Brain Teaser

Finding the answers to fuel system diagnostic problems can be a real brainteaser. You know what the questions are, but you need to use your experience to find the answers. Once you've sorted through all the clues and found the answers to some of the questions, the rest of the answers will often fall into place. It's just like filling in the words on a crossword puzzle. The more letters you fill in, the easier it gets to solve the rest of the puzzle.

This month we're going to work our way through a puzzle called Volvo 240 LH-Jetronic. If you're already familiar with Bosch fuel injection systems, you know the letters used to identify Bosch systems really do stand for something. Bosch engineers don't pick fuel system letters just because they sound good together.

We know that the L in L-Jetronic stands for *Luft* or air, but what about the H in LH-Jetronic? H stands for *Hitzdracht*, German for hot wire. Put the two together and you've got *Luft-Hitzdracht*, or hot-air wire. No, that doesn't mean that LH systems are equipped with built-in toaster ovens. Hot-air wire refers to the LH system's main input load sensor, the hot wire air mass meter.

L To LH

LH-Jetronic has many similarities to Bosch L-Jetronic systems. Many of the sensor inputs and control outputs on an LH-Jetronic system are nearly identical to those found on earlier L-Jetronic systems. Both are air flow controlled systems which measure the intake air flow to determine engine load.

The main difference between the two systems is the way that each measures the engine's intake air flow. L-Jetronic systems use a vane type air flow meter to measure the **volume** of intake air flow. The LH system's hot wire air mass meter measures the **mass**, not the volume, of the air passing through it.

The biggest advantage of measuring air mass, rather than volume, is that the air mass meter can automatically compensate for changes in both ambient air temperatures and barometric pressures. There's no need for additional sensors to measure these operating parameters. The air mass meter can also give more accurate readings over a wider range of operating conditions than is possible with vane style air flow meters.

The hot wire is actually a thin strand of platinum wire stretched across the inside of the air mass meter. Current from the control unit heats the wire. Inlet air flow tries to cool the wire as it passes through the sensor. A bridge circuit inside the air mass meter adjusts the current to the hot wire to keep the wire's temperature a constant 100 degrees C (180 degrees F) above the inlet air temperature.

Changes in engine load are indicated by changes in the amount of heating current needed to maintain the hot wire's temperature at 100 degrees C above the inlet air temperature. These changes in heating current are measured as a voltage drop across a fixed resistance inside the air mass meter's bridge circuit.

Changes in the amount of voltage drop at the bridge circuit are directly linked to changes in the inlet air mass. The air mass meter sends this output load signal to the control unit. This makes the air mass meter's response to changes in engine load quicker than an air flow meter, plus there are no moving parts to wear out or get damaged.

The LH system also does a better job with idle speed control. Early L systems used an auxiliary air regulator to control fast idle speed during cold engine operation. The ECU couldn't control the auxiliary air regulator or fast idle speed. And once the bi-metal spring inside the auxiliary air regulator relaxed, there was no way to open the regulator again until the engine cooled off.

The Volvo LH electronic control unit (ECU) directly controls the system's idle stabilizer valve to maintain the proper idle speed during changes in engine temperature and engine load. The correct idle speed is always maintained, whether the engine has just been started at 20 below or has been running for several hours on a hot day.

LH To LH II And Beyond

Volvo first used LH-Jetronic on 1982 240 GL models equipped with 2.3 liter engines. Early Volvo systems were called LH I. A revised and updated version called LH II came along in 1983. By 1987 all Volvo gas engines, including the 2.6 liter V-6, were using LH II.

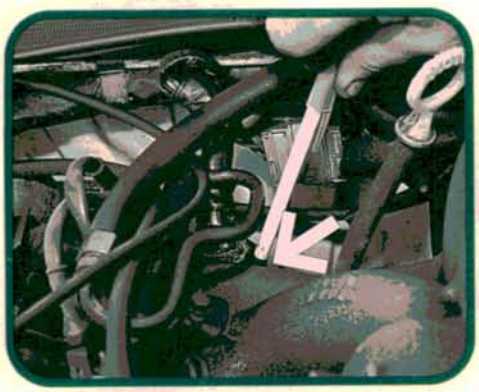
The LH II system is less complicated than the LH I system it replaced (how often does that happen?). Several parts that were used on the earlier system have been eliminated on LH II systems:

- an engine vacuum switch
- a thermal time switch
- a cold start injector
- a separate control unit for the idle speed system

An updated LH-Motronic system with self diagnostics and adaptive self-learning ability replaced the Volvo LH II system in 1988. This system combines fuel and ignition control into a single system and is still in use today on late model 240 and 700 series Volvos.

