F - BASIC TESTING

1994 Volvo 960

1994 ENGINE PERFORMANCE
Volvo Basic Diagnostic Procedures

Volvo; 850, 940, 960

INTRODUCTION

The following diagnostic steps will help prevent overlooking a simple problem. This is also where to begin diagnosis for a no-start condition.
The first step in diagnosing any driveability problem is verifying the customer complaint with a test drive under the conditions the problem reportedly occurred.

Before entering self-diagnostics, perform a careful and complete visual inspection. Most engine control problems result from mechanical breakdowns, poor electrical connections or damaged/misrouted vacuum hoses. Before condemning the computerized system, perform each test listed in this article.

NOTE: Perform all voltage tests using a Digital Volt-Ohmmeter (DVOM) with a minimum 10-megohm input impedance, unless otherwise instructed in test procedure.

PRELIMINARY INSPECTION & ADJUSTMENTS

VISUAL INSPECTION

Visually inspect all electrical wiring. Look for chafed, stretched, cut or pinched wiring. Ensure electrical connectors fit tightly and are not corroded. Ensure vacuum hoses are properly routed and not pinched or cut. See M - VACUUM DIAGRAMS article in the ENGINE PERFORMANCE Section to verify routing and connections (if necessary). Inspect air induction system for possible vacuum leaks.

MECHANICAL INSPECTION

Compression
Check engine mechanical condition using a compression gauge, vacuum gauge or engine analyzer. See engine analyzer manual for specific instructions.

WARNING: Do not use ignition switch during compression tests on fuel injected vehicles. Use a remote starter to crank engine. Fuel injectors on many models are triggered by ignition switch during cranking mode, which can create a fire hazard or contaminate engine oiling system.

COMPRESSION SPECIFICATIONS TABLE

Application	Specification
Compression Pressure (Minimum)	
850	
Non-Turbo	189-219 psi (13.2-15.3 kg/cm²)
Turbo	156-185 psi (11-13 kg/cm²)
940	128 psi (9 kg/cm²)
960	184 psi (13 kg/cm²)

Exhaust System Backpressure

1) Exhaust system can be checked using a vacuum or pressure gauge. Remove oxygen sensor or air injection check valve (if equipped).

2) Connect a 1-10 psi pressure gauge, and run engine at 2500 RPM. If exhaust system backpressure is greater than 1 3/4-2 psi, exhaust system or catalytic converter is plugged.

3) If using a vacuum gauge, connect vacuum gauge hose to intake manifold vacuum port and start engine. Observe vacuum gauge. Open throttle part way and hold steadily. If vacuum gauge reading slowly drops after stabilizing, exhaust system should be checked for a restriction.

FUEL SYSTEM

WARNING: Always relieve fuel pressure before disconnecting any fuel injection-related component. DO NOT allow fuel to contact engine or electrical components.

FUEL PRESSURE

Fuel Pressure

1) Before disconnecting, cover fuel line connector using shop towel to absorb any fuel spray. Connect Fuel Pressure Gauge (5011) between fuel line and fuel rail. Seal free end of hose using Plug (5266) or use Fuel Drainage Unit (981 2270, 2273 and 2282).

2) On 940, lift out central electrical unit behind ashtray and remove system relay. See Fig. 1. On 850, lift cover on central electrical unit located in engine compartment and remove fuel pump relay. See Fig. 2. On 940, connect a jumper wire between relay terminals No. 30 and 87/2. See Fig. 3.

3) On 850, connect a jumper wire between relay terminals No. 1 and 3. See Fig. 4. On 960, remove fuel injection fuses No. 30 and 31. See Fig. 5. Connect jumper wire between fuse terminals No. 30 and 31.

4) On all models, turn ignition on. Fuel pump should start. Fuel filler cover can be removed to determine whether main pump is operating. Fuel pressure should be about 43.5 psi (3.06 kg/cm^2). If pressure is too low, pinch return hose by hand and check whether pressure rises. DO NOT allow pressure to exceed 86 psi (6 kg/cm^2).

5) If pressure rises rapidly, pump and lines are okay. Replace pressure regulator and recheck line pressure. If pressure rises slowly, fuel filter, fuel pump strainer or fuel lines are blocked. If pressure does not rise, fuel pump is probably faulty.

6) If pressure is too high, remove jumper wire between relay or fuse terminals. Remove return hose from pressure regulator, and blow in pipe. Remove vacuum hose from pressure regulator, and blow in pipe. If both hoses are open, pressure regulator is defective. Replace regulator, and recheck pressure.

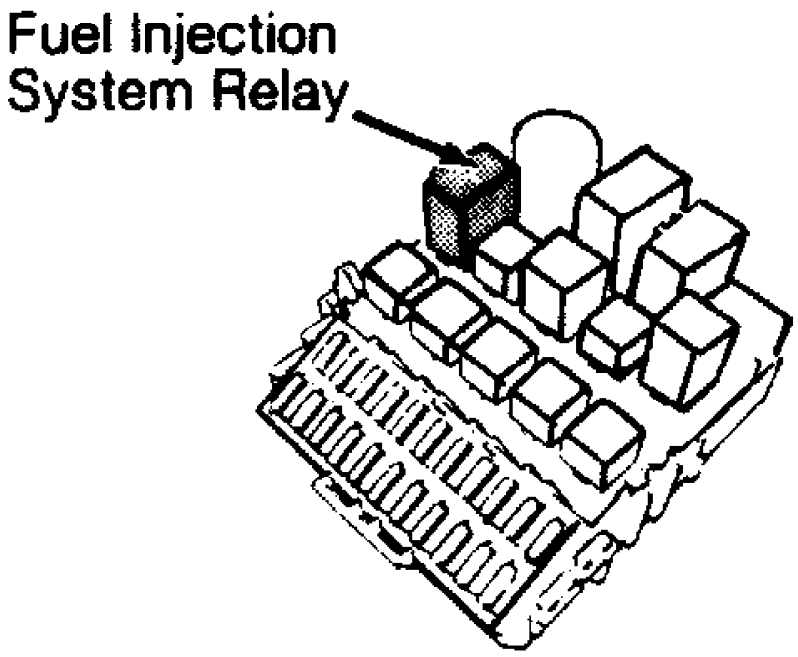

Fig. 1: Locating Fuel System Relay (940)
Courtesy of Volvo Cars of North America.

