E - THEORY/OPERATION

1995 Volvo 850

1995 ENGINE PERFORMANCE
Volvo - Theory & Operation

850

INTRODUCTION

This article covers basic description and operation of engine performance-related systems and components. Read this article before diagnosing vehicles or systems with which you are not completely familiar.

COMPUTERIZED ENGINE CONTROLS

850 non-turbo models use a Bosch LH 3.2 multiport fuel injection system with a EZ129K electronic ignition system with knock sensor, and with self-diagnostic capabilities.

Vehicle uses an Electronic Control Unit (ECU) that receives input from engine monitoring sensors. These sensors include camshaft sensor, coolant temperature sensor, oxygen sensor, knock sensor, mass airflow meter/sensor and throttle switch. ECU uses these input signals to control air/fuel mixture for emission control, fuel economy and good driveability. Ignition control is provided by a separate ignition ECU.

CONTROL UNITS

Electronic Control Units (ECUs) provide precise control of fuel and ignition. Each system has self-diagnostic capabilities.

850 non-turbo models use separate ECUs for fuel injection and ignition control, located in right front of engine compartment.

NOTE: Components are grouped into 2 categories. The first category is INPUT DEVICES, which are components that control or produce voltage signals monitored by control unit. The second category is OUTPUT SIGNALS, which are components controlled by control unit.

INPUT DEVICES

Available input signals include:

A/C Switch

Signals fuel injection ECU of A/C operation. This allows fuel injection ECU to control idle speed with idle valve.

Air Temperature Sensor

Information gathered from air temperature sensor is combined with information from pressure sensor to calculate intake air mass.

Engine Coolant Temperature Sensor

Engine Coolant Temperature (ECT) sensor is a negative temperature coefficient type, meaning its resistance lessens as temperature increases. Four cylinder sensor unit has 2 resistors. One resistor is connected to fuel injection ECU and the other resistor is connected to the ignition ECU.

Knock Sensor

Knock sensor detects knocking and sends signal to Motronic or ignition ECU. ECU is able to gradually retard ignition timing to each individual cylinder. If knocking does not stop, a signal is sent to fuel injection ECU to enrich air/fuel mixture.

Ignition Control Unit

Ignition ECU serves as an input device for fuel injection calculation. Ignition ECU provides information on engine speed, crankshaft or camshaft position, knocking, etc.

Mass Airflow Meter

This meter measures intake air mass. Measure sensor is a heated wire which is maintained at 250°F (120°C) warmer than intake air. Fuel injection ECU is able to calculate mass of intake air by measuring amount of current required to maintain wire temperature. When engine is turned off, any contaminants on wire is burned off by heating wire to greater than 1800°F (1000°C).

Mass Airflow Sensor

This sensor uses a hot film, rather than a heated wire to measure intake air mass. Since working temperature is high at 338°F (170°C), and flow and temperature-sensitive resistances are mounted on side of hot film, a burn-off function is not required.

Heated Oxygen Sensor (HO2S)

Also known as a Lambda probe, this heated oxygen sensor generates an electrical signal proportional to air/fuel mixture. Fuel injection ECU uses this information to adjust amount of injected fuel.

Throttle Position (TP) Sensor

The TP sensor signals ignition and fuel injection ECUs when throttle is fully closed or fully open.

OUTPUT SIGNALS

ECU processes information from input sensors and sends appropriate voltage control signals to control devices.

NOTE: For theory and operation of each output component, refer to system indicated after component.

CHECK ENGINE Light

See CHECK ENGINE LIGHT under SELF-DIAGNOSTIC SYSTEM.

EGR Solenoid Valve

See EXHAUST GAS RECIRCULATION (EGR) under EMISSION SYSTEMS.

Fuel Injectors

See FUEL CONTROL under FUEL SYSTEM.

Fuel Pump

See FUEL DELIVERY under FUEL SYSTEM.

Idle Valve

See IDLE SPEED under FUEL SYSTEM.

Ignition Control Unit

See IGNITION SYSTEM.

Power Transistor & Ignition Coil

See ELECTRONIC IGNITION under IGNITION SYSTEM.

FUEL SYSTEM

FUEL DELIVERY

Fuel Pump

850 is equipped with an in-tank fuel pump. Fuel pump is equipped with check valves to hold fuel pressure in system when ignition is off. Fuel from main pump is sent through an in-line fuel filter. Fuel is then sent to fuel pressure regulator where pressure is maintained at a constant pressure in relationship to manifold pressure. Excess fuel returns to fuel tank via a return line.

Fuel Pressure Regulator

Pressure regulator is a sealed unit which is divided by a diaphragm into 2 chambers (fuel and spring chambers). Fuel chamber receives fuel through inlet side from injector fuel rail. Spring chamber is connected to intake manifold vacuum. At idle, intake manifold vacuum is high. Diaphragm is pulled back by intake manifold vacuum. Any excessive fuel is returned to fuel tank. As throttle is depressed, intake manifold vacuum decreases. Regulator spring overcomes manifold vacuum, increasing fuel pressure.

