

# **Evaporative System Leak Detection**

John Trajnowski  
Ford Motor Company

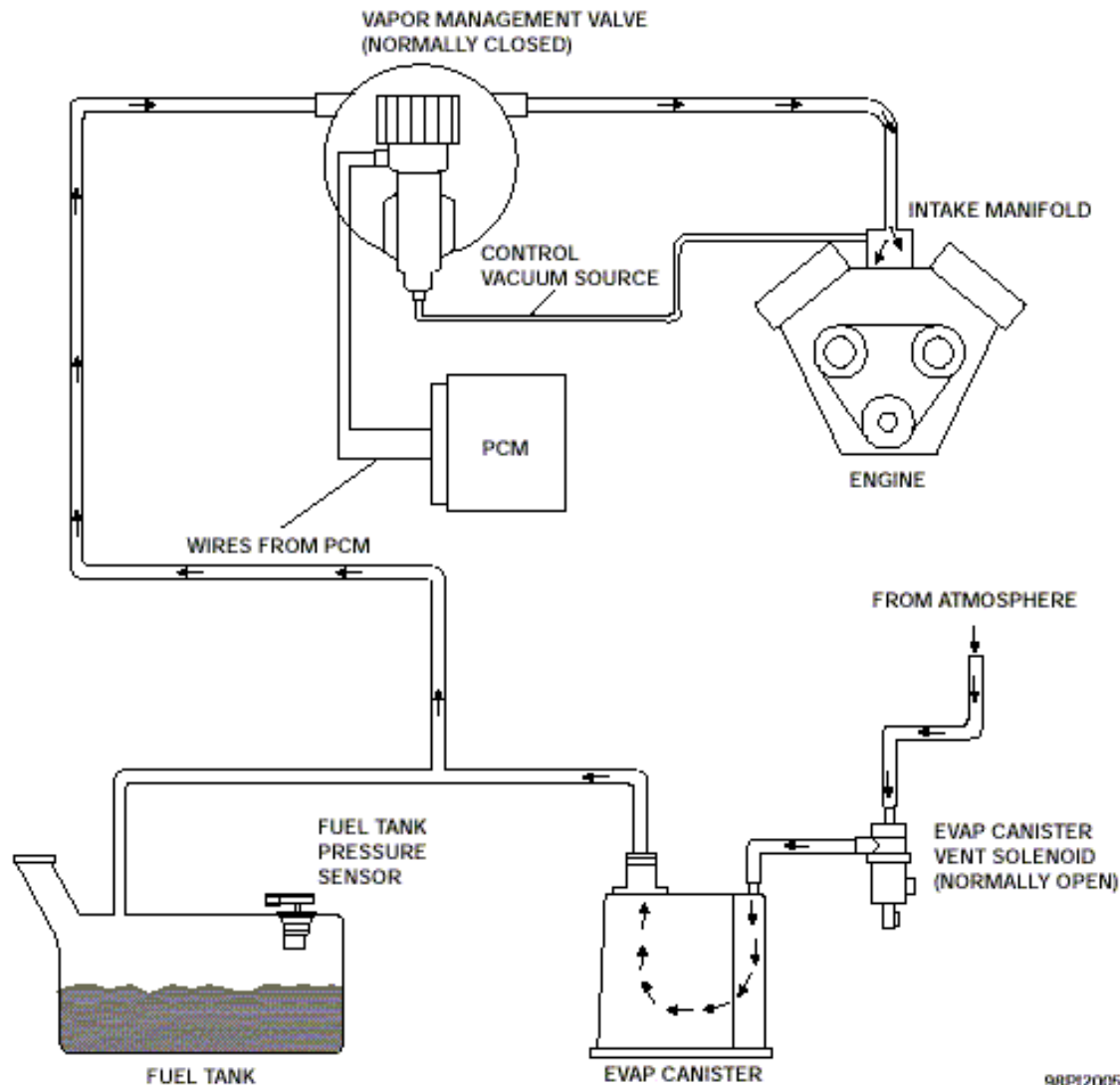
**OBD2K2**  
**Ogden, Utah**

23 May 2002

# Evaporative System Leak Detection

- Regulatory Requirement
  - Detect vapor leaks in the evaporative system greater than or equal to a leak caused by a 0.020 inch diameter orifice
- Examples of different control / monitoring methods
  - Ford Vacuum-Based Evap Monitor
  - DaimlerChrysler Pressure Pump Evap Monitor
  - GM Engine Off Natural Vacuum Evap Monitor

# Ford Vacuum-Based Evap Monitor



98P12005

# Ford Vacuum-Based Evap Monitor

- The evap system monitor checks the evaporative emissions system for leaks that would allow vapors to vent directly to the atmosphere.
- The PCM does this by closing off the canister vent valve and opening the purge valve, drawing a vacuum on the entire evaporative system.
- By measuring the amount of vacuum (using the fuel tank pressure sensor), holding it for a set period of time, and measuring it again, the PCM can tell if a leak is present.
  - If there are no leaks, the final reading should be very close to the initial reading.
  - A small leak (0.040” and 0.020”) shows up as a noticeable difference in the two measurements.
  - A large or a gross leak does not allow the system to draw down the required vacuum.

# Ford Vacuum-Based Evap Monitor

## Ford 0.020" evap monitor operation

DTCs	P0455 (gross leak), P1450, (excessive vacuum), P0457 (gross leak, cap off), P1443 (gross leak, no flow), P0442 (0.040" leak), P0456 (0.020" leak)
Monitor execution	minimum 6 hr. soak once per driving cycle for 0.040" dia leak once per driving cycle, no refueling event for 0.020" dia leak
Monitor Sequence	HO2S monitor for front sensors completed and OK
Sensors/Components OK	MAF, IAT, VSS, ECT, CKP, TP, FTP, VMV, CVS
Monitoring Duration	360 seconds for 0.040" (within first 30 minutes from engine start) 60 seconds for 0.020" (within first 10 minutes from engine start)

# Ford Vacuum-Based Evap Monitor

## Ford 0.020” evap monitor entry conditions

Entry condition	Minimum	Maximum
Engine off (soak) time	6 hours	
Time since engine start-up for 0.040”	330 sec	1800 sec
Time since engine start-up for 0.020” idle test	30 sec	600 sec
Refueling event (for 0.020” idle test only)	none	
Intake Air Temp for 0.040”	40 °F	90 - 100 °F
Intake Air Temp for 0.020”	40 °F	90 °F
Vehicle Speed for cruise test, 0.040 and 0.020”	40 mph	80 mph
Vehicle Speed for idle test, 0.020”		3 mph
Fuel Fill Level for 0.040”	15%	85%
Fuel Fill Level for 0.020”	40%	85%
BARO (<8,000 ft altitude)	22.0 “ Hg	
Engine Load	20%	70%
Purge Dutycycle	75%	100%
Fuel Tank Pressure Range	- 17 H <sub>2</sub> O	1.5 H <sub>2</sub> O

# **Leak Detection Pump (LDP)**

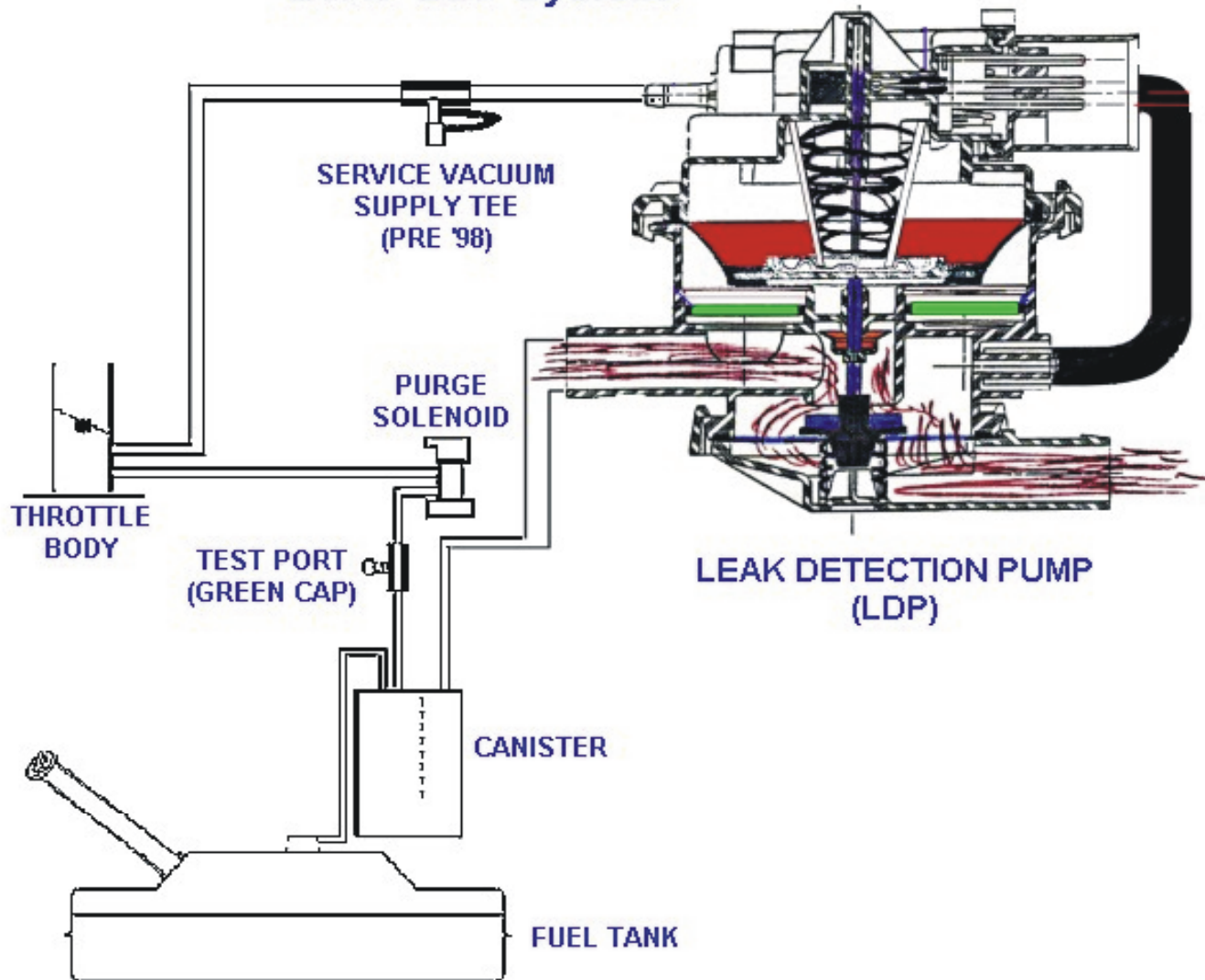
## **Evaporative System Leak Detection**