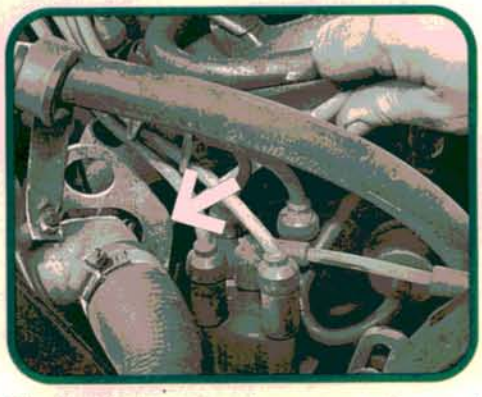
This overview will concentrate on the LH II system.

—By Karl Seyfert



1

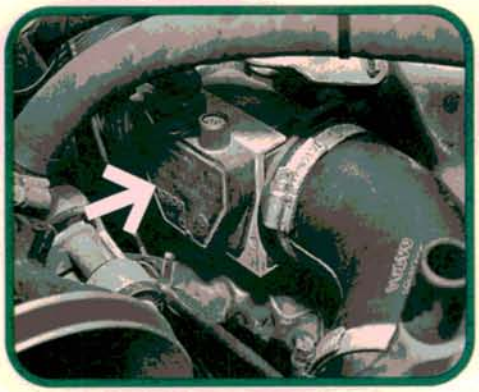
The NTC coolant temperature sensor is located below the last runner on the intake manifold (arrow). An intermittent engine surge or high idle speed may be caused by loose terminals in the sensor's harness connector. The sensor's resistance can be checked using ECU terminal 2 and ground.



2

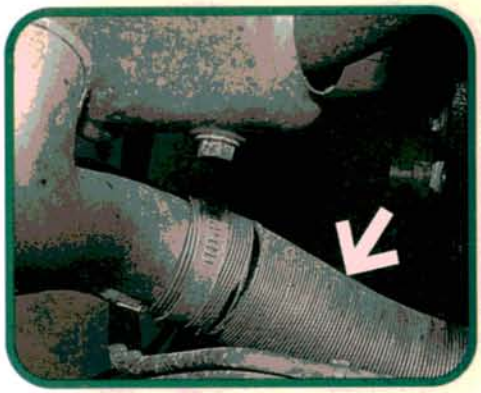
The coolant temperature sensor is near the thermostat housing and easier to reach on late model 240s. The negative temperature coefficient (NTC) sensor's resistance should be 290-364 ohms at 80 C (175 F). High sensor resistance readings at the ECU may be caused by a poor sensor ground at the intake manifold.

Brain Teaser



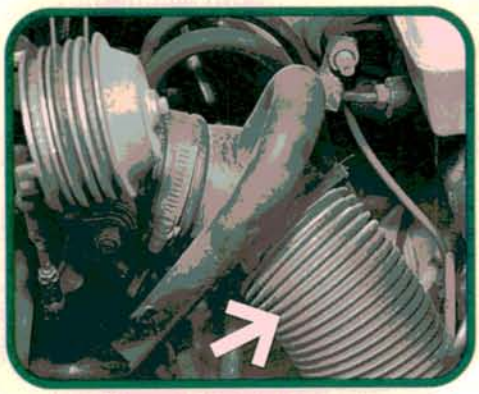
3

The LH air mass meter measures the incoming air mass. The air mass meter automatically compensates for changes in ambient air temperature and pressure, eliminating the need for sensors to measure these changes. Vane type air flow meters measure inlet air volume, and need a separate sensor to measure inlet air temperature.



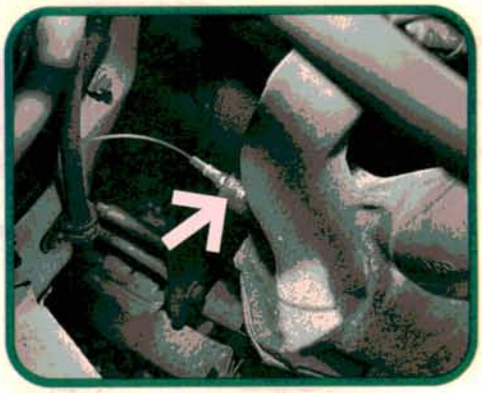
4

Check the operation of the thermostatically controlled air filter housing during each 5000 mile service. A defective thermostat will direct heated exhaust manifold air (arrow) through the air mass meter at all times and may cause premature air mass meter failure. If the air mass meter has failed, check the thermostat.



