EPA-AA-TEB-82-2

Evaluation of the Fuel Maximiser™ - A Retrofit Fuel Economy Device

By

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November 1981

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Background

The U.S Postal Service investigates items advertised through the mail, for possible prosecution if mail-fraud is suspected. The U.S. Postal service requested that EPA evaluate the Fuel Maximiser™, a fuel economy retrofit device. The purpose of the evaluation was to determine if the device in question did perform as it was claimed. A meeting was held with the U.S. Postal Service representative and with representatives of the device. The device representatives explained the theory by which the device works and presented substantiating test data. An evaluation of the theory and data presented is made in EPA Report EPA-AA-TEB-511-82-1.

Description of Device:

The following description of the device was included in the supporting data supplied by the device manufacturer. Figure 1 shows the actual device.

"The present invention comprises a pair of closely adjacent, preferably oppositely wound electrically conductive coils which are encapsulated in a suitable insulating material and form an efficiency unit. The coils have their ends connected to each other and are preferably wound about an iron core such that the number of windings on one coil is three times the number of windings on the other coil.

"The encapsulated efficiency unit is positioned closely adjacent the positive pole of the battery for the engine while an electrical wire extends from the encapsulated coils at one end and is electrically connected to the negative terminal of the battery at its other end. The first mentioned end of the wire is preferably electrically connected to the coils, either directly or indirectly by connection with the iron core."

Test Procedure - Road Testing

A two-phase test plan was devised which took into account the device inventors concerns about testing. The first phase involved on-road testing as suggested by the device inventors. The second phase involved chassis dynamometer testing.

The inventor supplied two proposed test plans to the EPA. A copy of his instructions are attached (see Attachment A). The Alternate Test Plan for fuel economy was run. The requirements were:

(1) "two vehicles required

(2) conduct test on an oval track or a measured section of highway of 50 miles or more one way and return to the starting point. Ambients should be observed. Both vehicle tests must be conducted the same day.

(3) In all tests no instrumentation can be used other than topping of the fuel tank. Bounce car to remove all air from the tank.

Note: Do not use fifth wheel for measurement.

The inventor was contacted as to the feasibility of installing in-vehicle volumetric fuel measurement systems. He stated that such instrumentation would not negate the effectiveness of his device. Two vehicles, a 1979 Pinto and a 1980 Citation were checked to manufacturers specifications. A detailed description of the test vehicles is attached (see Attachment B). Two Fluidyne volumetric fuel measurement devices were sent to the GM Proving Ground for calibration and cleaning. Both instruments calibrated within 1% over the useful flow rates. Several additional procedures were followed. They were:

i) The vehicles were warmed for 1/2 hour prior to beginning the test.

ii) The fuel measurement did not begin until the vehicle had stabilized at 50 mph.

iii) The two cars were driven in tandem with the same driver-vehicle combination during each phase of the test.

iv) The first day of testing after both vehicles completed the first run, the device was installed only on the Pinto, after which a second run was made. The second day the same procedure was followed but the device was installed only on the Citation.

v) After the first two days of testing, it was noted that the second run of 100 miles consistently demonstrated higher fuel economy from the first run. This was probably due to engine temperature considerations and increased ambient temperatures during the test day. To determine the effect of the device, two additional test days were run where the first run was made with the device installed and the second run made without the device. Any reduction in the fuel economy gains noted during the second run could then be attributed to the device. On the third day of testing, the device was initially installed on the Pinto. On the fourth day, the device was initially installed on the Citation.

vi) On the first day of testing, the Pinto demonstrated unrepresentative fuel economy (low) for the first leg of the run. This data was considered an outlier and not used in analysis. Comparative results were based only on the down leg of the two runs.

Results - Road Testing

A Summary of the test data is given below:

Fuel Maximiser™ On Road Test Data

			Pinto		Citation	
Date	Run No.	Leg	Fuel Economy	Composite	Fuel Economy	Composite
10/7/81	#1	Up	25.07	26.61	19.68**	23.72
10/7/81	#1	Down	28.35		29.85	
10/7/81	#2	Up	*26.13	*27.34	27.92	29.59
10/7/81	#2	Down	*28.66		31.48	
10/16/81	#1	Up	26.33	27.54	27.14	29.10
10/16/81	#1	Down	28.88		31.36	
10/16/81	#2	Up	27.71	28.31	*29.23	*30.27
10/16/81	#2	Down	28.94		*31.39	
10/28/81	#1	Up	*27.06	*27.66	27.98	29.05
10/28/81	#1	Down	*28.29		30.20	
10/28/81	#2	Up	27.11	27.89	28.37	29.42
10/28/81	#2	Down	28.72		30.55	
10/29/81	#1	Up	27.63	27.27	*29.88	*29.46
10/29/81	#1	Down	26.92		29.06	
10/29/81	#2	Up	28.26	27.73	30.70	29.93
10/29/81	#2	Down	27.21		29.20	

