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Emissions and Fuel Economy of the Dresser Economizer, a Retrofit Device

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Abstract

This report describes the results of testing the Dresser Economizer as part of an evaluation under Section 511 of the Motor Vehicle Information and Cost Savings Act. This device is a gasket which is installed between the intake manifold and the cylinder head. The size of each passage is approximately half that of the original unit. Such a constriction increases the velocity and turbulence of the incoming charge. This is claimed to cause a more homogenous mixture and result in improved fuel economy and driveability, especially when the engine is cold. The primary purpose of this project was to evaluate the effect of the Dresser Economizer on fuel economy and levels of exhaust emissions. Secondary purposes were to measure any loss in vehicle power and possible changes in driveability.

Testing of three recent model year passenger cars was conducted at EPA's Motor Vehicle Emission Laboratory during September and October of 1981. The basic test sequence included the Federal Test Procedure (FTP) and the Highway Fuel Economy Test (HFET). These tests were performed both before and after installation of the Dresser Economizer and again after restoration of the vehicle. Except for a 2% decrease in the average hydrocarbon emissions for the HFET, all regulated emissions were slightly increased. Fuel economy was found to decrease approximately one percent on the FTP and two percent on the HFET. None of these changes were found to be statistically significant. Vehicle performance was not noticeably affected.

Background

Section 511 of the Motor Vehicle Information and Cost Savings Act empowers the Environmental Protection Agency (EPA) to evaluate devices which may improve fuel economy of conventional motor vehicles. The EPA has developed and instituted a procedure whereby an individual or organization may apply for an evaluation of the device or fuel additive. This procedure requires the applicant to submit a technical description of the system in conjunction with results from actual testing. Once a complete application is received, the EPA will conduct an engineering evaluation and publish the results in the Federal Register. In those cases where the device shows promise, the EPA will conduct its own tests as a part of the evaluation. Such testing is performed at EPA's Motor Vehicle Emission Laboratory in Ann Arbor.

In June, 1981, EPA received an application from Dresser Industries for an evaluation of the Dresser Economizer. This device was claimed to improve the fuel economy and driveability of light duty vehicles with carbureted gasoline engines. Based on an evaluation of the test results submitted to support the claims for the device, EPA chose to conduct confirmatory testing. The primary purpose of the testing was to determine the effect of the device on fuel economy and exhaust emissions. Secondary purposes included an evaluation of the vehicle performance and other driveability factors.

Description of the Device

The Dresser Economizer is a gasket which is installed between the intake manifold and the cylinder head. It replaces the original unit. The area of each passage is approximately half of that in the OEM version with a slight bell mouth shape formed at each port. Such a constriction increases the velocity and turbulence of the incoming charge. This is said to cause a more homogenous mixture and result in improved fuel economy and driveability, especially when the engine is cold.

Program Design

Three typical recent production vehicles were used: a Plymouth Volare with a 6-cylinder engine; an Oldsmobile Cutlass with a 6-cylinder engine; and a Chevrolet Nova with an 8-cylinder engine. All vehicles were equipped with automatic transmissions. A more detailed description of each vehicle is provided in Appendix A.

Exhaust emission tests were conducted according to the 1977 Federal Test Procedure (FTP) described in the Federal Register of June 28, 1977, and the EPA Highway Fuel Economy Test (HFET) described in the Federal Register of September 10, 1976. The vehicles were not tested for evaporative emissions. Indolene fuel was used for all testing.

In addition to the exhaust emission tests, engine power was also evaluated at each step by performing wide-open-throttle (WOT) accelerations from 5 mph to 60 mph while on the chassis dynamometer. The elapsed time was measured with a stop watch. Driveability was also observed at all times.

The following test sequence was employed. This test sequence had been previously approved by the applicant.

1. Adjust engine parameters to manufacturer's specifications.
2. Conduct triplicate acceleration tests.
3. Conduct duplicate baseline FTP and HFET sequences.
4. Install device.
5. If detonation is noticed, retard the basic timing by two degrees.
6. Conduct triplicate acceleration tests.
7. Conduct duplicate FTP and HFET sequences.
8. Remove device.
9. Conduct triplicate acceleration tests.
10. Conduct duplicate FTP and HFET sequences.
11. If timing was adjusted as part of the installation, return the vehicle to manufacturer's specifications.
12. Conduct triplicate acceleration tests.
13. Conduct duplicate FTP and HFET sequences.

Conduct of the Program

Installation of the Dresser Economizer on the test vehicles was performed in accordance with the instructions provided by the applicant. The procedures for each vehicle were observed and approved by James Pince of Dresser Industries. Each installation required approximately four man-hours.