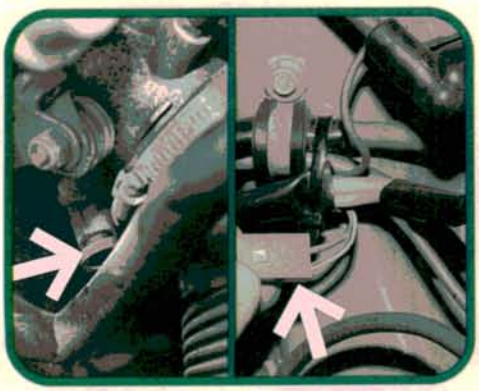
5

Check for vacuum leaks in the plastic bellows that connect the air mass meter to the throttle housing. Bellows leaks allow false air into the system, causing a rough, unstable idle, and sputtering during acceleration. These symptoms are similar to air mass meter problems. Check the bellows before condemning the meter.



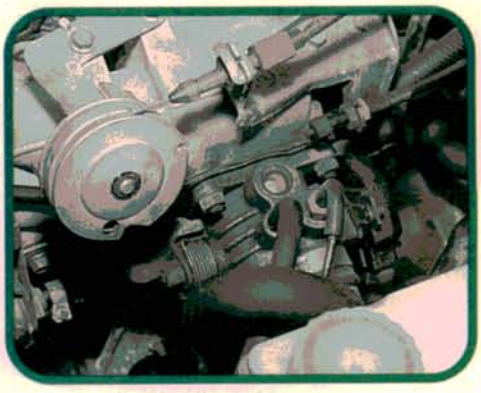
6

A hesitation at cruising speeds may be caused by a contaminated or lazy oxygen sensor (arrow). The oxygen sensor's switching time will slow as it gets older. Switching time can be tested with an oscilloscope. An alternate method is to disconnect the sensor, then drive the car to see if the hesitation disappears.



7

Base idle speed is adjusted at this thumb screw under the throttle housing (left photo). Before setting base idle, ground the blue/white wire in this two wire connector below the ignition coil (right photo). The throttle plate and throttle switch must be closed during this adjustment.



8

Deposits in the throttle housing may keep the throttle plate from closing completely at idle. This can also keep the throttle switch contacts open, which will raise the idle speed about 300 RPM above normal. Remove the air inlet hose, then use carburetor cleaner to remove the throttle housing deposits.

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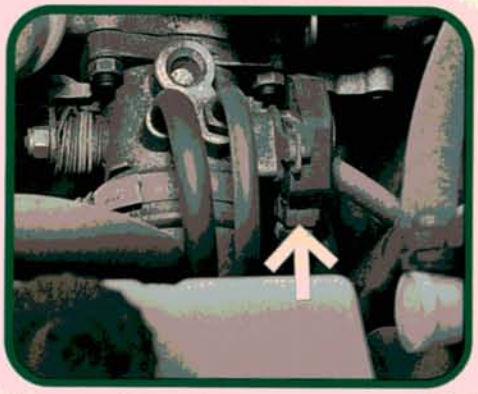
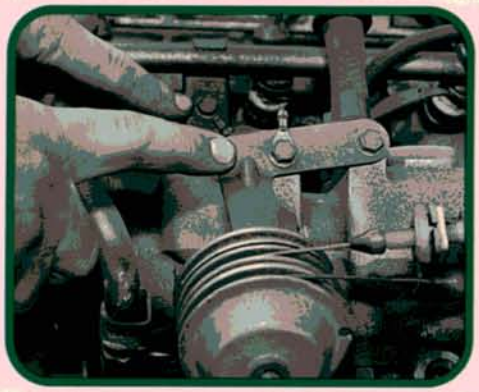


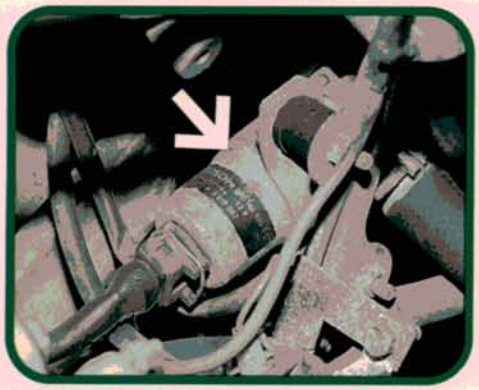
9

The throttle switch has idle and full throttle contacts. Both sets of switch contacts are open when the throttle opening is anywhere between these points. The switch's closed throttle contacts should click open as soon as the throttle is opened. Check switch contact operation with an ohmmeter.



10

The LH system depends on a steady voltage supply and good system grounds for proper operation. Low alternator output, a dead battery cell, or other electrical problems will have a direct effect on the system's operation. Always check the condition of these ground connections on the intake manifold (arrows).



