EPA-AA-EOD/TPB-86/2

Technical Report

# 1986 Transport Canada Correlation Program

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NOTICE



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## Background

This test program was initiated in response to Transport Canada's request to determine the degree of correlation in exhaust emissions and fuel consumption measurement between Environment Canada, EPA, Ford, GM and two Chrysler facilities (Chelsea Proving Grounds and Highland Park). In Canada, testing took place at the Environment Canada Emissions Test Laboratory, a facility operated by the Ontario Provincial Government in Toronto. The Canadian Government is adopting U.S. emission levels for the 1988 MY vehicles. They feel correlating with EPA and manufacturers' laboratories is critical to establishing the credibility of their test facility.

The Environment Canada facility was recently shut down for approximately one month. During that time, dynamometers were moved to new pit locations and gas bottle plumbing was rearranged. It has been their experience that such changes can have an effect on test results once testing resumes. Their desire was to collect correlation data at several test facilities. Therefore, the correlation program included dynamometer tests at Environment Canada's facility, EPA and manufacturers' laboratories, and gas bottle analysis on EPA's master bench.

## Program Design

The test sequence consisted of one cold start FTP, one HFET and three coastdowns from 55-45 mph. An LA-4 served as the preconditioning for the following day of testing. This sequence was to be performed three times at each laboratory.

The test vehicle was a 1984 Buick Century station wagon calibrated to Canadian standards. It was equipped with a 2.5 liter engine using throttle body fuel injection. The emission control system was an open loop type without a catalytic converter. The vehicle was not equipped to measure drive wheel torque or volumetric fuel consumption.

The actual testing schedule was:

| | |
|---|---|
| 11/01/85 - 11/22/85* | Environment Canada D002 |
| 11/11/85 - 11/28/85* | Environment Canada D001 |
| 12/08/85 - 12/14/85 | Chrysler Proving Grounds |
| 12/15/85 - 12/21/85 | Chrysler Highland Park |
| 1/05/86 - 1/11/86 | Ford |
| 1/12/86 - 1/18/86 | EPA |
| 1/19/86 - 1/25/86 | GM |
| 2/20/86 - 2/28/86 | Environment Canada D002 |

Environment Canada conducted only two tests on dynamometer D002 to conclude the program. These were added to the first set because both sets of data were similar, for a total of five tests on dynamometer D002.

*Instead of conducting three tests in three days on a particular dynamometer, Environment Canada used the most recent in-house tests conducted on the respective dynamometers. Since tests were not conducted daily, the test dates overlap and several weeks were required to obtain three emission tests on each dynamometer.

## Results

The following tests results and observations were obtained from this correlation program.

1. Environment Canada measured 11.9% higher FTP HC, 28.9% higher FTP CO and 6.1% higher FTP $CO_2$ on dynamometer D001.

2. Environment Canada measured 9.7% higher FTP HC, 33.6% higher FTP CO, and 8.4% higher FTP $CO_2$ on dynamometer D002.

3. Both Environment Canada dynamometer sites exhibited significant differences in HFET fuel economy, -6.4% and -8.0%, for D001 and D002, respectively.

4. The Chrysler Chelsea Proving Grounds facility exhibited fuel economy differences of -3.7% and -5.2% for the FTP and HFET, respectively.

5. The Chrysler Highland Park laboratory exhibited offsets in FTP and HFET fuel economy of -4.1% and -5.5%, respectively.

## Discussion

Table 1 is a summary of the FTP and HFET emission and fuel economy data obtained at EPA and participating laboratories in chronological order.

Due to miscommunication, we conducted two tests with a heat build prior to the FTP. Since this was not performed at the other participating facilities, it was decided to conduct two more tests without the heat build so that we would have comparable results with the other participants. The test results labeled EPA w/heat build are those tests that were performed with a heat build prior to the FTP. These tests are not included in the total mean in Table 1. EPA tests were also conducted on different dynamometers. The tests with the heat build were conducted on dynamometer D005 and those without the heat build were conducted on dynamometer D003.

Tables A-1 and A-2, in the appendix, are in the standard output format of the EPA LABCOR computer program which calculates the mean, standard deviation, coefficient of variation, and the percent difference of sample means. Percent difference results are based on the mean of the tests in the first row, which is the grand mean of EPA tests without the heat build.

Only those testing laboratories that exhibited statistically significant differences, in percent, using a t-test at the 95% confidence levels, are summarized in Table 2.

The gas bottle analysis is summarized in Table 3.

Table 1

1986 Transport Canada Correlation Program
Emission and Fuel Economy Results

| Test Lab | N | | FTP HC | FTP CO | FTP $NO_x$ | FTP $CO_2$ | FTP FE | HFET FE |
|---|---|---|---|---|---|---|---|---|
| | | | g/mi | | | | MPG | |
| Envm't Canada D002 | 5 | x | 1.55 | 9.27 | 1.37 | 377 | 22.4 | 35.4 |
| | | s | 0.05 | 1.39 | 0.10 | 7.6 | 0.4 | 1.2 |
| Envm't Canada D001 | 3 | x | 1.58 | 9.37 | 1.27 | 369 | 22.8 | 36.6 |
| | | s | 0.02 | 0.29 | 0.11 | 9.7 | 0.6 | 0.6 |
| Chrysler Proving Grounds | 3 | x | 1.44 | 7.36 | 1.28 | 361 | 23.5 | 36.5 |
| | | s | 0.04 | 0.36 | 0.05 | 1.8 | 0.1 | 0.2 |
| Chrysler Highland Park | 4 | x | 1.48 | 6.58 | 1.26 | 364 | 23.4 | 36.4 |
| | | s | 0.04 | 0.39 | 0.07 | 3.4 | 0.2 | 0.1 |
| Ford | 3 | x | 1.28 | 6.29 | 1.32 | 355 | 24.1 | 37.7 |
| | | s | 0.02 | 0.12 | 0.05 | 3.8 | 0.3 | 0.4 |
| EPA D003 | 2 | x | 1.41 | 7.27 | 1.24 | 348 | 24.4 | 38.5 |
| | | s | 0.05 | 0.96 | 0.01 | 4.9 | 0.4 | 0.4 |
| GM | 3 | x | 1.46 | 7.55 | 1.27 | 351 | 24.1 | 37.6 |
| | | s | 0.01 | 0.45 | 0.03 | 3.1 | 0.2 | 0.3 |
| Total | 23 | x | 1.47 | 7.88 | 1.30 | 363 | 23.4 | 36.7 |
| | | s | 0.10 | 1.50 | 0.08 | 11.0 | 0.8 | 1.1 |
| EPA w/Heat Build D005 | 2 | x | 1.45 | 10.2 | 1.37 | 349 | 24.1 | 37.1 |
| | | s | 0.03 | 0.18 | 0.03 | 0.7 | 0.1 | 0.4 |