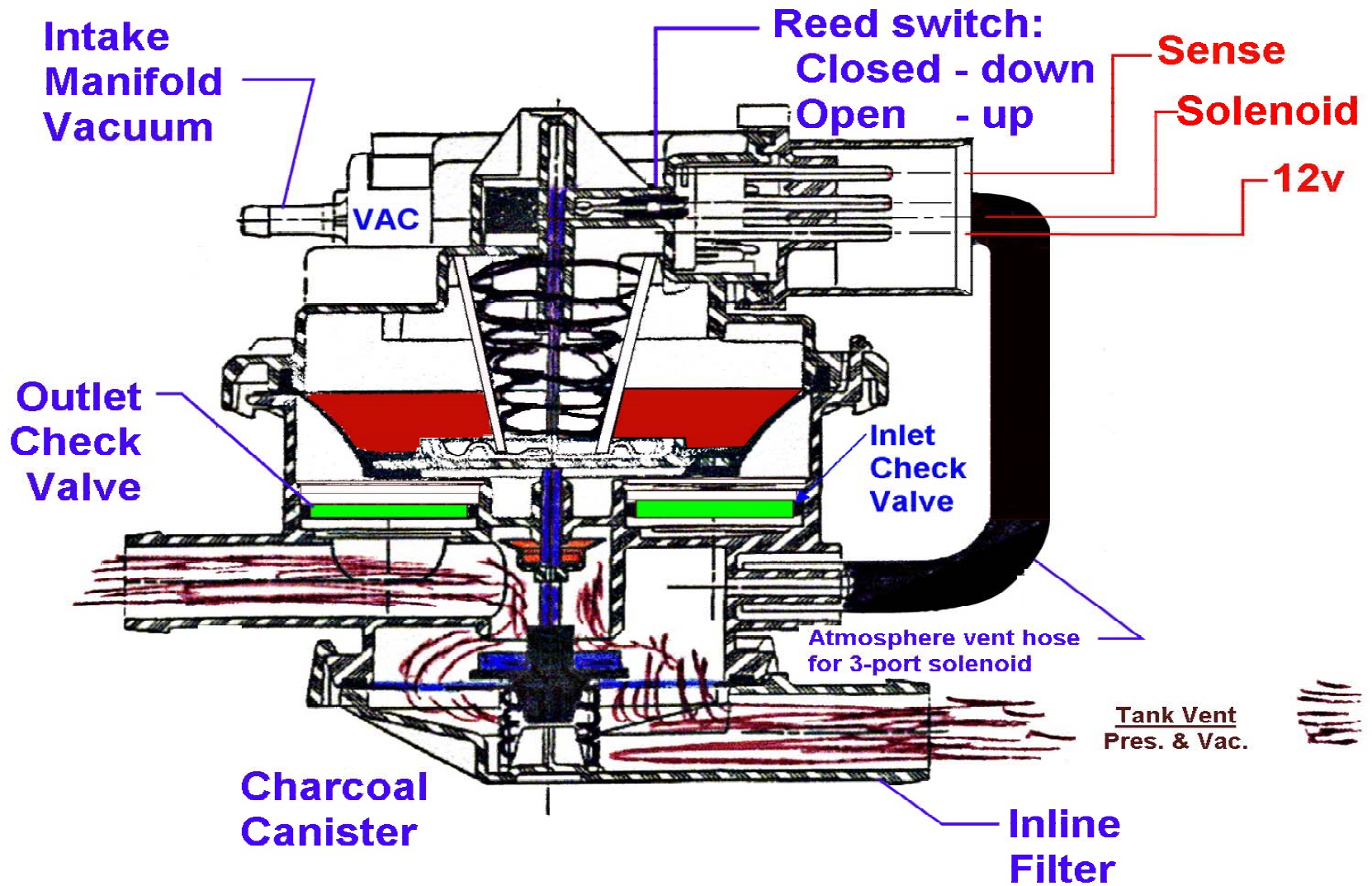
Frank Krich  
Hal Zatorski  
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23 May 2002

# EVAP LDP System





# **LDP Evaporative Leak Detection Monitor Functional Operation**

- LDP stands for leak detection pump; the evaporative emissions system is pressurized using an on-board pump
- LDP pump period has an inverse relationship to flow through the evap system and, thus, is inversely correlated to leak size
- Monitor performs electrical tests on pump prior to conducting a pinched line test to determine if leak tests can proceed
- Monitor then proceeds to pump up the system when enabled to determine the presence of leaks by comparison of observed pump periods to defined leak size based thresholds

# LDP Evaporative Leak Detection Monitor Enable Conditions

- Enable conditions for the LDP Evaporative Leak Detection Monitor 0.020 inch diameter leak test:
  - Ambient temperature between 39.2 and 86 degrees F
  - Fuel level between 30 and 85 % of fuel tank capacity
  - 0.040 inch diameter leak test has passed
  - Vehicle speed < 35 mph
  - Stabilization time > 9.935 seconds

# LDP Evaporative Leak Detection Monitor Abort / Suspend Conditions

- Abort/suspend conditions for the LDP Evaporative Leak Detection Monitor 0.020 inch diameter leak test:

- Engine manifold vacuum to suspend  $< 98.857$  torr

- Vacuum suspend time  $> 9.634$  seconds

- Engine manifold vacuum to abort  $< 74.143$  torr

- Low vacuum time to abort  $> 33.718$  seconds

# LDP Evaporative Leak Detection Fault Codes

•P-Codes used with LDP Evaporative Leak Detection diagnostic:

- P0442, evap leak monitor medium leak detected (>0.040 inch)
- P0441, evap purge flow monitor failure
- P0455, evap leak monitor large leak detected (>0.090 inch)
- P0443, evap purge solenoid circuit
- P0456, evap leak monitor small leak detected (>0.020 inch)
- P1486, evap leak monitor pinched hose found
- P1494, leak detection pump switch or mechanical fault
- P1495, leak detection pump solenoid circuit

# **Evaporative System Leak Detection Using Naturally Occuring Vacuum Phenomenon**

David Ferris  
General Motors

**OBD2K2**  
**Ogden, Utah**

23 May 2002

- **Background**

- Finding 0.020” leaks is extremely challenging
- Two factors have degraded the capability of traditional vacuum/pressure based diagnostics
  - tank architectures are more complex
    - materials and structures are less rigid
    - modifications to stiffen tanks may cause other problems
  - larger vapor volumes make it much more difficult to detect small leaks
- New 0.020” monitor needs low sensitivity to:
  - Temperature and fuel volatility
  - Fuel level / fuel tank volume and flex