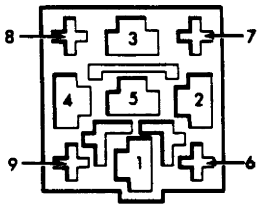

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Fig. 2: Locating Fuel Pump Relay (850)
Courtesy of Volvo Cars of North America.

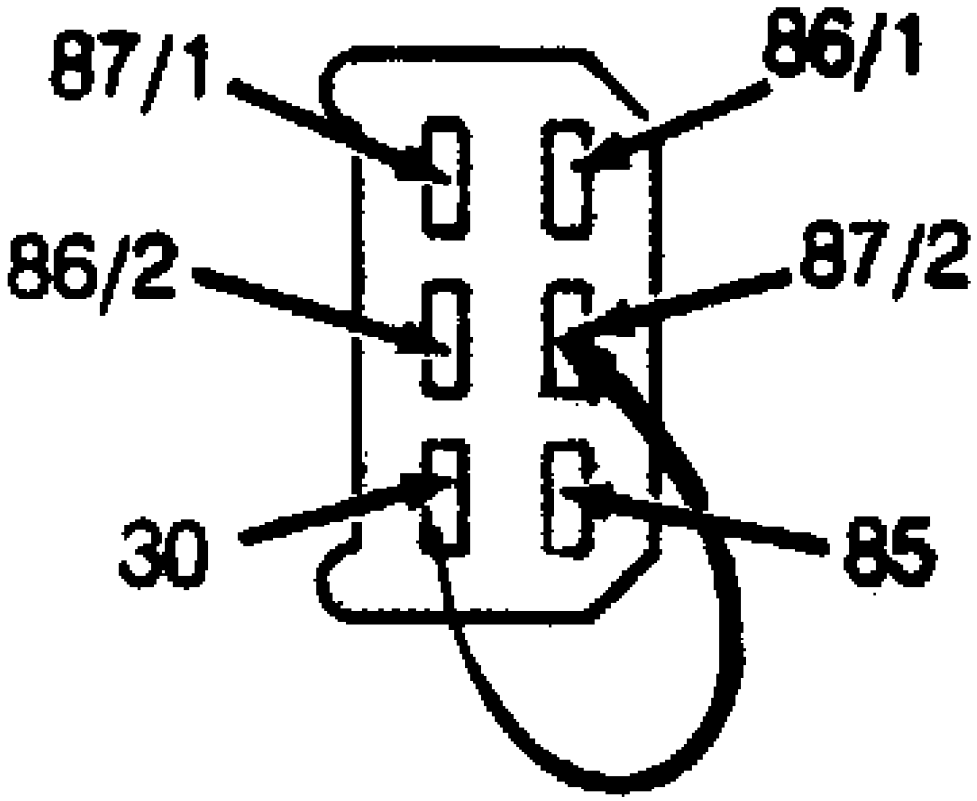

Fig. 3: Identifying Fuel Injection System Relay Terminals (940)
Courtesy of Volvo Cars of North America.

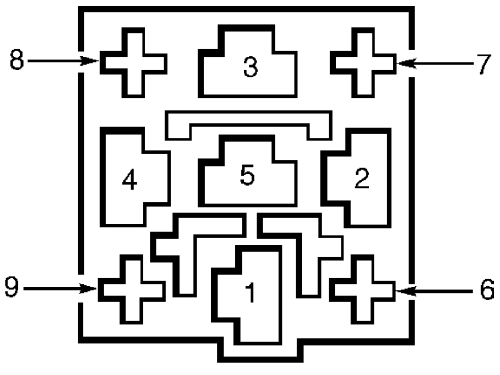

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Fig. 4: Identifying Fuel Pump Relay Terminals (850)
Courtesy of Volvo Cars of North America.