Following each installation, the engine was audibly checked for detonation under a number of driving conditions. Detonation was not observed for any vehicle. Thus, timing was not adjusted and steps 5, 11, 12 and 13 of the test plan were not performed.* All vehicles were checked with a Sun engine analyzer to assure no changes had occurred.

The vehicles were tested during September and October of 1981. All tests were performed by EPA at the Motor Vehicle Emission Laboratory in Ann Arbor. The test sequence was conducted as written except the measurements for acceleration time required in Step 9 were not conducted. However, we determined that this oversight did not adversely affect the results of the program since no spark advance was changed and the subsequent emission tests were essentially identical to the baseline tests.

Test Results

Tables 1 and 2 summarize the results of this testing. Emission levels are listed in grams per mile while fuel economy is shown in miles per gallon. The results of the individual tests on each vehicle are presented in Appendices B, C, and D. Although these appendices include the test results after the vehicles were restored, these values were not used in developing Table 1. These tests were performed to assure that the engine had not changed during the testing or as a result of the mechanical work required to install and remove the device.

*Because removal of the intake manifold on the Nova also required the removal of the distributor, the initial timing was reset after reinstallation of all components.

Table 1
Summary of Emission Test Results

Vehicle	Configuration	FTP HC	FTP CO	FTP NOx	FTP F.E.	HFET HC	HFET CO	HFET NOx	HFET F.E.
Plymouth Volare	Baseline	.74	8.7	.89	18.99	.84	20.6	.58	25.78
	Device	.78	10.6	.85	18.47	.76	20.3	.48	24.88
	Ave. Change	5%	22%	-4%	-2.7%	-10%	-1%	-17%	-3.5%
Chevrolet Nova	Baseline	.94	14.4	1.60	13.10	.22	0.2	2.55	17.78
	Device	1.08	15.4	1.79	13.02	.25	0.3	2.72	17.29
	Ave. Change	15%	7%	12%	-0.6%	14%	50%	7%	-2.8%
Oldsmobile Cutlass	Baseline	1.04	10.8	1.20	18.98	.15	1.6	1.46	25.74
	Device	1.04	10.3	1.38	19.05	.16	2.0	1.84	25.70
	Ave. Change	0%	-5%	15%	0.4%	7%	25%	26%	-0.2%
Overall Fleet	Baseline	.91	11.3	1.23	16.51	.40	7.5	1.53	22.41
	Device	.97	12.1	1.34	16.35	.39	7.5	1.68	21.91
	Ave. Change	7%	7%	9%	-1.0%	-2%	0%	10%	-2.2%

Note: Emission results are in grams per mile. Fuel economy values are in miles per gallon.

Table 2
Summary of WOT Acceleration Test Results

Vehicle	Run	5-60 mph time (sec) Baseline	5-60 mph time (sec) Device	Average Change
Plymouth Volare	1	15.2	16.6	
	2	15.0	16.2	
	3	15.0	16.4	
Average		15.1	16.4	9%
Chevrolet Nova	1	11.4	11.2	
	2	11.2	11.6	
	3	11.4	11.4	
Average		11.3	11.4	1%
Oldsmobile Cutlass	1	15.6	16.8	
	2	15.8	16.8	
	3	15.8	16.8	
Average		15.7	16.8	7%
Overall		14.0	14.9	6%

Using the Student's "T" test, a statistical analysis was made of the exhaust emission and fuel economy data. At a 95% confidence level, this analysis indicated that there were no significant changes in the average fleet emission or fuel economy levels.

Although the evaluation was subjective, driveability of the vehicles under both cold and warm conditions was not noticeably affected. The only exception was acceleration rate at WOT. Even this loss was not to a degree that would be noticed by most drivers.

Conclusions

In general, the Dresser Economizer was found to have no significant effect on emissions, fuel economy or performance. More specific findings are as follows:

1. The installation instructions were found to be adequate.

2. Use of the Dresser Economizer resulted in an average increase in hydrocarbon emissions of 7% for the FTP and a decrease in average emissions of 2% for the HFET.