**E**ngine

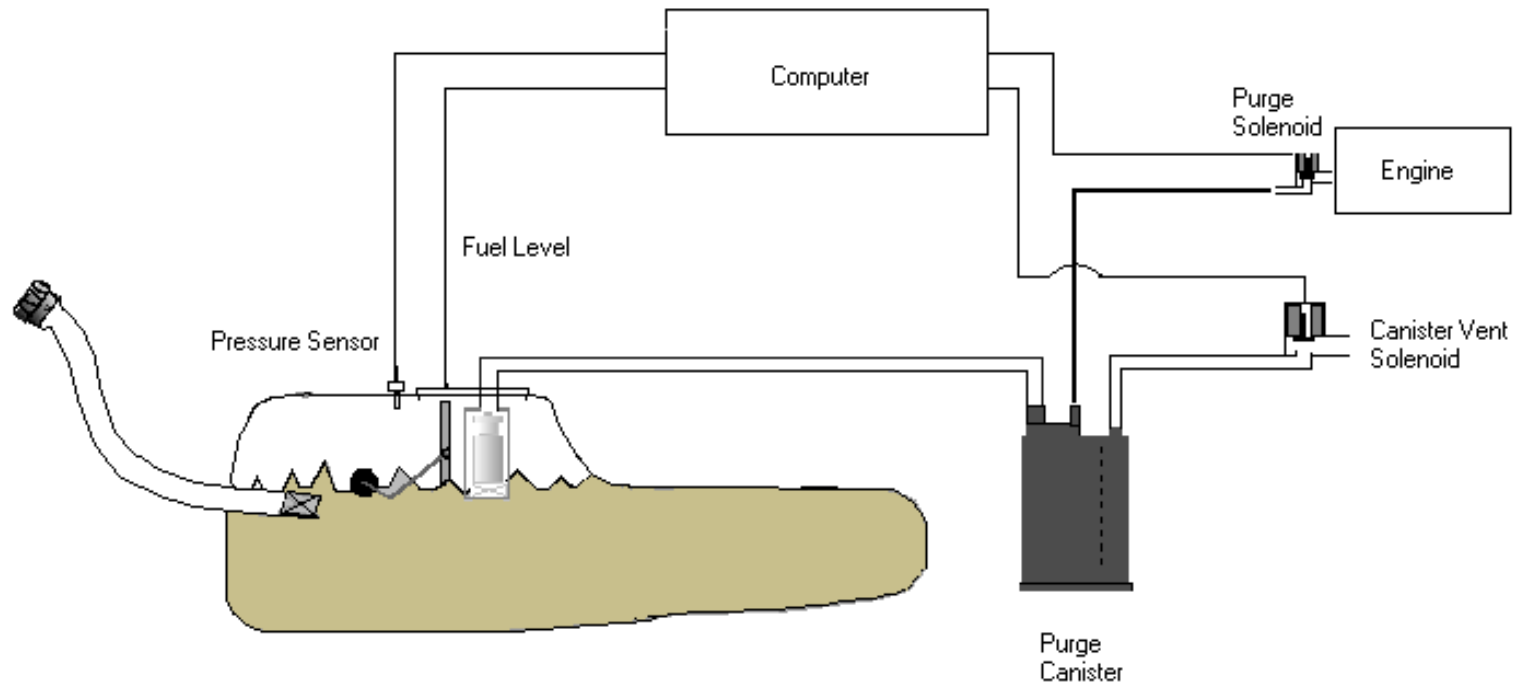
**O**ff

**N**atural

**V**acuum

Developed by General Motors Powertrain

# GM Engine Off Natural Vacuum Monitor



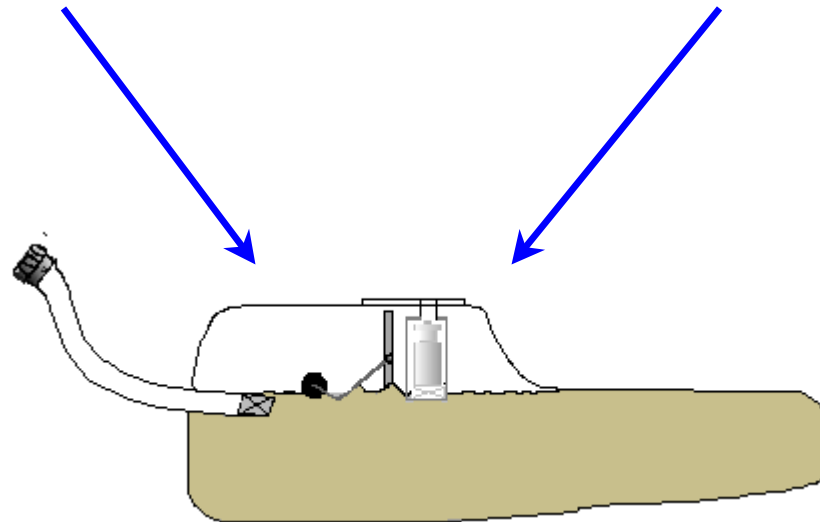
# Sources of Heat into the Fuel Tank

## Radiation:

- Sun Energy

## Work Energy Added:

- fuel pump



## Convection:

- airflow under vehicle
- heat from road
- exhaust heat
- ambient temperature

## Conduction:

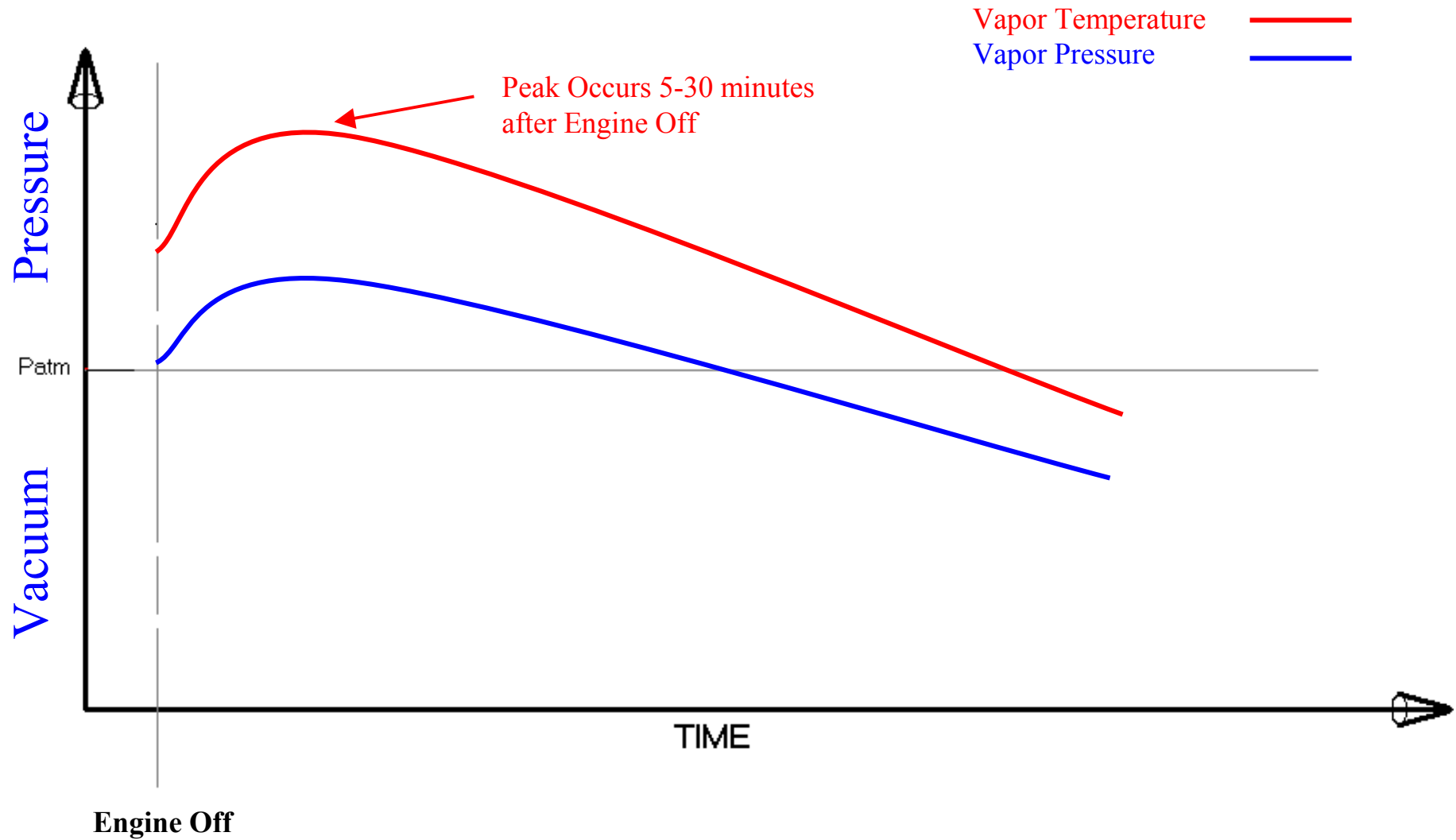
- exhaust heat
- fuel pump
- return fuel
- ambient temperature

# • GM EONV Algorithm Description

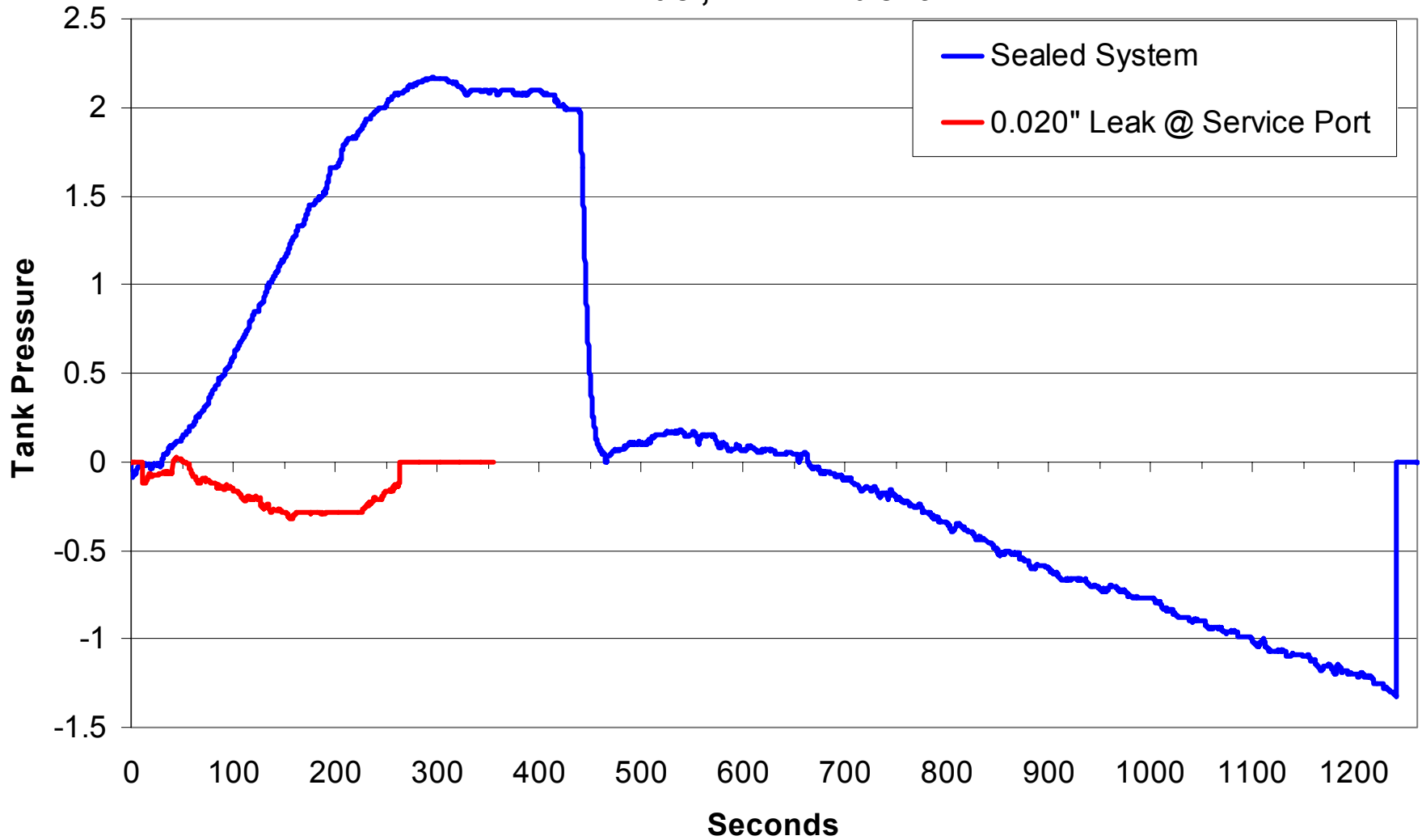
## – Enable criteria for EONV

- Needs sufficient driving to warm up fuel tank, then executes when engine is off
- Diagnostic analyzes ambient temperature, fuel level, run time, coolant temperature and distance traveled before enabling
- Enable only after trips with a cold start so that the pressure sensor is properly rezeroed
- Time since last complete EONV test must be greater than a calibrated amount of time
  - due to battery life constraints
  - calibration longer if last EONV test passed
  - one complete test per day
  - no more than two attempts per day

# Typical Press/Temp Profile During Soak



2003 Chevy Silverado - Single 24 Gallon  
3.50" H2O Target  
7RVP Fuel, 21C Ambient



# Summary - 0.020” Evap Leak Monitors

## Need for Flexibility

- Ford Vacuum-Based Evap Monitor
  - Test runs during idle, soon after a cold start
  - Unique enable/disable criteria for ignition off time
  - Manufacturer specific codes needed P1443, 1450
- DaimlerChrysler Pressure Pump Evap Monitor
  - Test runs during idle and low speed cruises
  - Unique enable/disable criteria for pressure pump
  - Manufacturer specific codes codes needed, P1486, 1494, 1495 for unique hardware, etc.
- GM Engine Off Natural Vacuum Evap Monitor
  - Test runs with engine off after a fully warmed up drive
  - Unique enable/disable criteria needed to preserve battery life and for fuel vapor temperature sensor (if used)

