Evaluation of Applicability of Inspection/Maintenance Tests on a Ford EEC-II Prototype

June 1979

by

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Abstract

This report presents testing results which were gathered to determine the suitability of existing I/M testing scenarios to a Ford car with computer based emission control system. This car had a microprocessor based three-way catalyst as well as computer controlled spark timing, exhaust gas recirculation, charcoal cannister purging, air injection, and altitude compensation. After suitable baselines were established, various components were made inoperative in the emission control system. Complete FTP, HFET, New York City Cycle, Federal Short Cycle, and I/M tests were run for each vehicle condition. Methane measurements were also taken during the later stages of the testing program.

This report presents the measured data taken during the tests.

Background

It is anticipated that, in the near future, electronics and computers will control many of the vital functions of automotive operation now regulated by mechanical means. As the Inspection/Maintenance effort is expanded it is a prerequisite that the test procedure used by the Inspection/Maintenance program be capable of determining equipment failure and parameter misadjustment. With the advent of advanced electronics into automobiles, it is necessary to evaluate the suitability of existing and proposed I/M tests to these future automobiles. To accomplish this evaluation, several prototype cars containing the best projected electronics of the future will be tested according to both the Federal Test Procedures and I/M tests. The derived data should indicate which I/M tests best suit these automobiles. This report presents the data collected on the first such automobile tested by the EPA, a 1979 Mercury with an EEC-II micro-processor controlled emission control system.

History

A 1979 Ford Motor Company, Mercury Marquis was delivered by Ford Motor Company to EPA-MVEL on March 2, 1979.

The vehicle was checked out, a vehicle identification sheet filled out, pressure taps installed in each exhaust pipe, and thermocouples, (K type), installed before and after each catalyst. The following Monday the vehicle was preconditioned and baseline testing began.

Testing Procedure

In order to test the vehicle the following test scenario was followed:

a. Federal Test Procedure (FTP) 1979 procedure, non-evaporative, no heat build.

b. Highway Fuel Economy Test (HFET) immediately after FTP.

c. New York City Cycle (NYCC) immediately after HFET.

d. Federal Short Cycle (FSS), two cycles immediately after NYCC.

e. Two Speed Idle Test with raw HC/CO garage type analyzer tested at 2500 RPM (neutral) and idle (neutral). The hood was closed and the auxiliary cooling fan turned off.

f. Abbreviated I/M Cycle with raw HC/CO garage analyzer tested at idle (neutral) momentarily accelerated to 2500 RPM (neutral), and then tested again at idle (neutral). The hood was closed and the auxiliary cooling fan turned off.

g. Federal Three Mode. The dynamometer was set at 1750 lbs. inertia and horsepower was set at 9.5 hp at 25.0 mph and 18.0 hp at 52.0 mph. The hood was open and the auxiliary cooling fan turned on. Idle HC and CO measurements were taken in drive and in neutral on a garage type analyzer.

h. Prolonged Idle Cycle. With the cooling fan off and hood closed, idle (neutral) HC and CO measurements were taken every minute for 10 minutes on a garage type analyzer.

A work sheet recording the I/M test results is shown in Attachment 1. Methane measurements were recorded for the last half of the test program but were not figured in the hydrocarbon results.

Vehicle Description

The Mercury Marquis supplied by Ford for this testing program was not a production car but very close to a 1979 certified production vehicle. Attachment 2 lists the specific vehicle parameters. The most important aspects of this automobiles emission control system were the sensors, actuators, and microprocessor units. A complete description of these components is given in Attachment 3.

Baseline Data

To accurately determine the effect of the various vehicle conditions it was necessary to have an accurate baseline determined for each constituent in each mode of every test type. Confirmatory baseline tests were run at the middle and at the end of the test program. A summary of the baseline test data is presented in Attachment 4. Although some of the first baseline tests were incorrectly preconditioned, it was felt that the actual test data was representative and so was included in the baseline average. Ford Motor Company also ran baseline tests on the car prior to supplying it to EPA. The Ford data is presented in Attachment 5.

Test Configurations and Results

After the baseline testing and sorting out of the testing procedures, several components of the emission control system were, one by one, deactivated prior to vehicle testing. Correspondence with Ford Motor Company aided in determining what effect on the electronic system various deactivations would have.

1. Limited Operating Strategy (LOS) Rich

Test numbers 79-7183, and 79-7184 were run with the Ford Rotunda EEC-II Electronic Emission Control Tester installed. This unit, which tees in between the microprocessor and its connector cable linkage, displays when different actuators and sensors are operating, and measured various parameters in the sensors and actuations such as resistance and voltage. The Ford microprocessor has a "Limited Operating Strategy" which is utilized if problems occur in the processor itself. This LOS mode locks the Feedback Carburetor Actuator (FBCA) stepper motor in place, sets all timing at a static 10° BTDC, stops all EGR, stops cannister venting, and bypasses air injection. The Rotunda unit could artificially lock the car into a LOS mode. During an acceleration, when the F/A ratio would probably be rich, the car was locked in the LOS mode. The car was then tested in this mode. These tests are designated LOS Rich.

2. Exhaust Gas Oxygen (EGO) Sensor

The next test, numbers 79-7185 and 79-7186, were conducted with the EGO Sensor disconnected. This resulted in a lean condition. When asked why this deactivation resulted in a lean condition, Ford said that it was due to internal tolerances of the microprocessor itself.

3. LOS Lean

The EGO sensor was disconnected to achieve a lean condition, then the Rotunda unit was locked in LOS mode and the EGO sensor reconnected. This should achieve a LOS Lean condition for test numbers 79-7187 and 79-7188.

4. EGR Valve Vacuum Line Disconnected

This configuration deactivated all EGR valve flow for test numbers 79-7189 and 79-7190.

5. Air Pump Locked in the Bypass Mode

This deactivation was performed by disconnecting the vacuum line to the air injection bypass valve and plugging it. This configuration resulted in no air injection during the test numbers 79-7191 and 79-7192.

6. Engine Coolant Temperature Switch

Test numbers 79-7193 and 79-7194 were run with the engine coolant temperature switch disconnected. This configuration made the vehicle run in "cold mode" during the entire test sequence.

7. Manifold Vacuum Disconnected

Test numbers 79-7197 and 79-7198 were run with the manifold vacuum sensor reading atmospheric pressure and the vacuum line plugged. This configuration made the microprocessor operate in wide open throttle (WOT) mode during the complete test.

8. Throttle Position Sensor

Test numbers 79-7199 and 79-7200 were run with the throttle position sensor disconnected.

9. Removed Catalysts

The tests, run on May 5, 1979, numbers 79-7201 and 79-7202, were run with new exhaust manifold pipes which duplicated the stock exhaust manifold and catalyst pipe. This data demonstrated total catalyst removal.

10. Removed Catalyst with Equivalent Back Pressure

Test numbers 79-7203 and 79-7204 were run with the catalyst removed and with a restrictor valve in the exhaust system which made the engine see exhaust back pressure equivalent to when the catalysts were installed.

11. Four Percent Misfire

Test numbers 79-7205 and 79-7206 were run with all systems operating and an artificial misfire introduced at 4% by a "black box".

12. Eight Percent Misfire

Test numbers 79-7485 and 79-7486 were run with the misfire increased to 8%.

13. Twelve Percent Misfire

Test numbers 79-7487 and 79-7488 were run with the misfire increased to 12%.

14. Feedback Carburetor Actuator (FBCA) Motor Locked in Lean Position

Ford Motor Company informed us that to achieve a maximum lean condition, one should hold the choke rod down for 30 seconds and then disconnect the FBCA stepper motor. Test numbers 79-7489 and 79-7490 were run in this condition.

15. Feedback Carburetor Actuator (FBCA) Motor Locked in Maximum Rich Condition

To achieve a maximum rich condition the FBCA motor was disconnected while the air pump was supplying injection air up stream of the EGO sensor. This caused the computer to "believe" a lean condition existed and drive the FBCA motor "full rich" where it was locked in place by disconnecting it. Two additional sets of I/M tests were run with this test. These were with air injection locked in the bypass mode, and with the FBCA motor then reconnected. These results are presented under test numbers 79-7493 and 79-7494.

Due to the magnitude of the data collected the test results are presented in five sections.

1. Attachment 6 displays the dilute sample data for the Federal Test Procedure (FTP), Highway Fuel Economy Test (HFET), New York City Cycle (NYCC), and Federal Short Cycle (FSS). The hydrocarbon (HC), carbon monoxide (CO), carbon dioxide (CO_2), and oxides of nitrogen (NOx) are presented in gms/mile. The average fuel economy is presented in miles/gallon. Due to the computer system at the MVEL, one test number was assigned to the FTP and one test number assigned to the rest of the tests run in that configuration.

2. Attachment 7 presents the standard I/M idle test data. The data on these charts are self explanatory.

3. Attachment 8 presents the data taken during the Prolonged Idle Cycle.

4. Attachment 9 is a listing of the comments made during each test including drivability evaluation, component deactivation, and problems noted during the test sequence. Again, the FTP has one test number, and the rest of the test sequence has a second number.

5. Attachment 10 displays the methane data for those tests run. Included are total hydrocarbons (THC), hydrocarbons-non-methane (HC-NM) and methane (METH) in units of gms/mile.

List of Attachments

Attachment Number 1	I/M Test Result Worksheet
Attachment Number 2	Test Vehicle Description
Attachment Number 3	Ford EEC-II Component Description
Attachment Number 4	EPA Baseline Data Summary
Attachment Number 5	Ford Baseline Data Summary
Attachment Number 6	Dilute Sample Data
Attachment Number 7	I/M Test Data
Attachment Number 8	I/M Prolonged Idle Test Data
Attachment Number 9	Test Comments
Attachment Number 10	Methane Test Results

I/M PROTOTYPE TESTING: RAW EXHAUST HC,CO DATA SHEET

Technicians:______________________ Location________ Date____________

Vehicle:__________________ ☐Baseline ☐Other____________________

TWO SPEED IDLE:		HC	CO	Comments
Hood closed,fan "OFF"				
2500±100 RPM (neutral)		____	____	____
Idle (N)		____	____	____
ABBREVIATED I/M IDLE CYCLE:				
Hood closed, fan "OFF"				
Idle (N)		____	____	____
Monentary rev. to 2500 RPM				
Idle (N)		____	____	____
FEDERAL THREE MODE: set 1750 lbs. IW				
Hood open, fan "ON", set _____ on thumbwheel (____ AHP @ 52 MPH)				
52 MPH - max. 3 min.		____	____	____
Set ____ IHP @ 25 MPH (____ AHP) with pendent				
25 MPH - max.3 min.		____	____	____
Idle (Drive)		____	____	____
Idle (N)		____	____	____
PROLONGED IDLE:				
Hood closed, fan "OFF"	Minutes			
	0	____	____	____
	1	____	____	____
	2	____	____	____
	3	____	____	____
	4	____	____	____
	5	____	____	____
	6	____	____	____
	7	____	____	____
	8	____	____	____
	9	____	____	____
	10	____	____	____

Test Vehicle Description

Model Year	Prototype
Make	Mercury Marquis
Emission Control System	EEC-II with EGR, AI, Dual Three Cat, Spark Control, Evap.
Engine Type	V-8
Bore x Stroke	-
Displacement	351
Rated Horsepower	-
Transmission	A-3
Axle Ratio	2.26
Chassis Type	Sedan
Tire Size	FR78-14
Inertia Weight	4500
VIN	9Z65H620944
AHP	12.0 hp
40% Fuel Tank Volume	7.6 gallons

HOW ELECTRONIC ENGINE CONTROL WORKS

"EEC" (Electronic Engine Control) was developed to use computer technology to provide vehicles with good performance that meet emissions and fuel economy standards.

Four main engine operating factors affect emissions, fuel economy and performance . . .