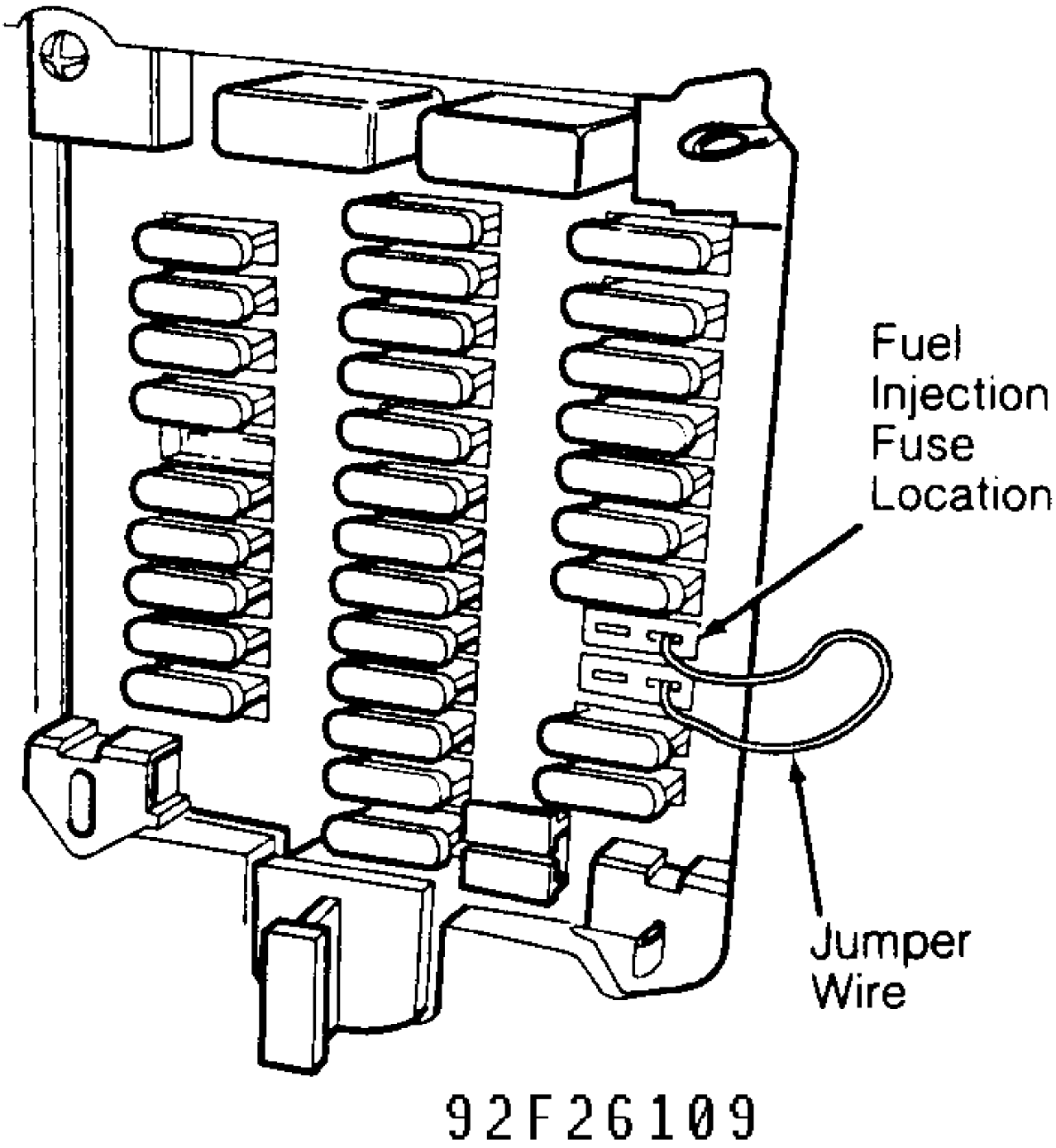

Fig. 5: Identifying Fuel Pump Fuses (960)
Courtesy of Volvo Cars of North America.

Fuel Pump Circuit (940)

1) Remove fuel injection system relay. Check voltage at terminal No. 30. See Figs. 1 and 3. If battery voltage does not exist, repair wiring between relay connector and battery.

2) Connect jumper wire between terminals No. 30 and 87/2 of fuel injection system relay connector. Fuel pump should run. If fuel pump does not run, check wiring between pump and relay. Also check

wiring between terminals No. 87/1 and 85 for continuity. Repair as necessary.

NOTE: ECU terminal identifications are marked on unit or connector.

CAUTION: Ignition must be off when connecting or disconnecting ECU connector.

Fuel Pump Circuit (850)

1) If fuel pump does not operate with ignition on, remove fuel pump relay. See Fig. 2. Connect jumper wire between fuel pump relay terminals No. 1 and 3. See Fig. 4. Turn ignition on. If fuel pump does not start, go to next step. If fuel pump starts, replace fuel pump relay.

2) Turn ignition off. To check relay ground, connect ohmmeter between ground and fuel pump relay terminal No. 2. See Fig. 4. 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. 4. 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. 4. 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. 4. Operate starter motor. If voltmeter indicates about 3 volts, replace relay.

6) If voltage is not to specification, check wiring between fuel pump relay and ECU. If wiring is okay, see ELECTRONIC CON-TROL UNIT - IGNITION (850) in I - SYSTEM/COMPONENT TESTS article in the ENGINE PERFORMANCE Section.

Fuel Pump Circuit (960)

If fuel pumps do not operate with ignition on, connect Breakout Box (999-3070) to ECU. See Fig. 6. Connect voltmeter between terminals No. 3 and 19. Voltmeter should indicate battery voltage. If battery voltage is not present, check wiring and voltage supply to pump relay. If voltage is present, check wiring and voltage supply to fuel pump.

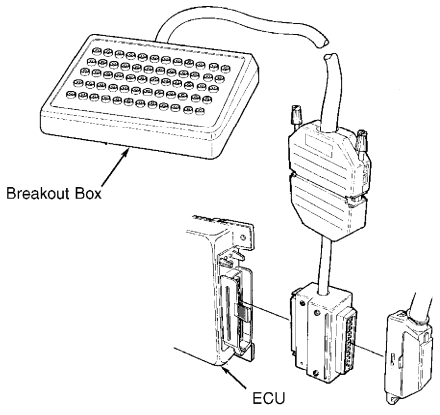

Fig. 6: Connecting Breakout Box To ECU (960 Shown; 850 Is Similar)

Courtesy of Volvo Cars of North America.

Injection System (Fuel Pump) Relay (940)

With ECU connector removed from ECU, ground ECU connector terminals No. 17 and 21. Pump relay should activate fuel pumps and pumps should start operating. Connect voltmeter between ground and terminal 87/2 in relay. See Fig. 3. Battery voltage should be present. Disconnect ground leads from ECU terminals No. 17 and 21. Replace relay if faulty.

IGNITION CHECKS

BENDIX REX-I

NOTE: ECU terminal identifications are marked on unit or connector.

940 Non-Turbo (Federal)

1) Ensure ground connections from ignition ECU and power stage to inlet manifold ground are okay. If ground connections are good, disconnect a spark plug wire from spark plug. Attach a test spark plug to disconnected spark plug wire, and ground spark plug. Crank engine, and monitor spark.

2) Strong Blue/White spark indicates engine or fuel system malfunction. If no or weak spark is present, reconnect spark plug wire to spark plug. Disconnect coil wire from distributor cap, and install test spark plug. Crank engine, and monitor spark. If no or weak spark is present, coil or ignition system primary circuit is defective.

3) If a strong Blue/White spark is present, check ignition rotor, distributor housing and spark plug wires. Replace components as necessary. If previous steps do not show defective components, go to next step.

4) Turn ignition off. Reconnect disconnected components. Ensure all connectors are secure and properly connected. With ignition off, remove panel from lower left dashboard and disconnect ignition ECU connector. Remove dust cover from connector. Ensure all pin connection sleeves are at same height.

5) Measure voltage at ignition ECU connector terminal No. 5. Voltage reading should be about 12 volts. If voltage is not present, check circuit between ignition ECU and fuse holder.

6) Turn ignition on. Open diagnostic connector at left rear of engine compartment, and connect test lead to socket No. 6 (marked on unit). See Fig. 7. Measure voltage at ignition ECU connector terminal No. 1. Voltage should be about 12 volts. Press test button on diagnostic unit. Voltage should now be zero volts. If voltage is not present at control unit or is 12 volts with button pushed, measure voltage at diagnostic unit connector.