# Catalyst Monitoring

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Ford Motor Company

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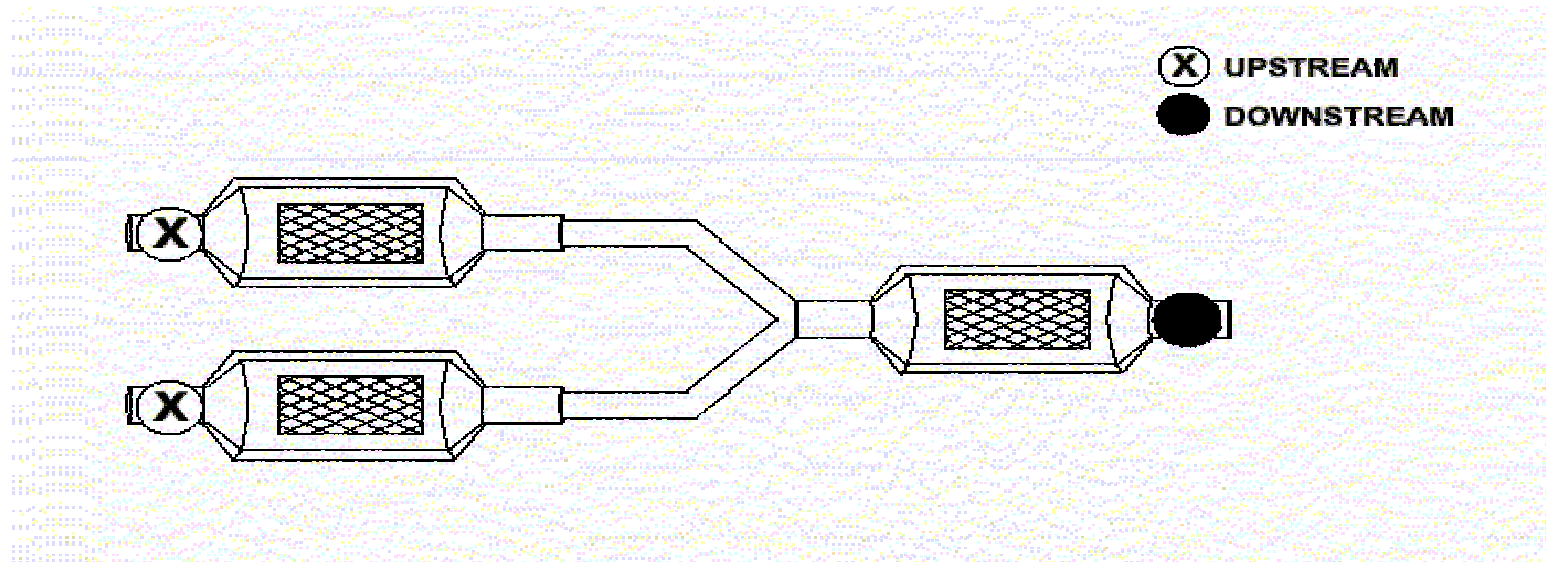
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# Catalyst Monitoring

- Regulatory Requirement
  - Detect catalyst system deterioration when conversion capability decreases to the point the HC emissions exceed 1.75 times the standard
- Examples of different control / monitoring methods
  - Ford Catalyst Monitor
  - DaimlerChrysler Catalyst Monitor
  - GM Intrusive Idle Catalyst Monitor

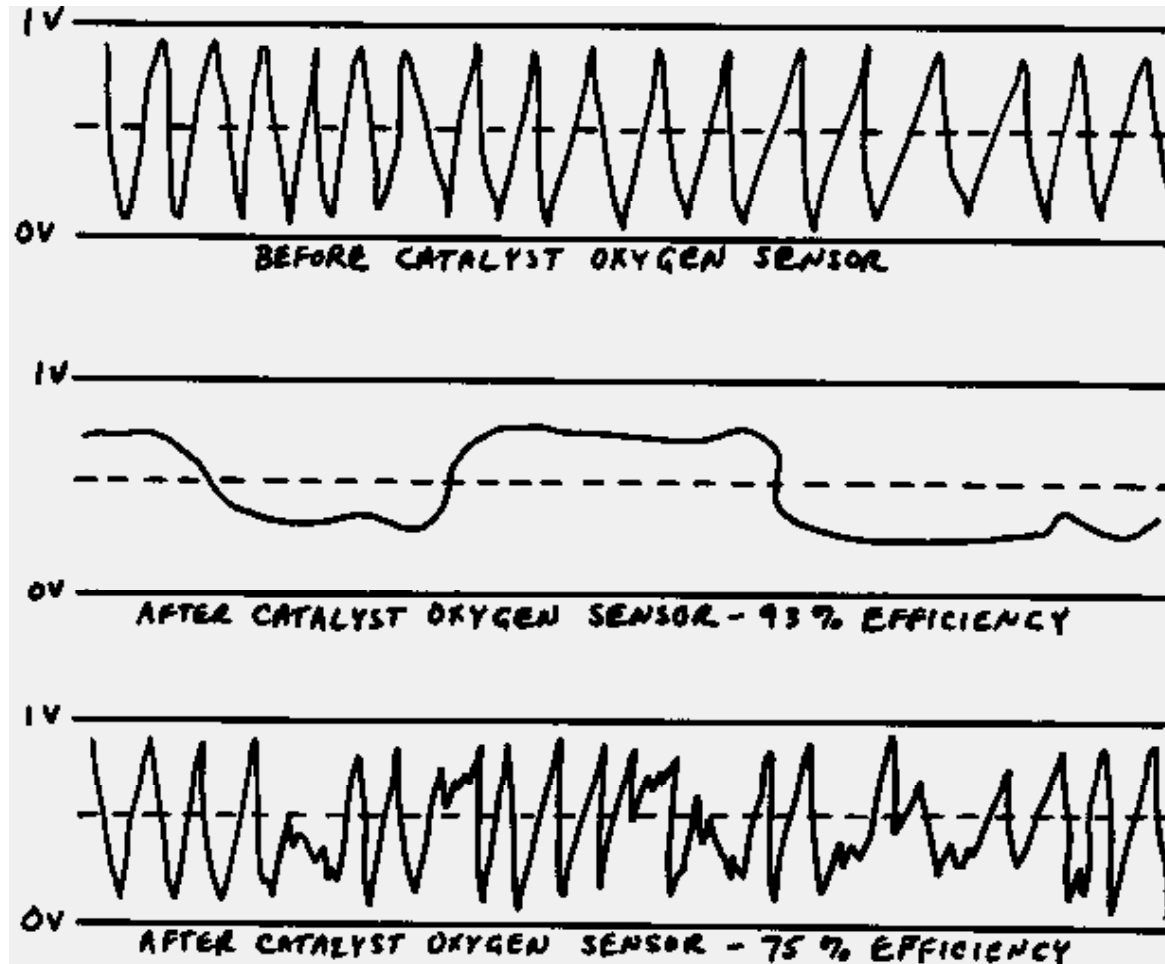
# Ford Catalyst Monitor

- Add Catalyst Monitor Sensor(s) (CMS) to monitor the oxygen storage capacity of the catalyst after catalyst can or after the first catalyst brick.
- A good catalyst will have a large amount of oxygen storage and will exhibit long switch times or few switches after the catalyst.
- CMS data is used to infer catalyst efficiency based on oxygen storage characteristics of the catalyst ceria washcoat.



# Catalyst Monitor Switch Ratio

$$\text{Switch Ratio} = \frac{\text{Number of Rear O}_2 \text{ Sensor Switches}}{\text{Number of Front O}_2 \text{ Sensor Switches}}$$



# Ford Catalyst Monitor

- Rear O2 Sensor, also known as the Catalyst Monitor Sensor (CMS), is used to monitor the oxygen storage capacity of the catalyst.
- Good catalysts will have a large amount of oxygen storage and will exhibit long switch times/few switches after the catalyst.
- The ratio of the number of switches of the rear HO2S to the front HO2S is used as a measure of catalyst efficiency.

# Catalyst Monitor

## Ford catalyst monitor entry conditions

Entry condition	Minimum	Maximum
Time since engine start-up (70 °F start)	330 sec	
Engine Coolant Temp	170 °F	230 °F
Intake Air Temp	20 °F	180 °F
Engine Load	10%	
Throttle Position	Part Throttle	Part Throttle
Time since entering closed loop fuel	30 sec	
Vehicle Speed	5 mph	70 mph
Inferred Catalyst Mid-bed Temperature	900 °F	
EGR flow (Note: an EGR fault disables EGR)	1%	12%
Fuel Level	15%	
Steady Air Mass Flow for each Air Mass cell (typically three cells)	1.0 lb/min	5.0 lb/min
(Note: FTP cycle is biased towards the low air mass range, 25 - 35 mph steady state driving must be performed to complete the monitor)		

# Catalyst Monitor

## Ford catalyst monitor DTCs

P0420/ P0430

Rear-to-front O2 sensor switch/index-ratio > 0.75 (bank monitor)

Rear-to-front O2 sensor switch/index-ratio > 0.60 (Y-pipe monitor)

# Catalyst Monitoring

Frank Krich  
Hal Zatorski  
DaimlerChrysler Corporation

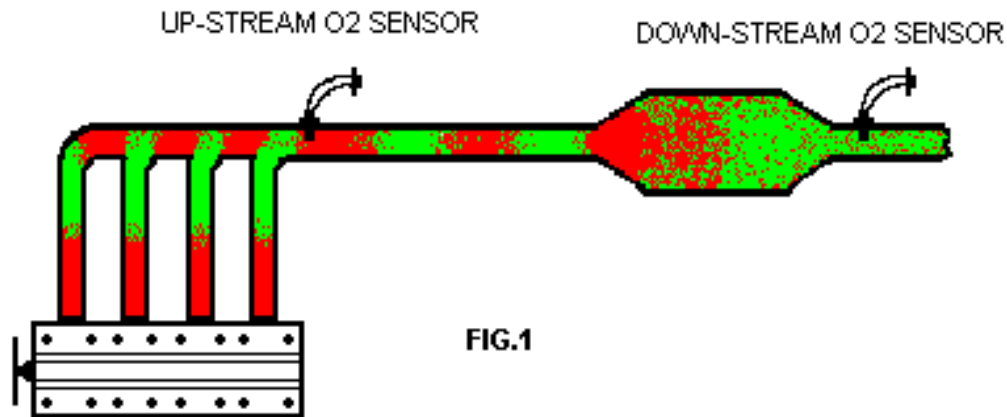
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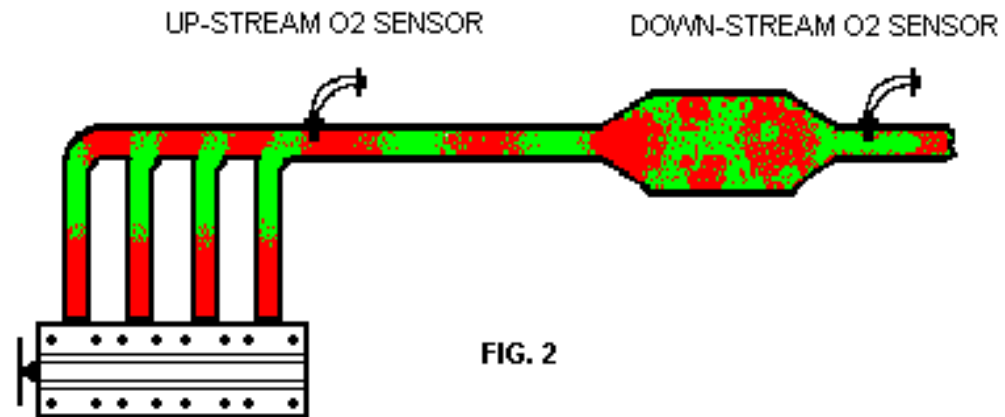
# DaimlerChrysler Catalyst Monitor




