

# Hot Flashes



Our Bosch LH-Jetronic article in April of this year gave you an overview of this electronic fuel injection system when it's installed on mid-1980s 240 series Volvos. That was a good starting point, but really just the beginning of the LH story. We didn't want to leave anyone out, so we're back again to look at some more recent LH systems. We'll show you what has changed, and what has stayed the same.

# Hot Flashes

Swedish auto engineers are apparently sold on the LH fuel system. LH is installed on all recent model Saab 900s and 9000s, 700 and 900 series Volvos, and of course it's still used on the venerable Volvo 240. The system has been upgraded several times, and it's gone by a variety of names, from LH II, to LH 2.2, to LH 2.4.

No matter which Swedish name plate you're working on, the heart of the LH system in all of its variations is still the hot wire air mass meter. Its platinum sensor wire can be seen glowing brightly at the beginning of this article. All LH systems rely on this important sensor input to determine changes in engine load.

## Bells and Whistles

Several new features have been added to the basic LH system. Late model Saab and Volvo systems now have adaptive self-learning ability. This allows the ECUs in these systems to tailor their outputs to changing driving conditions, engine mechanical condition, driver inputs, and fuel quality. This lets the engine deliver its maximum output with the lowest possible emissions at all times.

ECU self-learning also means fewer manual adjustments for repair technicians. Later LH systems with self-learning have eliminated the CO adjustment screw at the air mass meter. The base idle adjusting screw has also been eliminated. Both of these operating parameters are constantly monitored and adjusted by the ECU, making manual adjustment unnecessary.

Self-learning systems work well as long as one important rule is followed. These systems don't care much for dirt of any kind. Apparently the engineers couldn't design in a tolerance for dirt or other deposits in the throttle housing or idle control valve. Keeping these two LH components clean takes the place of routine idle speed and CO adjustments.

To simplify diagnosis, a self-diagnostic system has also been added to late model Saabs and Volvos LH 2.4 systems. Fault codes can be pulled out of the Volvo system without dedicated test equipment. A small diagnostic socket located behind the left strut tower is used to retrieve the codes. The diagnostic socket is also the access point for retrieving ignition system fault codes. Terminal 2 at the diagnostic socket is used for the fuel system and terminal 6 handles the ignition system.

There are 18 different fault codes in the LH diagnostic system. Only three codes can be stored by the ECU at the same time. If there are more than three fault codes present, you'll need to repair these problems first, then check for any additional codes. We'll detail code retrieval, erasure, and other Volvo self-diagnostic functions in our photo captions.

The Saab LH 2.4 system is a little less user friendly when it comes to code retrieval. It's necessary to locate terminal 2 at a 10 pin connector under the rear passenger seat. By running a switched jumper wire between the gray/white wire at terminal 2 and ground, fault codes can be read at the Check Engine light on the dash.

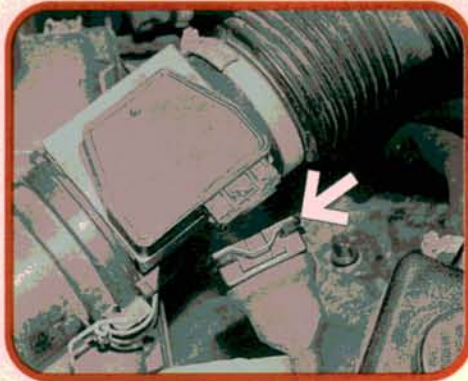
Be sure you attach your ground wire to the correct terminal. Saab warns against grounding any of the other terminals in the 10 pin connector, or damage may result. Whether it's a Saab or Volvo, a DVOM and a complete system wiring diagram will still be needed to track down problems after the ECU has given you all of its fault code information.

Ignition control is still handled by a separate ECU, even on late model LH 2.4 systems. But the fuel and ignition ECUs are in much closer communication than they were on earlier models. The Volvo LH 2.4 fuel system ECU receives RPM, crank position, and knock control enrichment signals from the EZ116K ignition system ECU. This is as close as you can come to an engine management system using two separate control units. Maybe two heads are better than one.