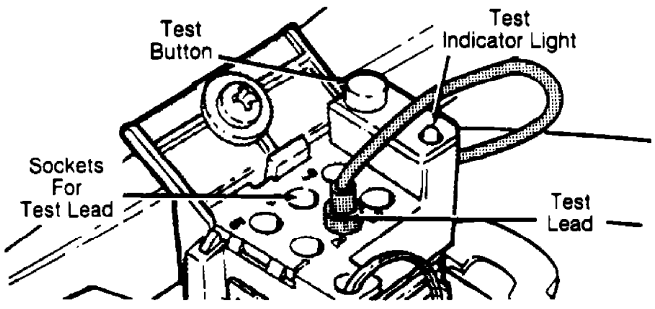

Fig. 7: Identifying Diagnostic Unit Components
Courtesy of Volvo Cars of North America.

7) Measure voltage at diagnostic unit connector Blue lead.

Voltage should be about 12 volts. Using ohmmeter, check continuity between diagnostic unit connector Black lead and ground. Ensure continuity exists.

8) Turn ignition off. Check continuity between diagnostic unit test lead and pin No. 8 (under function selector button). Ohmmeter should indicate infinity. Press test button on diagnostic unit. Continuity should now be present.

9) Using ohmmeter, test for continuity of diagnostic unit LED. Connect ohmmeter leads to pin under LED and to test lead. Continuity should exist in only one direction.

10) Turn ignition on. Measure voltage at ignition ECU terminal No. 6 (Blue wire). Voltage should be about 12 volts. Turn ignition off. Using ohmmeter, check continuity between ignition ECU connector terminals No. 20 (Brown wire) and No. 14 (Black wire). Continuity should exist.

11) Measure resistance between ground and ignition ECU connector terminal No. 2 (Red/Black wire). See COOLANT TEMPERATURE SENSOR RESISTANCE table. If reading is not correct, test sensor directly to determine if fault is in sensor or wiring.

COOLANT TEMPERATURE SENSOR RESISTANCE TABLE

Temperature °F (°C)	Ohms
-22 (-30)	30,000
-4 (-20)	15,000-16,000
32 (0)	5800-6000
68 (20)	2200-2400
104 (40)	1000-1200
140 (60)	600
176 (80)	340-360
212 (100)	180-190
248 (120)	100-120

12) Check continuity between ignition ECU connector terminal No. 7 (Orange wire) and ground. Ensure continuity exists. Depress accelerator until throttle switch opens slightly. Ohmmeter reading should increase to infinity. If reading is not correct, measure throttle switch resistance directly to determine if fault is in switch or wiring. Adjust throttle switch if necessary. See D - ADJUSTMENTS article in the ENGINE PERFORMANCE Section.

13) Remove panel under right side of dash, at right side of bulkhead. Remove glove box. Turn ignition off. Disconnect fuel injection ECU connector. Check for continuity between ignition ECU terminal No. 8 (Yellow wire) and fuel injection ECU terminal No. 25 (Yellow wire). If continuity is not present, check connectors and wiring. Repair as necessary. If continuity is still not present, internal fault is present in an ECU. Reconnect fuel injection ECU connector, and replace glove box and panel.

14) Check P/M (pulse) generator by measuring resistance between ignition ECU terminals No. 10 (Red wire) and No. 23 (Blue wire). Resistance should be 215-265 ohms. Ensure shield is connected to ECU terminal No. 11.

15) Disconnect knock sensor connector, and place a jumper wire between terminals. Check continuity between ignition ECU terminals No. 12 (Black wire) and No. 13 (Green wire). Ohmmeter should show continuity. Ensure resistance to ground is infinity. If resistance is too high (infinity), remove jumper wire and test each wiring lead. If leads are intact, replace knock sensor.

16) Reconnect knock sensor connector. Reassemble and reconnect ignition ECU connector.

17) Disconnect connectors from ignition coil and power stage.

Remove mounting screws and lift ignition coil from power stage. Measure resistance across low tension side of ignition coil. Resistance should be about .5 ohm.

18) Measure resistance between high tension terminal and each low tension terminal. Resistance should be about 5000 ohms. If resistance is not as specified, replace ignition coil.

19) Turn ignition on. Check for battery voltage at Blue wire of 3-pin power stage connector. If voltage is low or does not exist, check power supply lead connections at ignition ECU and ignition coil/power stage. Ensure voltage does not drop to less than 10.5 volts while engine is cranking. Turn ignition off.

20) Ensure ground is present at Brown/Black wire of 3-pin power stage connector and at Black wire of 2-pin power stage connector. Using a self-powered test light or buzzer, check for continuity between Orange wire of 2-pin power stage connector and ignition ECU terminal No. 16.

21) If no defects are found in previous steps or engine still malfunctions after repairs, install new ignition ECU. Recheck system as necessary. Reinstall ignition coil. Reassemble ignition ECU connector, and reconnect it to ECU. Reconnect ignition coil/power stage connectors.

BOSCH EZ116K

NOTE: ECU terminal identifications are marked on unit or connector.

940

1) Ensure ground connections from ignition ECU and power stage to inlet manifold ground are okay. If ground connections are good, disconnect a spark plug wire from spark plug. Connect a test spark plug to disconnected spark plug wire, and ground spark plug. Crank engine, and monitor spark.

2) A strong Blue/White spark indicates engine or fuel system malfunction. If no or weak spark is present, reconnect spark plug wire to spark plug. Disconnect coil wire from distributor cap, and install test spark plug. Crank engine, and monitor spark. If no spark or weak spark is present, coil or ignition system primary circuit is defective.

3) If a strong Blue/White spark is present, check ignition rotor, distributor housing and spark plug wires. Replace components as necessary. If previous steps show no defective components, go to next step.

4) Turn ignition off. Reconnect disconnected components. Ensure all connectors are secure and properly connected. With ignition off, remove panel from lower left dashboard and disconnect ignition ECU connector. Remove dust cover from connector. Ensure all ECU pin connection sleeves are at same height.

5) Measure voltage at ignition ECU connector terminal No. 5. Voltage should be about 12 volts. If voltage is not present, check circuit between ignition ECU and fuse holder.

6) Turn ignition on. Open diagnostic connector at left rear of engine compartment, and connect test lead to socket No. 6 (marked on unit). See Fig. 7. Measure voltage at ignition ECU connector terminal No. 1. Voltage should be about 12 volts. Press test button on diagnostic unit. Voltage should now be zero volt. If voltage is not present at control unit or if voltmeter reads 12 volts with button pushed, measure voltage at diagnostic unit connector.

7) Measure voltage at diagnostic unit connector Blue lead. Voltage should be about 12 volts. Using ohmmeter, check continuity between diagnostic connector Black lead and ground. Continuity should exist.

