

LOW AMBIENT TEMPERATURE
EMISSION TESTING, A
PRELIMINARY REPORT

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Background

This is a report on the first part of a program to characterize exhaust emissions at low temperatures. The testing accomplished thus far was done on two pre-1968 and three post-1968 vehicles. It was desirable to determine if any basic differences in performance at low ambient temperatures existed between controlled and pre-controlled vehicles.

Test Program

The vehicles tested consisted of the following. All were equipped with automatic transmissions:

1962 Chevrolet	283 CID	8 cylinder
1963 Ford	289 CID	8 cylinder
1970 Valiant	225 CID	6 cylinder
1970 Chevrolet	350 CID	8 cylinder
1971 Ford	351 CID	8 cylinder

The vehicles were tested using a Clayton dynamometer according to the 1975 Federal Test Procedure, except for changes in ambient temperature. The vehicles were each tested twice at the following ambient temperatures: 68-86°F (baseline), 60°F, 50°F, and 40°F. The 60° and 50°F tests were achieved simply by changing the thermostat setting in the test cell. The 40°F temperature was achieved by opening the outside doors slightly and drawing into the cell the outside cold air by means of a fan. This method was not precise because the rear of the cell near the doors was necessarily 30°F to achieve a temperature of 40°F at the front of the vehicle, and it was not possible to have a steady temperature for vehicle soak because of normal changes in atmospheric temperature. Soak temperatures varied by as much as 5° during the twelve hour period, but for about four hours before the test, and during the test, the cell temperature was within two degrees of the nominal 40°F test temperature. Temperatures of the air being blown into the engine, engine water and air going into the carburetor were continuously recorded throughout the emission testing.

Test Results

The test data and calculations are presented in the Appendix of this report. Carbon monoxide and hydrocarbon emissions tended to increase at the lower temperatures (except in the unexpected case of the 1962 Chevrolet CO emissions at 40°). At 40° one of the older vehicles had 29% more CO than baseline and the other

had 59% less, for an average of 17% less than baseline, while all the newer vehicles increased greatly at 40° to an average of 75% greater than baseline. Oxides of nitrogen emissions on the uncontrolled vehicles stayed about the same while on the controlled cars NOx slightly decreased at the lower temperatures. Carbon dioxide emissions varied insignificantly with no discernable trend.

Conclusions

Compared to their baseline tests at 68-86°F, post-1968 controlled vehicles show a relatively greater increase in carbon monoxide emissions as temperature is reduced than was evident for the pre-controlled vehicles. This trend, however, is predicted based on very limited data.

APPENDIX

TABLE I

Average Emission Levels
(all results in grams per mile)

2 pre-1968 vehicles (avg.)

	Baseline	60°	50°	40°
HC	6.17	7.66	7.20	8.23
CO	90.2	98.6	94.1	74.4
NOx	4.50	4.38	4.65	4.28

3 post-1968 vehicles (avg.)

	Baseline	60°	50°	40°
HC	2.28	2.48	2.79	3.13
CO	21.6	27.8	31.4	37.8
NOx	6.14	5.82	5.49	5.65

BLE II

Percent	Change from Baseline (68°-86°F)	
	<u>HC</u>	
	Pre-1968	Post-1968
60°	+24	+9
50°	+17	+22
40°	+33	+37
	<u>CO</u>	
	Pre-1968	Post-1968
60°	+9	+29
50°	+4	+45
40°	-17	+75
	<u>NOx</u>	
	Pre-1968	Post-1968
60°	-3	-5
50°	+3	-11
40°	-5	-8

TABLE III
Individual Vehicle Emission Data
(all results in grams per mile)

Each figure is the average of two tests

1962 Chevrolet EPA 157

	HC	CO	CO ₂	NOx
Baseline	5.50	94.8	599	4.43
60°	6.97	100.9	625	3.99
50°	6.39	89.4	625	4.26
40°	8.20	38.7	632	4.49

1963 Ford EPA 155

	HC	CO	CO ₂	NOx
Baseline	6.84	85.7	564	4.58
60°	8.36	96.4	606	4.77
50°	8.02	98.8	610	5.05
40°	8.26	110.2	575	4.06

1970 Valiant EPA 158

	HC	CO	CO ₂	NOx
Baseline	1.85	21.2	458	7.38
60°	2.44	29.4	456	6.29
50°	3.27	35.6	445	5.61
40°	3.83	45.1	453	6.67

1971 Ford EPA 161

	HC	CO	CO ₂	NOx
Baseline	2.71	18.9	725	5.39
60°	2.79	25.5	747	5.43
50°	2.69	26.3	698	5.42
40°	3.43	35.9	718	5.12

1970 Chevrolet EPA 160

	HC	CO	CO ₂	NOx
Baseline	2.27	24.8	732	5.66
60°	2.27	28.6	770	5.73
50°	2.41	32.3	731	5.44
40°	2.12	32.38	736	5.16