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Table 2

1986 Transport Canada Correlation Program
Significant Percent Differences*

| | | FTP | | | | HFET | |
|---|---|---|---|---|---|---|---|
| Test Lab | N | HC | CO | $CO_2$ | MPG | MPG | Coastdowns |
| Envm't Canada D002 | 5 | +9.7 | +33.6 | +8.4 | -8.4 | -8.0 | --- |
| Envm't Canada D001 | 3 | +11.9 | +28.9 | +6.1 | -6.4 | --- | -4.2 |
| Chrysler Proving Grounds | 3 | --- | --- | --- | --- | --- | -3.1 |
| Ford | 3 | -9.3 | --- | --- | --- | --- | --- |
| EPA w/Heat Build D005 | 2 | --- | +40.3 | --- | --- | --- | -3.1 |

$$\text{Percent Difference} = \frac{(\text{MFR} - \text{EPA w/o Heat Build})}{\text{EPA w/o Heat Build}} \times 100$$

N = Number of Tests

*Based on 95% Conficdence Level

Table 3

1986 Transport Canada Correlation Program
Gas Bottle Analysis

| Gas | Cylinder Number | Environment Canada Conc.(ppm) | Master Bench EPA Conc.(ppm) | % Difference |
|---|---|---|---|---|
| HC | S11253 | 17.12 | 17.28 | -0.95 |
| | S10829 | 43.26 | 43.70 | -1.00 |
| CO | S10130 | 51.21 | 51.84 | -1.21 |
| | S10097 | 307.79 | 310.55 | -0.89 |
| | S10930 | 1547.59 | 1548.20 | -0.04 |
| | S12647 | 1670.65 | 1670.10 | +0.03 |
| $NO_x$ | S12451 | 28.49 | 30.26 | -5.86 |
| | S12305 | 70.58 | 71.29 | -1.00 |
| $CO_2$ | S12616 | 0.523% | 0.516% | +0.83 |
| | S12618 | 1.530% | 1.532% | -0.14 |

$$\% \text{ Difference} = \frac{\text{Environment Canada} - \text{EPA}}{\text{EPA}} \times 100$$

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Emission and Fuel Economy Results - Figures A-1 - A-7 of the appendix present composite results for emissions and fuel economy. These figures are GM "tri-plots". This method of data presentation shows individual test values along the vertical leg of each triangle and plots the mean of the data at the intersection of the other two legs of the triangle. All GM tri-plots display a plus and minus band around the mean of the two EPA tests without the heat build. With the exception of the $\pm$ 3.0 percent bands around the fuel economy means, the control chart limits on Figures A-1 - A-4 and A-7 are somewhat arbitrary and are based on engineering judgment and historical observations of actual emissions data.

Several observations can be made by examining these data. Both Environment Canada dynamometer sites exhibited significant percent differences in FTP HC, CO and $CO_2$ and HFET Fuel economy as shown in Table 2. Since this vehicle complies with Canadian standards, the emission levels to be measured for this program are much higher then what we normally expect. Because the absolute levels are high, a 9.7% offset in FTP HC with this vehicle is easier to prove than differences obtained from a program that uses a vehicle that meets U.S. emissions standards. The Environment Canada facility was the only one that showed significant percent differences in more than one constituent. Both Chrysler facilities exhibited fuel economy offsets of over -3%. Although Chrysler's Highland Park facility demonstrated offsets of -4.1% and -5.5% for FTP and HFET, respectively, and Chrysler's Chelsea Proving Grounds facility exhibited FTP and HFET fuel economy offsets of -3.7% and -5.2%, respectively, these percent differences are not significant at the 95% confidence level. These offsets do not coincide with Chrysler's FTP and HFET paired data percent differences which ranges between +2% to +3% over a longer time period.

EPA's tests with the heat build exhibited a significant difference in FTP CO of +40%. Some of this difference is due to loading the canister. These EPA results with the heat build are included in the report because we thought it would be interesting to show what effect the diurnal has on emission results. Relative to the EPA tests without the diurnal heat build, these tests also demonstrated HFET fuel economy offsets of -3.6%. Although the fuel economy difference is above -3%, it is within the variability we see with the Volvo REPCA (our cross check vehicle) between these two dynamometer sites.

Gas Analysis - Ten working standards from Environment Canada were analyzed in the EPA gas standards laboratory. Table 3 summarizes the results of this analysis. Environment Canada exhibited small negative offsets in 8 out of the 10 gas bottle analyses. Overall, there is good correlation between gas concentration measurements, with the exception of the low concentration of $NO_x$ (30 ppm).

## Summary

The Environment Canada laboratory demonstrated statistically significant offsets in emissions and fuel economy. These offsets could be a result of how the data were generated because they did not run three consecutive tests. Instead, they selected the three most recent emission tests with this vehicle. Also, Environment Canada's offsets may be attributed to calibration differences resulting from modifications that were done to the laboratory. The two Chrysler facilities, Highland Park and the Chelsea Proving Grounds, demonstrated fuel economy offsets of over -3%. However, they were not statistically significant at the 95% confidence level. Ford and GM demonstrated reasonable correlation with EPA despite the variability of the vehicle.

## Recommendations for Future Work

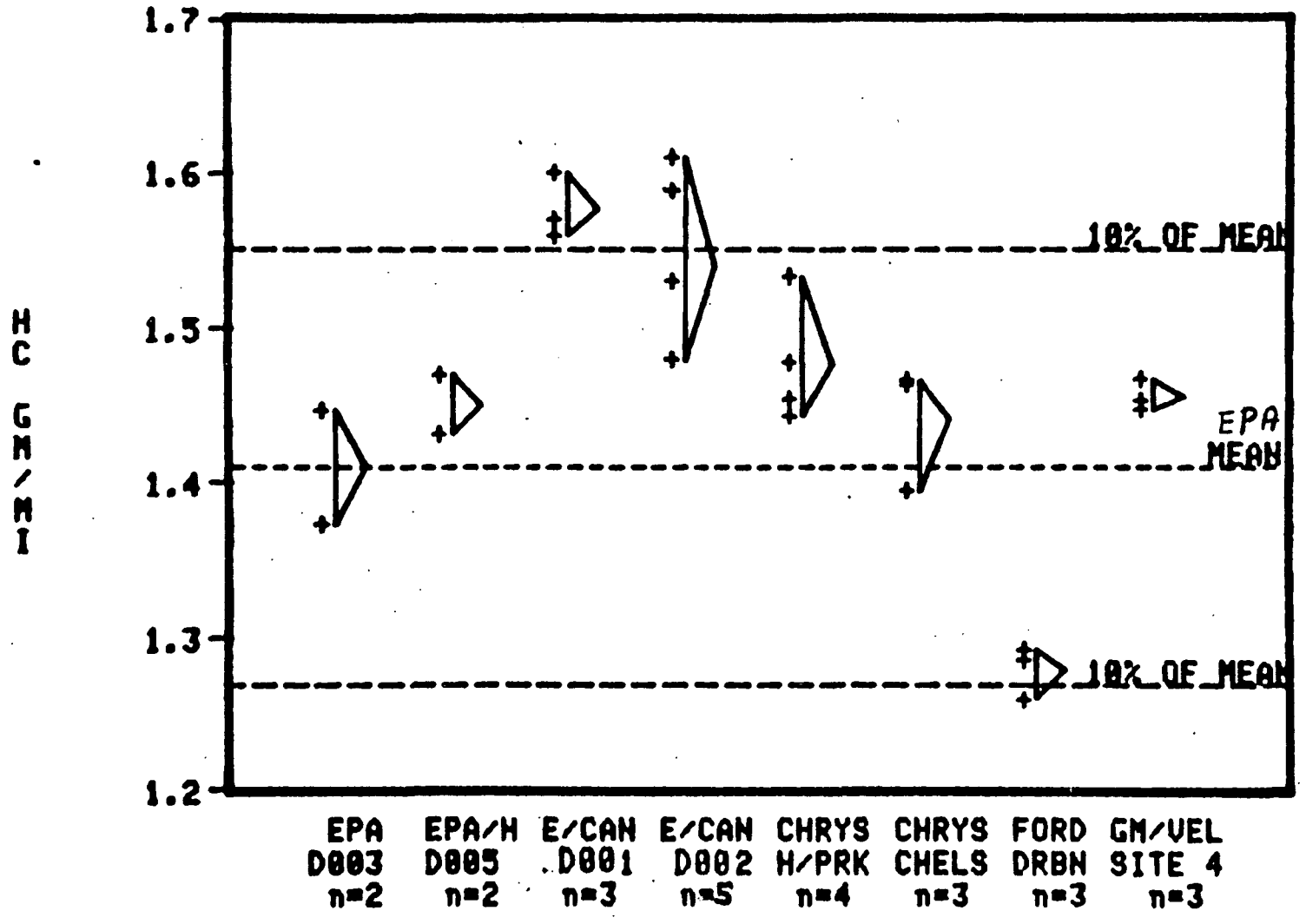
1. Future programs can be more effective if the test vehicle is more repeatable. Also, the vehicle should be equipped with a drive wheel torque meter and a fuel meter.