8) Turn ignition off. Check continuity between diagnostic test lead and pin No. 8 (under function selector button). Ohmmeter

should read infinity. Press button on diagnostic unit. Ohmmeter should now show continuity.

9) Using ohmmeter, check continuity of diagnostic unit LED. Connect ohmmeter leads to test lead and to pin under LED. Continuity should exist in one direction only.

10) Turn ignition on. Measure voltage at ignition ECU terminal No. 6 (Blue wire). Voltage should be about 12 volts. Turn ignition off. Check continuity between ignition ECU connector terminals No. 20 (Brown wire) and No. 14 (Black wire). Continuity should be present.

11) Measure resistance between ground and ignition ECU connector terminal No. 2 (Red/Black wire). See COOLANT TEMPERATURE SENSOR RESISTANCE table under BENDIX REX-I. If reading is not correct, test sensor directly to determine if fault is in sensor or wiring.

12) Check continuity between ignition ECU connector terminal No. 7 (Orange wire) and ground. Ohmmeter should show continuity. Depress accelerator until throttle switch opens slightly. Ohmmeter reading should increase to infinity. If reading is not correct, measure throttle switch resistance directly to determine if fault is in switch or wiring. Adjust throttle switch if necessary. See D - ADJUSTMENTS article in the ENGINE PERFORMANCE Section.

13) Measure voltage at ignition ECU connector terminal No. 8 (Yellow wire). Turn ignition on. Voltage should be about .1 volt. If reading is not correct, check for open circuit between ignition ECU and fuel injection ECU or for fault in fuel injection ECU.

14) Turn ignition off. Measure resistance between ignition ECU connector terminals No. 10 (Red wire) and No. 23 (Blue wire). Resistance should be 215-265 ohms. Ensure shield is connected to ignition ECU terminal No. 11.

15) Disconnect knock sensor connector and place a jumper wire between terminals. Check continuity between ignition ECU terminals No. 12 (Black wire) and No. 13 (Green wire). Ohmmeter should show continuity. Ensure resistance to ground is infinity. If resistance is too high (infinity), remove jumper wire and test each wiring lead. If leads are intact, replace knock sensor.

16) Reconnect knock sensor connector. Reassemble and reconnect ignition ECU connector.

17) Remove air cleaner assembly. Ensure ignition is off, and disconnect power stage connector. Power stage is located at front of left front fender panel. Remove connector dust cover. Connect multimeter negative (-) lead to ground and positive (+) lead to connector pin No. 4. Turn ignition on, and note voltage reading. Voltage should be about 12 volts.

18) Leave multimeter attached, and crank starter motor. Voltage should be at least 10.5 volts. If voltage is too low, check battery and charging system. If voltage is not present, check Blue wire from ignition ECU to ignition coil and power stage. Repair or replace as necessary.

19) Check continuity of power stage ground by connecting multimeter to power stage connector pin No. 2 and ground. Multimeter should show continuity. Check ignition coil resistance. Connect multimeter to power stage connector pins No. 1 and 4. Resistance should be 0.6-1.0 ohm. If resistance is less than 0.6 ohm, check wires for short circuit.

20) If wires are okay but resistance is still not 0.6-1.0 ohm, connect multimeter between ignition coil terminals No. 1 (Red/White wire) and No. 15 (Blue wire). If resistance is not 0.6-1.0 ohm, install a new ignition coil. If resistance is 0.6-1.0 ohm, check continuity of wires between ignition coil and power stage connector pins No. 1 and 4. Repair or replace as necessary.

21) Check shield (ground) wire between ignition ECU and power stage. Shield wire is connected to power stage connector pin No. 3 (Gray wire). Repair if necessary. Ensure power stage is receiving

signal from ignition ECU. Disconnect wires from ignition coil terminal No. 1. Connect multimeter positive (+) lead to power stage connector pin No. 5 and negative (-) lead to ground.

22) Crank starter motor, and monitor voltage reading. Voltage should pulsate between 0-2 volts. If voltage is within specification, install a new power stage and recheck circuit. If voltage is very low and/or irregular, check wiring between ignition ECU and crankshaft position sensor. Repair or replace as necessary.

23) Turn ignition off. If no defects are found in previous steps or if engine still malfunctions after repairs, install a new ignition ECU. Recheck system as necessary.

BOSCH EZ129K

850 Non-Turbo

1) Disconnect coil wire from distributor cap. Put coil wire next to ground and operate starter motor. If spark is present, check distributor rotor and cap. If spark is not present, go to next step.

2) Connect voltmeter between ignition coil connector terminal No. 15 (Red wire) and ground. Turn ignition on. If battery voltage is not present, check voltage supply to ignition coil. If battery voltage is present, turn ignition off and go to next step.

3) Connect voltmeter between ignition coil terminal No. 1 (Blue wire) and ground. Operate starter motor. If about .7-1.3 volts are present, repeat test using new ignition coil. If about .7-1.3 volts are not present, turn ignition off and go to next step.

4) Disconnect engine speed sensor connector located close to flywheel. Connect an ohmmeter between sensor terminals. If resistance is about 200-400 ohms, go to next step and check Camshaft Position Sensor (CMP) signal. If resistance is not about 200-400 ohms, replace sensor.

NOTE: Engine speed sensor is also known as Vehicle Speed Sensor (VSS) or impulse sensor.

5) Remove intake hose. Bend aside rubber sleeve on CMP connector. Connect voltmeter between connector terminal No. 2 and ground. See Fig. 8. Operate starter motor. If voltage reading varies between 0-5 volts, go to step 7). If voltage reading does not vary between 0-5 volts, go to next step.

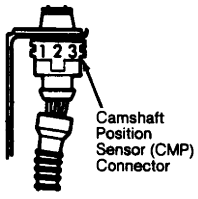

Fig. 8: Identifying Camshaft Position Sensor (CMP) Terminals
Courtesy of Volvo Cars of North America.

6) Connect voltmeter between CMP connector terminal No. 3 and ground. Turn ignition on. About 10 volts should be present. Turn ignition off. Connect an ohmmeter between CMP connector terminal No. 1 and ground. Ohmmeter should show about zero ohms. If voltage supply and ground are okay, repeat test using new CMP. If voltage supply and ground are not okay, reconnect intake hose and go to step 9).

