Eco-2 Vapor Pressure Enhancer Study

Prepared by

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FINAL REPORT

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Introduction

The purpose of this study was to determine the effectiveness of the Eco-2 Vapor Pressure Enhancer in reducing emissions and increasing fuel economy. The method used for such determination was a comparison of emissions and fuel economy test results obtained prior to device installation with those achieved after the device was installed. To stabilize the vehicle prior to testing, forty miles were accumulated prior to each test series. For each vehicle a series of three EPA-75 FTPs and three Highway Fuel Economy Tests (HWFET) were performed without the device installed. After the device was installed, each vehicle was subject to another series of three EPA-75 FTPs and three HWFETs.

All testing for this study was performed at Wallace Environmental Testing Laboratories, Inc. using the guidelines of 40CFR86.

Test Procedures

Four late model trucks were tested under dynamometer conditions. Emissions Technology of Texas provided the trucks for this study. The test selection consisted of 1996-1998 and 2000 model year trucks (See Table 1 for a complete list of test vehicles). The starting mileage on the trucks ranged from 99,814 to 130,890 miles.

All testing and mileage accumulation was performed using 87-octane, commercially available fuel.

Each truck's emission levels were tested using the three phase, EPA-75 Federal Test Procedure, as outlined in *Code of Federal Regulations, Title 40, Part 86*. A Clayton model ECE-50 dynamometer with direct-drive variable inertia flywheel system was used for testing. The inertia system on this dynamometer can simulate vehicle weights from 1,000-5,750 lbs. in 125-lb increments. A 5,000 cfm cooling fan in front of each test vehicles provided air flow during all tests. During soak periods, the fan was turned off. Wallace Environmental Testing Laboratories' Constant Volume Sampler, a Horiba Instruments CVS, was used for collecting vehicle emissions samples.

All of the Light Duty Trucks were equipped with an OBD II system. This system enables the vehicle control module to determine if all exhaust emission related systems are functioning properly. The module can monitor systems which could adversely effect engine emissions. (i.e. Engine misfire, incorrect fuel mixture, ignition timing problems, etc.) At the request of Emissions Technology of Texas, a laptop computer was used to collect data from the OBD II system. The laptop utilized commercially available software, CarCode©, which logged all data available through the OBD II socket.

Table 1. Test Vehicles

Description	Classification	Engine Size	Starting Mileage	Appendix Location
1998 Dodge Ram 1500	Light Duty Truck	3.9 L, V-6	99,814 miles	A
1996 GMC Safari	Light Duty Truck	4.3 L, V-6	109,780 miles	B
2000 Chevrolet 1500	Light Duty Truck	4.3 L, V-8	130,637 miles	C
1997 Ford F350	Heavy Duty Truck	5.8 L, V-8	130,890 miles	D

The EPA-75 Federal Test Procedure consists of three phases. The first phase is approximately 505 seconds, the second phase is approximately 870 seconds, and the third phase is 505 seconds. Between the second and third phase is a 540 second soak period. The HWFET consists of one-765 second phase.

Prior to testing, all fuel was drained. 87-octane, commercially available fuel was added to the vehicle. One three-phase city driving cycle and one one-phase driving cycle were driven to accumulate 20 miles on the vehicle. The vehicle was then taken on the road for 4 heavy throttle accelerations. One three-phase city driving cycle and one one-phase driving cycle were driven to accumulate 20 miles on the vehicle. Three EPA-75 FTPs and Three HWFET were then performed without the device.

The device was then added to the vehicle under the instruction of Emissions Technology of Texas. Again, the fuel was drained and fuel from the same batch of commercially available, 87-octane fuel was added. One three-phase city driving cycle and one one-phase driving cycle were driven to accumulate 20 miles on the vehicle. The vehicle was then taken on the road for 4 heavy throttle accelerations. One three-phase city driving cycle and one one-phase driving cycle were driven to accumulate 20 miles on the vehicle. Three EPA-75 FTPs and Three HWFET were then performed with the device installed.