2. Better coordination is needed to shorten the time frame of the program and make the data more relevant.

3. The Environment Canada laboratory should examine their quality control diagnostics as a first step to investigate the offsets seen in this program.

ENVIRONMENT OF CANADA CORRELATION '86 FIGURE A-1

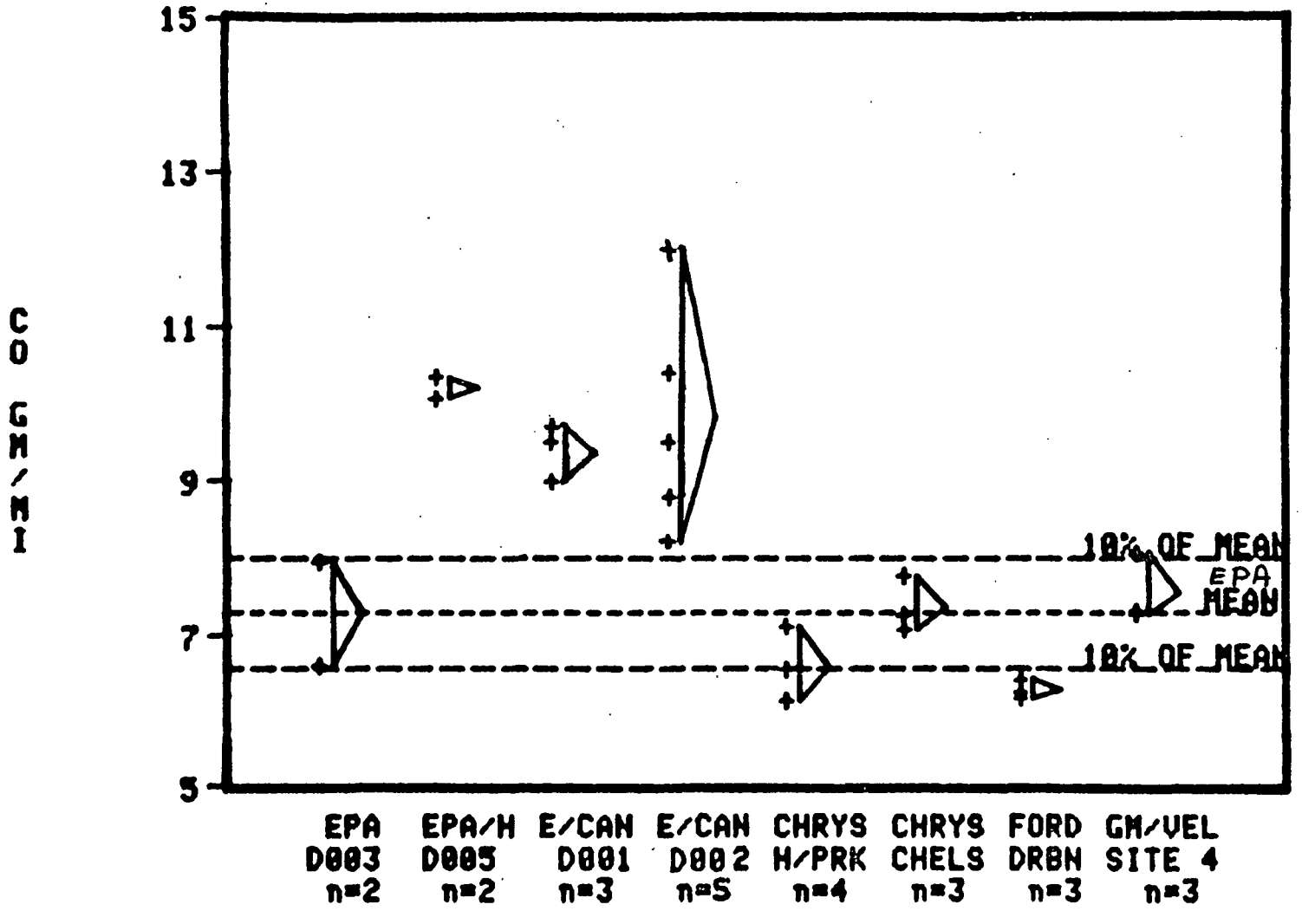
BUICK CENTURY S/W VEH.#84-006