11

The idle stabilizer valve is hidden under the intake manifold. A duty cycle signal from the control unit directs the valve to divert a controlled amount of air around the throttle plate to control idle speed at all engine temperatures. Swollen hoses or loose clamps may cause false air leaks around the stabilizer valve.

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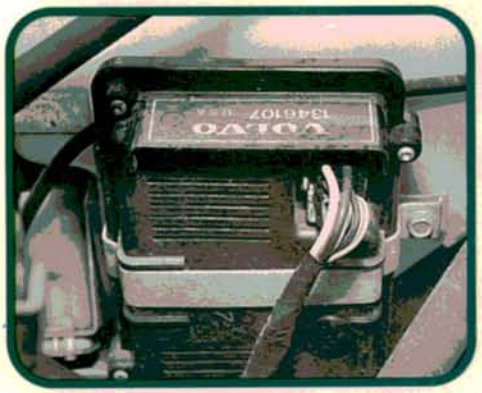
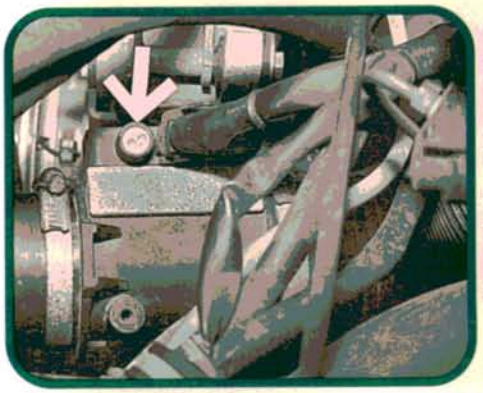


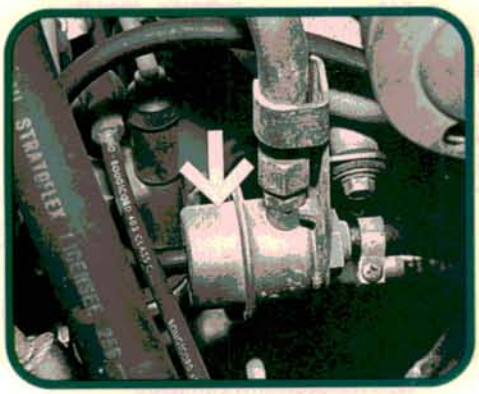
12

Ignition isn't controlled by the LH control unit. This separate control unit on the right inner fender handles the spark control duties. The LH control unit uses a signal from the negative side of the coil primary as a main sensor input. Later LH-Motronic systems combine fuel and ignition control.



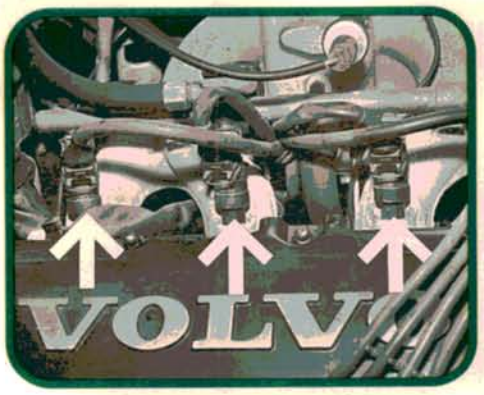
13

To adjust CO percentage, disconnect the oxygen sensor, then remove the anti-tamper plug at the air mass meter (arrow). If you can't adjust the CO to specs, check carefully for vacuum leaks, a misadjusted throttle switch, poor connections to the air mass meter, or a failed air mass meter.



14

The fuel pressure regulator's vacuum diaphragm (arrow) maintains the fuel system pressure at aconstant level above intake manifold pressure. Several shops suggested to us that bad pressure regulators are the cause behind many fuel pump failures. Always check the regulator's operation when you replace a pump.



15

All four injectors fire at once. Injector pulse duration is controlled by the ECU. Connect an ohmmeter between fuel pump relay terminal 87 and ECU terminal 13 to test the injector circuit resistance. Total circuit resistance should be about 4 ohms. Higher resistance indicates defective injectors or injector wiring.

16

Check for leaking injector o-ring seals and intake manifold gaskets on high mileage engines. Any extra unmeasured air that sneaks in will affect system operation. Spray the areas around the injectors and intake ports with carburetor cleaner while watching for changes in the idle speed.

17

To prevent ECU terminal damage, Volvo warns against backprobing the control unit's harness connector terminals during circuit testing. The harness connector's plastic cover can be removed to reveal a set of test contacts along the side of the connector. Test harnesses are also manufactured by Bosch.