## EXHAUST SIGNAL IN AN UNDERFLOOR CATALYST SYSTEM

### FUNCTIONING CATALYST

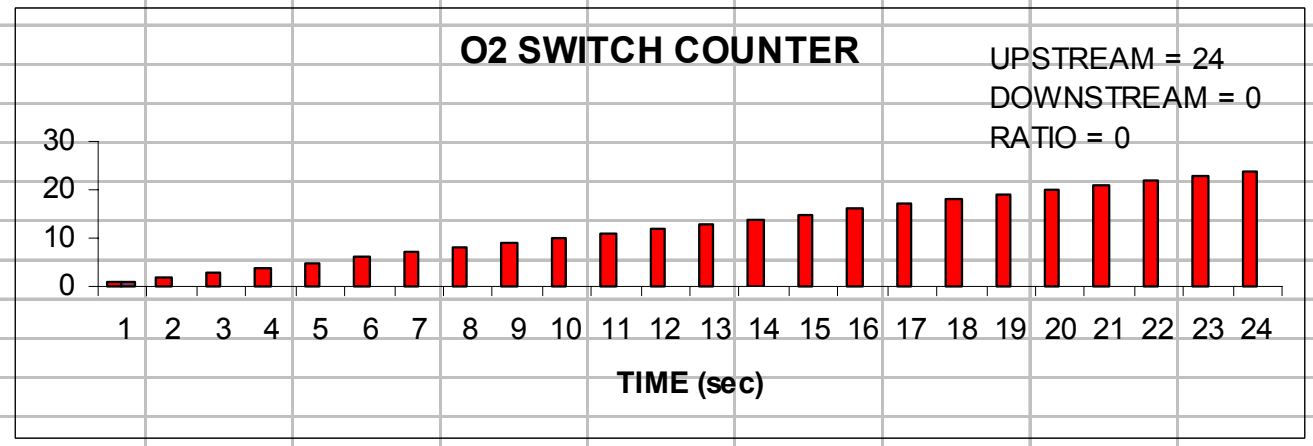
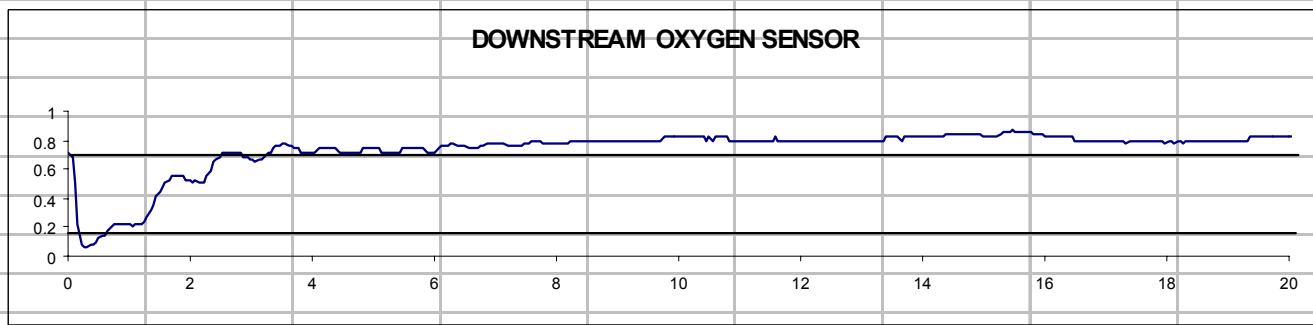
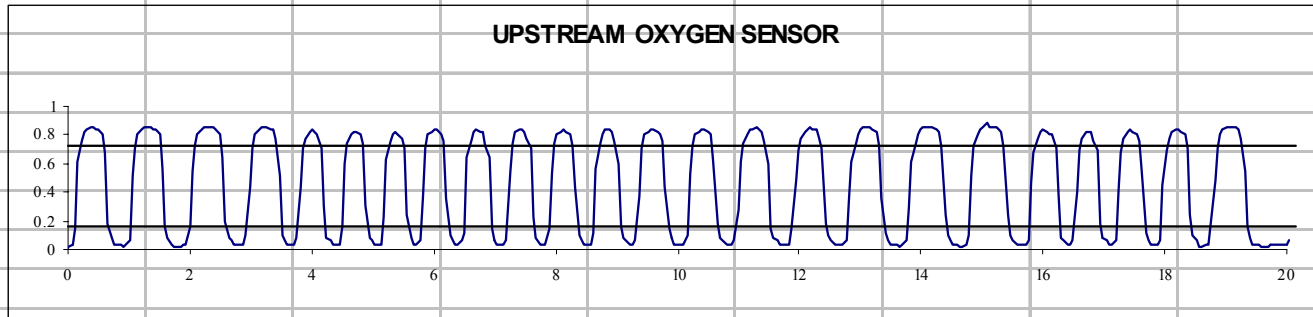


### DEGRADED CATALYST



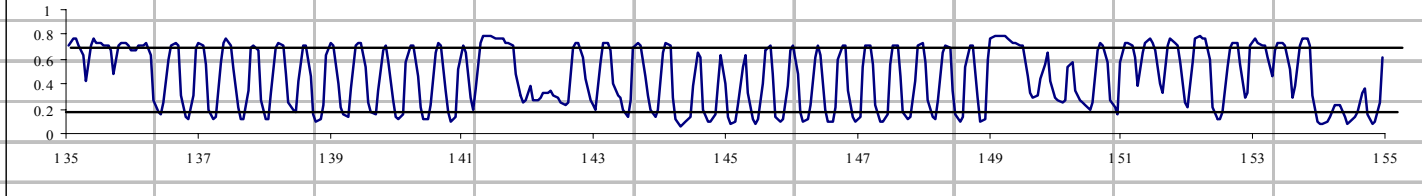
-  LEAN BIASED SIGNAL
-  RICH BIASED SIGNAL
-  MIXED SIGNAL

# FUNCTIONAL CATALYST

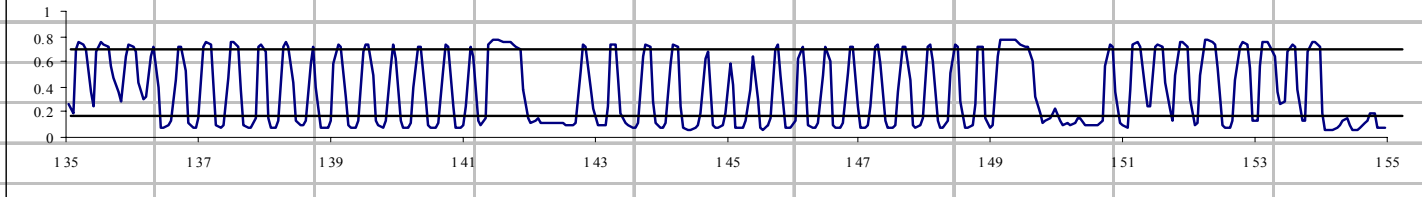


# OBD FAILED CATALYST

## UPSTREAM OXYGEN SENSOR VOLTAGE

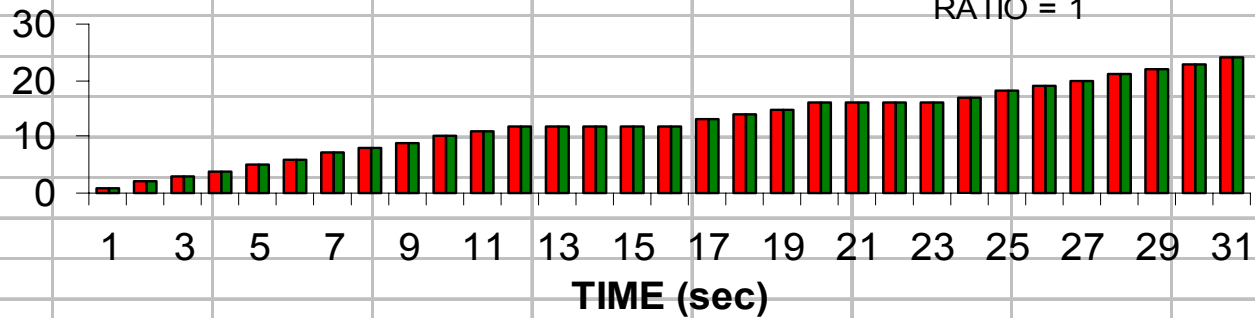


## DOWNSTREAM OXYGEN SENSOR VOLTAGE



## O2 SWITCH COUNTER

UPSTREAM = 24  
DOWNSTREAM = 24  
RATIO = 1



# DaimlerChrysler Catalyst Monitor Functional Operation

- Determines if catalyst has deteriorated to point of tailpipe emissions exceeding malfunction threshold
- Response rate of downstream (D/S) O<sub>2</sub> sensor relative to response of upstream (U/S) sensor measures catalyst ability to store O<sub>2</sub> - from which efficiency is inferred
- When enabled, D/S O<sub>2</sub> fuel feedback control is disabled and U/S O<sub>2</sub> fuel feedback control is replaced with catalyst fuel feedback control (i.e., OBD takes control)
- In Phase 1, Catalyst Monitor will fast pass if the O<sub>2</sub> sensor signals indicate that sensor response is fast and catalyst O<sub>2</sub> storage is in excess, inferring a robust catalyst

# Catalyst Monitor Functional Operation

(continued)

- Phase 2 only used if catalyst has not passed in Phase 1; monitor accumulates U/S and D/S switch counts during the full test time; ratio of D/S to U/S counts is post-processed by an EWMA (exponentially weighted moving average) diagnostic using both slow and fast filtering
- One catalyst failure mode detected is slow deterioration typical of high mileage catalysts - MIL will illuminate when the slow EWMA value exceeds a defined limit
- In fast catastrophic deterioration, typical of over-heated catalysts, the slow EWMA value will be set to the fast EWMA value and the MIL will illuminate when the slow EWMA value exceeds a defined limit

# DaimlerChrysler Catalyst Monitor Enable Conditions

- Enable conditions for the catalyst monitor:
  - All O2 sensor enabled
  - All O2 bank(s) ready
  - Catalyst monitor banks 1 & 2 global not disabled
  - Catalyst monitor banks 1 & 2 not stopped
  - Catalyst monitor banks 1 & 2 not conflicted
  - Catalyst monitor banks 1 & 2 not suspended
  - Engine must be running a least 90 seconds
  - Engine coolant temperature must be greater than 70 degrees F

# DaimlerChrysler Catalyst Monitor

## Enable Conditions

(continued)

- Enable Conditions for the Catalyst Monitor:
  - Accumulated vehicle speed greater than 20 mph
  - Fuel / air ratio between 0.0099945 and 0.1000061
  - Engine must stabilize for 1 second
  - Vehicle speed between 20 and 50 mph (some applications run at idle only)
  - P-Ratio (Map/Baro) between 0.3506 and 0.5693
  - Engine speed between 1,312 and 1,920 rpm