ENVIRONMENT OF CANADA CORRELATION '86

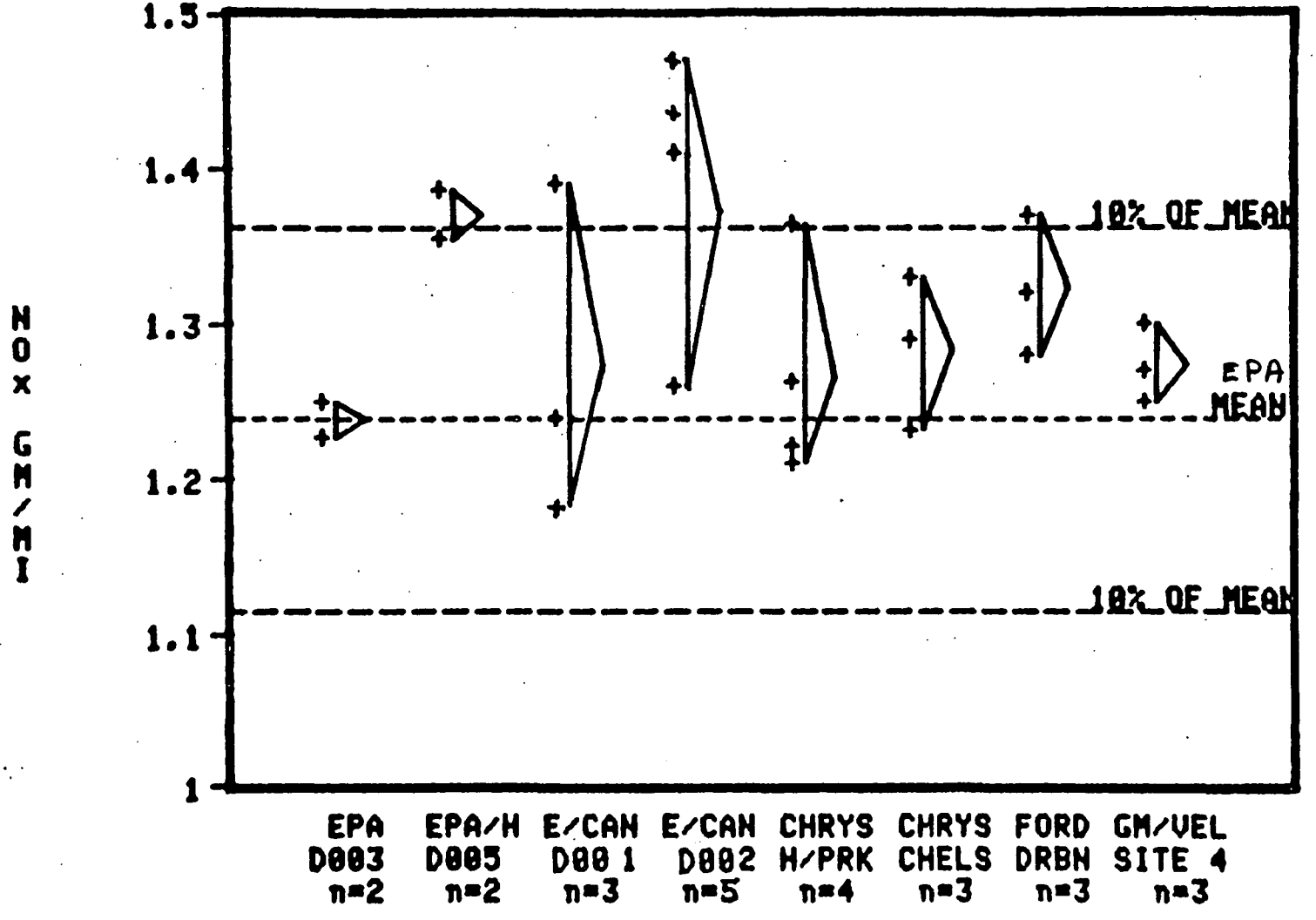
FIGURE A-2

BUICK CENTURY S/W VEH.#84-006



ENVIRONMENT OF CANADA CORRELATION '86 FIGURE A-3

BUICK CENTURY S/W VEH.#84-006



ENVIRONMENT OF CANADA CORRELATION '86 FIGURE A-4

BUICK CENTURY S/W VEH.#84-006

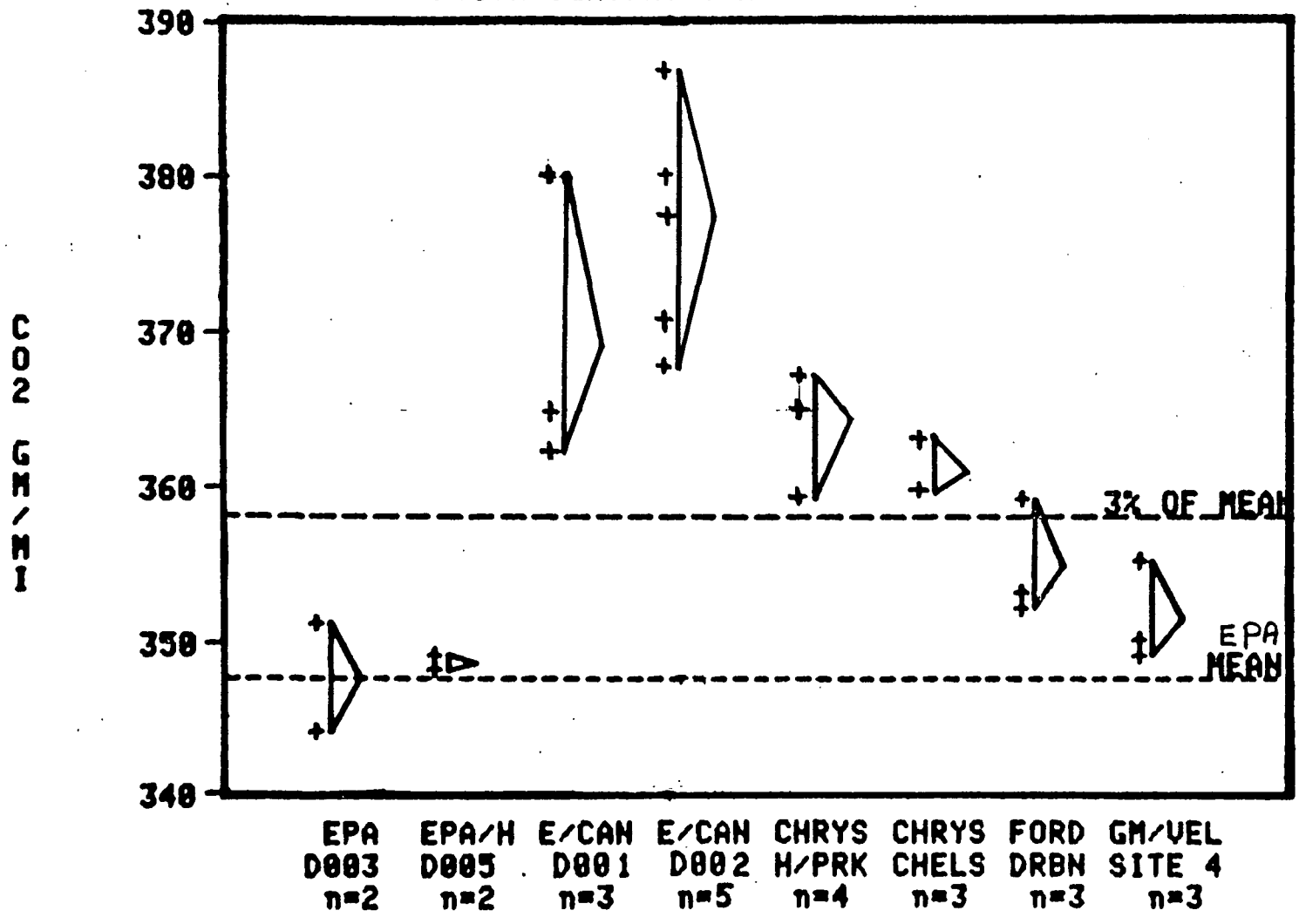
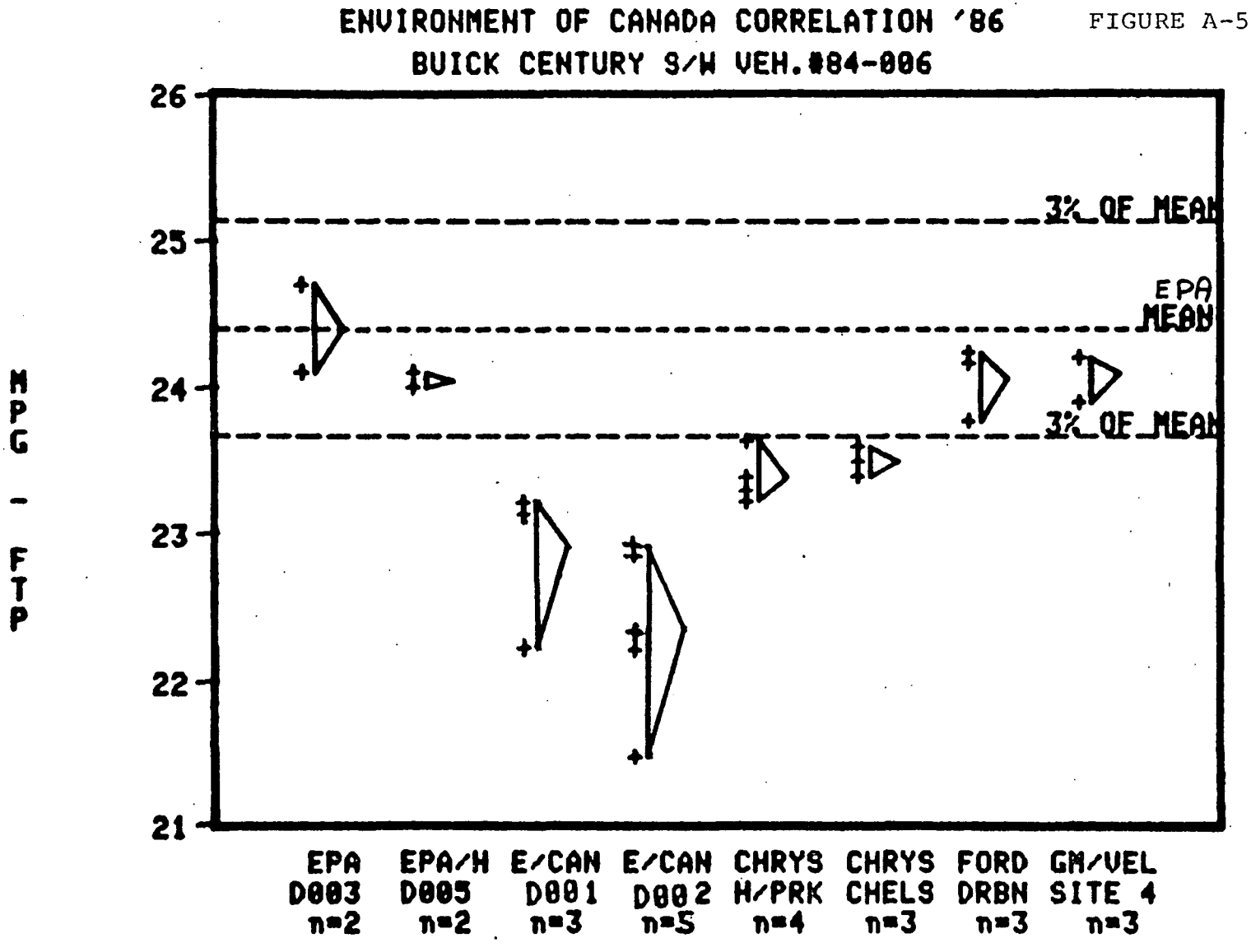