3. Carbon monoxide emissions were increased an average of 7% and 1% for the FTP and HFET, respectively.

4. Oxides of nitrogen were increased an average of 8% and 10% for the FTP and HFET, respectively.

5. Use of the Dresser Economizer resulted in a 1% decrease in fuel economy on the FTP and a 2% decrease on the HFET.

6. Average acceleration time from 5 mph to 60 mph was increased approximately 6%.

7. Cold/hot starting and cold/hot performance was not noticeably affected.

Appendix A

Test Vehicle Descriptions

Make/Model	Plymouth Volare	Oldsmobile Cutlass	Chevrolet Nova
Model Year	1979	1979	1975
Type	2 door	2 door	2 door
Vehicle I.D.	HL29C9B217336	3R47A9M523280	1X27L5L115735
Initial Odometer	31809	35670	7243
Engine Type	Spark Ignition	Spark Ignition	Spark Ignition
Configuration	In-line 6	V6	V8
Displacement	225 CID	231 CID	350 CID
Fuel Metering	1V Carburetor	2V Carburetor	4V Carburetor
Fuel Requirement	Unleaded	Unleaded	Unleaded
Transmission	Automatic	Automatic	Automatic
Tires	D78X14	P195/75R14	ER78X14
Inertia Weight	3500	3500	4000
Actual HP @50 mph	11.3	12.2	12.0
Emission Control Systems	EGR Catalyst Air Injection	EGR Catalyst Air Injection	EGR Catalyst Air Injection

Appendix B

Test Results - Plymouth Volare

Test Date	Test #	Config-uration	FTP HC	FTP CO	FTP NOx	FTP F.E.	HFET HC	HFET CO	HFET NOx	HFET F.E.
9-29-81	810947	Baseline	0.70	9.0	0.88	18.89				
9-29-81	810948	Baseline					0.77	19.1	0.56	25.67
9-30-81	810949	Baseline	0.78	8.4	0.90	19.08				
9-30-81	810950	Baseline					0.92	22.1	0.61	25.88
10-6-81	810951	Device	0.74	11.6	0.83	18.45				
10-6-81	810952	Device					0.87	22.1	0.53	24.95
10-7-81	810953	Device	0.82	9.7	0.88	18.48				
10-7-81	810954	Device					0.66	18.6	0.44	24.82
10-14-81	810955	Restored	0.63	9.0	0.96	18.47				
10-14-81	810956	Restored					0.54	15.2	0.42	25.66
10-15-81	810957	Restored	0.69	9.3	0.93	18.52				
10-15-81	810958	Restored					0.51	14.7	0.39	25.88

Note: Emission results are in grams per mile. Fuel economy values are in miles per gallon.

Appendix C

Test Results - Chevrolet Nova

Test Date	Test #	Config-uration	FTP HC	FTP CO	FTP NOx	FTP F.E.	HFET HC	HFET CO	HFET NOx	HFET F.E.
10-1-81	810969	Baseline	0.94	14.8	1.58	13.02				
10-1-81	810970	Baseline					0.22	0.2	2.56	17.67
10-2-81	810985	Baseline	0.93	13.9	1.63	13.19				
10-2-81	810986	Baseline					0.22	0.2	2.54	17.89
10-7-81	810971	Device	1.10	15.7	1.90	13.08				
10-7-81	810972	Device					0.26	0.4	2.72	17.25
10-8-81	810973	Device	1.05	15.1	1.68	12.95				
10-8-81	810974	Device					0.24	0.2	2.71	17.33
10-28-81	810981	Restored	0.85	10.6	1.75	13.24				
10-28-81	810982	Restored					0.21	0.2	2.52	17.89
10-29-81	810983	Restored	0.77	9.4	1.80	13.30				
10-29-81	810984	Restored					0.20	0.1	2.47	17.82

Note: Emission results are in grams per mile. Fuel economy values are in miles per gallon.

Appendix D

Test Results - Oldsmobile Cutlass

Test Date	Test #	Config-uration	FTP HC	FTP CO	FTP NOx	FTP F.E.	HFET HC	HFET CO	HFET NOx	HFET F.E.
9-29-81	810987	Baseline	1.03	11.0	1.20	18.85				
9-29-81	810988	Baseline					0.12	1.2	1.50	25.68
9-30-81	810989	Baseline	1.06	10.5	1.20	19.12				
9-30-81	810990	Baseline					0.18	2.1	1.43	25.79
10-6-81	810991	Device	1.10	10.6	1.32	19.15				
10-6-81	810992	Device					0.18	2.1	1.80	25.86
10-7-81	810993	Device	0.99	10.0	1.43	18.95				
10-7-81	810994	Device					0.15	1.8	1.87	25.53
10-14-81	810995	Restored	0.87	9.2	1.29	18.86				
10-14-81	810996	Restored					0.08	0.7	1.49	25.68
10-22-81	811001	Restored	0.85	8.9	1.25	19.21				
10-22-81	811002	Restored					0.12	1.2	1.48	25.76

Note: Emission results are in grams per mile. Fuel economy values are in miles per gallon.