

A Second Evaluation of the  
Echlin Retrofit Emission Control System

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## Background

In October of 1972, EPA's first report on the Echlin retrofit system was published. While the EPA testing did indicate that the installation of the Echlin system could result in significant reductions in a vehicle's NOx emissions, it appeared that it was the adjustments (mainly timing modifications) recommended with the Echlin device installation rather than the Echlin device itself that were causing the NOx reductions. Representatives of the Echlin Manufacturing Company had reported that their device allowed timing to be retarded without experiencing the temperature and performance penalties normally associated with such modifications. The EPA series of tests indicated, however, that the Echlin system did nothing to improve engine cooling or eliminate the fuel economy penalty associated with retarded spark timing.

Echlin provided us with the results of a 24-car fleet test of their system which indicated a 26% reduction in hydrocarbons, 5% reduction in carbon monoxide and a 44% reduction in oxides of nitrogen was achieved with the use of the Echlin system. Since the earlier EPA evaluation seemed contrary to those Echlin personnel had run, it was decided to schedule a new series of tests on a later model vehicle, one more representative of the class of vehicles for which the Echlin system is certified in California.

## System Tested

The complete Echlin system consists of:

1. An "ultra-sonic generator" (air bleed-type device reportedly designed to produce ultra-sonic energy which in turn creates "a new combustion environment").
2. A carburetor spacer plate.
3. Tubing, which is used to connect the generator to the spacer plate.
4. Gaskets necessary for removal and replacement of the carburetor.

In addition to the installation of this hardware, Echlin recommends that the spark timing be retarded to 2° BTDC, the idle CO be set to 2% and the vacuum advance line be disconnected and plugged. The kit for this particular car also included a replacement for the vacuum advance unit to eliminate any breaker plate wobble which might occur.

### Vehicle Tested

The vehicle used in this evaluation was a 1970 Chevrolet Impala powered by a 350 CID engine with a two-barrel carburetor. This vehicle is equipped with an automatic transmission.

### Test Program

The 1975 Federal Test Procedure was used to determine exhaust emission levels. Details of this procedure can be found in Attachment I of this report. Four different configurations of the vehicle were tested:

1. Baseline, no modifications.
2. Same as above except vacuum spark advance was disconnected and plugged and timing was retarded to 2° BTDC per Echlin specifications.
3. Complete Echlin system including disconnect of vacuum advance, 2° BTDC timing, 2% idle CO, and the "ultra-sonic generator".
4. Same as above without Echlin "ultra-sonic generator" device installed.

In each of these configurations fuel consumption was determined using both carbon balance and weighing techniques.

### Test Results

Emission test and fuel consumption results are summarized in Table I.

The complete Echlin system reduced hydrocarbons slightly (18%), increased carbon monoxide significantly (77%), and reduced oxides of nitrogen slightly (13%). There was a 7% fuel economy penalty associated with the use of the complete system.

Removal of the Echlin "ultra-sonic generator" device, while leaving all other adjustments recommended by Echlin the same, resulted in HC emissions 1% higher than baseline, CO emissions 220% higher than baseline, and NOx emissions 18% lower than baseline. A fuel economy penalty compared to baseline of 14% was measured.

Returning the idle CO level to the baseline setting while leaving the vacuum advance disconnected and the timing retarded produces the lowest emission levels of the test series. Hydrocarbons were 36% lower than the baseline, carbon monoxide was increased only 12% and oxides of nitrogen were reduced 28% from the baseline. Fuel economy was only 4% poorer than baseline.

No adverse driveability was noticed in any of the four configurations.

#### Conclusions from the Testing

1. The timing modifications recommended by Echlin reduced hydrocarbon and oxides of nitrogen levels significantly.
2. The idle CO levels recommended by Echlin significantly increased the carbon monoxide level.
3. The Echlin hardware itself had no beneficial effects on emissions or fuel economy. The "ultra-sonic generator" portion of the Echlin system causes some enleanment of the mixture which can be cancelled out or over-compensated for by enrichening the idle CO setting of the carburetor. Using the recommended timing modifications (vacuum spark advance disconnect and 2° BTDC) without the Echlin system resulted in lower HC emissions, lower CO emissions, lower NO<sub>x</sub> emissions, and better fuel economy than was achieved using the Echlin hardware.
4. System installation required removal and replacement of the carburetor and modification of the choke linkage. Some vehicles may require modifications to the heat stove since there may be sealing problems after the spacer plate is installed below the carburetor.

#### Comments

1. The timing modifications recommended by Echlin should reduce hydrocarbon and oxides of nitrogen levels from most in-use vehicles.

2. The idle CO levels recommended by Echlin could significantly increase the carbon monoxide levels of many in-use vehicles.

3. The Echlin system may cause durability (valve burning) and eventually emission problems on some vehicles because there is no provision for restoring vacuum spark advance when engine temperature is high. Temperature problems could be anticipated from the fuel economy penalty measured.

It should be noted that these conclusions and comments do not necessarily contradict the results of the Echlin 24-car fleet test. These conclusions indicate, however, that the Echlin Company might have been able to achieve greater emission reductions with less fuel economy penalty had they only altered the timing of those 24 vehicles and not installed their device and reset the idle CO.

TABLE I

Echlin Device Test Series  
 1975 Federal Test Procedure  
 (all emission data in grams per mile)

	<u>Test No.</u>	<u>HC</u>	<u>CO</u>	<u>NOx</u>	<u>MPG</u>
Baseline	16-0053	1.67	17.96	3.37	12.1
	16-0063	1.83	16.55	3.28	11.9
	16-0074	2.11	18.28	3.23	11.3
	AVERAGE	1.87	17.6	3.29	11.8
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VSAD and 2° BTDC	16-0170	1.16	21.61	2.34	11.0
	16-0179	1.21	20.57	2.37	11.2
	16-0193	1.13	16.26	2.26	11.5
	16-0163	1.26	20.44	2.49	11.6
	AVERAGE	1.19	19.72	2.37	11.3
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% change from baseline		-36%	+12%	-28%	-4%
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Echlin System	16-0108	1.62	30.99	3.08	11.0
	16-0112	1.49	32.04	2.64	11.0
	16-0113	1.52	30.19	2.87	11.1
	AVERAGE	1.54	31.07	2.86	11.0
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% change from baseline		-18%	+77%	-13%	-7%
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VSAD, 2° CO, 2° BTDC	16-0090	1.93	57.09	2.72	10.2
	16-0092	1.86	55.60	2.78	10.2
	16-0096	1.88	56.11	2.61	10.1
	AVERAGE	1.89	56.27	2.70	10.2
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% change from baseline		+1%	+220%	-18%	-14%