FIGURE A-5


ENVIRONMENT OF CANADA CORRELATION '86
BUICK CENTURY S/W VEH.#84-006
MPG - FTP
26
25
24
23
22
21
3% OF MEAN
EPA MEAN
3% OF MEAN
EPA D003 n=2
EPA/H D005 n=2
E/CAN D001 n=3
E/CAN D002 n=5
CHRYS H/PRK n=4
CHRYS CHELS n=3
FORD DRBN n=3
GM/VEL SITE 4 n=3

ENVIRONMENT OF CANADA CORRELATION '86 FIGURE A-6

BUICK CENTURY S/W VEH.#84-006

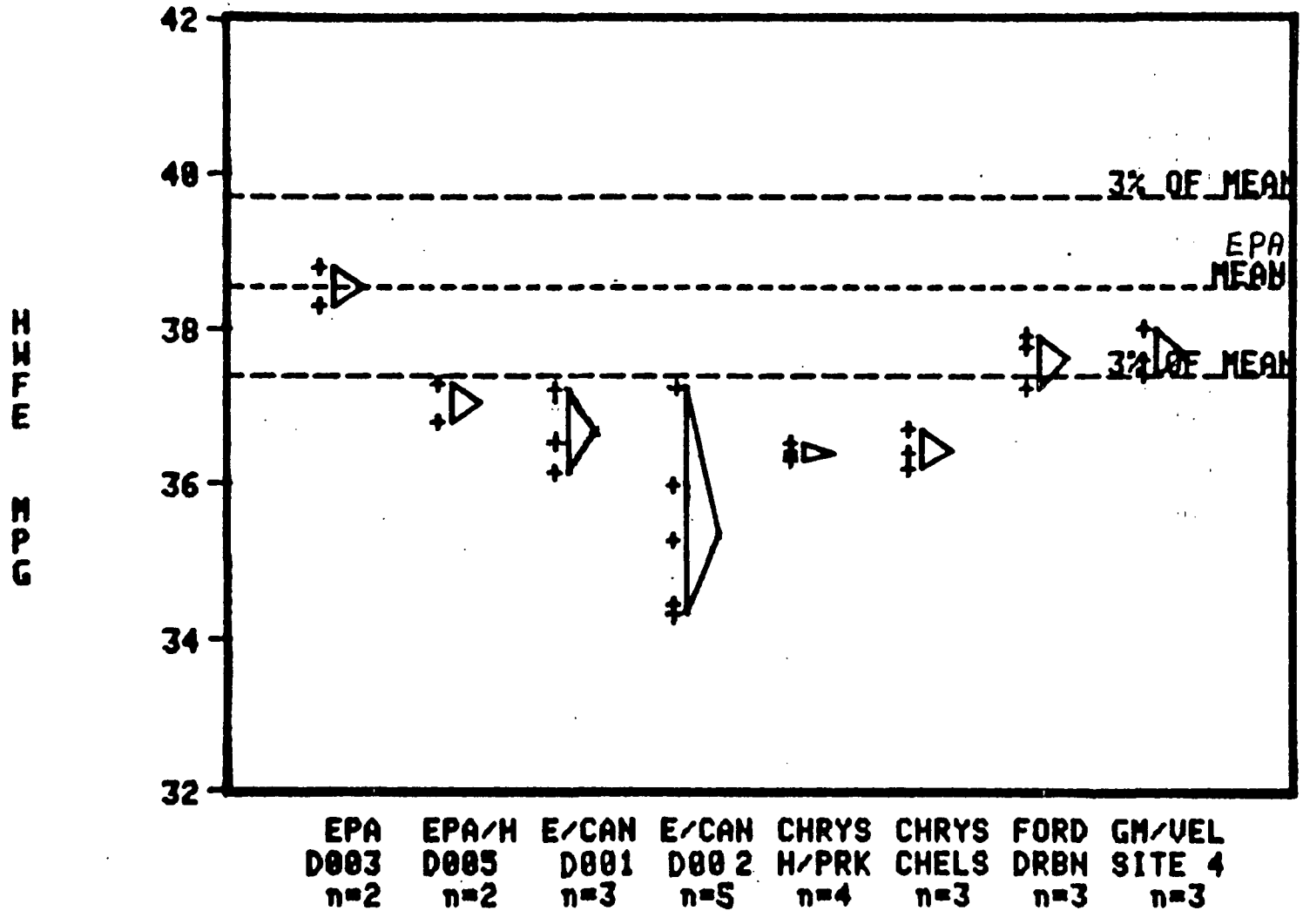
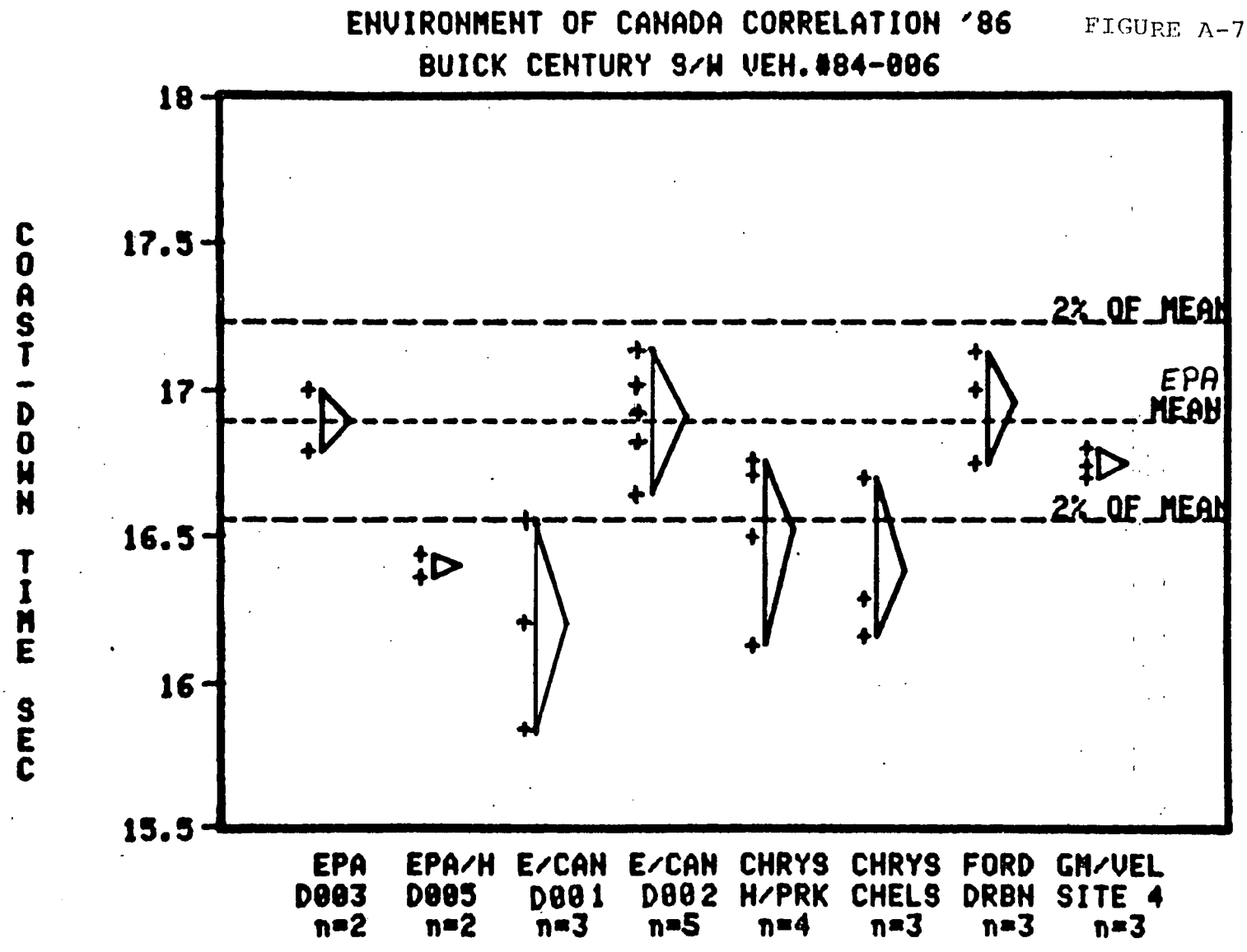


FIGURE A-7


ENVIRONMENT OF CANADA CORRELATION '86
BUICK CENTURY 9/W VEH.#84-006
COAST-DOWN TIME SEC
18
17.5
17
16.5
16
15.5
2% OF MEAN
EPA MEAN
2% OF MEAN
EPA D003 n=2
EPA/H D005 n=2
E/CAN D001 n=3
E/CAN D002 n=5
CHRYS H/PRK n=4
CHRYS CHELS n=3
FORD DRBN n=3
GM/VEL SITE 4 n=3