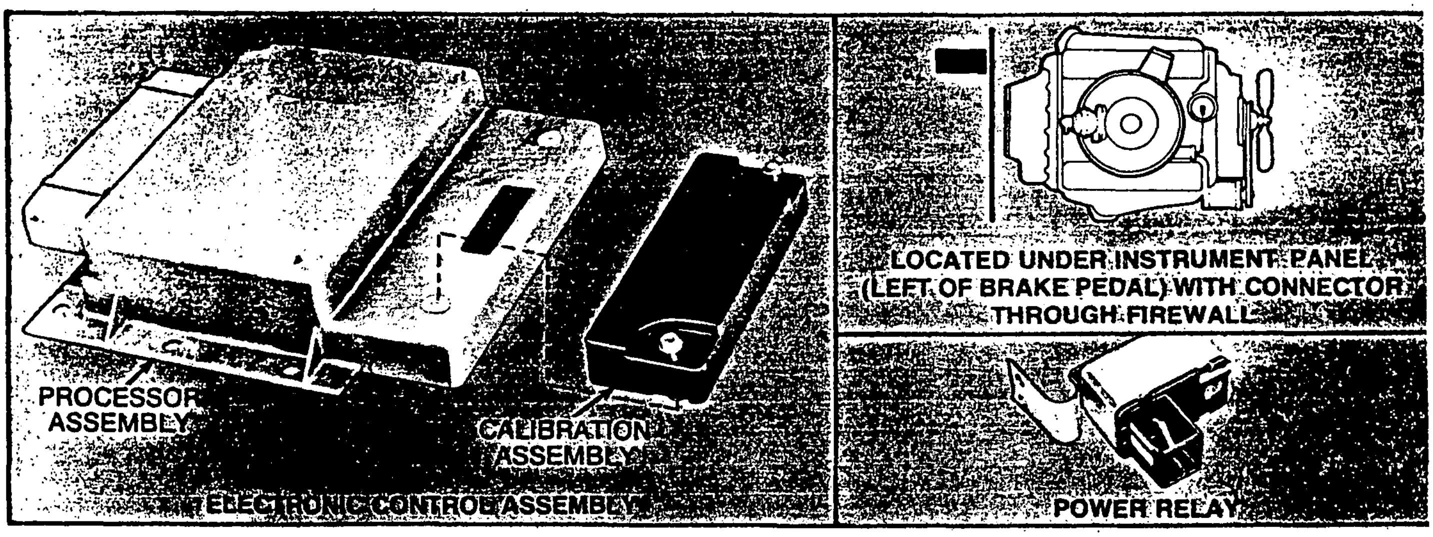
- Ignition timing
- Air/fuel ratio
- Exhaust Gas Recirculation (EGR) flow rate
- Thermactor air control

The EEC-II system controls all of these factors more accurately than previous methods. Accurate control of these factors makes it possible to set the engine to the best settings for various conditions of load, speed, temperature and altitude. In effect, the EEC-II system uses computer technology to "re-tune" the engin while the vehicle is being operated. The result is im proved fuel economy, emission levels and perfoı mance under varying driving conditions.

The EEC-II system can be divided into three group according to function. All are described on the follov ing pages:

- **Sensors** — collect and send operating informatio to the Electronic Control Assembly.
- **Electronic Control Assembly (ECA)** — "brain" o the system.
- **Actuators** — carry out instructions from the Elec tronic Control Assembly.

Electronic Control Assembly (ECA)



The ECA (Electronic Control Assembly) controls the entire EEC system and can be described as the "brain" of the system.

The ECA is a solid-state micro-computer that is divided into two parts: the Processor Assembly (the aluminum housing) and the Calibration Assembly (the black plastic housing attached to the Processor Assembly).

The Processor Assembly contains the micro-computer and the solid-state circuitry that permits it to receive and send out signals. It is designed to . . .

- Supply some sensors with a reference voltage.
- Receive the incoming signals from sensors.
- Calculate the proper spark advance, air/fuel ratio, EGR flow and thermactor air flow.
- Send out control signals to adjust spark timing air/fuel ratio, EGR flow, thermactor air mode, evaporation canister purge and idle speed.

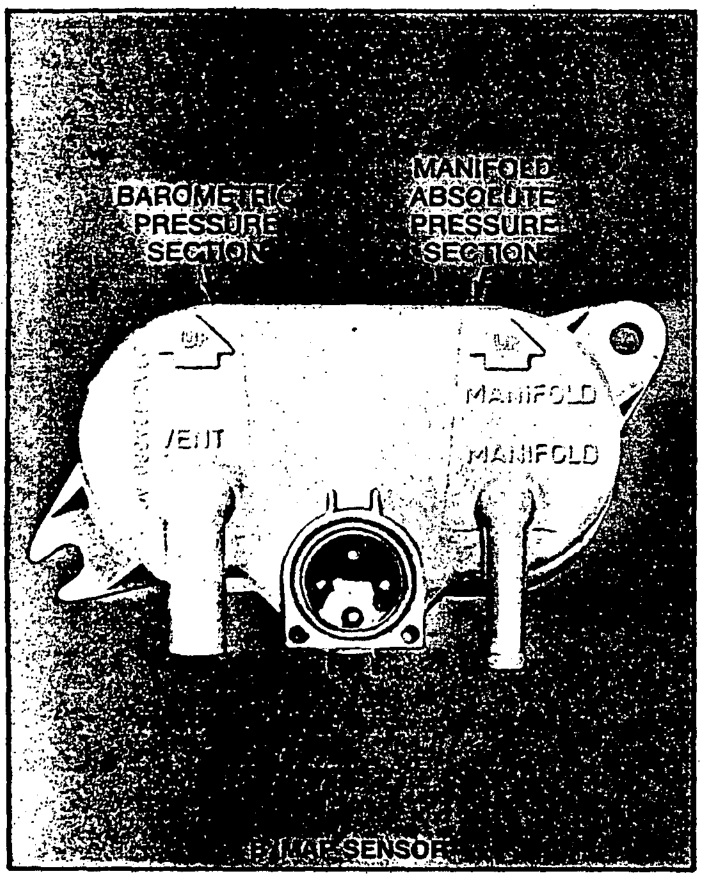
The Calibration Assembly contains the "memory" anc programming used by the Processor Assembly. The Calibration Assembly is designed to provide operatinç information for that particular vehicle line for use by the micro-computer located in the Processor Assembly. Different calibration information is used in different vehicle lines, such as 49 states and California.

The Power Relay is activated by the ignition switch to supply battery voltage to the ECA and other EEC system components. The relay also protects the ECA from damage due to reversed voltage polarity. It is mountec on the ECA mounting bracket under the instrumen

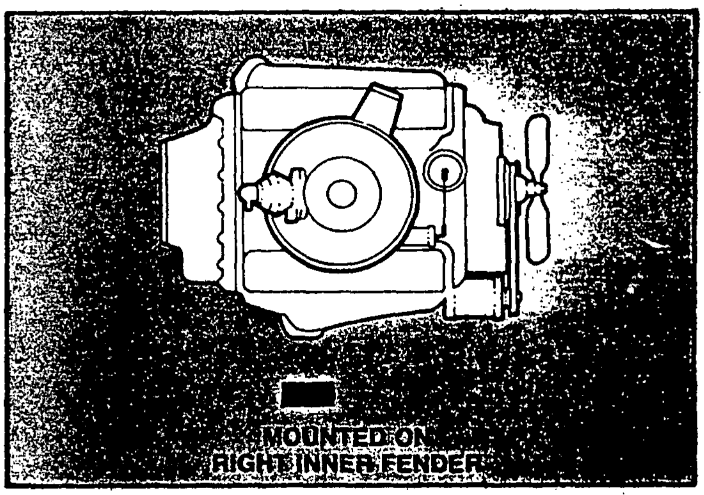
SENSORS

NOTE: The ECA supplies five of the sensors (BP, MAP, EVP, ECT and TP) with a "*reference*" voltage (VREF) of 8.0 to 10.0 volts. Each of these sensors "steps down" the reference voltage to form its signal. The ECA measures sensor signal voltage relative to this VREF. Thus **an important test measurement is to be sure the reference voltage is within proper limits.**

B/MAP (Barometric/Manifold Absolute Pressure) Sensors



The B/MAP sensor housing contains two sensor sections. The BP (Barometric Pressure) section senses barometric pressure of atmospheric air in the engine compartment. The MAP (Manifold Absolute Pressure) section senses the absolute pressure of the mixture in the intake manifold. Manifold absolute pressure is defined as atmospheric pressure minus manifold vacuum. (Both use VREF to form their signal.)



The BP sensor section supplies the ECA with a signal proportional to the barometric pressure of underhood air. The ECA uses this signal to compensate spark advance and EGR rate for changes in altitude.

The MAP sensor section is connected to the intake manifold by a hose and supplies the ECA with a signal proportional to the absolute pressure of the air/fuel mixture in the manifold. The ECA uses this signal to compensate spark advance and exhaust gas recirculation rate to fit engine load.

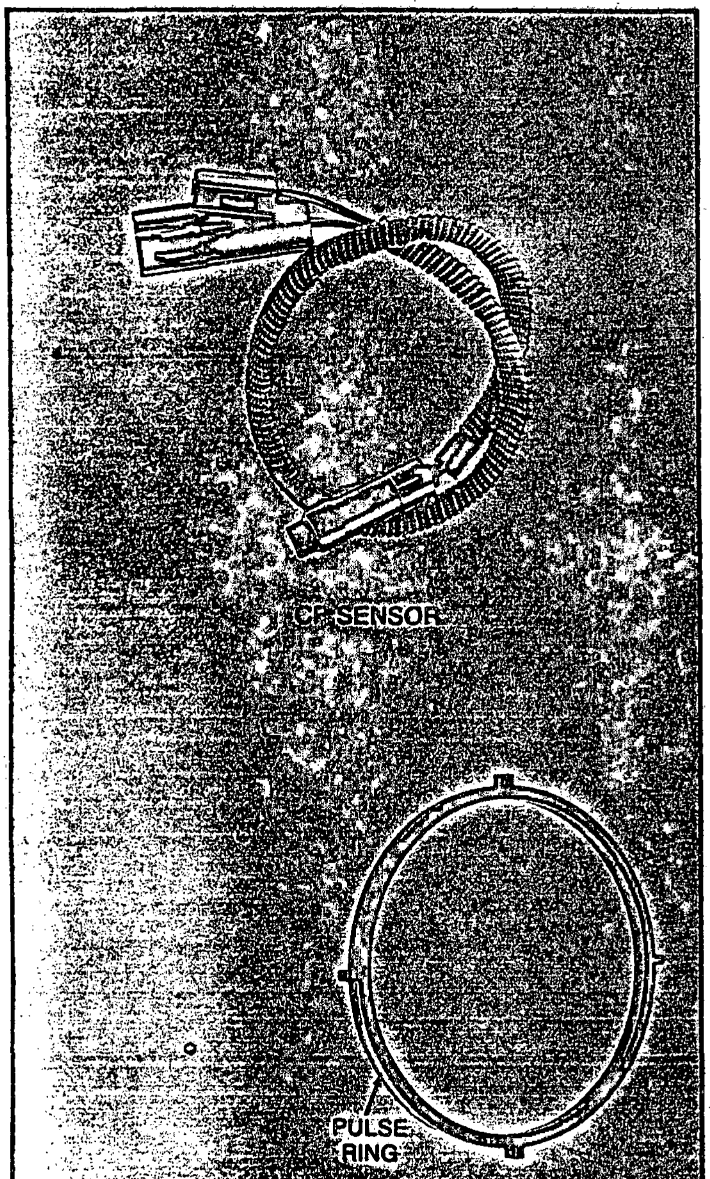
Both sensor sections use a capacitive sensing element to sense pressure. The sensor voltage signal changes proportional to pressure applied to the capacitive sensing element. Higher pressure results in higher sensor voltage.

CP (Crankshaft Position) Sensor

The CP sensor and "pulse" ring pressed on the vibration damper work together to supply the ECA with a signal indicating crankshaft position. (The CP sensor generates its own voltage and is not supplied with VREF.)

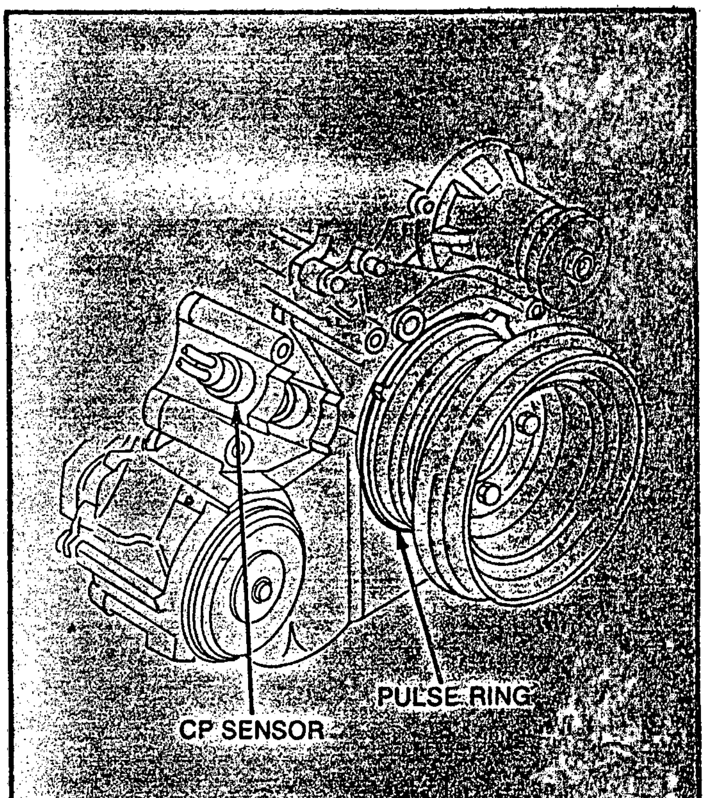
The steel pulse ring . . .

- is carefully positioned on the damper during manufacture and cannot be removed or adjusted.
- has four lobes spaced 90° apart and is positioned 10° before TDC (top dead center). (Only four lobes are required since only four cylinders fire during each crankshaft revolution.)