# DaimlerChrysler Catalyst Monitor Disables

- Catalyst Monitor will NOT run if:
  - O2 monitor is intrusive
  - Fuel system monitor has a lean or rich fault
  - Misfire monitor has any misfire fault
  - O2 sensor has a high or low circuit or performance fault
  - There is a fuel injector high or low circuit fault
  - There is an ignition coil primary or secondary circuit fault
  - There is a throttle circuit or performance fault

# Catalyst Monitor Disables

(continued)

- Catalyst Monitor will NOT run if:
  - There is an EGR circuit or performance fault
  - There is a purge system circuit or performance fault
  - There is a temperature sensor circuit or performance fault
  - There is a fuel level sensor circuit or performance fault
  - There is a shutdown timer fault
  - There is an O2 heater circuit / performance fault
  - There is a MAP circuit or performance fault

# Catalyst Monitor Fault Codes

- P-Codes used with the Catalyst Monitor:
  - P0420, Catalyst Monitor efficiency bank 1
  - P0430, Catalyst Monitor efficiency bank 2

# **Catalyst Monitoring**

## **GM Passive Catalyst Monitor and Intrusive (Active) Idle Catalyst Monitor**

David Ferris  
General Motors

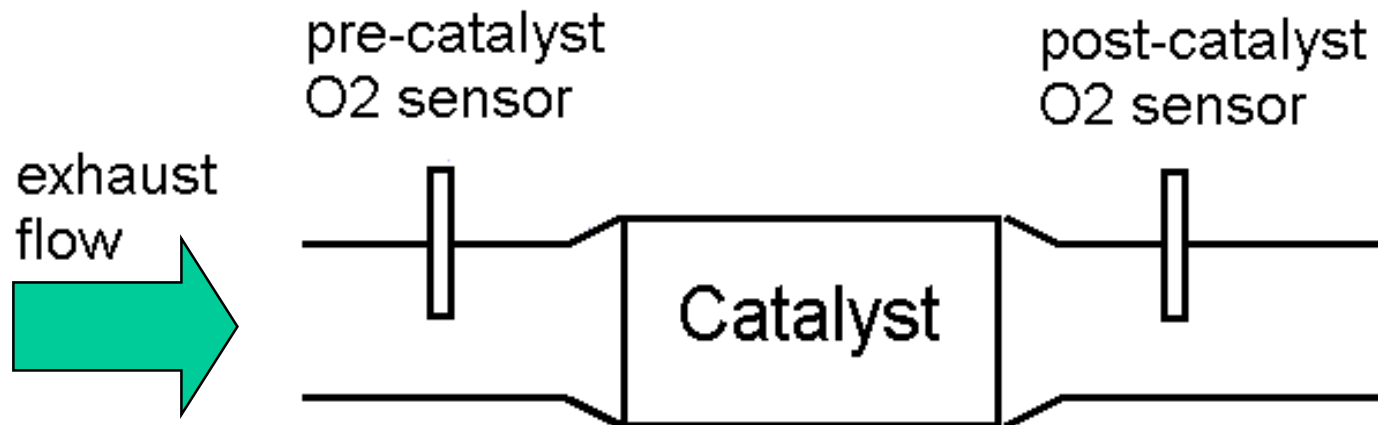
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# OBD System Monitoring

## Catalyst Monitoring Technology

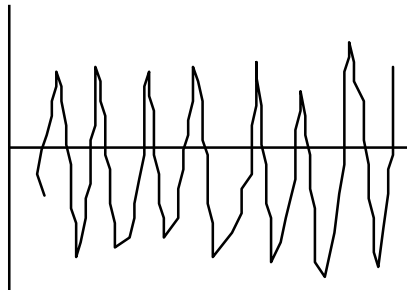
- The catalyst diagnostic measures the oxidation storage capacity (OSC) of the cerium in the catalyst. The diagnostic uses pre- and post-catalyst oxygen sensors and compares the two signals during vehicle operation. The post-catalyst sensor was added specifically to monitor the catalyst. Two basic methods are employed (passive and active), with several variations for each method, e.g., full versus partial volume monitor.



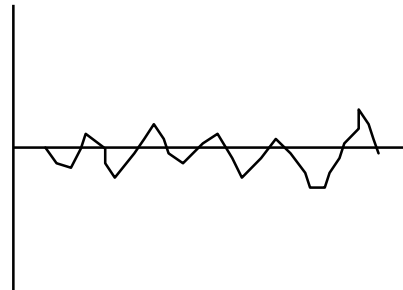
# OBD System Monitoring

## Catalyst Monitoring Technology

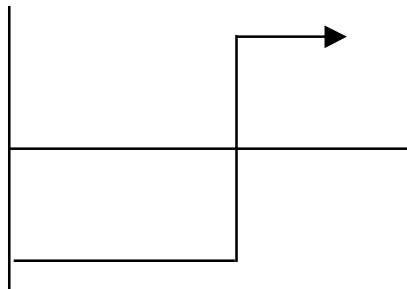
- Catalyst Monitor - Passive and Active Methods:



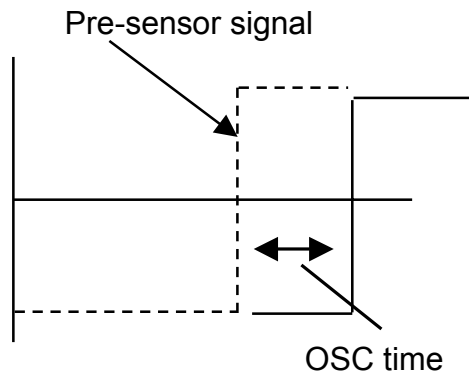
$AFR_{IN}$



$AFR_{OUT}$



observations at  
inlet sensor



observations at  
outlet sensor

### Method #1: Passive method

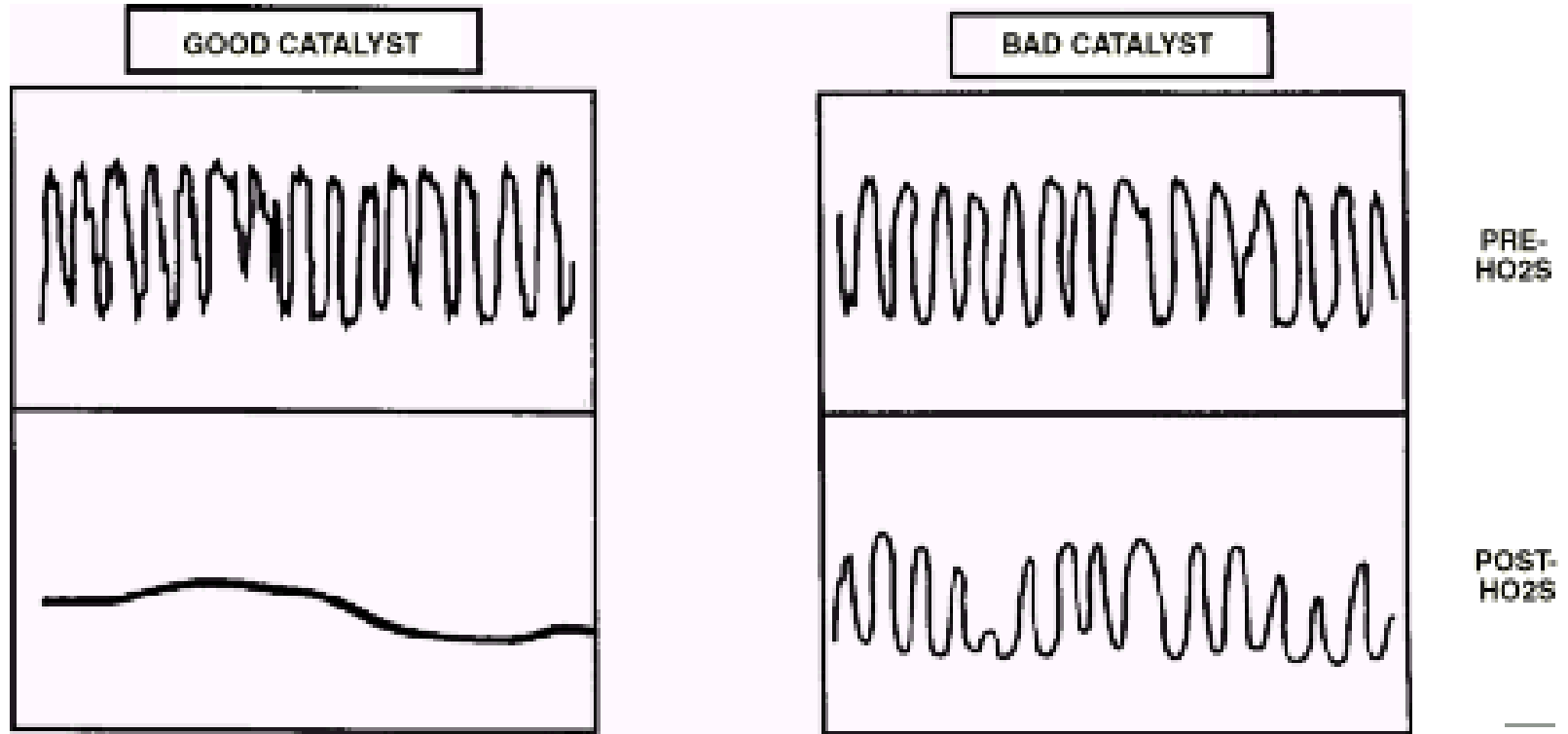
The frequency/amplitude during normal closed-loop steady state operation is compared for the two sensors. A highly dampened state at the post sensor location indicates a good catalyst.

### Method #2: Active method

First, the diagnostic briefly forces the Air Fuel Ratio (AFR) rich, to reduce the cerium oxide. Then the AFR is stepped lean, and the arrival time for the lean pulse at the post sensor location is measured. A long delay indicates a good catalyst. This can also be done in reverse, that is, a lean step followed by a rich step. An intrusive test is more robust than a passive test, but it may cause a small increase in emissions.