# TABLE A-1

PRJ: TRANSPORT CANADA CORR. LAB CORRELATION SUMMARY PROCESSED: MAY 20, 1986

TEST PROCEDURE: FTP VIN: 84-006 INERTIA WT: 3250 ACTUAL HP 7.6

| LAB | N | | CH4 | HC | CO | NOX | CO2 | FE | BARO | SHUM | NXFC | CDT | DB | EVAP/AUXILIARY FIELD OPTION | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | <-----G/MI-----> | | | | | (MPG) | (IN-HG) | | (G/LB) | | | BAG DATA NOT USED | | |
| EPA | 2 | MEAN | 0.0 | 1.410 | 7.27 | 1.24 | 348. | 24.4 | 29.20 | 50.5 | 0.897 | 0.0 | 74.8 | 0.0 | 0.0 | 0.0 |
| | | STD. DEV. | 0.0 | .0523 | 0.955 | .014 | 4.9 | 0.4 | 0.21 | 1.53 | 0.006 | 0.0 | 0.21 | 0.0 | 0.0 | 0.0 |
| | | C.V.% | 0.0 | 3.7 | 13.1 | 1.1 | 1.4 | 1.7 | 0.73 | 3.0 | 0.662 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 |
| EPA W/HEAT BUILD | 2 | MEAN | 0.042 | 1.451 | 10.21 | 1.37 | 349. | 24.1 | 29.14 | 50.2 | 0.896 | 0.0 | 76.6 | 0.0 | 0.0 | 0.0 |
| | | STD. DEV. | .0007 | .0269 | 0.184 | .028 | 0.7 | 0.1 | 0.311 | 0.54 | 0.002 | 0.0 | 0.06 | 0.0 | 0.0 | 0.0 |
| | | C.V.% | 1.7 | 1.9 | 1.8 | 2.1 | 0.2 | 0.3 | 1.07 | 1.1 | 0.231 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| | | DIFF. % | 0.0 | 2.9 | 40.3 | 10.5 | 0.3 | -1.4 | -0.2 | -0.6 | -0.1 | 0.0 | 2.3 | 0.0 | 0.0 | 0.0 |
| ENVM'T CAN D001 | 3 | MEAN | 0.0 | 1.577 | 9.37 | 1.27 | 369. | 22.8 | 29.89 | 51.0 | 0.899 | 0.0 | 75.8 | 0.0 | 0.0 | 0.0 |
| | | STD. DEV. | 0.0 | .0197 | 0.286 | .108 | 9.7 | 0.6 | 0.270 | 3.00 | 0.011 | 0.0 | 0.60 | 0.0 | 0.0 | 0.0 |
| | | C.V.% | 0.0 | 1.3 | 3.1 | 8.5 | 2.6 | 2.5 | 0.90 | 5.9 | 1.268 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 |
| | | DIFF. % | 0.0 | 11.9 | 28.9 | 2.3 | 6.1 | -6.4 | 2.4 | 1.0 | 0.2 | 0.0 | 1.2 | 0.0 | 0.0 | 0.0 |
| ENVM'T CAN D002 | 5 | MEAN | 0.0 | 1.547 | 9.72 | 1.37 | 377. | 22.4 | 29.62 | 53.2 | 0.907 | 0.0 | 80.2 | 0.0 | 0.0 | 0.0 |
| | | STD. DEV. | 0.0 | .0529 | 1.386 | .098 | 7.6 | 0.4 | 0.332 | 4.70 | 0.018 | 0.0 | 1.19 | 0.0 | 0.0 | 0.0 |
| | | C.V.% | 0.0 | 3.4 | 14.3 | 7.2 | 2.0 | 1.9 | 1.12 | 8.8 | 1.989 | 0.0 | 1.5 | 0.0 | 0.0 | 0.0 |
| | | DIFF. % | 0.0 | 9.7 | 33.6 | 10.4 | 8.4 | -8.4 | 1.5 | 5.3 | 1.2 | 0.0 | 7.2 | 0.0 | 0.0 | 0.0 |
| CHRYS CHELSEA-PG | 3 | MEAN | 0.0 | 1.442 | 7.36 | 1.28 | 361. | 23.5 | 28.94 | 50.2 | 0.896 | 0.0 | 75.0 | 0.0 | 0.0 | 0.0 |
| | | STD. DEV. | 0.0 | .0404 | 0.356 | .049 | 1.8 | 0.1 | 0.026 | 5.23 | 0.020 | 0.0 | 1.73 | 0.0 | 0.0 | 0.0 |
| | | C.V.% | 0.0 | 2.8 | 4.8 | 3.8 | 0.5 | 0.4 | 0.09 | 10.4 | 2.232 | 0.0 | 2.3 | 0.0 | 0.0 | 0.0 |
| | | DIFF. % | 0.0 | 2.2 | 1.2 | 3.5 | 3.9 | -3.7 | -0.9 | -0.6 | -0.1 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 |
| CHRYS HLAND PARK | 4 | MEAN | 0.0 | 1.477 | 6.58 | 1.26 | 364. | 23.4 | 29.48 | 43.0 | 0.871 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | STD. DEV. | 0.0 | .0396 | 0.399 | .070 | 3.4 | 0.2 | 0.148 | 11.9 | 0.044 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | C.V.% | 0.0 | 2.7 | 6.1 | 5.5 | 0.9 | 0.8 | 0.50 | 27.7 | 5.046 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | DIFF. % | 0.0 | 4.8 | -9.5 | 2.0 | 4.7 | -4.1 | 1.0 | -14.8 | -2.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| FORD | 3 | MEAN | 1.249 | 1.279 | 6.29 | 1.32 | 355. | 24.1 | 29.44 | 32.6 | 0.834 | 0.0 | 74.0 | 0.0 | 0.0 | 0.0 |
| | | STD. DEV. | .0168 | .0168 | 0.122 | .045 | 3.8 | 0.3 | 0.122 | 0.88 | 0.003 | 0.0 | 1.22 | 0.0 | 0.0 | 0.0 |
| | | C.V.% | 1.3 | 1.3 | 1.9 | 3.4 | 1.1 | 1.1 | 0.42 | 2.7 | 0.338 | 0.0 | 1.7 | 0.0 | 0.0 | 0.0 |
| | | DIFF. % | 0.0 | -9.3 | -13.6 | 6.7 | 2.1 | -1.4 | 0.8 | -35.4 | -7.0 | 0.0 | -1.2 | 0.0 | 0.0 | 0.0 |
| GENERAL MOTORS | 3 | MEAN | 0.0 | 1.456 | 7.55 | 1.27 | 351. | 24.1 | 28.87 | 49.1 | 0.892 | 0.0 | 75.2 | 0.0 | 0.0 | 0.0 |
| | | STD. DEV. | 0.0 | .0097 | 0.450 | .025 | 3.1 | 0.2 | 0.315 | 0.77 | 0.003 | 0.0 | 0.29 | 0.0 | 0.0 | 0.0 |
| | | C.V.% | 0.0 | 0.7 | 6.0 | 2.0 | 0.9 | 0.7 | 1.09 | 1.6 | 0.332 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 |
| | | DIFF. % | 0.0 | 3.3 | 3.7 | 2.7 | 1.0 | -1.1 | -1.1 | -2.7 | -0.6 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 |

C.V.% IS THE COEFFICIENT OF VARIATION. ((STD. DEV./MEAN) *100).

DIFF.% IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LABS. (((MFR-EPA)/EPA) * 100).