*with device
**questionable data

There are several ways to analyze this test data

A. Car to Car Comparison

1. This method assumes that each vehicle would see the same improvement from run #1 to run #2.

2. Any difference noted when the device was added would be attributed to the device.

3. The (Run #2 - Run #1)/((Run #1 + Run #2)/2) X 100 percentages were calculated. The results are given below:

Date	Vehicle with Device	Vehicle without Device	Device Contribution
10/7/81	2.70%	5.23%*	(-) 2.62%
10/16/81	3.94%	2.76%	(+) 1.18%
10/28/81**	.83%	1.27%	(+) .44%
10/29/81**	1.58%	1.67%	(+) .09%
			Ave = (-) .22%

*based only on down run comparison.

**since device was tested first, this is a positive value.

B. Individual Car Comparison

1. This method assumes that a vehicle would see the same improvement from run #1 to run #2 each day.

2. Any difference between the amount of improvement could be attributed to the device.

3. Average (non-device improvements) were calculated and are presented below.

Vehicle without Device (Average)		Vehicle with Device	Device Contribution
Pinto	2.22%	2.70%	(+) .49%
Pinto	2.22%	.83%	(+) 1.39%
Citation	3.30%*	3.94%	(-) .64%
Citation	3.30%*	1.58%	(+) 1.72%
*uses only the down leg of the 10-7 data			Ave = (+) .74%

C. A third method of analysis is to average all of the tests for each vehicle without the device and compare it to the average of the data with the device.

1. This method assumes that the variables induced by ambient conditions and day-to-day testing are cancelled out during the test project.

2. This method assumes that the Run #1 - Run #2 difference will also cancel out.

Vehicle without Device (mpg)	Vehicle with Device (mpg)	Device Contribution (%)
Pinto 27.56	27.50	(-) .22%
Citation 29.37	29.86	(+) 1.69%
		Ave = (+) .74%

All three methods of analysis show that the Fuel Maximiser™ has negligible effect on fuel economy. The (+) .74% improvement is well within the test-to-test variability of the road test. The data does demonstrate the problems with running a simple without/with test. Such a test would not account for the changes in vehicle and ambient conditions and would demonstrate a false gain in fuel economy attributed to the device.

Test Procedure - Dynamometer Testing

A second set of tests were run at EPA in which the test vehicles were tested on a vehicle dynamometer. However once the Fuel Maximiser™ was installed, the vehicle was not touched by tie down straps or exhaust collection system. This was due to the inventor's concerns that grounding of the vehicle negates the effectiveness of the Fuel Maximiser™ by rerouting the ion flow generated by the device. The procedure was performed by not using a restraining cable, only wheel chocks. Similarly an exhaust collection cone was placed around the vehicle exhaust system. The negative pressure of the collection system takes in all of the vehicle exhaust without touching the exhaust system. No other instrumentation such as fans, drivers aides, etc., were allowed to touch the vehicles. The actual testing sequence was as follows:

a. The test vehicles were set to manufacturer's specifications.

b. Baseline testing which included two FTP and two HFET test sequences was run with the vehicle restrained by a tie-down cable and without the device installed.

c. The device was then installed according to the installation instructions in the device package.

d. The vehicles then were fueled from fuel cans and driven on an average urban driving cycle until three tanks of fuel each were consumed. Each night the vehicles were parked in a fenced off area to avoid accidental grounding of the vehicles.

e. The vehicles were pushed by hand onto a vehicle dynamometer where the wheel chocks and exhaust collection cone were used. Two "with device" FTP/HFET sequences were performed on each vehicle.

f. The device was then removed and the vehicle grounded with the metal tie-down strap. The regular exhaust collection system was attached to the vehicle exhaust. One or two FTP/HFET sequences were performed on each vehicle.