# OBD System Monitoring

## Passive Catalyst Monitor



Oxygen Sensor Signals

# Active Catalyst Monitor

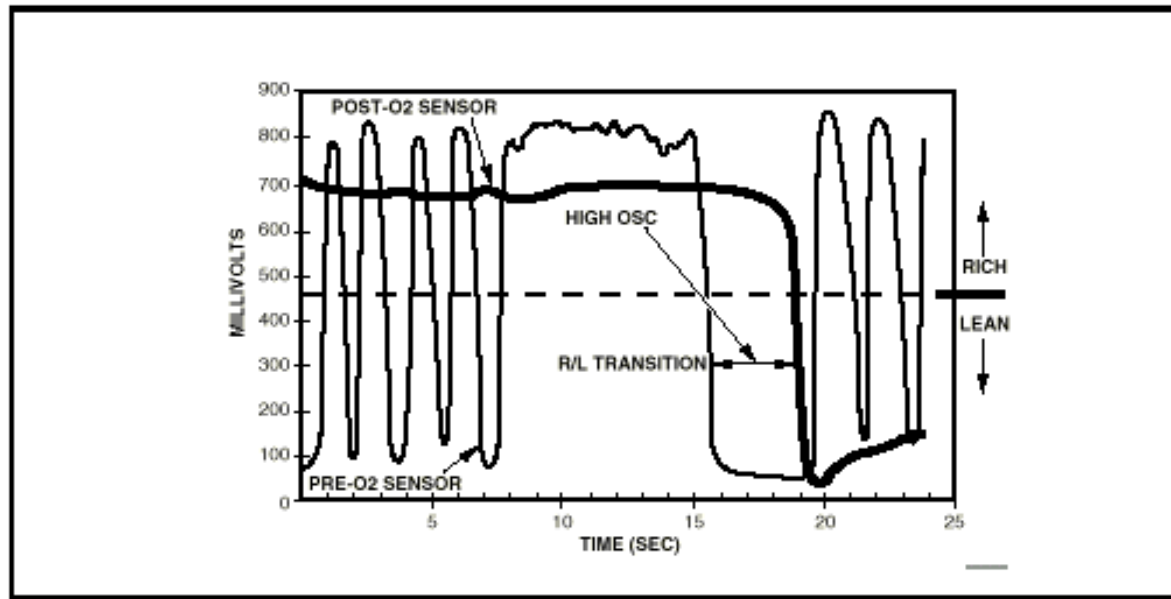


Figure 4-9, Idle Catalyst Monitor (High Oxygen Storage)

Good Catalyst

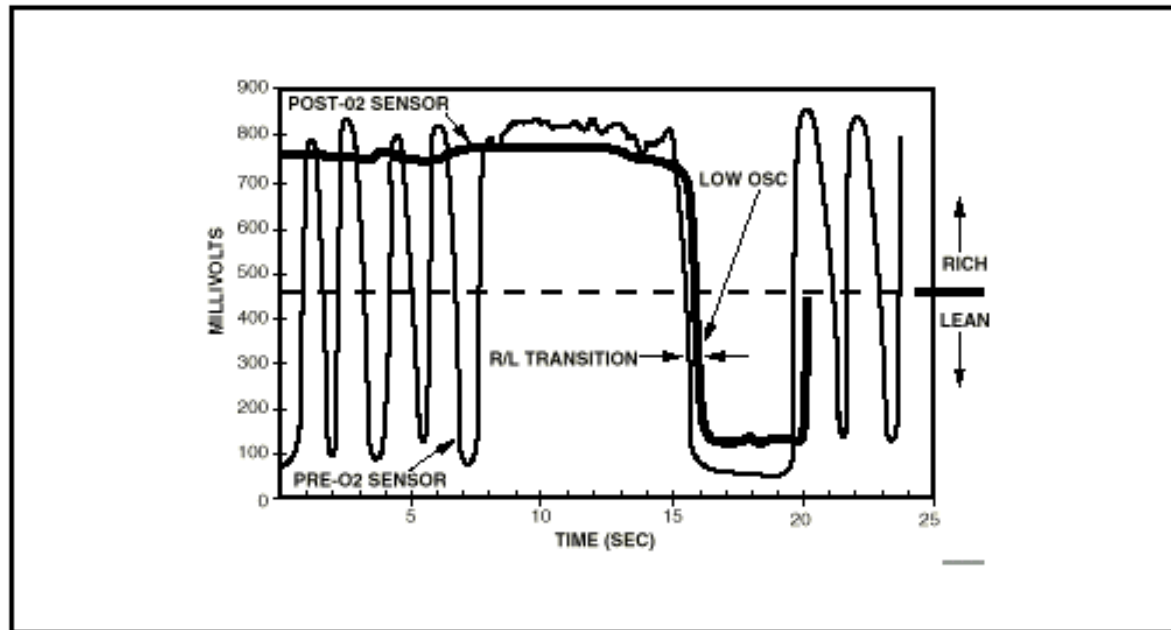


Figure 4-10, Idle Catalyst Monitor (Low Oxygen Storage)

Bad Catalyst

# Summary - Catalyst Monitors

## Need for Flexibility

- Ford Catalyst Monitor
  - Fully passive test
  - Runs during steady cruises
- DaimlerChrysler Catalyst Monitor
  - Partially intrusive / active (two-stage)
  - Runs during idle or steady cruises
- GM Intrusive Idle Catalyst Monitor
  - Fully intrusive / active
  - Test runs during idle after engine is fully warmed up
  - Unique idle control enable criteria for stable idle

# **Exhaust Gas Recirculation (EGR) Valve Monitoring**

John Trajnowski  
Ford Motor Company

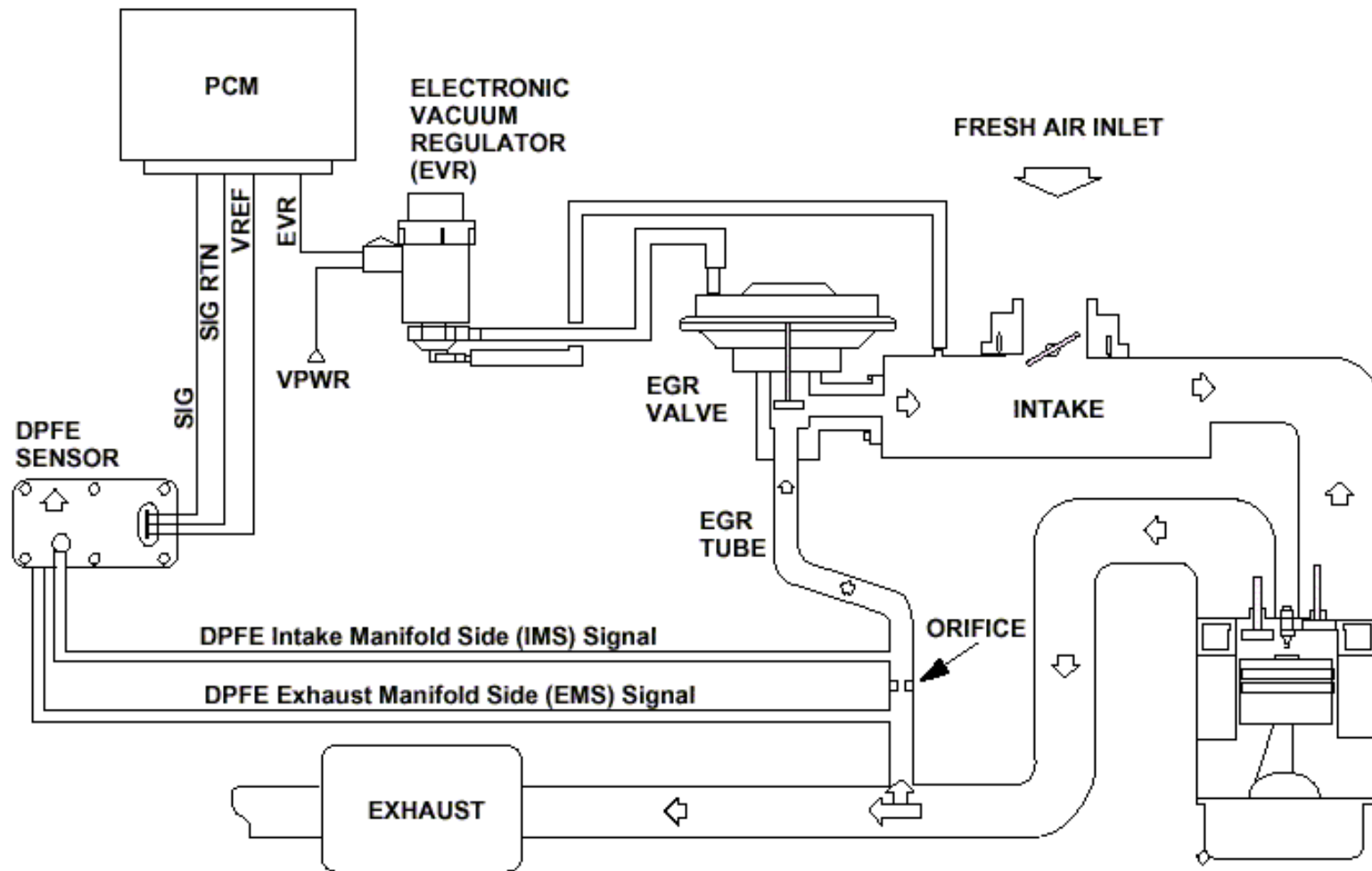
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**Ogden, Utah**

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# EGR Monitoring

- Regulatory Requirement
  - Detect deterioration in EGR flow such that a vehicle would exceed 1.5 times any of the applicable FTP emission standards
- Examples of different control / monitoring methods
  - Ford Delta Pressure EGR Monitor
  - DaimlerChrysler Linear Solenoid EGR Monitor
  - GM Linear EGR Monitor

# Ford Delta Pressure EGR Monitor



# Ford Delta Pressure EGR Monitor

- The Delta Pressure Feedback EGR system is a closed loop EGR control system that uses Delta Pressure Feedback EGR sensor (DPFE) to measure EGR flow across an orifice in the EGR tube.
- When the EGR valve is open, a pressure differential is created across the orifice and measured by the DPFE sensor.
- This DPFE measurement is used to control the EGR vacuum regulator (EVR), which provides vacuum to open and modulate the EGR valve and to monitor for proper EGR flow.
- EGR monitor detects electrical circuit faults as well as proper EGR flow.