FUEL CONTROL

ECU calculates base injection pulse width by processing signals from various engine sensors. Engine speed information is provided to fuel injection ECU via ignition ECU. During normal driving conditions, injection duration is regulated in reference to mass air meter/sensor, engine speed, oxygen content of exhaust gases and coolant temperature. Under full throttle conditions, a richer fuel mixture is provided for increased power and to reduce combustion heat in engine and catalytic converter.

Fuel Injectors

Each injector incorporates a solenoid, plunger and needle valve which opens and closes an orifice. Control unit supplies current through auxiliary relay for a predetermined period, opening all injectors simultaneously to inject atomized fuel. Injection takes place twice per revolution while starter motor is running and once per revolution under normal driving conditions. Fuel is injected into intake manifold close to each intake valve.

IDLE SPEED

Engine idle speed is controlled by ECU depending upon engine operating conditions. ECU senses engine operating conditions and determines best idle speed. Idle speed is controlled by varying air passage inside idle valve.

Idle Valve

Idle valve uses a solenoid or motor to control by-pass air. Signal from ECU determines idle speed by controlling amount of by-pass air.

IGNITION SYSTEM

ELECTRONIC IGNITION

Distributor ignition ECU computes correct timing of each ignition pulse in response to signals from vehicle speed sensor (supplies information on engine speed and crankshaft position),

camshaft position sensor (assists control module to determine rate of combustion in cylinders), knock sensors (supply signals indicating engine knock), fuel injection ECU (supplies information on throttle opening, engine load, and coolant temperature. Transmission ECM (supplies signals indicating reduction in torque required prior to gear shift).

IGNITION TIMING CONTROL

Ignition Timing Advance Control

Ignition timing is totally controlled by an ECU. Ignition timing is based on preprogrammed information and modified by inputs from engine sensors.

Knock Sensor

850 has two knock sensors. Knock sensors are fitted to cylinder block to sense detonation inside cylinders. When detonation is detected, ECU retards ignition timing in each cylinder individually until knocking stops.

EMISSION SYSTEMS

FUEL EVAPORATIVE SYSTEM (EVAP)

Evaporative emissions system is designed to prevent fuel vapor from entering atmosphere. Fuel system is completely sealed and vented only through a carbon canister. System consists of pressure/vacuum relief fuel filler cap, rollover valve, charcoal canister, purge valve and various connecting hoses.

Fuel pressure/vacuum relief filler cap allows excessive tank pressure to vent. It also allows air into fuel tank if vacuum should become excessive due to a malfunction in fuel evaporation system. Fuel tank vapor is vented by a line through rollover valve to charcoal canister. Rollover valve is located in vent line close to fuel tank. Valve is designed to prevent fuel spillage if vehicle rolls over. Valve is open until vehicle is at a 45-degree angle or more from horizontal position.

Canister Purge Valve

Charcoal canister is filled with activated charcoal. Fuel vapor from tank is absorbed by charcoal when engine is not running. When engine is running faster than idle, canister purge valve opens and fuel vapor is drawn into engine and burned.

EXHAUST GAS RECIRCULATION (EGR)

EGR System

EGR system operates by returning some exhaust gases to engine to be mixed with air/fuel mixture. This exhaust gas, which is basically inert at this stage, lowers combustion temperature. Reducing combustion temperature reduces amount of oxides of nitrogen (NOx) released into atmosphere.

EGR Solenoid Valve

When engine coolant temperature is less than 115°F (45°C), solenoid receives no current and EGR system is inactive. With engine at operating temperature, solenoid receives current from relay and opens vacuum line to EGR valve. EGR valve is opened completely by negative pressure. Even the slightest throttle opening opens idle switch. Time relay cuts current to solenoid, disconnecting EGR system for about 5 seconds and avoiding HC and particle build-up during acceleration from idle.

EGR Electronic Vacuum Regulator Valve (EVRV)

EGR valve is supplied with a vacuum control signal from connection in lower section of the EVRV. Vacuum in intake manifold is supplied to upper connection. EVRV stabilizes signal from intake manifold and converts control module signal into a modified vacuum signal for controlling EGR valve.

SELF-DIAGNOSTIC SYSTEM

A CHECK ENGINE light glows to signal driver of a system malfunction. Fault codes are retrieved through the diagnostic unit, located in right front of engine compartment. The diagnostic unit is equipped with an LED indicator, activation button and function select cable. See the G - TESTS W/CODES article.

CHECK ENGINE LIGHT

NOTE: CHECK ENGINE light is also known as Malfunction Indicator Light (MIL).

CHECK ENGINE light is located on instrument panel. Light will illuminate when ignition switch is turned to ON position (bulb check) or when emission-related systems are malfunctioning during normal engine operation.