### Volvo LH 2.4 Fault Code Key

- 1-1-1 No faults
- 1-1-2 Fault in control unit
- 1-1-3 Fault in injector
- 1-2-1 Signal to/from air mass meter faulty
- 1-2-3 Signal missing to/from coolant temperature sensor (possible grounding short)
- 1-3-1 Ignition system RPM signal missing
- 1-3-2 Battery voltage too low or too high
- 1-3-3 Throttle switch idle setting faulty (possible grounding short)
- 2-1-2 Lambda-sond signal missing or faulty
- 2-1-3 Throttle switch full load setting faulty (possible grounding short)
- 2-2-1 Lambda-sond not operating
- 2-2-3 Signal missing to/from idle valve
- 2-3-1 Self-adjusting Lambda-sond not operating
- 2-3-2 Self-adjusting Lambda-sond not operating
- 2-3-3 Idle valve closed (possible air leak)
- 3-1-1 Speedometer signal missing
- 3-1-2 Knock-related fuel enrichment signal missing
- 3-2-2 Air mass meter hot wire burn-off cleaning not working

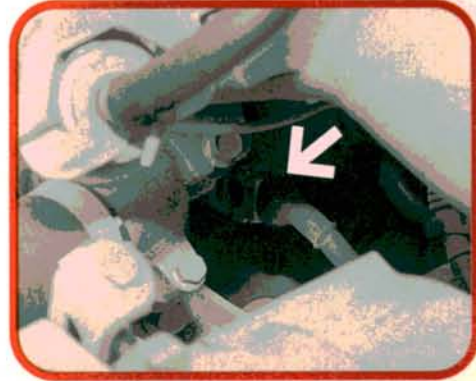
# Hot Flashes



1

## Air Mass Meter Failures

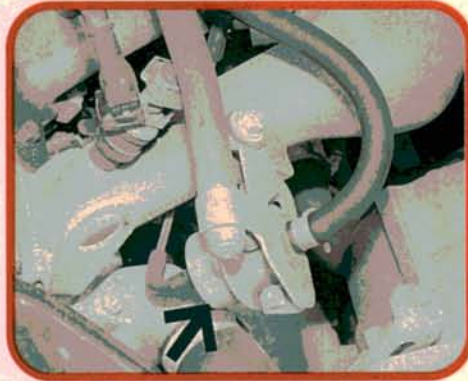
If the air mass meter fails, the engine may run poorly or not at all. To quickly diagnose the sensor, remove its harness connector with the ignition off. Now start the engine. The ECU's limp home mode sets injector pulse width at a fixed value, letting the engine run at reduced speed.



2

## Coolant Temperature Sensor Failures

An open or short in the coolant temperature sensor or sensor wiring may cause the engine speed to surge while driving and cause a high or low idle speed. Idle speed may race if the sensor goes to an open circuit after the engine is warmed up. (An intermittent failure can make this a diagnostic nightmare.)



3

## Fuel Pressure Regulator Failures

Fuel pressure regulator failures on Volvo systems may cause starting problems. The pressure regulator and the fuel pump check valve maintain rest pressure after shutdown. Hard hot restarts result if the regulator vents pressure back to the tank. Vacuum leaks will also affect operating fuel pressures.



4

## Correct Fuel Pressure

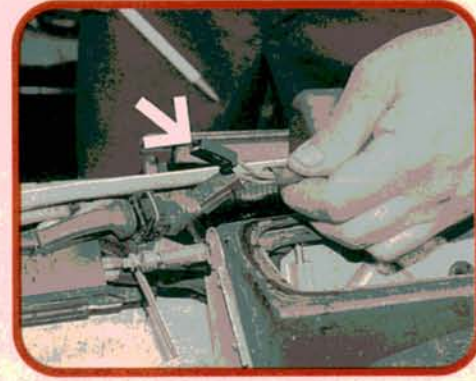
Proper fuel rail pressure is important for system operation. A faulty pressure regulator will affect the system's ability to deliver the correct amount of fuel. If fuel pressure is too high or too low, either too much or too little fuel is going to be injected each time the injectors open.