# Ford Delta Pressure EGR Monitor

## Need for Flexibility

- Driving conditions to execute vacuum monitor
  - Needs sufficient steady-state cruise, idle and acceleration time to properly test EGR system and components.
- Conditions needed to disable monitor
  - IAT, ECT needed to avoid extreme temperatures (typical)
  - TP, MAF, rpm needed to verify driving conditions
  - DPFE or EVR sensor malfunctions
- Manufacturer specific diagnostic trouble codes
  - P1400/P1401 DPFE Circuit Low/High
  - P1405/P1406 DPFE Upstream/Downstream Hose Off/Plugged
  - P1409 EVR Circuit Open or Shorted

# **DaimlerChrysler Linear Solenoid Exhaust Gas Recirculation (LSEGR) Valve Monitoring**

Frank Krich  
Hal Zatorski  
DaimlerChrysler Corporation

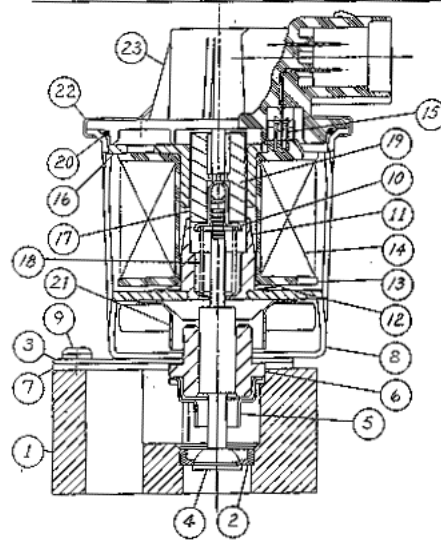
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# LSEGR Description

- Linear Solenoid Exhaust Gas Recirculation
- 0 to 5 volt linear solenoid device
- Direction for all DaimlerChrysler NGC (Next Generation Engine Controller) equipped packages starting 2002 MY

MINI EEGR VALVE - PRODUCTION ASSEMBLY



No.	COMPONENT
1	Base
2	Valve Seat
3	Base Cover
4	Pin/Pintle
5	Pin Protector
6	Bearing
7	Gasket
8	Shell
9	Drive Screw
10	Spring Locator
11	Lower Stator
12	Spring Washer
13	Bobbin
14	Wire
15	Terminals
16	Upper Stator
17	Sleeve
18	Spring
19	Armature
20	O-ring
21	Guard
22	Clinch Ring
23	Sensor Cap Assembly

# LSEGR Failure Modes

- EGR flow is less than expected
  - EGR is stuck closed or in a low flow scenario
    - Detected by EGR rationality test
  - EGR valve is restricted or obstructed
    - Detected by engine roughness metric
- EGR flow is more than expected
  - EGR valve is stuck high but does NOT stall engine
    - Detected by EGR rationality test - looks for continuous error between desired and actual position for a period of time
  - EGR valve is stuck high inducing engine dieout
    - Does not require diagnosis

# LSEGR Failure Modes

(continued)

- EGR valve dynamic movement is not as expected
  - Detected by EGR rationality test - looks for continuous error between desired and actual position for a period of time
  
- EGR high or low (out of range)
  - Set fault for position sensor voltage above 4.89 volts or below 0.10 volts

# LSEGR Monitor Functional Operation

- Wait period
  - Time to allow the system to stabilize (2sec)
- Arm condition:
  - All enable conditions must be met, EGR remains off
  - Average combustion roughness is measured for 2 sec
  - Base engine roughness is determined
- Test condition:
  - EGR is turned on for 1 second and roughness is monitored for a calibrateable amount of time
  - If roughness exceeds the threshold for 1/2 second, LSEGR is functioning properly
  - If no change in roughness is detected, LSEGR is not functioning properly

# LSEGR Monitor Functional Operation

(continued)

- Once LSEGR monitor has passed, LSEGR will be considered functional for that entire key-on
- If LSEGR monitor fails:
  - The LSEGR monitor will continue to increase the amount the LSEGR valve is opened to increase flow
  - The LSEGR valve repeatedly opens an incremental amount on subsequent tests
  - Once the LSEGR monitor has repeated this sequence 12 times (6/trip) and there is still no response, the LSEGR is not working and MIL illumination will occur
- Once LSEGR MIL has been set:
  - LSEGR operation ceases
  - LSEGR fuel and spark no longer used

# LSEGR Monitor Enable Conditions

- Manifold absolute pressure is between 0 - 60KPa
- Engine speed is between 480 - 850 RPM
- EGR is enabled and active
- Engine coolant temperature is  $>70^{\circ}\text{C}$
- No misfire temporary or matured fault present
- The following must not change electrical state:
  - A/C clutch
  - Power steering switch
  - Cooling fans

## LSEGR Monitor Disables

- LSEGR monitor will NOT run if:
  - Fuel system monitor has a lean or rich fault
  - Misfire monitor has any misfire faults
  - O2 sensor has a high or low circuit or performance fault
  - There is a fuel injector high or low circuit fault
  - There is an ignition coil primary or secondary circuit fault
  - There is an O2 heater circuit / performance fault
  - There is a MAP circuit or performance fault
  - There is a throttle circuit or performance fault
  - There is a vehicle speed sensor circuit or performance fault

# LSEGR Monitor Disables

(continued)

- LSEGR monitor will NOT run if:
  - There is a purge system circuit or performance fault
  - There is a power steering circuit or performance fault
  - There is an EGR position sensor circuit or performance fault
  - There is a temperature sensor circuit or performance fault
  - There is a fuel level sensor circuit or performance fault
  - There is a brake switch circuit or performance fault
  - There is an internal PCM (powertrain control module) fault

# LSEGR Monitor Fault Codes

- P-Codes used for LSEGR monitor:
  - P0401, EGR system performance failure
  - P0404, EGR position sensor rationality performance failure
  - P0403, EGR solenoid circuit error
  - P0405, EGR sensor voltage low fault
  - P0406, EGR sensor voltage high fault

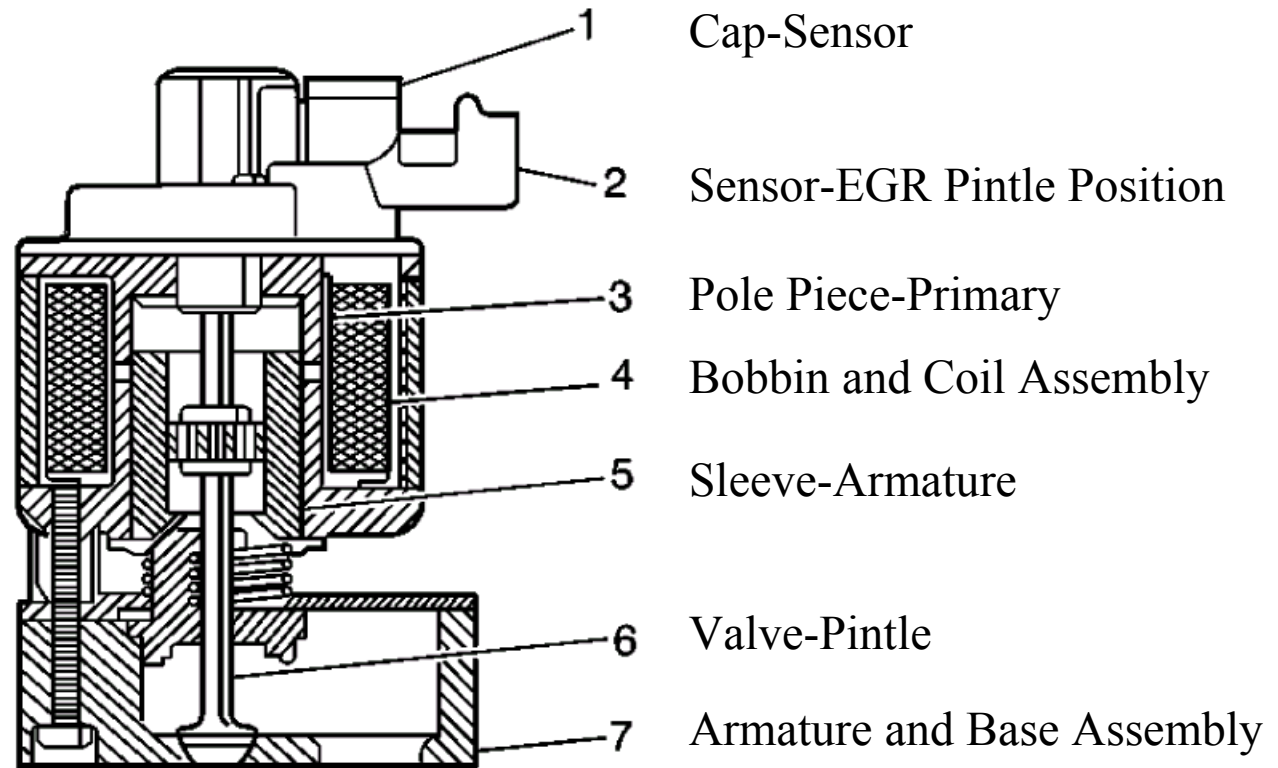
# **OBD Monitoring for GM Linear Exhaust Gas Recirculation (EGR) Valve**

David Ferris  
General Motors

**OBD2K2**  
**Ogden, Utah**

23 May 2002

# GM Linear EGR Valve



- Design and operation

- PWM electrical control (versus vacuum control)
- Feedback via pintle position sensor (versus pressure sensor)

# GM Linear EGR System Monitor

- **EGR LOW FLOW RATE (P0401 - standard code)**
- **Test Description:** The Delta MAP Flow Test satisfies CARB's low flow detection requirement by monitoring the flow through the valve and predicting the point that emissions will exceed 150% of the standard. The valve is opened during closed throttle decelerations. There is an increase in manifold absolute pressure (MAP) due to the increased flow into the engine. This increase in MAP can be correlated to the flow through the EGR system. The measured increase in MAP is compared to an expected MAP change, and the difference is filtered into an exponentially weighted moving average (EWMA). If this moving average of flow error crosses a threshold, the malfunction code will set.

# GM Linear EGR System Monitor

- **CLOSED VALVE PINTLE ERROR (P1404 - manufacturer specific code)**
- **Test Description:** This diagnostic was developed to detect a specific failure mode for the GM linear EGR valve. The test is performed when the desired EGR position is zero (closed). The Linear EGR control software includes logic for a learned low position (auto-zero). If the difference between the current position and the learned low position is too high for a certain amount of time, a closed valve failure is logged. This failure has to be detected a number of times in a row, before the malfunction code is set.

# Summary - EGR Flow Monitors

## Need for Flexibility

- Ford Delta Pressure Feedback EGR Monitor
  - Test runs during idle, acceleration, and steady cruise
  - Unique enable/disable criteria related to pressure sensor
  - Manufacturer specific codes needed for unique hardware
- DaimlerChrysler Linear Solenoid EGR Monitor
  - Test runs during idle
- GM Linear EGR Monitor
  - Test runs during closed throttle decelerations
  - Unique ETC enable/disable criteria needed
  - Manufacturer specific code needed for unique hardware

# **OBID System Monitoring**

## **Response to Specific Questions**

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# Response to Specific Questions

- Why don't all monitors work the same way?
  - Unique engine and emission control hardware
  - Creative new diagnostic methods
- Why aren't all the fault codes standardized?
  - New CARB regulations will force the use of standard codes as soon as practical
  - Unique or new engine and emission control hardware and new diagnostics drive unique repairs and manufacturer specific codes
  - Standard codes lag behind rapidly changing technology

# Response to Specific Questions

- Why don't all manufacturers use the same "drive-cycle" to run all the monitors?
  - Different diagnostics work best under different conditions, e.g., evap monitor requires idle before engine has warmed up versus catalyst monitor requires idle after catalyst is hot
- Why does the list of DTCs that disable a given monitor vary from manufacturer to manufacturer?
  - Results from different hardware, monitoring strategies, and manufacturer specific codes

# Response to Specific Questions

- Why don't all scan tools work on all cars?
  - Manufacturer specific (enhanced) tools / cartridges offer substantially greater capability than generics
  - Manufacturer specific tools are not required to work on all brands
- Why do some manufacturers turn the MIL on in one trip for a fault and others take two trips for the same fault?
  - 1 trip has advantage of quickly warning driver (used when serious performance problems or damage is imminent)
  - 2 trips are generally used to avoid being too sensitive to temporary intermittent problems
  - Some vehicles use statistical protocols, e.g., EWMA