7) If voltage reading varied between 0-5 volts in step 5), disconnect power stage connector at ignition coil. Bend back rubber sleeve on connector. Check ground supply by connecting ohmmeter between connector terminal No. 1 and ground. See Fig. 9. Ohmmeter should indicate zero ohms. Check voltage supply by connecting

voltmeter between terminal No. 3 and ground. Turn ignition on. Battery voltage should be present.

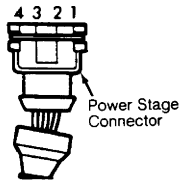

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Fig. 9: Identifying Power Stage Connector Terminals
Courtesy of Volvo Cars of North America.

8) Check power stage control signal by connecting voltmeter between terminal No. 4 and ground. Operate starter motor. Voltmeter should indicate .7-1.3 volts. If ground, voltage and control signal are okay, repeat test using new power stage. If ground connection and voltage are faulty, check wiring. If control signal is not present, go to next step and check ECU input and output signals.

9) Connect Breakout Box (981 3190) and Adapter (981 3195) to distributor ignition ECU. See Fig. 6. 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.

10) To install measuring unit, 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 measuring unit to adapter 60-pin connector.

11) Ensure ignition is off. To check ECU input and output signals, connect ohmmeter between measuring unit terminal No. 20 and ground, then between measuring unit terminal No. 29 and ground. Ohmmeter should indicate about zero ohms in both cases.

12) Ensure ignition is off. Connect ohmmeter between measuring unit terminals No. 20 and 2, and between measuring unit terminals No. 20 and 15. Ohmmeter should indicate about zero ohms in both cases.

13) Ensure ignition is off. Connect voltmeter between measuring unit terminals No. 20 and 10. Battery voltage should be present. Turn ignition on. Connect voltmeter between measuring unit terminals No. 20 and 30. Battery voltage should be present.

14) Check engine speed sensor signal by connecting voltmeter between measuring unit terminals No. 1 and 2. Operate starter motor. Voltmeter should indicate 300-400 millivolts. If signal is not present, check sensor. See code 1-3-1 diagnosis in
G - TESTS W/CODES article in the ENGINE PERFORMANCE Section. If signal is present, go to next step and check Camshaft Position Sensor (CMP) signal.

NOTE: Engine speed sensor is also known as Vehicle Speed Sensor (VSS) or impulse sensor.

15) Connect voltmeter between measuring unit terminals No. 20 and 4. Operate starter motor. Voltage should vary between 0-5 volts. If voltage is okay, go to next step. If voltage is not okay, connect voltmeter between measuring unit terminals No. 20 and 14. Voltmeter should indicate about 10 volts. If voltage is present, but signal is not present, repeat test using new CMP. If voltage is not present, repeat test using new ECM.

16) If voltage was okay in step 15), connect voltmeter between measuring unit terminals No. 20 and 43. Operate starter motor.

Voltage should indicate about 5-7 volts. If voltage is not present, repeat test using ECU. If voltage is present, ignition system is operating properly.

MOTRONIC 1.8

960 (Determining Whether Fault Is Fuel Or Ignition)

Using a volt-meter, check voltage at injectors when engine is hot. If voltage is about 250-400 millivolts, fault is in ignition system and/or an injector is blocked.

Checking Ground Connections

1) Turn ignition off. Remove fuse No. 24. Connect Breakout Box (999-3070) to ECU. See Fig. 6. Connect ohmmeter between ground and terminals No. 19, 24, 26, 30 and 48. Resistance should be about zero ohms on all measurements.

2) Check power unit ground connections under each power unit. Connect an ohmmeter between ground and terminal No. 4 on front power unit connector and then on rear power unit connector.

3) Ohmmeter should indicate about zero ohms in both cases. If ohmmeter does not indicate about zero ohms in both cases, check connectors and wiring.

Voltage Supply To Ignition Coils

Turn ignition on. Connect volt-meter between ground and test terminal at rear of engine. See Fig. 10. Voltmeter should show battery voltage. If battery voltage is not present, check relay, wiring and connectors.

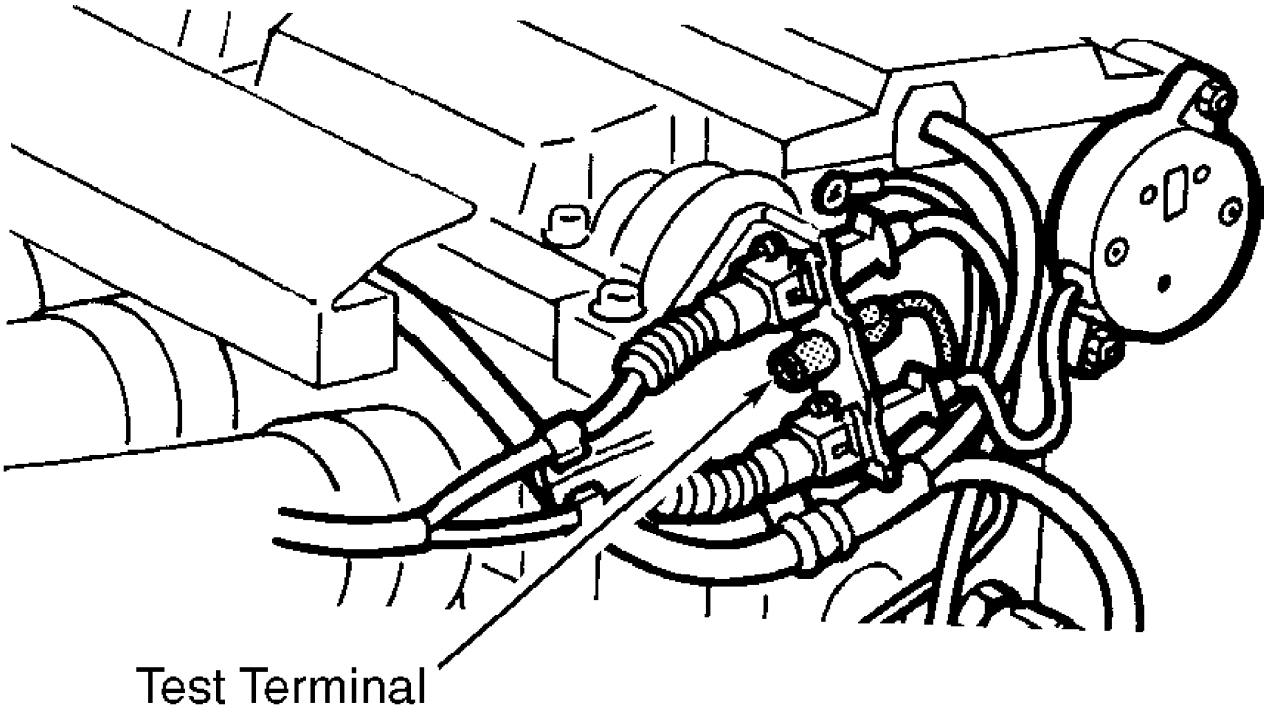

Fig. 10: Locating Test Terminal At Rear Of Engine
Courtesy of Volvo Cars of North America.

