UNDERSTANDING FEDERAL TEST PROCEDURES

To get a better understanding of OBD-II and learn why these systems are designed the way they are, we need to understand the Federal Test Procedure (FTP) test and emissions standards .Before we can do this, we need to understand the actual measurements used for modern cut-points, called grams-per-mile.

Many technicians are familiar with the concentration numbers displayed on the typical exhaust gas analyzers used in a shop environment. However, these numbers do not represent the actual pollution level of the vehicle. For example, a four cylinder engine that shows a reading of 1 percent carbon monoxide on a conventional five-gas exhaust analyzer does not produce the same amount of pollutants as a V8 engine showing the same concentration percentages on the same five-gas analyzer.

Grams-per-mile is a more accurate representation of actual emission levels. The "grams" in the GPM reading is the actual weight of the particular gas being measured compared with the actual number of miles driven. Another measurement used is grams-per-hour (GPH). This is used to measure evaporative emissions when the car is at rest.

Grams-per-mile is derived from a concentration measurement taken while the car is driven on a dynamometer. The analyzer uses a constant volume sampler to compute the actual weight of the emissions released by the vehicle during the test.

Still confused? Several years ago one of my good friends explained grams-per-mile this way .A typical aspirin tablet is 500 milligrams. If a car is emitting 2 grams of hydrocarbons per mile, this is the same as throwing four aspirins tablets worth of gasoline out the window for every mile you drive. New vehicle tailpipe emissions are typically less than 1/8 of a gram of hydrocarbons for each mile driven.

EPA Gas Mileage Estimates

With the cost of gasoline being near an all time high, many customers are paying much closer attention to their gas mileage. As a result of this, some of them may believe they're not getting the gas mileage they should, or what they saw listed on the window sticker (EPA Label) at the time of purchase. This article will attempt to explain why a customer's gas mileage may differ from what is indicated on the EPA label.

The U.S. Environmental Protection Agency (EPA) refers to their numbers as a "Gas Mileage Estimate", and once you understand how they're obtained you will understand why they refer to them as such. The gas mileage numbers shown on the EPA Label ARE NOT a measure of actual fuel consumed. They are a calculation of waste substances from the vehicle. The EPA says in a paper written on the subject; "we know how much carbon is in a gallon of gasoline, so by measuring the carbon compounds expelled in the exhaust we can calculate the fuel economy". They indicate that the same test is performed to each vehicle under very controlled conditions, and "the results can be used with confidence to compare similar cars".

The test itself is performed in a laboratory on a dynamometer and consists of two segments. The 'city' segment simulates a 7.5 mile, stop-and-go trip with an average speed of 19.5 MPH. The "trip" takes 23 minutes to complete and has 18 stops. Approximately 18% of the time is spent idling. The 'highway' segment simulates a 10 mile, 12.75 minute trip and averages 47 MPH. This segment includes very little idling and no stops.

To make the numbers on the EPA label more useful for consumers, the EPA adjusts the laboratory test results to compensate for the difference between the controlled laboratory conditions and actual driving on the road. The city estimate is lowered by 10% and the highway estimate is lowered by 22%. However, there are many variables that will have an effect on a customer's actual gas mileage, and make it difficult to achieve the same mileage as that printed on the EPA label. The following are just some of those variables:

Temperature:

The laboratory tests are done in a controlled climate of 68° to 86° F. Cooler temperatures have a significant affect on gas mileage, especially during short trips. Tires are also a factor; the rolling resistance of a cold tire is greater than those that have been warmed up.

Road Conditions and Terrain:

Rough pavement; potholes, gravel surfaced roads, wet or snow covered roads will adversely affect gas mileage. Going uphill will also decrease gas mileage significantly, up to 30% for steeper grades on main highways. Once, the energy saved going downhill is less than the energy used to go uphill. Overall gas mileage will decrease in hilly terrain.

Vehicle Load:

The laboratory test is performed with a driver and passenger with a combined weight of 300 lbs. Additional weight of any kind will decrease gas mileage.

Vehicle Speed and Wind Conditions:

Vehicle Speed and Wind Conditions: Aerodynamic factors are important in determining the kind of gas mileage you get. The formula; VCA, where V = speed times speed or speed squared, C = the air resistance factor, which is the combination of coefficient of drag (Cd) and the density of air (which changes with temperature and barometric pressure) and A = frontal area of the vehicle. You can see that it can quickly become very complicated, so lets take a look at what effect the V2 part of the formula has on how much horsepower is needed to move the vehicle at speed. Let's take a look at the difference between 55 and 65 MPH:

55 X 55 = 3025
65 X 65 = 4225

This clearly shows that with only an 18% increase in speed alone (55 to 65 MPH) there is a 40% increase in resistance (3025 to 4225). Now factor in a headwind of 15 MPH; the speed through the air is now 80 MPH: 80 X 80 = 6400. With the headwind put into the equation, the aerodynamic resistance has now increased an additional 51% over the 65 MPH with no headwind. The resistance created with increased speed goes up quickly. More horsepower is needed to overcome this increased resistance, and more horsepower means less gas mileage.

Driving Styles:

Different drivers using the same vehicle over the same road and in the same weather conditions can experience up to a 20% variation in gas mileage. Aggressive driving techniques such as fast starts and driving at high speeds will substantially reduce gas mileage. Even the same driver on the same route may see a substantial variation in their gas mileage due to different traffic or weather conditions.

So where does this leave you if a customer comes in with a gas mileage complaint? It's difficult to give a 'one size fits all' answer to that question, but generally speaking, you should follow the normal diagnostic process. Meaning, that you should check for diagnostic trouble codes, monitor the 02 sensor operation, compare the injector pulse

width to an identical model under identical RPM and load conditions. If all of the values are normal, but the customer is adamant about their vehicle giving them poor gas mileage, then performing a 'controlled' gas mileage test may be necessary:

- Record the start mileage (SM) from the odometer.
- Fill the tank until the fuel nozzle cancels, do not top it off.
- Drive the vehicle 50-100 miles*
- Record the ending mileage (EM) from the odometer.
- Fill the tank at the same filling station using the same pump and nozzle, again without topping off; record the gallons used (G).
- Compute gas mileage by dividing gallons used (G) into miles driven (M). (SM - EM = M) G / M = MPG

* It is recommended that someone other than the customer log the miles.