5

## Clogged Idle Control Valve

Crankcase emissions may form deposits on both Saab and Volvo idle control valves, causing the shutter wheel inside the valve to stick open. To check the valve operation, clamp its hose closed with hose pliers. If the idle speed drops several hundred RPM, remove and clean the valve.



6

## Saab 900 Base Idle Set Procedure

Setting the base idle speed on LH systems requires overriding the idle control valve. The base idle grounding lead is in a different location on each LH system. On pre-1989 Saab 900s, it's the single green wire with a red tracer at the right inner fender (arrow). Ground this wire, then adjust the base idle speed.

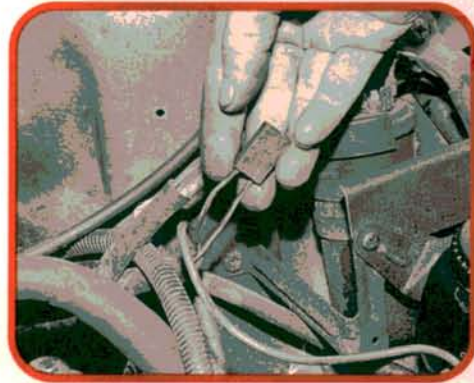
# Hot Flashes



7

## Saab 9000 Base Idle Set Procedure

Early Saab 9000s use a slightly different setup. Remove the plastic cover at the left upper corner of the firewall. Connect a ground wire to the single terminal under the cover (arrow). Late model 9000 and 900s with self-learning ability have no external base idle and CO adjustment points.



8

## Volvo 240 Base Idle Set Procedure

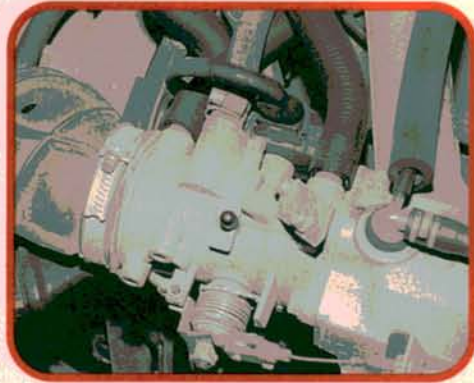
The grounding lead on early Volvo 240 LH systems is located near the ignition coil at the left inner fender well. It's a blue wire with a white tracer that ends at a two wire connector. Ground the wire, then turn the thumb screw at the bottom of the throttle housing to adjust idle speed.



9

## Volvo 7 Series Base Idle Set Procedure

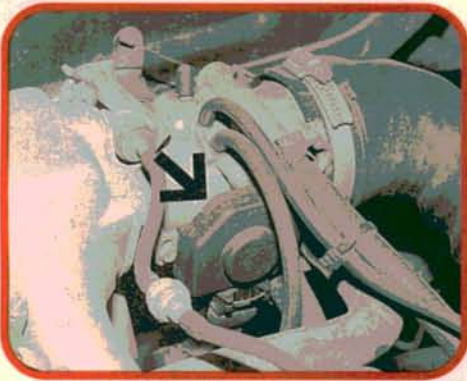
The grounding lead on early 700 series Volvos is located in the right inner fender area. The red/white wire also ends at a two wire connector. Later Volvos with LH 2.4 systems use adaptive self-learning to control idle speed control. External ground leads and thumb wheels have been eliminated.



10

## Throttle Housing Deposits

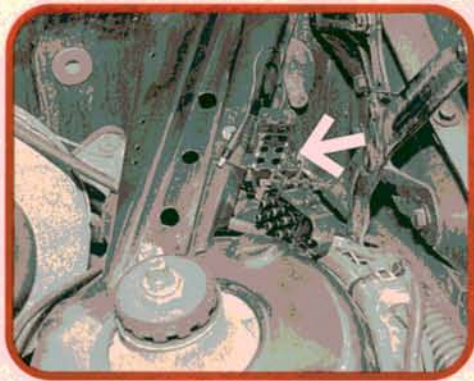
A clean throttle housing is very important, especially on later adaptive systems. Deposits in the throttle housing cause the throttle plate to hang open slightly at idle. This throws the ECU a curve as it tries to adjust the idle control valve to maintain the correct idle speed and CO percentage.