Cylinder Miss

Idle engine. Disconnect and reconnect one injector connector

at a time. If engine speed drops when connector is disconnected, cylinder is okay.

Checking Firing Pulse At Ignition Coil

1) Make an adapter to fit between ignition coil connector and test diode (999-5280). Connect test diode. See Fig. 11.

2) Start engine. Diode should flash if signal is present. If signal is present, go to step 5). If no signal is present, connect voltmeter between ground and control unit terminals connected to each ignition coil.

3) If voltage is about 3.5 volts, an open circuit is present between control unit and ignition coil. If voltmeter indicates 60-100 millivolts, connect diode tester with positive side connected to control unit terminal for cylinder to be checked and to terminal No. 1 on corresponding ignition coil connector. Check components with leads reversed.

4) Connect diode tester with positive side connected to ground and to terminal No. 1 on ignition coil connector. Check components with leads reversed. If fault is present, check wiring.

5) Remove coil and plug. Install another plug in cylinder. Install original plug in ignition coil. Start engine and check for spark. If no spark is present, check whether coil or plug is faulty. Install plug in another coil. If spark is present, replace original coil. If no spark is present, replace spark plug.

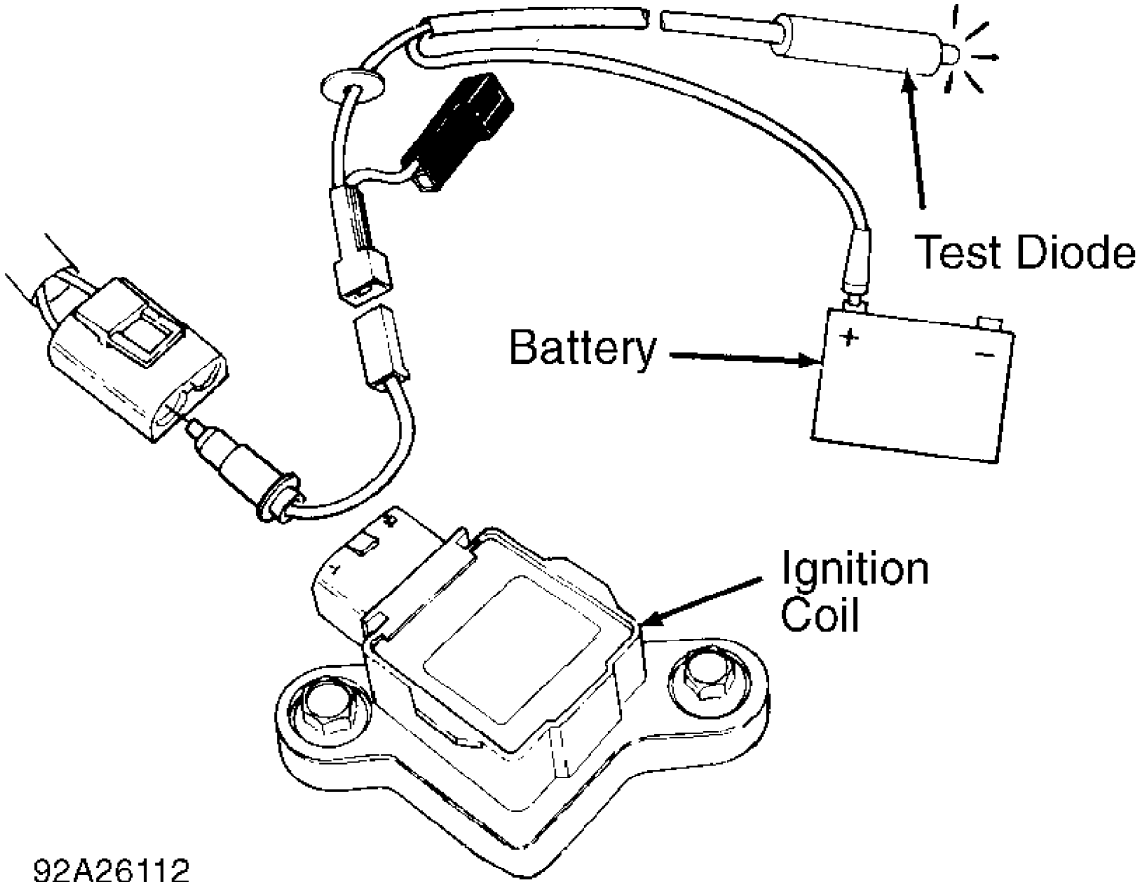

Fig. 11: Checking Firing Pulse At Ignition Coil
Courtesy of Volvo Cars of North America.

850 Turbo (No Start)

1) Determine if fault is fuel or ignition. Check fuel pressure. See FUEL PRESSURE under FUEL SYSTEM. If fuel pressure is not as specified, repair fuel system as necessary. If fuel pressure is as specified, fuel system is okay, check for spark. Go to next step.

2) Using a high output spark tester, check for spark at end of one spark plug wire. If spark is not present, go to next step. If spark is present, remove and inspect all spark plugs. Replace spark plugs as necessary. Try to start engine. If engine starts, fault was due to spark plugs. If engine does not start, check for defective mass airflow sensor or coolant temperature sensor. See K - SENSOR RANGE CHARTS article in the ENGINE PERFORMANCE Section.

3) Disconnect RPM sensor connector. Using an ohmmeter, measure resistance between sensor connector terminals. If resistance is 200-500 ohms, RPM sensor is okay. Go to next step. If resistance is not 200-500 ohms, replace RPM sensor.