# TABLE A-2

PRJ: TRANSPORT CANADA CORR. LAB CORRELATION SUMMARY PROCESSED: MAY 20, 1986

TEST PROCEDURE: HFET VIN: 84-006 INERTIA WT: 3250 ACTUAL HP 7.6

| LAB | N | | CH4 | HC | CO | NOX | CO2 | FE | BARO | SHUM | NXFC | CDT | DB | EVAP/AUXILIARY FIELD OPTION | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | <----------G/MI----------> | | | | | (MPG) | (IN-HG) | (G/LB) | | | | BAG DATA NOT USED | | |
| EPA | 2 | MEAN | 0.0 | 0.707 | 2.13 | 1.30 | 225. | 38.5 | 29.21 | 50.6 | 0.897 | 16.90 | 74.1 | 0.0 | 0.0 | 0.0 |
| | | STD. DEV. | 0.0 | .0148 | 0.117 | .023 | 2.6 | 0.4 | 0.19 | 1.70 | 0.007 | 0.16 | 0.42 | 0.0 | 0.0 | 0.0 |
| | | C.V.% | 0.0 | 2.1 | 5.5 | 1.8 | 1.1 | 1.1 | 0.65 | 3.4 | 0.730 | 0.92 | 0.6 | 0.0 | 0.0 | 0.0 |
| EPA W/HEAT BUILD | 2 | MEAN | 0.0 | 0.704 | 2.70 | 1.40 | 233. | 37.1 | 29.16 | 51.6 | 0.901 | 16.37 | 77.8 | 0.0 | 0.0 | 0.0 |
| | | STD. DEV. | 0.0 | .0177 | 0.631 | .001 | 1.4 | 0.4 | 0.297 | 0.42 | 0.002 | 0.01 | 2.40 | 0.0 | 0.0 | 0.0 |
| | | C.V.% | 0.0 | 2.5 | 23.4 | 0.1 | 0.6 | 1.1 | 1.02 | 0.8 | 0.203 | 0.1 | 3.1 | 0.0 | 0.0 | 0.0 |
| | | DIFF. % | 0.0 | -0.4 | 26.5 | 7.6 | 3.6 | -3.6 | -0.2 | 2.0 | 0.4 | -3.1 | 5.0 | 0.0 | 0.0 | 0.0 |
| ENVM'T CAN D001 | 3 | MEAN | 0.0 | 0.756 | 3.26 | 1.23 | 235. | 36.6 | 29.88 | 50.1 | 0.895 | 16.20 | 79.4 | 0.0 | 0.0 | 0.0 |
| | | STD. DEV. | 0.0 | .0044 | 0.333 | .223 | 3.9 | 0.6 | 0.270 | 6.59 | 0.025 | 0.37 | 1.04 | 0.0 | 0.0 | 0.0 |
| | | C.V.% | 0.0 | 0.6 | 10.2 | 18.1 | 1.6 | 1.5 | 0.90 | 13.2 | 2.746 | 2.3 | 1.3 | 0.0 | 0.0 | 0.0 |
| | | DIFF. % | 0.0 | 6.9 | 52.8 | -5.2 | 4.5 | -4.9 | 2.3 | -1.1 | -0.2 | -4.2 | 7.2 | 0.0 | 0.0 | 0.0 |
| ENVM'T CAN D002 | 5 | MEAN | 0.0 | 0.779 | 4.01 | 1.31 | 243. | 35.4 | 29.62 | 50.8 | 0.898 | 16.91 | 83.4 | 0.0 | 0.0 | 0.0 |
| | | STD. DEV. | 0.0 | .0231 | 1.664 | .096 | 7.8 | 1.2 | 0.335 | 4.82 | 0.018 | 0.18 | 1.18 | 0.0 | 0.0 | 0.0 |
| | | C.V.% | 0.0 | 3.0 | 41.5 | 7.3 | 3.2 | 3.4 | 1.13 | 9.5 | 2.010 | 1.1 | 1.4 | 0.0 | 0.0 | 0.0 |
| | | DIFF. % | 0.0 | 10.1 | 88.1 | 1.0 | 8.1 | -8.0 | 1.4 | 0.4 | 0.1 | 0.1 | 12.5 | 0.0 | 0.0 | 0.0 |
| CHRYS CHELSEA-PG | 3 | MEAN | 0.0 | 0.729 | 2.75 | 1.44 | 237. | 36.5 | 28.93 | 45.7 | 0.879 | 16.38 | 76.0 | 0.0 | 0.0 | 0.0 |
| | | STD. DEV. | 0.0 | .0180 | 0.307 | .032 | 2.3 | 0.2 | 0.026 | 2.08 | 0.008 | 0.28 | 2.65 | 0.0 | 0.0 | 0.0 |
| | | C.V.% | 0.0 | 2.5 | 11.1 | 2.2 | 1.0 | 0.5 | 0.09 | 4.6 | 0.858 | 1.7 | 3.5 | 0.0 | 0.0 | 0.0 |
| | | DIFF. % | 0.0 | 3.1 | 29.1 | 10.7 | 5.3 | -5.2 | -1.0 | -9.7 | -2.0 | -3.1 | 2.6 | 0.0 | 0.0 | 0.0 |
| CHRYS HLAND PARK | 4 | MEAN | 0.0 | 0.736 | 3.02 | 1.30 | 236. | 36.4 | 29.48 | 39.8 | 0.858 | 16.48 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | STD. DEV. | 0.0 | .0142 | 0.553 | .057 | 0.9 | 0.1 | 0.161 | 7.47 | 0.026 | 0.26 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | C.V.% | 0.0 | 1.9 | 18.3 | 4.4 | 0.4 | 0.3 | 0.55 | 18.8 | 3.006 | 1.6 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | DIFF. % | 0.0 | 4.0 | 41.8 | 0.3 | 5.2 | -5.5 | 1.0 | -21.4 | -4.3 | -2.5 | 0.0 | 0.0 | 0.0 | 0.0 |