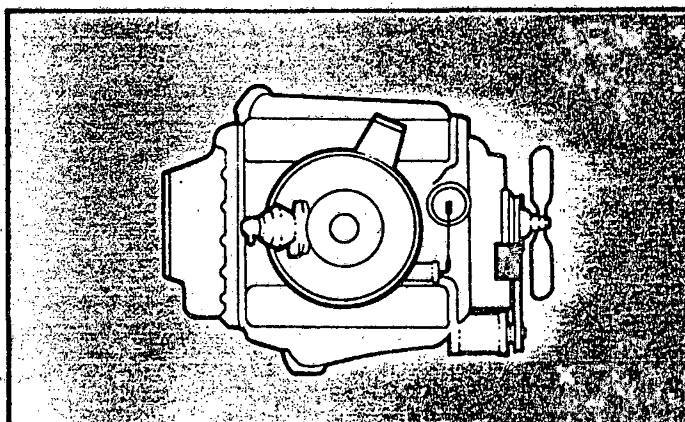


CP SENSOR AND PULSE RING

The pulse ring lobes pass by the tip of the sensor, "cutting" the magnetic field at the sensor tip and generating a voltage-pulse signal that indicates crankshaft position (similar to the operation of a breakerless distributor stator and rotor).

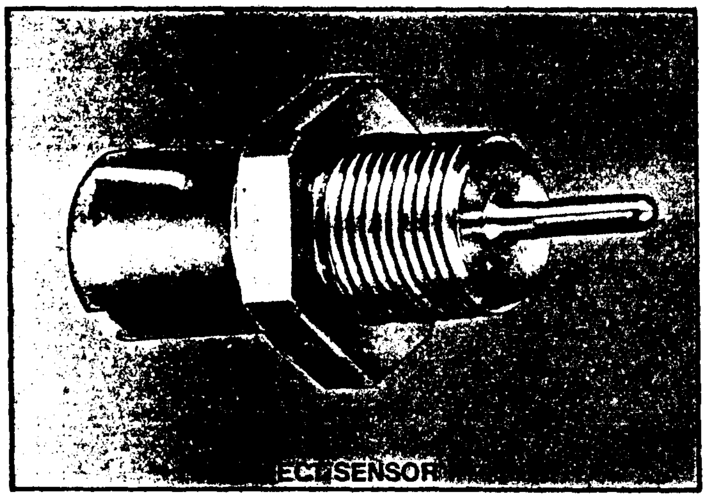


CP SENSOR AND PULSE RING MOUNTED ON ENGINE

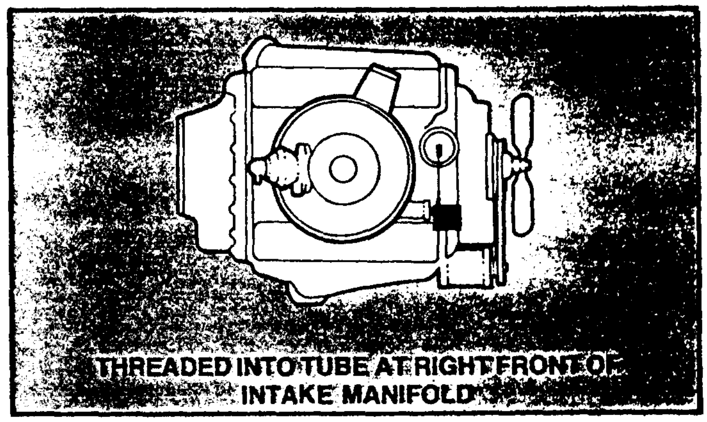

MOUNTED AT RIGHT FRONT OF ENGINE NEAR VIBRATION DAMPER

ECT (Engine Coolant Temperature) Sensor

The ECT sensor is located in a cooling system passage near the engine thermostat. It senses the temperature of the engine coolant. The ECT sensor contains a thermistor (a thermal resistor whose resistance varies with temperature). When the thermistor is exposed to a low temperature, its resistance is high. As the temperature rises, the thermistor's resistance decreases proportionally. The ECA interprets the resistance of the ECT to determine the temperature of the engine coolant. (The ECT sensor is not supplied directly with VREF, but the ECA uses VREF internally to measure the ECT resistance.)



ECT SENSOR



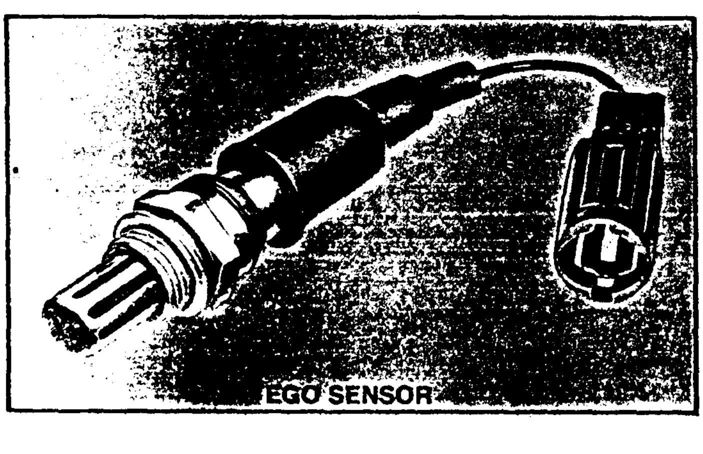
THREADED INTO TUBE AT RIGHT FRONT OF INTAKE MANIFOLD

EGO (Exhaust Gas Oxygen) Sensor

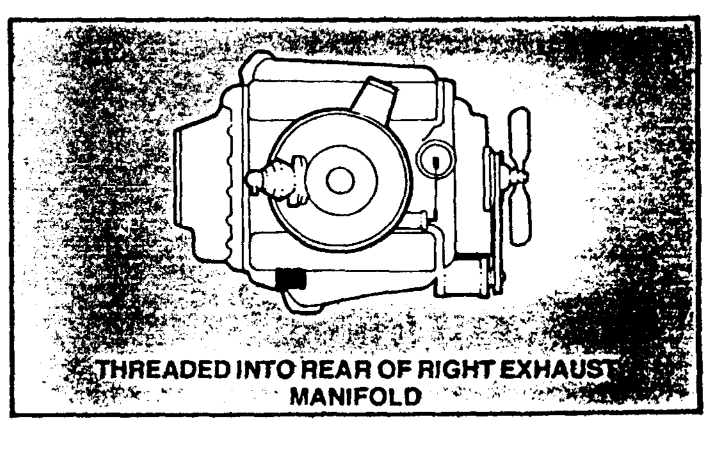
The EGO sensor supplies the ECA with a signal which represents rich or lean engine operation by generating a voltage corresponding to the amount of oxygen in the exhaust gas. (It is not supplied with VREF.)

The EGO sensor operates by comparing the oxygen content of the exhaust gas with the oxygen content of atmospheric air. When the air/fuel ratio is lean, the sensor detects that the oxygen content of the exhaust gas is near that of atmospheric air and generates low voltage (−0.5 to 0.2V). When the air/fuel ratio is rich, the EGO sensor detects a low oxygen content in the exhaust gas and generates a higher voltage (0.6 to 1.1V).

CAUTION: Be careful not to set the DVOM to "ohms" when hooked directly to the EGO sensor lead during testing. The EGO sensor resistance **cannot** be measured by connecting an ohmmeter directly to its output lead. Sensor damage will result if this is attempted.



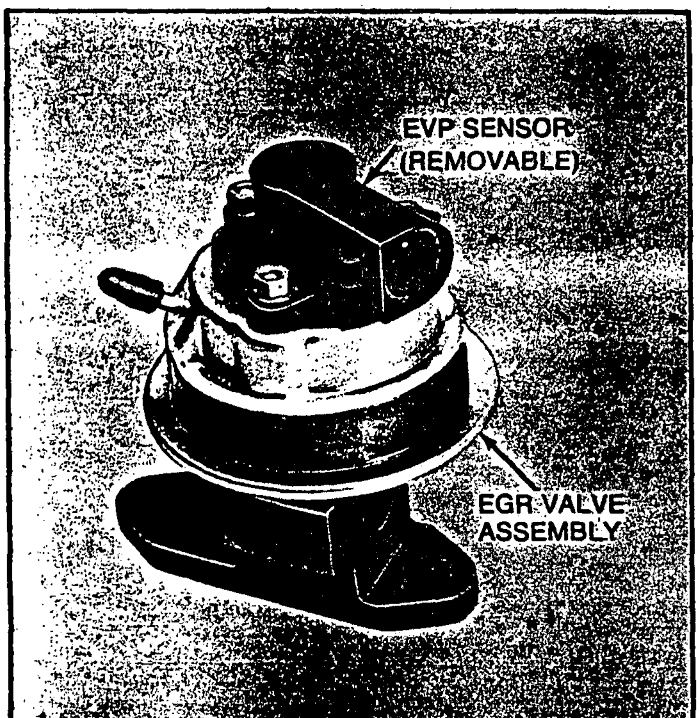
EGO SENSOR



THREADED INTO REAR OF RIGHT EXHAUST MANIFOLD

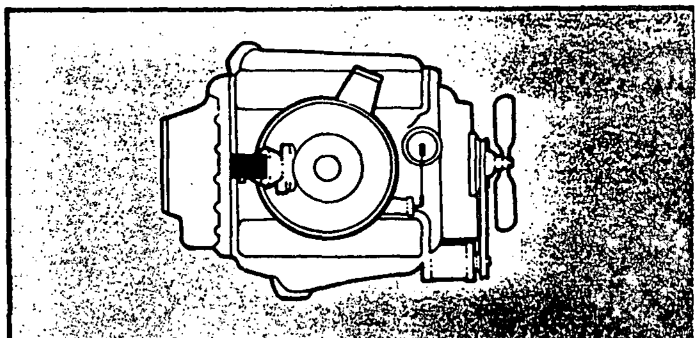
EVP (EGR Valve Position) Sensor

The EVP sensor provides the ECA with information about the amount of EGR flow entering the intake manifold. The EVP sensor does this by supplying a signal proportional to the position of the exhaust gas recirculation (EGR) pintle valve. This position signal is interpreted by the ECA as a measure of EGR flow. (The EVP sensor uses VREF.)



EVP/EGR ASSEMBLY

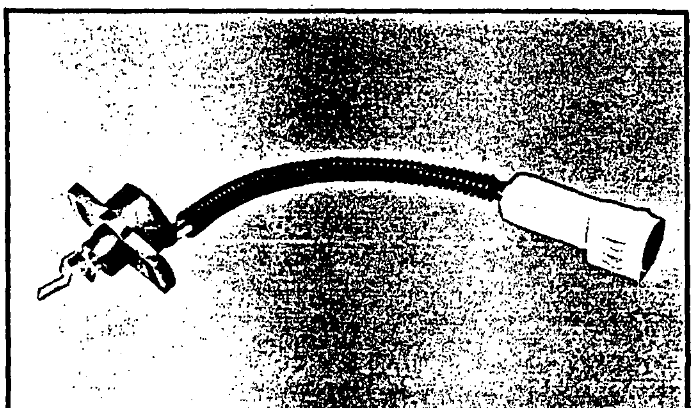
The EVP sensor is a variable resistor that moves with the EGR pintle valve stem. As the pintle valve opens, the pintle stem moves, and the resistance in the EVP sensor increases. This increases the voltage of the EVP signal to the ECA.



MOUNTED ON TOP OF EGR VALVE ASSEMBLY

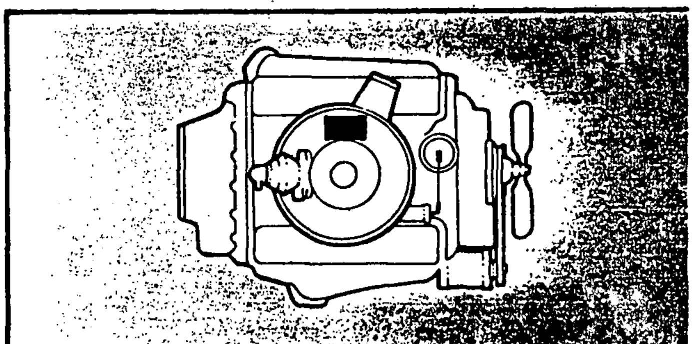
TP (Throttle Position) Sensor

The TP sensor supplies the ECA with a signal proportional to the opening angle of the carburetor throttle plates. (It uses VREF.)



TP SENSOR

The TP sensor is a variable resistor attached to th carburetor throttle shaft. As the throttle opens, the TI sensor resistance increases, increasing the voltage o the TP sensor signal.