A summary of the results is given below:

Table I

A. Pinto Test #	Date	HC	FTP Results CO	NOx	FE	Comments
81-0287	7-29-81	1.187	9.481	1.5620	22.47	Baseline
81-0312	7-30-81	1.184	8.923	1.7296	21.91	Baseline
81-0488	8-13-81	1.210	9.148	1.7493	21.94	with Fuel Maximiser™
81-0490	8-14-81	1.183	9.068	1.7243	21.84	with Fuel Maximiser™
81-0492	8-21-81	1.155	8.930	1.9259	21.97	without Fuel Maximiser™
B. Citation						
81-0494	8-25-81	.380	3.227	1.054	19.43	Baseline
81-0496	8-27-81	.416	3.615	1.044	19.93	Baseline
81-0498	9-16-81	.373	4.036	1.054	19.81	with Fuel Maximiser™
81-0852	9-17-81	.377	3.080	1.121	20.02	with Fuel Maximiser™
81-0856	9-18-81	.416	3.133	1.117	20.10	without Fuel Maximiser™
81-0858	9-22-81	.411	4.593	1.086	20.04	without Fuel Maximiser™

Table II

A. Pinto Test #	Date	HC	HFET Results CO	NOx	FE	Comments
81-0286	7-29-81	.4896	.947	1.6798	29.96	Baseline
81-0313	7-30-81	.5130	.961	1.7179	29.84	Baseline
81-0489	8-13-81	.4747	.959	1.9023	30.16	with Fuel Maximiser™
81-0491	8-14-81	.4258	.866	1.8184	29.88	with Fuel Maximiser™
81-0493	8-19-81	.4841	.868	1.2457	30.38	without Fuel Maximiser™
81-0616	8-21-81	.4770	.898	2.183	30.17	without Fuel Maximiser™
B. Citation						
81-0380	8-5-81	.04579	.1285	1.0879	29.14	previous Baseline
81-0409	8-6-81	.04622	.2480	1.0251	29.02	previous Baseline
81-0410	8-6-81	.05293	.4863	.9181	28.99	previous Baseline
81-0495	8-25-81	.0504	1.1361	.8417	27.63*	Baseline
81-0497	8-27-81	.0513	.4576	.9196	28.34	Baseline
81-0499	9-16-81	.0590	.6025	.8545	28.69	with Fuel Maximiser™
81-0853	9-17-81	.0560	.5404	.9733	28.98	with Fuel Maximiser™
81-0857	9-18-81	.0506	.2854	1.0053	29.11	without Fuel Maximiser™
81-0859	9-22-81	.0512	.1925	.9791	28.94	without Fuel Maximiser™

*Questionable data. Three previous baseline tests (shown) gave fuel economy much higher than the 27.63. Therefore, for analysis an average of all 5 baseline tests will be used.

Table III
Comparison Summary

A. Pinto	FTP (in gms/mile)					HFET (in gms/mile)				
	# of tests	HC	CO	NOx	FE-mpg	# of tests	HC	CO	NOx	FE-mpg
Without Device	3	1.18	9.11	1.74	22.12	4	.49	.92	1.96	30.08
With Device	2	1.20	9.11	1.74	21.89	2	.45	.91	1.86	30.02
% Difference		+1.83	0.0	0.0	-1.04		-8.3	-.6	-4.92	-.2
B. Citation										
Without Device	4	.41	3.64	1.08	19.88	7	.05	.42	.97	28.74
With Device	2	.38	3.56	1.09	19.91	2	.06	.57	.91	28.84
% Difference		-7.6	-2.31	+1.14	+.18		+15.5	+36.32	-5.6	+.32

A copy of the actual EPA test data sheets for these tests is attached (see Attachment C).

Analysis of EPA Dynamometer Testing:

The EPA laboratory testing showed that for both vehicles the Fuel Maximiser™ had an insignificant effect on fuel economy or emissions. The changes noted on HC, CO, and NOx for the HFET cycle are not significant when one looks at the magnitude of the numbers. There will normally be some variation in fuel economy noted during extended mileage accumulation. Therefore the shifts noted in CO and FE for the Citation are not unusual. It is proper to average the baseline values on either side of the "with Fuel Maximiser™" tests because no "residual type effect" claims are made for the device. Such an average compensates for gradual chages in the test vehicles performance.

Conclusions

The results of the EPA testing demonstrate that with either road or dynamometer testing procedures, the Fuel Maximiser™ failed to improve vehicle fuel economy. The two test vehicles tested are representative of domestic manufactured vehicles and should have noted an improvement if the device performed as it was claimed. Since both test programs found no change in fuel consumption attributable to the device, it is concluded that the Fuel Maximiser™ has no effect on fuel economy.