11

## Throttle Switch Adjustment

Proper throttle switch adjustment is critical on late model systems, especially those that don't have air bypass screws to adjust base idle speed. After you have adjusted the idle stop screw or cleaned the throttle housing on these systems, make sure the throttle switch is properly adjusted.



12

## Reading Volvo Fault Codes

The LH 2.4 fuel system on 1989 and later Volvos can store diagnostic fault codes. A check engine light warns the driver of fuel system problems. There are 18 different fault codes, but the ECU can only store three at a time. To read codes, locate the diagnostic socket at the left inner fender.

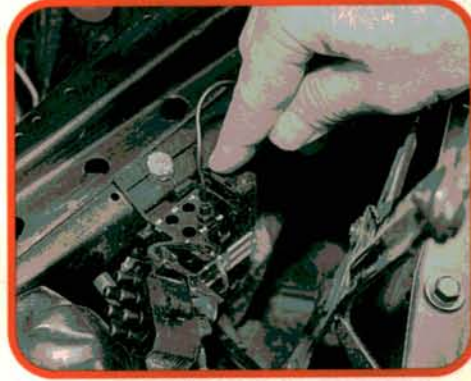
# Hot Flashes



13

## More On Fault Codes

Remove the cover, then connect the selector cable to pin 2. Turn on the ignition, then press the diagnostic button for one to three seconds. The LED will flash three digit fault codes, one code at a time. Press again to check for additional codes. All stored codes have been read when the first code is repeated.



14

## Erasing Fault Codes

To erase the fault code memory, leave the selector cable in pin 2. Turn the ignition on, then press the button for five seconds. The LED should light within three seconds after releasing the button. Press the button again for five seconds with the LED lit. The LED should go off when the button is released.



15

## Testing System Inputs

To test system inputs, leave the selector cable in pin 2. With the ignition on, press the diagnostic button twice (at least one second each time). The LED should begin flashing rapidly. Open the throttle slightly. The LED should flash the idle switch code. If not, the switch is out of adjustment or damaged.



16

## Testing System Outputs

Three of the system outputs can be tested in the last diagnostic mode. With the ignition on, press the diagnostic button three times. The ECU will cycle the injectors, idle valve, and canister solenoid off and on. Grab each output to make sure it's clicking while the LED is flashing.



17

## False Trouble Codes

Some LH 2.4 systems may store false codes for no apparent reason. Checking the affected circuits may not turn up anything unusual. Phantom codes can often be traced to the ECU harness connector. Turn the ignition off, wait one minute, then remove and clean the harness connector and ECU terminals.



18

## Oxygen Sensor Failures

Old O<sub>2</sub> sensor in LH systems aren't like old soldiers, they do die. Complaints of high CO readings may be caused by a dead sensor that's sending a steady lean signal to the ECU. The customer may not know he has a problem until the car fails an emissions test. Replace the sensor at the recommended intervals.

# Hot Flashes

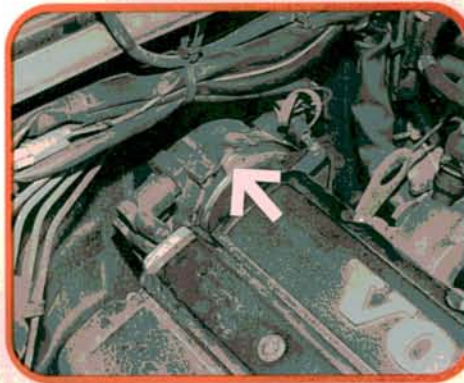
---



19

## Charging System Voltage

Like all electronic injection systems, LH depends on proper input voltage and good grounds. Make sure the charging system is in order before you start any other troubleshooting. The ground leads on this Volvo LH 2.4 system travel a long way from the ECU to these bolts at the top of the intake manifold.



20

## Ignition Systems

Saab and Volvo LH fuel systems still have separate ignition systems. The ignition and fuel systems work together as engine management partners, but use separate ECUs. The EZ116K ignition system used with LH 2.4 systems sends an RPM, crank position, and knock enrichment signal to the LH ECU.

---