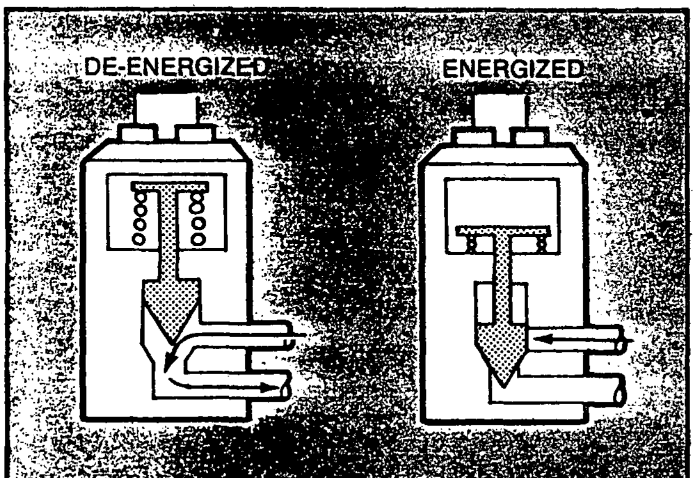
MOUNTED ON BRACKET ON THROTTLE SIDE OF CARBURETOR

ACTUATORS

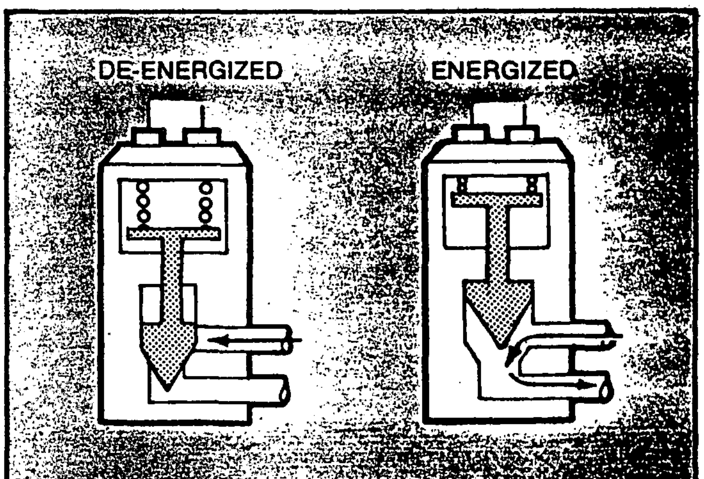
"Sensors" send information to the ECA. "Actuators" carry out adjustments on command from the ECA.

Six of the actuators are **solenoid valves** consisting of a wire coil and a plunger attached to the valve stem. One end of the coil is supplied with battery voltage by the power relay. The other end is connected to the ECA so the valve does not move unless instructed to by the ECA. To energize the solenoid, the ECA switches this coil end to ground, allowing current to flow in the coil and creating a magnetic field that attracts the plunger and moves the valve stem to open or close it.

One type of solenoid valve is normally open when no power is applied and a spring holds the valve open. Applying power closes the valve. The other type is normally closed and needs power applied to open it against spring tension.



NORMALLY OPEN



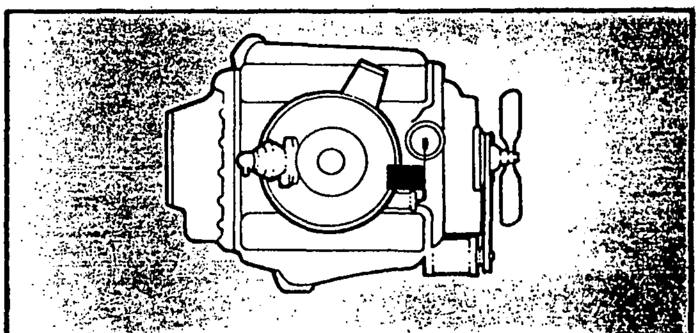
NORMALLY CLOSED

CANP (Canister Purge) Solenoid Valve

The CANP solenoid valve is a normally closed valve that controls vacuum from the intake manifold to the fuel vapor collection canister:

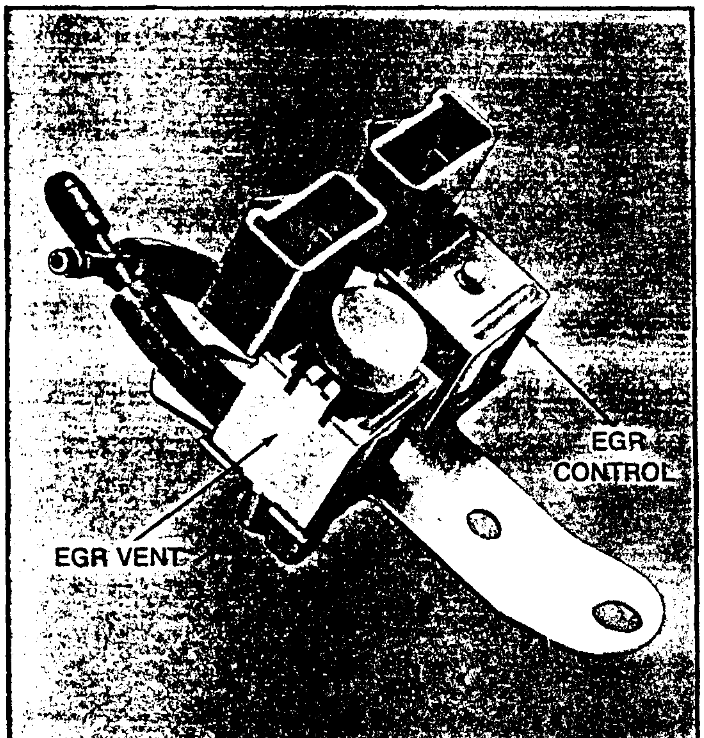
- In the de-energized position it seals the fuel vapor collection canister from manifold vacuum.
- In the energized position it allows the intake manifold vacuum to draw fuel vapors from the fuel vapor collection canister to be burned in the engine.


CANP SOLENOID VALVE

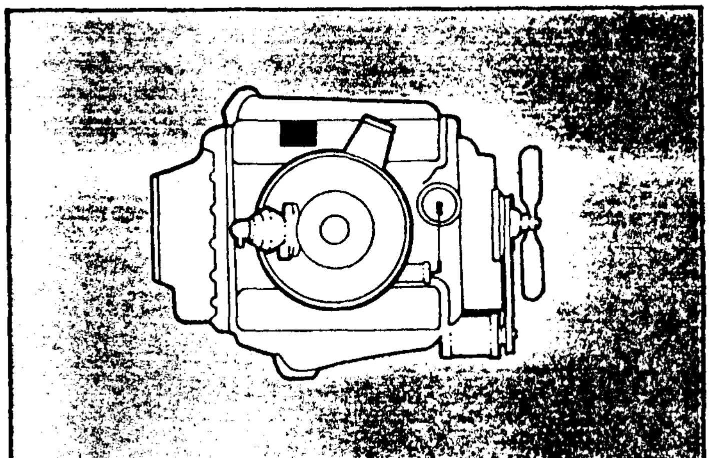

ON HOSE FROM EVAPORATIVE CANISTER TO CARBURETOR

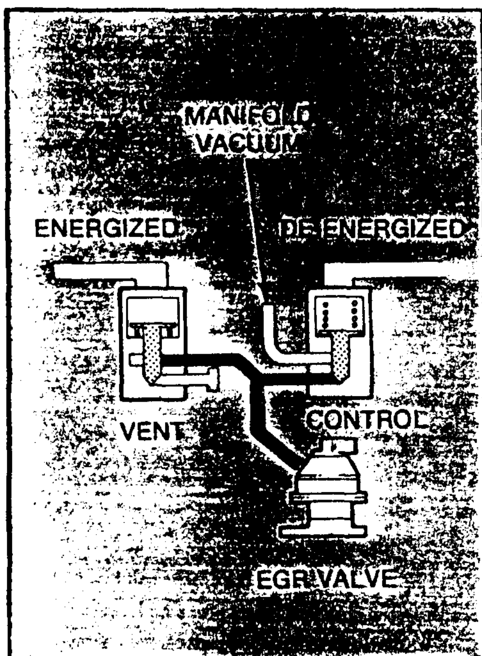
EGRC & EGRV (EGR Control & Vent) Solenoid Valves Assembly

The EGRV valve is normally open and the EGRC valve normally closed. The EGRV & EGRC solenoid valves work together to control vacuum to the EGR valve, as shown in the three diagrams below.

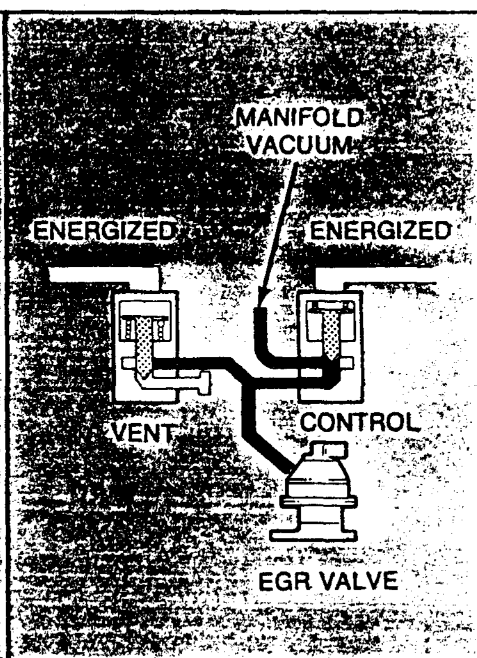


EGR VENT AND EGR CONTROL SOLENOID VALVES

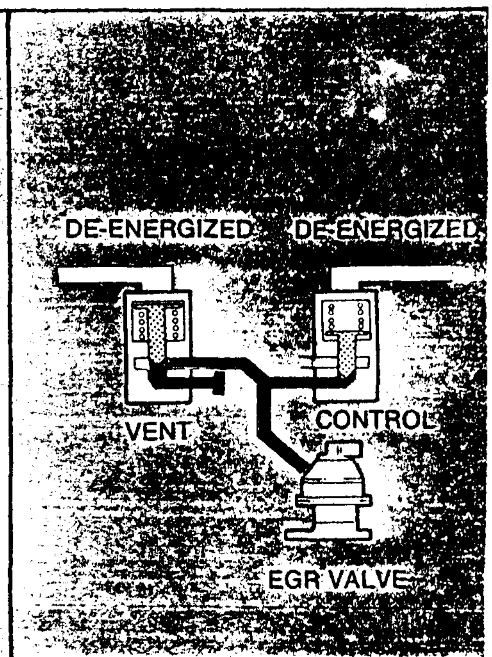

MOUNTED ON LEFT ROCKER ARM COVER



MAINTAIN EGR FLOW
Existing vacuum is trapped in line, holding EGR valve in same position.

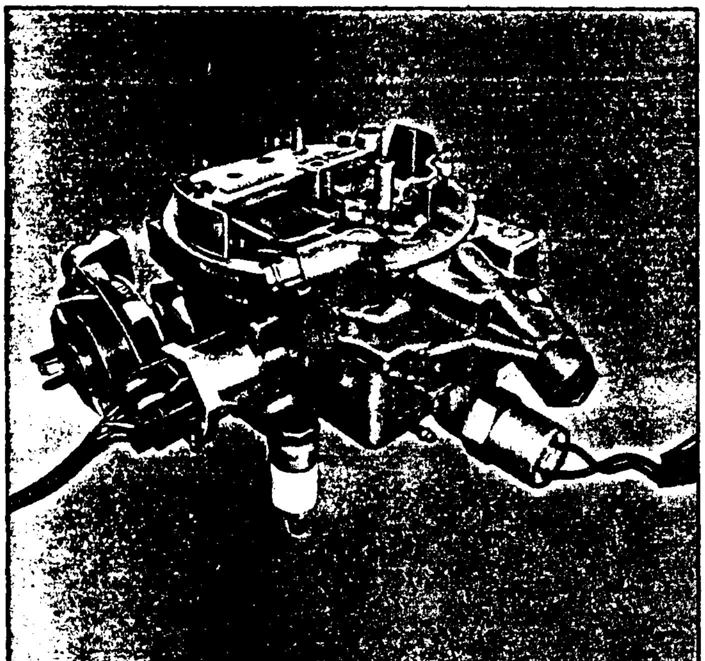


INCREASE EGR FLOW
Increased vacuum opens EGR valve for more EGR flow.



DECREASE EGR FLOW
Existing vacuum in lines is vented to atmosphere.

FBCA (Feedback Carburetor Actuator)



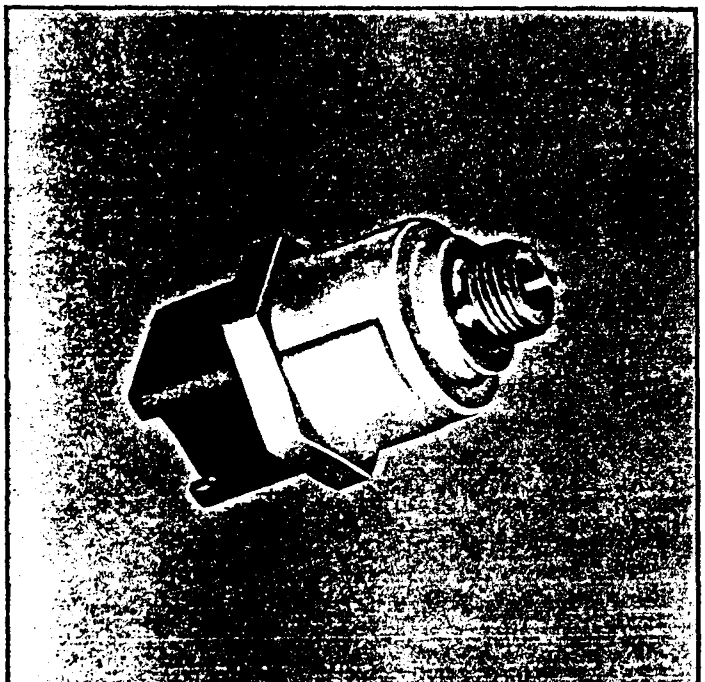
MOTORCRAFT 7200 CARBURETOR WITH FBCA

The FBCA controls air/fuel ratio on signal from the ECA by adjusting the position of a vacuum bleed metering rod in the carburetor. This actuator is not a solenoid but a combination motor and leadscrew. The leadscrew changes the rotary motion of the motor to a linear (in and out) motion of the actuator shaft.