For each EPA-75 FTP and HWFET, except those performed on the 1998 Dodge Ram 1500, the amount of fuel added to the vehicle prior to testing was measured into an external fuel tank. After each test the remaining fuel was drained and measured. The volumetric fuel economy was calculated by dividing the amount of fuel consumed during testing by the mileage accumulated during the test.

Test Results

EPA-75 Testing

The effect of adding the Eco-2 Vapor Pressure Enhancer was found in all instances to reduce most regulated emissions. Emission of hydrocarbon (HC), carbon monoxide (CO) and oxides of nitrogen (NO_x) were all reduced on the 1996 GMC Safari. The other three vehicles' emissions were reduced in two of three of the regulated emissions (See Table 2).

Table 2. Effect of Eco-2 Vapor Pressure Enhancer on Regulated Emissions

Vehicle	HC	CO	NO_x
1998 Dodge Ram 1500	0.693 %*	-2.712 %	-6.515 %
1996 GMC Safari	-13.136 %	-1.387 %	-4.534 %
2000 Chevrolet 1500	-4.307 %	9.184 %	-17.210 %
1997 Ford F350	-9.029 %	-2.415 %	1.530 %

*Positive values indicate an increase in emissions levels.

The greatest decrease in HC was found when the device was installed on the 1996 GMC Safari. The 1998 Dodge Ram 1500 had the greatest decrease in CO with the device installed. The 2000 Chevrolet 1500 had the largest decrease in NO_x of the vehicles tested. A graphical representation of regulated emissions effect on each vehicle is provided in Chart 1.

Chart 1. Graphical Representation of Eco-2 Vapor Pressure Enhancer on Regulated Emissions

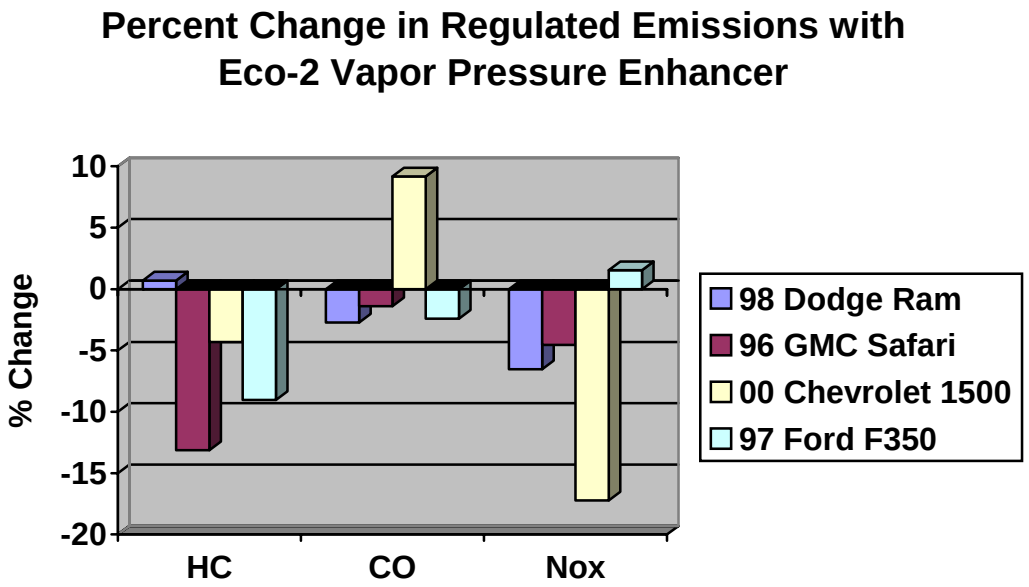

Table 3 shows the average effect on emissions over all vehicles.

Table 3. Average Effect of Eco-2 Vapor Pressure Enhancer on Regulated Emissions

HC	CO	NO_x
-6.445 %	0.668 %	-6.682 %

HWFET and Volumetric Fuel Economy

The HWFET calculates fuel economy based on HC emissions. Volumetric fuel economy calculations are based upon the fuel consumed during the test. Table 4 provides an overview of the effect of the addition of the device on fuel economy.

