Haynes shows you how

1 General information

1 All models have various built-in fuel system features which help to minimize emissions, and all models have a crankcase emissions-control system (described in the following paragraphs). A catalytic converter, EGR and evaporative emission control systems are also present.

Crankcase emission control

2 To reduce the emission of unburned hydrocarbons from the crankcase into the atmosphere, the engine is sealed, and the blow-by gases and oil vapor are drawn from the crankcase and the valve cover, through an oil separator, into the intake tract, to be burned by the engine during normal combustion.

3 Under conditions of high manifold vacuum (idling, deceleration) the gases will be sucked positively out of the crankcase. Under conditions of low manifold vacuum (acceleration, full- throttle running) the gases are forced out of the crankcase by the (relatively) higher crankcase pressure; if the engine is worn, the raised crankcase pressure (due to increased blow-by) will cause some of the flow to return under all manifold conditions.

Exhaust emission control

4 To minimize the amount of pollutants which escape into the atmosphere, these models are equipped with a catalytic converter in the exhaust system. The fuel-injection/engine control system is of the “closed-loop” type; an oxygen sensor in the exhaust system provides the ECM with constant feedback, enabling the ECM to adjust the mixture to provide the best possible conditions for the converter to operate.

5 The oxygen sensor has a built-in heating element, controlled by the ECM, to quickly bring the sensor’s tip to an efficient operating temperature. The sensor’s tip is sensitive to oxygen, and sends the ECM a varying voltage depending on the amount of oxygen in the exhaust gases. If the intake air/fuel mixture is too high, the exhaust gases are low in oxygen, so the sensor sends a low-voltage signal. The voltage rises as the mixture weakens and the amount of oxygen in the exhaust gases rises. Peak conversion efficiency of all major pollutants occurs if the intake air/fuel mixture is maintained at the chemically-correct ratio for the complete combustion of gasoline - 14.7 parts (by weight) of air to 1 part of fuel (the “stoichiometric” ratio). The sensor output voltage alters in a large step at this point, the ECM using the signal change as a reference point, and correcting the intake air/fuel mixture accordingly by altering the fuel injector pulse width (the length of time that the injector is open).

Evaporative emission control

6 An evaporative emissions control system minimizes the escape of unburned hydrocarbons into the atmosphere. The fuel tank filler cap is sealed, and a charcoal canister, mounted in the engine compartment, collects the gasoline vapors generated in the tank when the car is parked. The canister stores them until they can be cleared from the canister (under the control of the ECM) via the purge solenoid valve. When the valve is opened, the fuel vapors pass into the intake tract, to be burned by the engine during normal combustion.

7 To ensure that the engine runs correctly when it is cold and/or idling, the ECM does not open the purge control valve until the engine has warmed up and is under load; the valve solenoid is then modulated on and off, to allow the stored vapor to pass into the intake tract.

Secondary air injection

8 All OBD-II six-cylinder engines, and January 1997 and later four-cylinder engines, are equipped with a secondary air injection system. The system consists of an electric air pump, an electric solenoid valve, a one-way check valve, a secondary air check-valve and the hoses, pipes and tubing connecting these components. When the engine is started, the ECM opens the electric solenoid valve and turns on the electric pump. The open solenoid valve allows air from the intake manifold to be drawn through the one-way check valve and the solenoid valve, and then to the pump, from which it is pumped through the secondary air check valve into the exhaust manifolds.

9 While the engine is warming up, the air/fuel mixture is richer than normal. Not all the fuel is burned in the combustion chamber. In a fully warmed up engine, any unburned hydrocarbons are catalyzed into less harmful substances in the catalytic converter. But during engine warm-up, the catalytic converter is not yet heated up to its normal operating temperature. The extra air introduced into the exhaust by the air pump increases the amount of oxygen in the exhaust stream, which helps unburned hydrocarbons to oxidize before they pass through the catalytic converter. Some of the oxygen also bonds with carbon monoxide, forming carbon dioxide and water.

10 The air injection pump and the solenoid valve are turned off by the ECM after a timed interval.