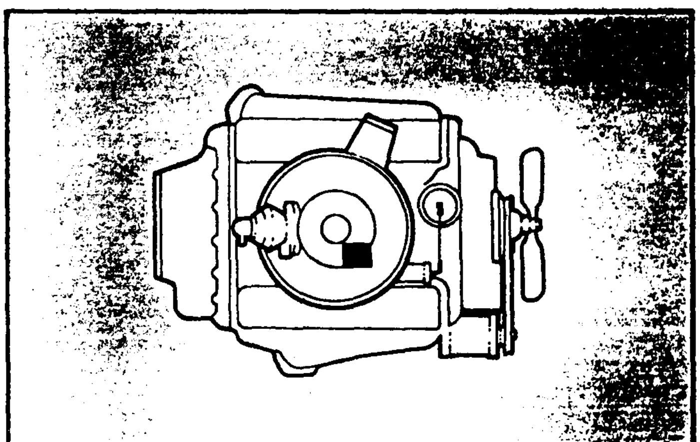
The FBCA actuator shaft can be set by ECA signal to any position between fully retracted and fully extended. When the actuator shaft is fully extended, the vacuum bleed metering rod is seated, permitting the slightly rich mixture to enter the engine unchanged.

When the actuator shaft is retracted, the metering rod bleeds vacuum from the control vacuum chamber into the fuel bowl. This lowers the air pressure in the fuel bowl, which leans the air/fuel mixture.

(The FBCA is mounted on the Motorcraft model 7200 carburetor. The model 7200 is used on all EEC-II vehicles. FBCA air/fuel ratio control is the only major difference between the model 7200 carburetor and the 2700 Variable Venturi carburetor used on other vehicle lines.)



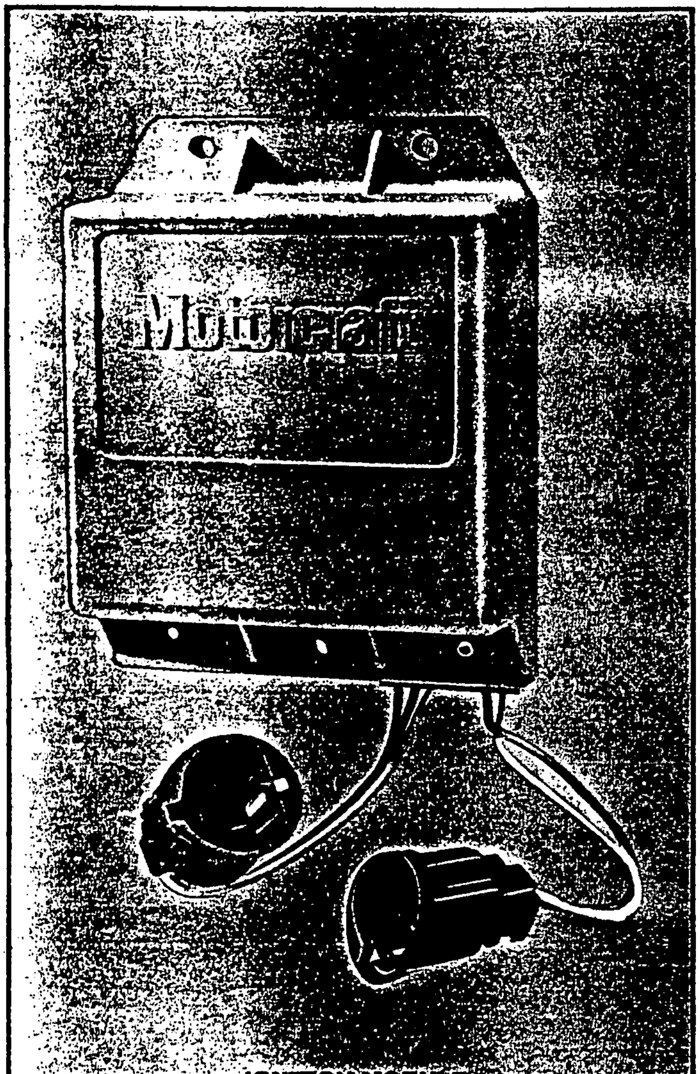
FBCA



THREADED ON RIGHT SIDE OF CARBURETOR

IM (Ignition Module)

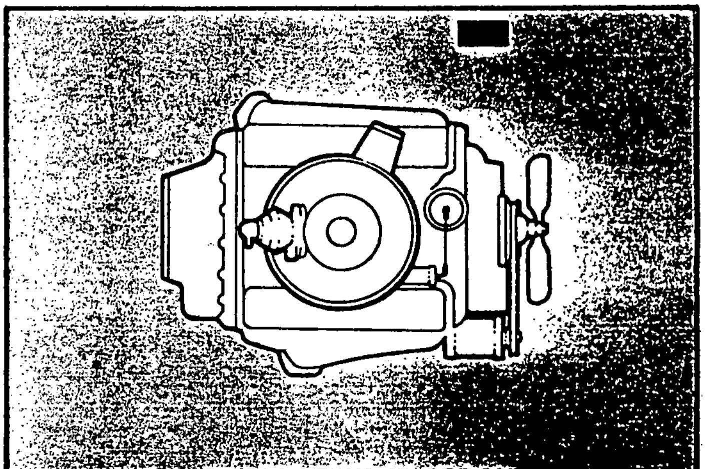
The Dura-Spark III Ignition Module controls ignition primary current to the ignition coil to produce spark plug firings.



IGNITION MODULE

The Dura-Spark III Ignition Module differs from earlier breakerless ignition modules in that it does not control "dwell." The dwell function is controlled by the ECA.

In effect, the Dura-Spark III Ignition Module acts as a switch, turning the ignition primary current on and off at the command of the ECA.



ON LEFT FENDER APRON

TAB & TAD (Thermactor Air Bypass & Diverter) Solenoid Valves Assembly

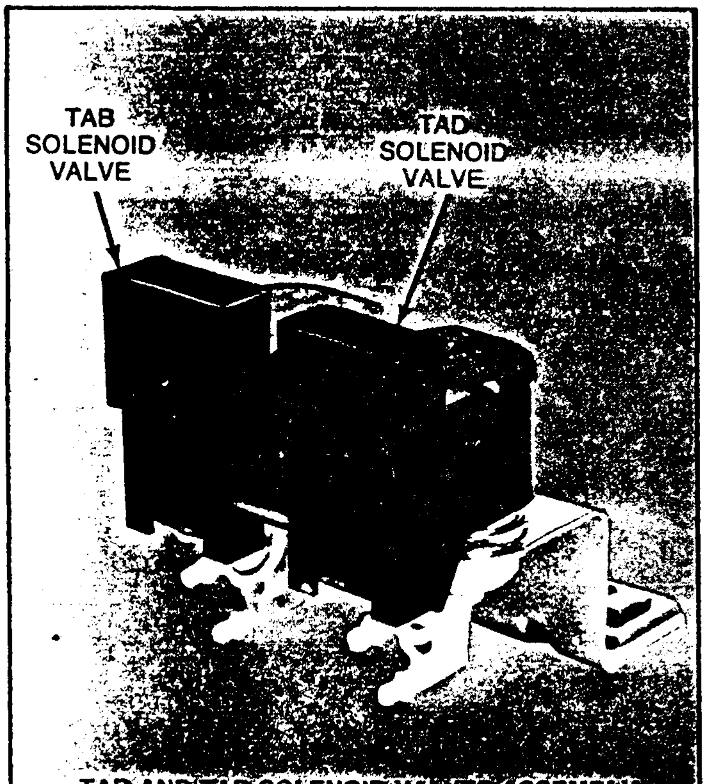
The TAB & TAD solenoid valves are identical, normally closed, vented valves.

The TAB solenoid valve controls manifold vacuum to the Thermactor Air Bypass (Dump) valve, which in turn controls whether air from the Thermactor pump is bypassed to atmosphere or routed to control of the diverter valve.

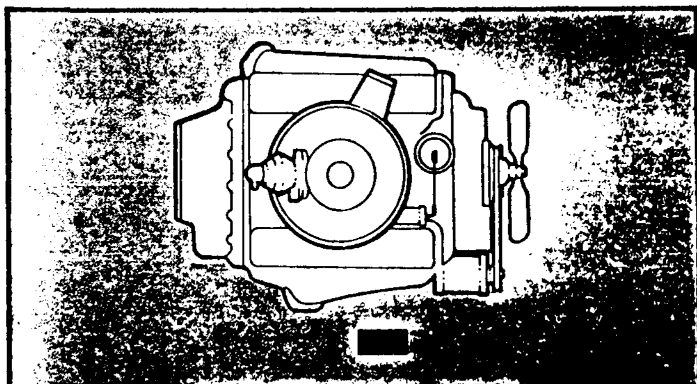
- In de-energized position, Thermactor air is "dumped" to the atmosphere.
- When energized by the ECA, Thermactor air is allowed to pass to Diverter (TAD) valve control.

The TAD solenoid valve controls manifold vacuum to the Thermactor Air Diverter valve which in turn controls which direction ("upstream" or "downstream") the Thermactor air is diverted.

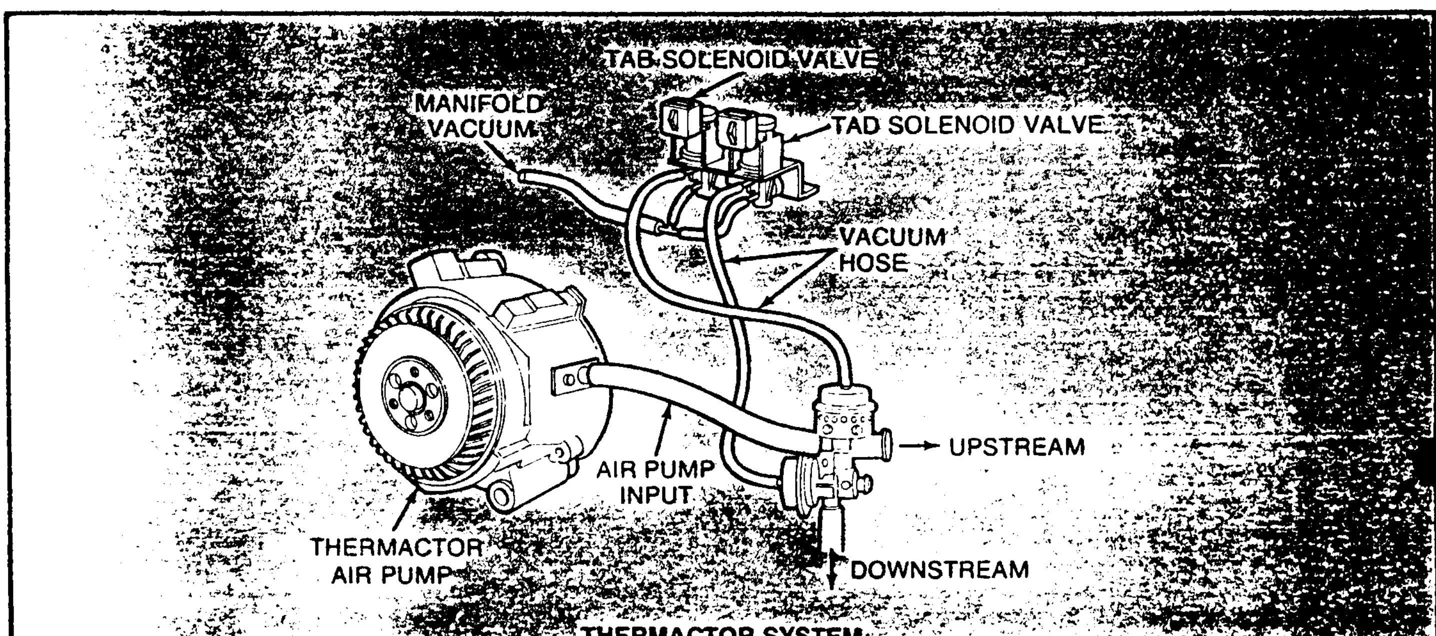
- In de-energized position, Thermactor air is diverted "downstream" to the bed of the catalytic converter.
- When energized by the ECA, Thermactor air is diverted "upstream" to the exhaust manifold.