4) Turn ignition off. Install Breakout Box (981-3190) to ECU. See Fig. 6. Turn ignition on. Set DVOM scale to measure frequency. Connect a DVOM between terminals A21 and A42. Observe DVOM and operate starter motor. If frequency is 1.5-2.0 Hz, go to next step. If frequency is not 1.5-2.0 Hz, a fault exists in Camshaft Position (CMP) sensor circuit. Repair circuit or replace defective CMP sensor and retest.

5) Turn ignition off. Disconnect ignition coil 4-pin connector. Measure voltage between ground and terminal No. 3 of ignition coil connector. See Fig. 12. If battery voltage is present, go to next step. If battery voltage is not present, check No. 4 fuse. Replace fuse as necessary. If fuse is okay, locate and repair open in wire between terminal No. 3 of ignition coil connector and fuse No. 4.

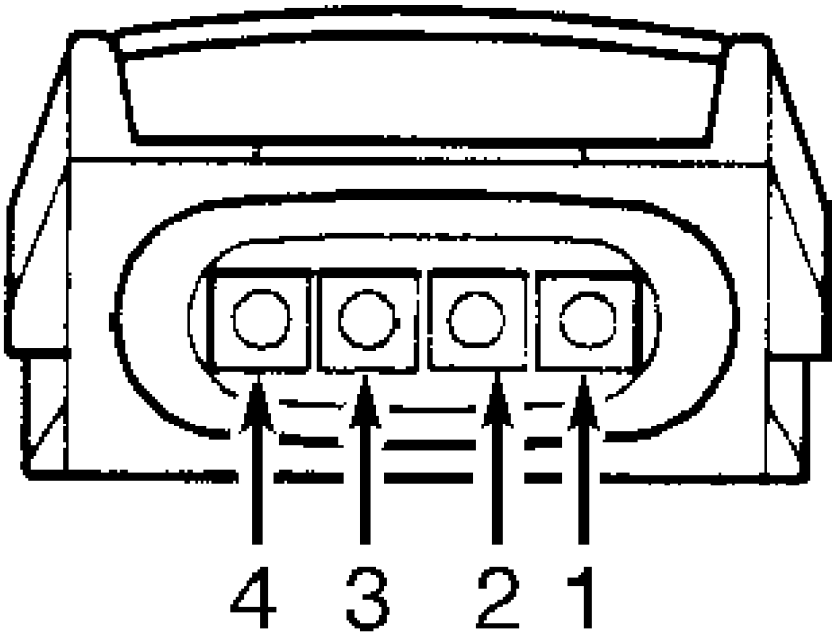

Fig. 12: Identifying Ignition Coil Connector Terminals (850 Turbo) Courtesy of Volvo Cars of North America.

6) Turn ignition off. Wait 90 seconds. Measure resistance between ground and terminal No. 1 of ignition coil connector. See

Fig. 12. If resistance is zero ohms, go to step 8). If resistance is not zero ohms, go to next step.

7) Turn ignition off. Disconnect and inspect ignition coil 4-pin connector. Clean or repair connector as necessary. Measure resistance between ground and terminal No. 1 of coil connector. See Fig. 12. If resistance is zero ohms, cleaning ignition coil connector corrected fault. If resistance is not zero ohms, locate and repair open in terminal No. 1 wire.

8) Turn ignition on. Set DVOM scale to measure frequency. Measure frequency between ground and terminal No. 4 of ignition coil connector while operating starter motor. See Fig. 12. If frequency is 8-10 Hz, circuit is okay. Go to step 11). If frequency is not 8-10 Hz, go to next step.

9) Turn ignition on. Measure voltage between ground and terminal No. 4 of ignition coil connector. If voltage is 0-1 volt, go to next step. If voltage is not 0-1 volt, check wire between terminal No. 4 of coil connector and terminal B11 of ECM connector for short to voltage. Repair as necessary.

10) Turn ignition off. Wait 90 seconds. Disconnect ECM connector. Measure resistance between ground and terminal No. 4 of ignition coil connector. See Fig. 12. If resistance is infinite, check for intermittent open in wire between terminal No. 4 of coil connector and terminal B11 of ECM connector. If resistance is not infinite, check for short to ground in wire between terminal No. 4 of coil connector and terminal B11 of ECM connector.

11) Turn ignition off. Connect ignition coil connector. Turn ignition on. Disconnect coil wire from distributor cap. Hold end of coil wire about 3-5 mm from ground. Operate starter and check for spark. If spark is present, go to next step. If spark is not present, replace ignition coil and retest.

12) Reconnect ignition coil wire. Try to start engine. If engine starts, fault was due to poor connection at ignition coil. If engine does not start, check distributor cap and rotor for cracks, moisture or dirt. Repair as necessary.

IDLE SPEED & IGNITION TIMING

If adjustable, ensure idle speed and ignition timing are set to specification. See IDLE SPEED & CO LEVEL and IGNITION TIMING tables. For idle speed adjustment procedures, see D - ADJUSTMENTS article in the ENGINE PERFORMANCE Section. Ignition timing is not adjustable.

IDLE SPEED & CO LEVEL TABLE (1)

Application	Idle RPM	(2) CO Level
850	(3) 850	(3) .2-.8%
940		
Non-Turbo	775	.4-.8%
Turbo	750	.4-.8%
960	750	.4-.8%

(1) - Idle speed and CO level can only be checked, not adjusted.
(2) - Measured upstream of catalytic converter with oxygen sensor connected.
(3) - With cooling fan off.

IGNITION TIMING TABLE (Degrees BTDC @ RPM)

Application	(1) Timing
850	
Non-Turbo	8-12 @ 750-850
Turbo	4-8 @ 750-850
940	
Non-Turbo	
EZ 116K (Bosch)	12 @ 725-825
REX-I (Bendix)	10 @ 725-825
Turbo	12 @ 750
960	5 @ 750

(1) - Ignition timing is computer-controlled and is not adjustable.

SUMMARY

If no faults were found while performing BASIC DIAGNOSTIC PROCEDURES, proceed to appropriate G - TESTS W/ CODES article in the ENGINE PERFORMANCE Section, see below. If no hard codes are found in self-diagnostics, proceed to H - TESTS W/O CODES article in the ENGINE PERFORMANCE Section for diagnosis by symptom (i.e., ROUGH IDLE, NO START, etc.) or intermittent diagnostic procedures.

* G - TESTS W/CODES - NON-TURBO
* G - TESTS W/CODES - TURBO
* G - TESTS W/CODES
* G - TESTS W/CODES