| FORD | 3 | MEAN | 0.0 | 0.658 | 2.49 | 1.44 | 229. | 37.7 | 29.47 | 33.2 | 0.836 | 16.96 | 75.4 | 0.0 | 0.0 | 0.0 |
| | | STD. DEV. | 0.0 | .0011 | 0.132 | .007 | 2.0 | 0.4 | 0.081 | 0.15 | 0.001 | 0.19 | 0.78 | 0.0 | 0.0 | 0.0 |
| | | C.V.% | 0.0 | 0.2 | 5.3 | 0.5 | 0.9 | 0.9 | 0.27 | 0.5 | 0.067 | 1.1 | 1.0 | 0.0 | 0.0 | 0.0 |
| | | DIFF. % | 0.0 | -7.0 | 16.9 | 11.2 | 2.1 | -2.2 | 0.9 | -34.4 | -6.8 | 0.4 | 1.8 | 0.0 | 0.0 | 0.0 |
| GENERAL MOTORS | 3 | MEAN | 0.0 | 0.751 | 4.15 | 1.32 | 227. | 37.6 | 28.89 | 50.4 | 0.896 | 16.75 | 75.0 | 0.0 | 0.0 | 0.0 |
| | | STD. DEV. | 0.0 | .0108 | 1.338 | .012 | 0.8 | 0.3 | 0.300 | 0.93 | 0.004 | 0.05 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | C.V.% | 0.0 | 1.4 | 32.3 | 0.9 | 0.4 | 0.8 | 1.04 | 1.8 | 0.398 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | DIFF. % | 0.0 | 6.1 | 94.5 | 1.9 | 0.9 | -2.2 | -1.1 | -0.4 | -0.1 | -0.9 | 1.2 | 0.0 | 0.0 | 0.0 |

C.V.% IS THE COEFFICIENT OF VARIATION. ((STD. DEV./MEAN) *100).

DIFF.% IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LABS. (((MFR-EPA)/EPA) * 100).

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

ANN ARBOR, MICHIGAN 48105

June 18, 1986

OFFICE OF
AIR, NOISE AND RADIATION

MEMORANDUM

SUBJECT: 1986 Transport Canada Correlation Program

FROM: Douglas H. DeVries, Engineer D. DeVries
Correlation and Engineering Services

TO: Eldert Bontekoe, Team Leader
Certification Branch Group

THRU: Martin Reineman, Manager MR
Correlation and Engineering Services

Attached is a report based on the Transport Canada Correlation Program which was conducted during November 1985 through February 1986.

This program was initiated at Transport Canada's request to determine the degree of correlation in exhaust emissions and fuel consumption measurement between Environment Canada, EPA, Ford, GM and two Chrysler facilities (Chelsea Proving Grounds and Highland Park). The major findings of this program were the following:

1. Environment Canada exhibited FTP HC and CO differences of +11.9% and +28.9% respectively, on their dynamometer D001.

2. Environment Canada exhibited FTP HC and CO difference of +9.7% and +33.6% respectively, on their dynamometer D002.

3. Environment Canada demonstrated fuel economy offsets of -6.4% and -8.0% for their dynamometer sites D001 and D002, respectively.

4. The Chrysler Chelsea Proving Grounds facility exhibited fuel economy differences of -3.7% and -5.2% for the FTP and HFET, respectively.

5. The Chrysler Highland Park Laboratory exhibited offsets in FTP and HFET fuel economy of -4.1% and -5.5%, respectively.

Please contact me if you have any questions concerning this report.

cc: R. Lawrence
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