TAB AND TAD SOLENOID VALVES ASSEMBLY



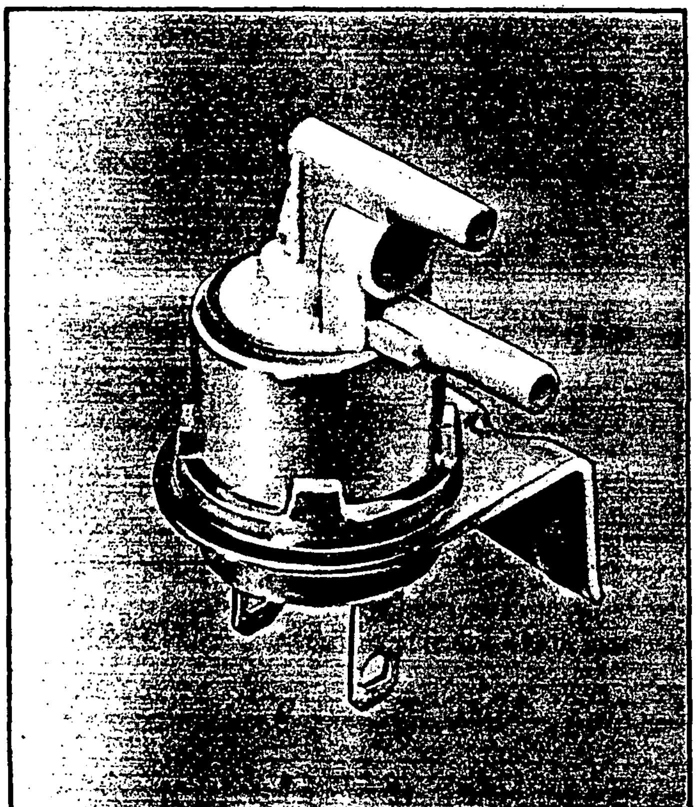
ON RIGHT FENDER APRON



THERMACTOR SYSTEM

TKS (Throttle Kicker) Solenoid Valve

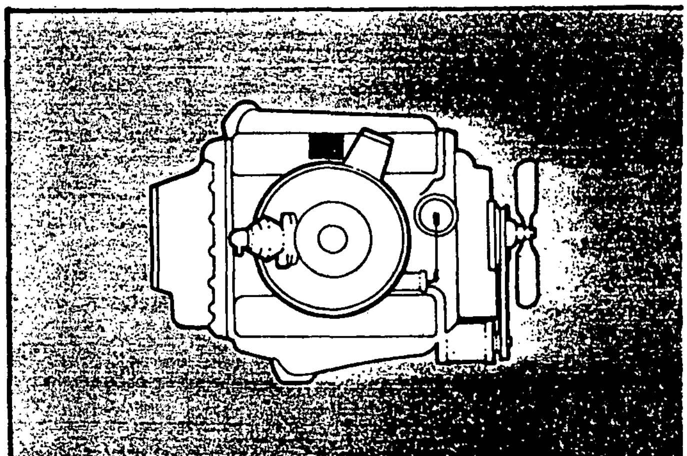
The TKS solenoid valve is a normally closed, vented valve that controls manifold vacuum to the throttle-kicker actuator. (Not all EEC-II engines are equipped with a throttle kicker.)



TK SOLENOID VALVE

The TKS solenoid valve . . .

- In de-energized position vents off any existing vacuum in the hose to the throttle-kicker dashpot.
- When energized by the ECA, allows manifold vacuum to pass to the throttle-kicker actuator to increase idle speed.
- The TKS valve is energized by the ECA when th vehicle air conditioning is on or the engine is col (to prevent stalling), or when the engine is overheating (to increase idle speed for improve cooling).



MOUNTED ON LEFT ROCKER ARM COVER

Note on Sensors and Actuators

Defective ECA's, sensors and actuators are replaced, not repaired. Therefore, the diagrams and explanations of their operation presented on these pages were for background information, **not** as a guide to repairing them.

CAUTION:

Shorting the wiring harness across a solenoid valve can burn out circuitry in the ECA that controls the solenoid valve actuators.

EEC-II SYSTEM OPERATION

As this section examines the total operation of the EEC-II system, it may be helpful to refer back to the descriptions of ECA, sensors and actuators.

There are two basic conditions for the EEC-II system:

- Limited Operation Strategy (LOS): functions during engine start, or upon failure of the ECA detected by a "safeguard" circuit in the ECA.
- Normal Operation: functions during normal vehicle driving conditions and provides full-range ECA control of all EEC-II System functions.

The LOS condition sets the actuator functions as follows:

- Ignition Module timing: Minimum spark advance (10° BTDC).
- Feedback Carburetor Actuator (FBCA): Locked at last controlled position. (On startup, the FBCA is driven full rich and then slightly lean.)
- EGR: No EGR (Exhaust Gas Recirculation).
- Thermactor Air (TAB): Bypass (dump) position.
- Canister Purge (CANP): Canister sealed, no purge.
- Throttle Kicker (TK): Low RPM idle.

The LOS condition is normally engaged for START by the presence of battery voltage on the CRANK (Starter relay) wire. During start, the LOS condition provides the actuator settings, described above, that are best for starting the engine.

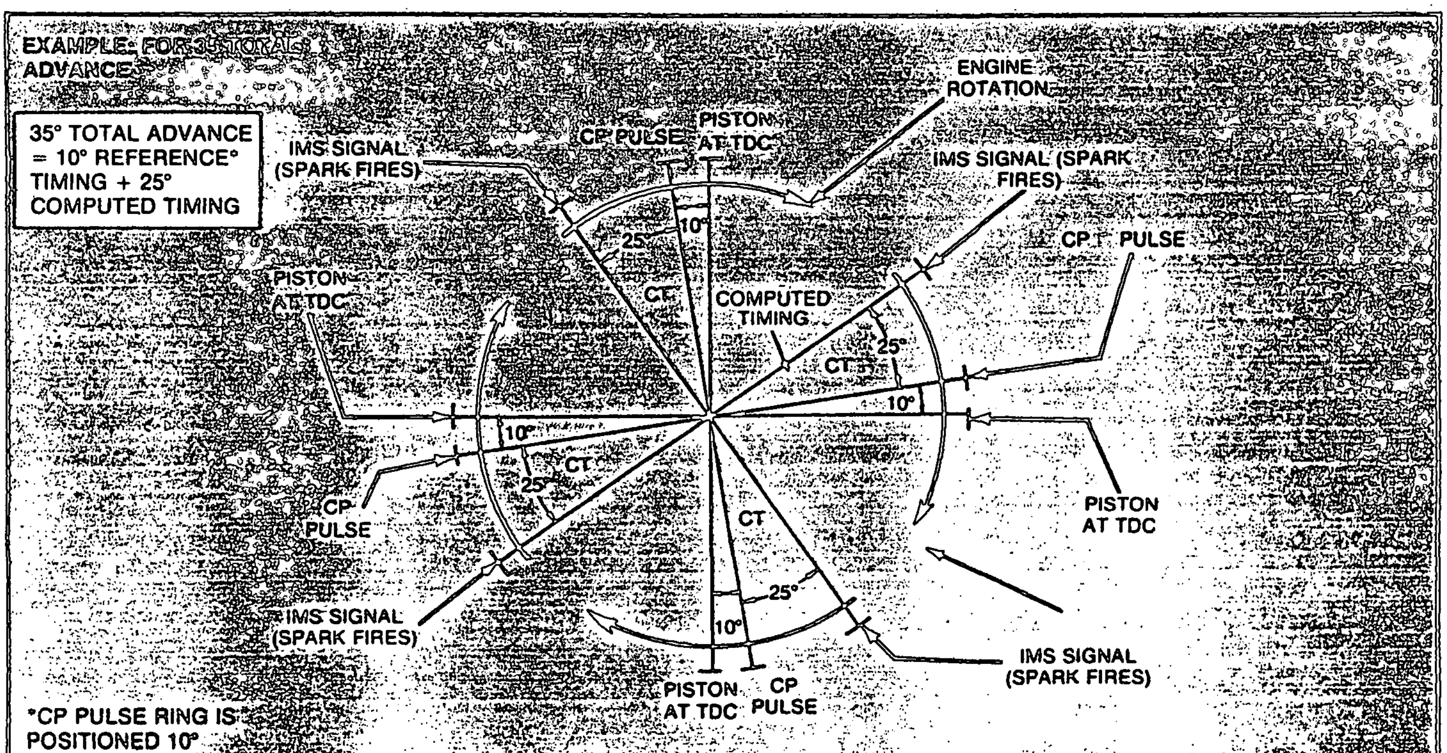
The LOS function on ECA failure provides a "limp home" condition that lets the driver get the vehicle in for service.

The Normal Operation Strategy condition is engaged during normal engine operation. During normal operation the ECA performs the calculations and carries out control of all functions previously described. (See "Sensors" and "Actuators.")

The ECA controls Computed Timing by monitoring the CP sensor signal and sending out the Ignition Module Signal (IMS) at the proper crankshaft position for the required spark advance. (See diagram below.)

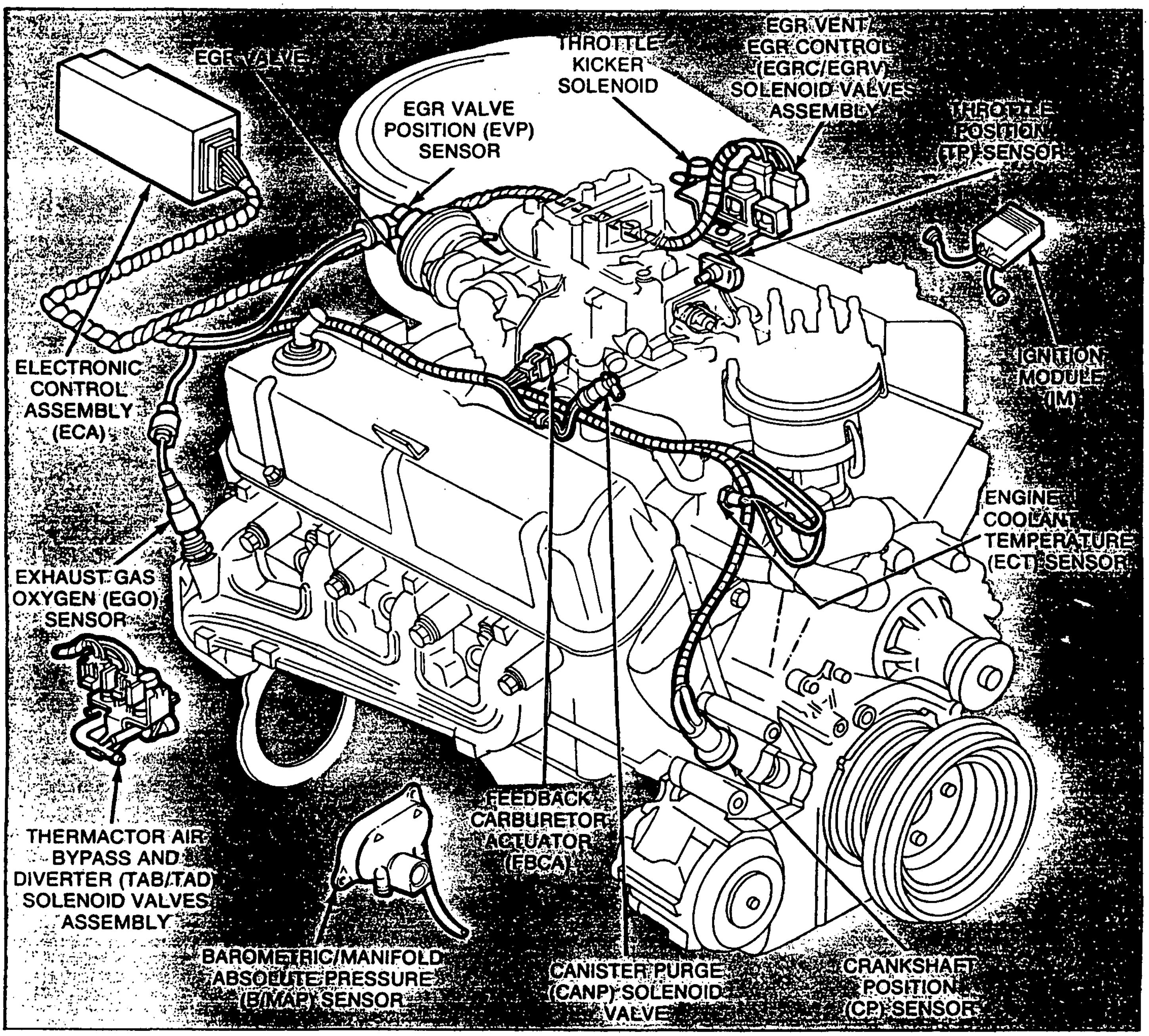
The ECA also uses the Ignition Module Signal to control the percentage of time (from one ignition firing to the next ignition firing) that current flows in the coil primary. (This is equivalent to "dwell".) The percentage that primary current flows remains constant for any engine speed or condition — except during LOS mode.

During LOS mode, primary current flows for a fixed time: .002 seconds (2 millisec), rather than for a percentage of the time.