Table 4. Effect of Eco-2 Vapor Pressure Enhancer on Fuel Economy

Vehicle	HWFET fuel economy	Volumetric fuel economy
1998 Ram 1500	1.37 %	N/A[t]
1996 GMC Safari	-0.094 %*	1.46 %
2000 Chevrolet 1500	0.15 %	-0.14 %
1997 Ford F350	1.17 %	2.44 %

*A negative value indicates a decrease in fuel economy.
[t] No volumetric fuel economy calculations were performed on the Ram 1500.

The 1998 Dodge Ram 1500 was unable to be tested using the volumetric fuel economy method as the Dodge was not factory equipped with a fuel return line.

The 1997 Ford F350 had the greatest increase in fuel economy, both as measured by the HWFET and the volumetric methods. A graphical representation of the fuel economy measurement results can be found in Chart 2, on the following page.

Chart 2. Percent Change in Fuel Economy with Eco-2 Vapor Pressure Enhancer

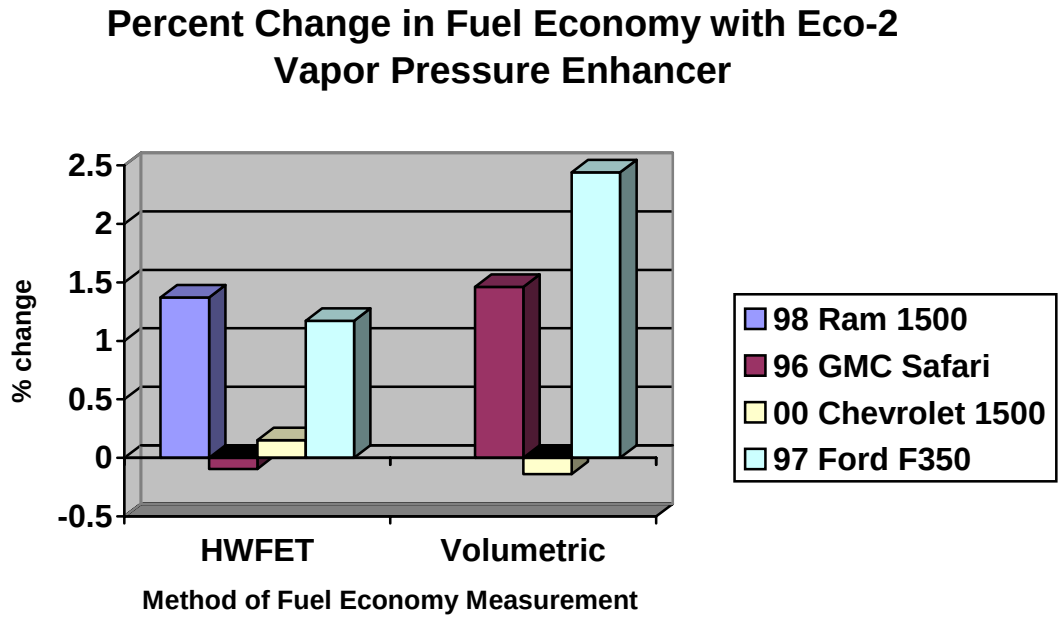

Table 5 shows the average effect on fuel economy over all vehicles.

Table 5. Average Effect of Eco-2 Vapor Pressure Enhancer on Fuel Economy

HWFET fuel economy	Volumetric fuel economy
0.649 %	1.253 %

OBD II monitoring

Of the four vehicles tested, three were equipped with an On Board Diagnostic system level II. Of the parameters monitored, Emissions Technology of Texas requested that the percent change of rpm, speed and throttle percent be calculated. Table 6 shows the average percent change in each of these parameters over the three vehicles that were monitored.

Table 6. Average percent change of monitored parameters with device installed.

% change	EPA-75 FTP	HWFET
rpm	- 0.3 %	- 0.367 %
Speed	- 2.267 %	- 0.133 %
Throttle %	1.067 %	2.833 %