottom of ECU box. Connect breakout box to adapter 60-pin connector.

3) Depending upon which knock sensor is being checked, disconnect front or rear knock sensor connector and connect a jumper wire between knock sensor connector terminals. See Fig. 4.

4) Connect ohmmeter between breakout box terminals No. 22 and 23, or 24 and 25 (depending on which sensor is being checked). Reading should be zero ohms. If reading is correct, replace knock sensor. Tighten knock sensor to 15 ft. lbs. (20 N.m). If ohmmeter does not indicate zero ohms, check distributor ignition ECU wiring.





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Fig. 4: Knock Sensor Connector Terminals (Typical)  
Courtesy of Volvo Cars of North America.

## EMISSION SYSTEMS & SUB-SYSTEMS

### EXHAUST GAS RECIRCULATION (EGR)

If circuit or component is faulty, a trouble code should set.  
See the G - TESTS W/CODES article.

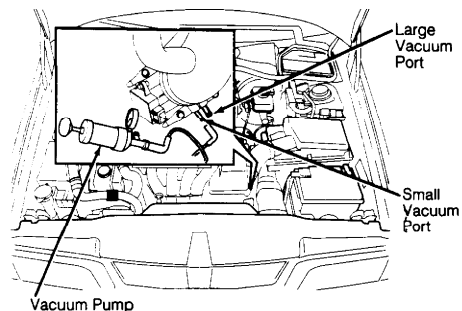
### FUEL EVAPORATIVE (EVAP)

EVAP Valve Check

1) Disconnect ventilation hose and canister guide from

throttle body. Connect vacuum pump to ventilation (large) port and begin pumping to obtain partial vacuum. See Fig. 5. Even though pressure returns quickly to atmosphere pressure, resistance should be felt when pumping.

2) If vacuum and resistance are okay, go next step. If vacuum cannot be reached or resistance is not okay, check ventilation hose connected to canister for damage or leakage. If hose is okay, repeat test using new canister.



93C78545

Fig. 5: Checking EVAP Valve  
Courtesy of Volvo Cars of North America.

3) Apply vacuum to small vacuum port. If partial vacuum is present, go to next step. If no partial vacuum is present, check vacuum hose connected to canister for leakage. If hose is okay, repeat test using new canister.

4) Maintain vacuum in vacuum hose. Blow into hose that fits into large port. If air passes through canister with slight resistance, canister and guide are okay. If air does not pass through canister, check vacuum hose for blockage. If vacuum hose is okay, repeat test using new canister.

## MISCELLANEOUS CONTROLS

NOTE: Although some of the controlled devices listed here are not technically engine performance components, they can affect drive-ability if they malfunction.

### COOLING FAN

#### Cooling Fan Motor

1) Connect Breakout Box (981-3190) and Adapter (981-3195) to distributor ignition ECU. Disconnect negative battery cable. Remove ECU cover located in right front engine compartment. Remove distributor ignition ECU. Press adapter onto ECU and pull lead upward through slot beside module. Press ECU, with adapter connected, into connector in bottom of ECU box. Connect breakout box to adapter 60-pin connector.

2) On vehicles without A/C, connect voltmeter between breakout box terminals No. 20 and 17. On vehicles with A/C, connect voltmeter between breakout box terminals No. 20 and 25. In both instances, battery voltage should be present. If battery voltage is not present, check wiring between fan motor, relay, and ground.