EXAMPLE OF ECA SPARK ADVANCE OPERATION

EEC-II System Schematic — Typical



Attachment 4

BASELINE SUMMARY

Dilute Samples*

	FTP					HFET					NYCC					F.S.S.				
	HC	CO	CO_2	NO_x	F.E.	HC	CO	CO_2	NO_x	F.E.	HC	CO	CO_2	NO_x	F.E.	HC	CO_2	CO	NO	F.E
Average	.24	1.33	593	1.32	14.9	.0264	.0024	411	.986	21.3	.2831	1.39	1187	1.602	7.46	.069	.062	464	.690	19.0
STD DEV.	.022	.315	13.3	.128	.35	.0021	.0042	15.6	.179	.36	.026	1.02	47.1	.145	.28	.007	.072	12.0	.099	.59
STD. DEV. as a percent of mean	9.4%	23.7%	2.2%	9.7%	2.40%	7.8%	----	3.8%	18.2%	1.7%	9.1%	73.3%	4.0%	9.1%	3.8%	9.7%	----	2.6%	14.4%	* *3.0%

INSPECTION/MAINTENANCE TESTS*

	Two Speed Idle*				Abbreviated I/M Cycle				Federal	Three Mode Cycle		
	2500 RPM		Neutral		Initial		Final		52 MPH	25 MPH	Drive Idle	Neutral Idle
	HC1	CO	HC	CO	HC	CO	HC	CO	HC/CO	HC/CO	HC/CO	HC/CO
Average	4.7	.003	1.7	.003	3.0	.003	3.1	.003	3.3/.0026	3/.0027	1.28/.004	1.43/.0025
STD DEV.	3.5	.005	2.2	.004	2.9	.007	3.9	.006	3.8/.004	2.9/.0046	1.6/.005	1.9/.0046
STD DEV. as a percent of the mean	---	----	---	-----	---	----	---	-----	---/----	---/-----	---/----	---/------

*HC in PPM Hexane
CO in Percent

PROLONGED IDLE CYCLE

	HC											CO										
	Int	1min.	2	3	4	5	6	7	8	9	10	Int	1	2	3	4	5	6	7	8	9	10
Average	1.43	1.0	2.0	2.0	2.57	2.14	2.67	3.28	2.57	*	*	.005	.0047	.0036	.010	.009	.005	.004	.004	.003	.003	.003
STD DEV.	1.902	1.53	2.45	2.24	2.14	2.91	1.36	3.3	2.76	3.04	*	.006	.006	.0055	.01	.006	.005	.007	.005	.005	.005	.005
STD. DEV/mean																						

* 2.71 * 3.43

* HC in PPM Hexane
CO in percent

Ford Baseline Data

Date	Test Type	HC	CO	CO_2	NOx	F.E.	Comments
2-26-79	FTP	.28	1.9	630	1.41	13.99	B/L
2-26-79	HFET	.03	.01	411	1.11	21.57	B/L
2-27-79	FTP	.25	1.42	660	4.28	13.37	w/EGO
2-27-79	HFET	.04	.02	460	4.52	19.27	w/EGO
3-1-79	FTP	.21	1.48	618	1.34	14.28	w/EGO
3-1-79	HFET	.03	.01	422	1.15	21.01	HW FGT

Comments are not very self explantory but the tests on 3-1-79 were said to be the relevant Ford baseline data. Compared to the MVEL FTP baseline averages:

	HC	CO	CO_2	NOx	F.E.
Ford	.21	1.48	618	1.34	14.28
MVEL	.24	1.33	593	1.32	14.90
Difference	.03	.15	25	.02	.62

Attachment 6

Ford Inspection/Maintenance Prototype Testing Study

Dilute Sample Tests

		FTP (gms/mile)					HFET (gms/mile)					NYCC (gms/mile)					FSS (gms/mile)				
Test Number		HC	CO	CO_2	NOx	F.E.	HC	CO	CO_2	NOx	F.E.	HC	CO	CO_2	NOx	F.E.	HC	CO	CO_2	NOx	F.E.
3-6-79	79-7171	.24	1.5	605	1.43	14.6															
3-6-79	79-7172						.029	.003	420	1.162	21.1	.258	1.048	1129	1.699	7.8	.074	.07	436	.753	20.3
3-7-79	79-7173	.27	1.4	591	1.37	14.9															
3-7-79	79-7174						.025	.0	407	1.192	21.8	.261	.830	1136	1.698	7.8	.074	.03	470	.788	18.9
3-8-79	79-7175	.23	1.2	598	1.41	14.8															
3-8-79	79-7176						.025	.0	414	1.097	21.4	.295	2.451	1129	1.616	7.8	.072	.23	465	.776	19.0
3-9-79	79-7177	.22	1.0	571	1.41	15.5															
3-9-79	79-7178						.026	.0	412	1.064	21.5	.279	.236	1212	1.794	7.3	.061	.02	463	.734	19.1
3-9-79	79-7179	VOID																			
3-13-79	79-7180						.026	.012	413	1.000	21.5	.333	3.231	1211	1.488	7.3	.078	.07	470	.689	18.9
3-14-79	79-7181	.21	1.0	581	1.30	15.2															
3-14-79	79-7182						.024	.0	418	.899	21.2	.301	1.189	1228	1.666	7.2	.064	.01	470	.693	18.8
3-15-79	79-7184	3.34	110.4	563	.45	11.9															
3-15-79	79-7183						1.738	90.298	410	.077	15.9	7.628	284.401	1036	.167	5.9	2.618	96.11	444	.136	14.7

Ford Inspection/Maintenance Prototype Testing Study

Dilute Sample Tests

Test Number		FTP (gms/mile)					HFET (gms/mile)					NYCC (gms/mile)					FSS (gms/mile)				
		HC	CO	CO_2	NOx	F.E.	HC	CO	CO_2	NOx	F.E.	HC	CO	CO_2	NOx	F.E.	HC	CO	CO_2	NOx	F.E.
3-16-79	79-7185	.22	1.1	623	3.97	14.2															
3-16-79	79-7186						.032	0.0	442	3.26	20.1	.415	4.18	1307	4.05	6.7	.095	.01	513	2.40	17.3
3-20-79	79-7187	1.98	51.3	630	.31	12.4															
3-20-79	79-7188						1.349	57.93	441	.06	16.5	5.209	117.84	1181	.279	6.4	1.684	43.71	489	.11	15.7
3-21-79	79-7189	.23	1.0	604	2.61	14.6															
3-21-79	79-7190						.026	0.0	428	2.87	20.7	.280	.21	1299	3.427	6.8	.065	0.0	490	1.74	18.1
3-22-79	79-7191	.69	10.7	592	.70	14.5															
3-22-79	79-7192						.020	.28	431	.74	20.6	.372	12.88	1250	.889	7.0	.049	.66	482	.43	18.4
3-23-79	79-7193	4.02	104.1	498	.93	13.2															
3-23-79	79-7194						2.655	86.51	341	.63	18.3	9.568	289.27	1001	1.178	6.0	3.557	104.38	392	.70	15.6
	79-7195	.26	1.3	602	1.07	14.7															
3-26-79	79-7196						.026	0.0	427	.70	20.7	.260	.46	1237	1.339	7.2	.061	.01	483	.51	18.3
	79-7197	3.09	77.5	529	.61	13.4															
3-27-79	79-7198						1.988	53.30	358	.95	19.8	4.50	59.23	1172	.465	6.9	1.582	23.46	449	.15	18.0
	79-7199	.22	1.4	611	.98	14.4															
3-28-79	79-7200						.027	0.0	435	.68	20.4	.166	.14	1235	1.570	7.2	.063	0.0	487	.48	18.2
	79-7201	2.70	19.2	571	1.94	14.5															
4-3-79	79-7202						1.441	9.57	403	1.55	21.0	5.927	53.02	1152	3.329	7.1	2.343	11.87	460	1.21	18.2

Ford Inspection/Maintenance Prototype Testing Study

Dilute Sample Tests

		FTP					HFET					NYCC					FSS				
Test Number		HC	CO	CO_2	NOx	F.E.	HC	CO	CO_2	NOx	F.E.	HC	CO	CO_2	NOx	F.E.	HC	CO	CO_2	NOx	F.E.
4-5-79	79-7203	2.54	18.8	555	1.83	15.0															
	79-7204						1.373	9.361	401	1.385	21.1	-	-	-	-	-	-	-	-	-	-
4-6-79	79-7205	.47	1.8	618	1.16	14.3															
	79-7206						.050	.003	442	.721	20.1	.316	1.59	1266	1.330	7.0	.085	.071	499	.516	17.8
	79-7485	.66	2.2	627	1.15	14.0															
4-9-79	79-7486						.074	.021	448	.440	19.8	.329	1.85	1248	1.019	7.1	.074	.043	497	.459	17.8
	79-7487	.89	1.4	641	1.19	13.7															
4-10-79	79-7488						.072	.036	462	.499	19.2	.366	2.64	1287	.870	6.9	.095	.212	512	.415	17.3
	79-7489	.21	.7	589	1.17	15.0															
4-11-79	79-7490						.243	3.581	425	.390	20.6	.252	.62	1173	1.865	7.5	.068	.058	432	.527	20.5
	79-7491	1.04	17.4	589	.78	14.3															
4-12-79	79-7520						1.536	35.681	375	.175	20.3	5.192	94.39	1106	.156	7.0	1.864	34.68	437	.044	17.8
	79-7521	.26	1.9	606	1.25	14.5															
4-13-79	79-7522						.030	.004	375	.777	20.9	.279	1.66	1216	1.518	7.3	.065	.056	476	.574	18.6

Ford Inspection/Maintenance Tests

Test Number		Two Speed Idle 2500 RPM HC	Two Speed Idle 2500 RPM CO	Two Speed Idle Neutral HC	Two Speed Idle Neutral CO	Abbreviated I/M Idle Cycle Initial HC	Abbreviated I/M Idle Cycle Initial CO	Abbreviated I/M Idle Cycle Final HC	Abbreviated I/M Idle Cycle Final CO	Federal Three Mode 52 mph HC/CO	Federal Three Mode 25 mph HC/CO	Federal Three Mode Drive Idle HC/CO	Federal Three Mode Neutral Idle HC/CO
3-6-79	79-7171												
3-6-79	79-7172												
3-7-79	79-7173												
3-7-79	79-7174	9	.01	5	.008	5	.005	6	.008	11/.01	3/.01	1/.01	1/.01
3-8-79	79-7175												
3-8-79	79-7176	8	0.0	4	0.0	4	0.0	5	0.0	5.0/0.0	9.0/0.0	4.0/0.0	5.0/0.0
3-9-79	79-7177												
	79-7179												
3-9-79	79-7178	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0/0	2/0	0/0	0/0
3-13-79	79-7180	8.0	0.0	0.0	0.0	5.0	0.0	1.0	0.0	3/0	4/0	3/0	3/0
3-14-79	79-7181												
3-14-79	79-7182	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2/0	1/0	0/0	0/0
3-15-79	79-7184												
3-15-79	79-7183	35.0	4.15	175.0	6.5	175	6.5	25	5.4	55/4.1	100/4.6	180/5.5	160/5.4

All HC readings in ppm (Hexane)
All CO readings in percent

Test Number		Two Speed Idle: 2500 RPM HC	2500 RPM CO	Neutral HC	Neutral CO	Abbreviated I/M Idle Cycle: Initial HC	Initial CO	Final HC	Final CO	Federal Three Mode: 52 mph HC/CO	25 mph HC/CO	Drive Idle HC/CO	Neutral Idle HC/CO
3-16-79	79-7185												
3-16-79	79-7186	20	.002	300	3.4	300	2.6	30	.01	10/0	10/0	200/1.2	165/.8
3-20-79	79-7187												
3-20-79	79-7188	20	4.8	270	7.2	260	7.0	240	5.9	65/2.4	100/2.7	150/.8	75/.3
3-21-79	79-7189												
3-21-79	79-7190	0	0	0	0	0	0	0	0	3/.005	1/.002	0/0	0/0
3-22-79	79-7191												
3-22-79	79-7192	50	1.5	10	0	10	0	10	0	0/0	0/0	0/0	3/0
3-23-79	79-7193												
3-23-79	79-7194	145	5.4	325	7.2	350	6.8	350	6.6	165/4.9	190/5.4	220/5.0	240/4.2
	79-7195												
3-26-79	79-7196	0	0	0	0	0	0	0	0	0/0	0/0	0/.005	0/0
	79-7197												
3-27-79	79-7198	100	4.5	360	5.0	300	4.0	325	4.8	145/2.1	165/1.9	210/.6	60/1.25
	79-7199												
3-28-79	79-7200	0	0	0	0	0	0	0	0	0/0	0/0	0/0	0/0
	79-7201												
4-3-79	79-7202	28	.6	325	.7	325	.7	325	.6	100/.55	130/.45	160/.55	230/.6

All HC readings in ppm (Hexane)
All CO readings in percent

Ford Inspection/Maintenance Tests

Test Number		Abbreviated I/M Idle Cycle: Two Speed Idle, 2500 RPM HC	2500 RPM CO	Neutral HC	Neutral CO	Initial HC	Initial CO	Final HC	Final CO	Federal Three Mode: 52 mph HC/CO	25 mph HC/CO	Drive Idle HC/CO	Neutral Idle HC/CO
4-5-79	79-7203												
	79-7204	200	.5	200	.6	250	.6	275	.6	100/.5	105/.4	160/.55	200/.55
4-6-79	79-7205												
	79-7206	450	3	10	.01	2	.02	0	.01	0/.015	0/.015	0/.012	0/.03
	79-7485												
4-9-79	79-7486	8	.001	0	.005	10	.005	0	.002	20/.002	9/.002	10/.004	8/.004
	79-7487												
4-10-79	79-7488	10	.002	100	.25	67	.15	50	.1	60/.003	20/.005	50/.005	170/.23
	79-7489												
4-11-79	79-7490	65	1.4	25	.01	20	.01	15	.01	65/.65	3/.02	0/.018	0/.018
	79-7491												
4-12-79	79-7520	80	3.4	185	2.5	190	2.4	220	3.2	105/2.7	125/2.8	150/1.1	0/.1
		100	5.0	260	3.5	235	3.0	270	3.8	140/3.1	155/2.8	190/1.1	50/.20
		60	2.0	18	.035	18	.02	15	.02	3/.02	0/.02	0/.02	0/.025
	79-7521												
4-13-79	79-7522	3	.01	3	.01	7	.018	10	.015	2/.008	2/.009	1/.012	1/.01

