

Evaluation of the Retronox
Clean Air System

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Test and Evaluation Branch
Emission Control Technology Division
Environmental Protection Agency

Background

The Test and Evaluation Branch of the Emission Control Technology Division is responsible for the testing of devices designed to reduce emissions from automobile engines. The Retronox Clean Air System manufactured by Dana Corporation for use in light duty vehicles is one such system. EPA was supplied with three Retronox systems for evaluation. The vehicles used in the evaluation included one uncontrolled car and two cars with a moderate degree of emission control.

Device and Vehicle Description

The Retronox Clean Air System is an exhaust gas recirculation system with a delayed spark advance. The spark advance is controlled with a vacuum delay valve between the carburetor and distributor. In addition, a modified PCV valve, giving increased flow through the PCV line, is used to give overall enleanment of the fuel-air mixture.

The system was tested on three vehicles, a 1963 Chevrolet with a 4.6 litre (283 CID) engine, a 1970 Chevrolet with a 5.7 litre (350 CID) engine, and a 1971 Ford with a 5.8 litre (351 CID) engine. The 1970 Chevrolet and the 1971 Ford were equipped with automatic transmissions. The 1963 Chevrolet had a three-speed manual gearbox. The 1963 Chevrolet was a "smoker," producing a significant amount of blue exhaust smoke, which could be the result of bad rings or valve guides. The results of installing the Retronox system on this car are considered significant, since vehicles in this condition would be encountered when retrofitting a large market.

Test Program

Before testing, all cars were adjusted to manufacturer's specifications. Initial tests were run in baseline configurations. The devices were then installed on the vehicles and further tests were run. No adjustments were made on the vehicles after installation of the devices.

All tests were run as directed in the 1975 Federal Test Procedure (Federal Register, Vol. 37, No. 221, Part II; November 15, 1972).

Results

Installation of the device resulted in significant reductions in NOx emissions from the 1970 Chevrolet and 1971 Ford. The Ford showed decreases in HC and CO, while the Chevrolet showed a decrease in CO but an increase in HC. Since the Chevrolet was running at very low levels of HC and CO in baseline configurations, installation of the Retronox system may have produced lean misfire.

The Retronox system installed on the 1963 Chevrolet resulted in reductions in HC and CO but left NOx emissions unchanged.

The system did not show a consistent effect on fuel consumption. The 1970 Chevrolet showed no change in fuel consumption when the device was correctly installed. The 1963 Chevrolet decreased its fuel consumption and the 1971 Ford increased its fuel consumption. Both of these changes are within the range of test-to-test variability.

Conclusions

Installation of the Retronox Clean Air System resulted in significant emission control on two of the three vehicles tested. The third vehicle installation, while demonstrating reduced carbon monoxide and oxides of nitrogen levels, was characterized by increased hydrocarbon emissions. This increase in hydrocarbon may be due to lean misfire as the baseline vehicle was operating quite lean. Fuel economy changes due to device installation were not consistent or significant.

An installation problem was encountered on the 1970 Chevrolet which pointed up the need, with this system, for careful attention by the installer. Even when the installation was corrected, the high HC emission data suggest that final carburetor checks or adjustments (which are not presently called for) might be beneficial.

Retronox - 1963 Chevrolet 283 CID
mass emissions in
grams/kilometer
(grams/mile)

<u>Baseline</u>	<u>HC</u>	<u>CO</u>	<u>NOx</u>	<u>Fuel Consumption</u>
	7.22 (11.62)	61.24 (98.53)	0.83 (1.33)	16.1 l/100 km (14.6 mpg)
	7.05 (11.34)	61.24 (98.53)	0.81 (1.30)	16.2 l/100 km (14.5 mpg)
	7.25 (11.67)	65.11 (104.77)	0.89 (1.44)	16.6 l/100 km (14.2 mpg)
Average	7.17 (11.54)	62.53 (100.61)	0.85 (1.36)	16.2 l/100 km (14.5 mpg)

Device Tests

	4.75 (7.65)	28.71 (46.19)	1.08 (1.74)	14.8 l/100 km (15.9 mpg)
	4.62 (7.44)	34.35 (55.27)	0.69 (1.11)	15.2 l/100 km (15.5 mpg)
	6.05 (9.74)	51.88 (83.47)	0.71 (1.15)	16.8 l/100 km (14.0 mpg)
Average	5.15 (8.28)	38.31 (61.64)	0.83 (1.33)	15.6 l/100 km (15.1 mpg)
% Change	-28%	-39%	-2%	+4%

Retronox - 1970 Chevrolet 350 CID
mass emissions in
grams/kilometer
(grams/mile)

<u>Baseline</u>	<u>HC</u>	<u>CO</u>	<u>NOx</u>	<u>Fuel Consumption</u>
	1.14 (1.84)	9.17 (14.75)	2.30 (3.70)	18.2 l/100 km (12.9 mpg)
	1.19 (1.92)	8.84 (14.22)	2.21 (3.55)	18.4 l/100 km (12.8 mpg)
	1.18 (1.90)	9.29 (14.94)	2.50 (4.02)	18.8 l/100 km (12.5 mpg)
Average	1.17 (1.89)	9.10 (14.64)	2.34 (3.76)	18.5 l/100 km (12.7 mpg)

Deyice Test

	2.03 (3.26)	5.72 (9.2)	1.27 (2.04)	18.8 l/100 km (12.5 mpg)
	1.72 (2.77)	5.78 (9.3)	1.27 (2.05)	18.7 l/100 km (12.6 mpg)
Average	1.88 (3.02)	5.75 (9.3)	1.27 (2.05)	18.8 l/100 km (12.6 mpg)
% Change	+61%	-37%	-46%	-1%

Retronox - 1971 Ford 351 CID
mass emissions in
grams/kilometer
(grams/mile)

<u>Baseline</u>	<u>HC</u>	<u>CO</u>	<u>NOx</u>	<u>Fuel Consumption</u>
	1.24 (1.99)	8.93 (14.37)	2.86 (4.60)	18.1 l/100 km (13.0 mpg)
	2.46 (3.96)	8.78 (14.12)	2.97 (4.78)	19.0 l/100 km (12.4 mpg)
	1.29 (2.08)	9.60 (15.44)	3.03 (4.87)	18.4 l/100 km (12.8 mpg)
Average	1.67 (2.68)	9.10 (14.64)	2.95 (4.75)	18.5 l/100 km (12.7 mpg)
Device Tests				
	1.65 (2.66)	7.45 (11.99)	1.51 (2.43)	20.6 l/100 km (11.4 mpg)
	1.27 (2.04)	5.73 (9.22)	1.25 (2.01)	17.7 l/100 km (13.3 mpg)
	1.78 (2.87)	7.09 (11.40)	1.31 (2.10)	19.0 l/100 km (12.4 mpg)
Average	1.57 (2.52)	6.76 (10.87)	1.35 (2.18)	19.0 l/100 km (12.4 mpg)
% Change	-6%	-26%	-54%	-2%