All HC readings in ppm (Hexane)
All CO readins in percent

Ford Inspection/Maintenance Prototype Testing Study

Prolonged Idle Cycle

Test Number		Hydrocarbon in ppm (Hexane)											Carbon Monoxide in Percent										
		Int.	1 min.	2	3	4	5	6	7	8	9	10	Int.	1 min.	2	3	4	5	6	7	8	9	10
3-6-79	79-7171																						
3-6-79	79-7172																						
3-7-79	79-7173																						
3-7-79	79-7174	1.0	1	3	2	2	3	3	3	2	2	2	.01	.01	.01	.009	.01	.008	.012	.01	.009	.012	.01
3-8-79	79-7175																						
3-8-79	79-7176	5.0	4.0	7.0	5.0	5.0	3.0	2.0	5.0	4.0	3.0	5.0	0	0	0	0.01	0.01	0	0	0	0	0	0
3-9-79	79-7177																						
3-9-79	79-7178	0	0	1	0	2	0	2	0	2	2	3	0	.01	0	.005	.002	0	0	0	0	0	0
	79-7179																						
3-13-79	79-7180	3	0	0	0	2	0	3	5	2	3	5	0	0	0	0	0	0	0	0	0	0	0
3-14-79	79-7181																						
3-14-79	79-7182	0	0	1	2	1	1	1	1	0	0	0	0	0	.002	.03	.02	.01	0	.005	0	0	0
3-15-79	79-7183	190	230	250	245	255	240	240	280	220	240	245	6.8	7.15	7.4	7.9	7.2	7.1	7.1	6.9	7.2	6.4	6.8
3-15-79	79-7184																						

Ford Inspection/Maintenance Prototype Testing Study

Prolonged Idle Cycle

Test Number		Hydrocarbon in ppm (Hexane)											Carbon Monoxide in Percent										
		Int.	1 min.	2	3	4	5	6	7	8	9	10	Int.	1 min.	2	3	4	5	6	7	8	9	10
3-16-79	79-7185																						
3-16-79	79-7186	160	180	195	225	260	290	300	325	300	300	275	.8	.85	1.2	2.3	2.7	3.1	3.6	4.0	3.2	3.2	2.7
3-20-79	79-7187																						
3-20-79	79-7188	30	55	80	80	93	100	105	101	110	115	115	.05	.1	.7	1.0	1.2	1.3	1.6	1.5	1.8	2.0	1.8
3-21-79	79-7189																						
3-21-79	79-7190	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3-22-79	79-7191																						
3-22-79	79-7192	3	3	5	3	6	5	3	4	5	3	3	0	0	0	0	0	0	0	0	0	0	0
3-23-79	79-7193																						
3-23-79	79-7194	230	235	250	265	290	350	360	315	300	300	300	3.9	4.1	4.6	5.3	5.8	6.6	6.9	5.9	5.8	5.6	5.6
3-23-79	79-7195																						
3-26-79	79-7196	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.01	.005	0	0	0	0	0
3-26-79	79-7197																						
3-27-79	79-7198	50	130	170	200	220	240	260	265	260	245	230	.1	.55	1.0	2.0	2.2	2.8	3.0	3.2	3.0	2.7	2.3
3-27-79	79-7199																						
3-28-79	79-7200	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3-28-79	79-7201																						
4-3-79	79-7202	200	230	240	250	270	300	350	300	325	350	275	.55	.7	.6	.55	.7	.8	.7	.6	.7	.6	.6

Ford Inspection/Maintenance Prototype Testing Study

Prolonged Idle Cycle

		Hydrocarbon in ppm (Hexane)											Carbon Monoxide in Percent										
Test Number		Int.	1 min.	2	3	4	5	6	7	8	9	10	Int.	1 min	2	3	4	5	6	7	8	9	10
4-5-79	79-7203,4	225	225	225	225	275	240	280	280	290	275	275	.5	.55	.55	.55	.5	.5	.55	.55	.6	.6	.6
4-6-79	79-7205,6	5	8	-	-	-	-	-	-	-	-	8	.02	.012	-	-	-	-	-	-	-	-	.02
4-6-79	79-7485																						
4-9-79	79-7486	20	10	5	10	3	12	14	5	12	10	6	.008	.003	.003	.002	.002	.004	.005	.003	.003	.002	.002
4-9-79	79-7487																						
4-10-79	79-7488	140	190	140	150	130	150	70	110	70	70	55	.23	.24	.21	.20	.20	.22	.17	.21	.15	.18	.16
4-10-79	79-7489																						
4-11-79	79-7490	0	3	6	9	10	10	10	10	10	10	10	.018	.019	.02	.018	.018	.017	.015	.013	.015	.015	.015
4-11-79	79-7491																						
4-12-79	79-7520	75	180	210	200	230	220	230	210	215	200	200	.45	1.4	2.4	2.2	2.7	2.4	2.5	2.2	2.1	1.8	2.1
		20	35	140	175	210	230	230	250	220	200	200	.05	.15	.7	1.1	2.6	2.2	2.0	2.4	2.3	1.5	1.5
		10	18	20	25	28	25	30	28	27	30	29	.02	.05	.02	.02	.02	.01	.01	.015	.02	.008	.005
4-13-79	79-7521																						
4-13-79	79-7522	1	2	2	5	6	8	5	9	8	9	9	.012	.013	.013	.015	.01	.01	.015	.01	.01	.01	.01

Ford Inspection/Maintenance Prototype Testing Study

Testing Comments and Description

Test Number		Comments
3-6-79	79-7171	PREPS with full fuel tank - Baseline
3-6-79	79-7172	Baseline
3-7-79	79-7173	PREP with incorrect HP and I.W. - Baseline
3-7-79	79-7174	Ran out of N_2, Bag Analysis Time = 40 min., DISTANCE = INCORRECT - Baseline
3-8-79	79-7175	PREP with incorrect IW and HP - Baseline
3-9-79	79-7176	Baseline
3-9-79	79-7177	Baseline
3-9-79	79-7178	Baseline
3-9-79	79-7179	
3-13-79	79-7180	No FTP (Voided) Varian broke - Baseline
3-14-79	79-7181	Baseline
3-14-79	79-7182	Baseline
3-15-79	79-7184	LOS Rich
3-15-79	79-7183	LOS Rich

Ford Inspection/Maintenance Prototype Testing Study

Testing Comments and Description

Test Number		Comments
3-16-79	79-7185	EGO Sensor Disconnected, Full Lean, Good Driveability
3-16-79	79-7186	EGO Sensor Disconnected, Full Lean, Good Driveability
3-20-79	79-7187	EGO Disconnected, Locked in LOS Then EGO Reconnected.
3-20-79	79-7188	EGO Disconnected, Locked in LOS Then EGO Reconnected.
3-21-79	79-7189	Disconnected EGR Vacuum Line.
3-21-79	79-7190	Disconnected EGR Vacuum Line
3-22-79	79-7191	Air Pump Locked in By-Pass Mode.
3-22-79	79-7192	Air Pump Locked in By-Pass Mode.
3-23-79	79-7193	Engine Coolant Temp. Disconnected.
3-23-79	79-7194	Engine Coolant Temp. Disconnected
3-23-79	79-7195	
3-26-79	79-7196	Baseline Data.
3-26-79	79-7197	
3-27-79	79-7198	Manifold Vacuum Disconnected.
3-27-79	79-7199	
3-28-79	79-7200	Throttle Body Sensor Disconnected.
3-28-79	79-7201	
4-3-79	79-7202	Removed Catalysts, No Flow Restrictor, Air Pump Downstream Diverted.

Ford Inspection/Maintenance Prototype Testing Study

Testing Comments and Description

Test Numbers		Comments
4-5-79	79-7203,4	Catalyst removed with restrictor in line to equalize EGBP, CO_2 readins out on NYCC and HFET.
4-6-79	79-7205,6	Four percent misfire, noticable vibration at idle, rough accels.
4-6-79	79-7485	
4-9-79	79-7486	Eight percent misfire, good driveability, rough idle and accels.
4-9-79	79-7487	
4-10-79	79-7488	Twelve percent misfire vibrations on accels, driveability good.
4-10-79	79-7489	
4-11-79	79-7490	FBCA stepper motor locked in lean position.
4-11-79	79-7491	
4-12-79	79-7520	FBCA stepper motor locked in maxrich position. I/M tests with air by-pass hose blocked. FBCA stepper motor locked in maxrich position. I/M tests with air by-pass hose blocked, normal F/A control background at end = 28/.01.
4-13-79	79-7521	
4-13-79	79-7522	Baseline.

Ford I/M Methane Results

Test #	Date	FTP			HFET			NYCC			FSS			Comments
		THC	HC-NM	Meth	THC	HC-NM	Meth	THC	HC-NM	Meth	THC	HC-NM	Meth	
79-7181	3-14-79	0.21	0.13	0.08										
79-7182	3-15-79				0.024	0.009	0.016	0.301	0.098	0.202	0.064	0.020	0.044	Baseline. Baseline.
79-7190	3-21-79				0.026	0.010	0.016	0.280	0.095	0.185	0.065	0.027	0.038	EGR disconnected.
79-7192	3-22-79				0.020	0.008	0.012	0.372	0.220	0.152	0.049	0.015	0.024	Air pump locked in bypass mode.
79-7193	3-23-79	4.02	3.74	0.28										Engine coolant sensor disconnected.
79-7194	3-23-79				2.655	2.443	0.212	9.568	8.833	0.734	3.557	3.287	0.269	Engine coolant sensor disconnected, HC span check of the HFET out of specs.
79-7195	3-26-79	0.26	0.17	0.09										Baseline.
79-7196	3-26-79				0.026	0.010	0.016	0.260	0.06	0.20	0.061	0.02	0.041	Baseline.
79-7197	3-27-79	3.09	2.86	0.23										Map vacumn line blocked, rough 2-3 upshifts.
79-7198	3-27-79				1.988	1.841	0.147	4.496	4.217	0.279	1.582	1.469	0.113	Map vacumn line blocked.
79-7199	3-28-79	0.22	0.15	0.07										Throttle position sensor disconnected, downshift at 195 sec.
79-7200	3-28-79				0.027	0.010	0.017	0.166	0.071	0.095	0.063	0.026	0.037	Throttle position sensor disconnected.
79-7201	4-3-79	2.70	2.61	0.09										
79-7202	4-3-79				1.441	1.390	0.051	5.927	5.727	0.2	2.343	2.282	0.061	Catalysts removed. No restrictor.
79-203	4-5-79	2.54	2.45	0.09										No catalysts, restrictors in line.
79-204	4-5-79				1.373	1.321	0.052	5.758	5.568	0.191	2.389	2.331	0.058	No catalysts, restrictor in line, CO_2 ball valve went on after FET. No CO_2 on NYCC & FSS.

Test #	Date	FTP THC	FTP HC-NM	FTP Meth	HFET THC	HFET HC-NM	HFET Meth	NYCC THC	NYCC HC-NM	NYCC Meth	FES THC	FES HC-NM	FES Meth	Comments
79-7205	4-6-79	0.47	0.40	0.07										4% misfire, catalysts reinstalled, rough running on accel.
79-7206	4-6-79				0.050	0.039	0.011	0.316	0.164	0.153	0.085	0.049	0.036	4% misfire, catalysts reinstalled.
79-7485	4-9-79	0.66	0.60	0.06										8% misfire, driveability good, rough idle & accel.
79-7486	4-9-79				0.074	0.064	0.010	0.329	0.210	0.120	0.074	0.052	0.023	Engine runs rough, driveability good, 8% misfire.
79-7487	4-10-79	0.89	0.84	0.05										12% misfire, vibrations on idle & accel., driveability good.
79-7488	4-10-79				0.072	0.068	0.009	0.366	0.296	0.070	0.095	0.076	0.019	Engine runs rough, driveability good, 12% misfire.
79-7289	4-11-79	0.21	0.14	0.07										FBCA stepper locked max. lean position.
79-7490	4-11-79				0.243	0.187	0.056	0.252	0.099	0.152	0.068	0.023	0.045	FBCA stepper motor locked in max. lean position.
79-7491	4-12-79	1.04	0.89	0.15										FBCA stepper motor locked in max. rich position.
79-7520	4-12-79				1.536	1.431	0.104	5.192	4.860	0.332	1.864	1.742	0.121	FBCA stepper motor locked in max. rich position
79-7521	4-13-79	0.26	0.17	0.09										Baseline.
79-7522	4-13-79				0.030	0.012	0.019	0.279	0.076	0.202	0.065	0.020	0.045	Baseline.

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