

Gasohol Test Program

by

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December, 1978

Introduction

A request for a waiver to permit use of 10% Ethanol in gasoline ("gasohol") is being considered by EPA-Mobile Source Enforcement Division (MSED). The Emission Control Technology Division (ECTD) in Ann Arbor, MI was requested to assist MSED by testing ten vehicles on two gasoline fuels and three gasohol fuels. In addition, ECTD directed Southwest Research Institute (a contractor laboratory) to test three vehicles on the five fuels plus other fuels containing MTBE and TBA.^{1/} EPA-ORD was requested to provide more extensive emission data on two test vehicles.

The Administrator's decision must be made within 180 days of receipt of the application for waiver otherwise the waiver is automatically granted.^{2/} The decision date for this waiver is December 16, 1978. Testing support from MSAPC was requested on September 28, 1978. Vehicles and fuel were acquired and vehicle tests began October 16 and were completed on November 20. Because of the limited time available, duplicate tests of each vehicle/fuel combination were planned with retesting for void tests to be done only on a time available basis.

Summary

Eleven vehicles (4 three-way systems and 7 oxidation catalyst systems) were tested on five fuels. A summer grade gasoline was selected as the base fuel and was used both before and after testing on the two commercial gasohols. Indolene and a gasohol fuel containing Indolene and Ethanol were the other two fuels. All gasohol fuels used in this program contained 10 percent Ethanol (by volume). Duplicate tests were planned on four fuels and four tests were planned on the base fuel.

The test procedure was similar to the standard FTP test normally run on certification vehicles. Some deviations from this procedure were required in order to acquire additional data, such as cannister weights. Also, void test criteria were adjusted when appropriate and when engineering judgement could be used to verify the integrity of the results.

In the following list comparisons of each gasohol fuel are made with the appropriate base fuel:

1. Gasohol fuels increased evaporative HC emissions an average of 49 to 62% on the eleven vehicles tested.
2. The two mixed gasohol fuels (gasoline mixed with 10% Ethanol) decreased exhaust HC by about 9% on all vehicles. The blended gasohol fuel (gasoline blended with 10% Ethanol for correct volatility) increased exhaust HC by an average of 24% on all vehicles.
3. Total HC (evap. & exhaust) for 3.3 trips per day increased 11 to 32 percent with the gasohol fuels.

^{1/} Methyl tertiary butyl ether and tertiary butyl alcohol are other fuel additives for which waivers have been requested.

^{2/} Sec. 211(f)(4) of the 1977 Clean Air Act Amendments

4. Evaporative emissions contained about 0.6 grams Ethanol and 3.3 to 5.4 grams HC (as $\text{CH}_{1.85}$) with the gasohol fuels.^{3/}
5. CO emissions decreased 20 to 34 percent with the gasohol fuels.
6. NOx emissions increased 6 to 11 percent with the gasohol fuels.
7. Fuel economy (by carbon balance) decreased 1 to 5 percent with the gasohol fuels.
8. Driveability complaints increased with the gasohol fuels.
9. Three-way catalyst systems were not appreciably different from oxidation catalyst systems in exhaust and evaporative emission sensitivity to gasohol fuels.
10. It is not known if a gasoline fuel containing 10 percent Ethanol can be commercially blended to match distillation characteristics of a gasoline fuel containing no Ethanol.
11. It is not known if a "blended" gasohol with volatility characteristics similar to a gasoline would give driveability or evaporative emission levels similar to the gasoline.

Test Procedure

The test procedure agreed upon for the ECTD program was to test each vehicle twice on each fuel using the standard FTP with SHED procedure as used for certification tests. Some modifications were necessary to allow for cannister weights to be taken before and after the Diurnal Breathing Loss (DBL) test and after the Hot Soak (HS) test.

Void test criteria normally applied to certification tests were waived for some tests where engineering judgment could be used to verify that the test results were valid for the purpose of this program. Typical examples of this include tests where a heat build for diurnal emissions might be one degree (F) out of tolerance or tests where an exhaust emission analyzer might respan 3-4 percent low when the tolerance is ± 2 percent.

Some portions of the FTP were made more restrictive to provide more repeatable SHED results.

-The overnight soak tolerance of 12-36 hours was adjusted to 12-24 hours.

-Two preconditioning driving cycles with a one hour hot soak between them and refueling prior to each cycle were required each time the fuel type was changed.

^{3/} Ethanol was measured during 12 Diurnal and 10 Hot Soak Tests. The HC reported here corresponds to those tests and is corrected for Ethanol response to the FID.

The complete test procedure is shown in Appendix A. Six vehicles could be run each day using two SHED and two chassis dynamometers. The vehicles were separated into two groups. The first group followed the fuel sequence of 1,2,3,4,5,3 with duplicate tests each time. The second group followed the fuel sequence of 3,4,5,3 and then fuels 1 and 2 if time permitted. Nearly all vehicles did receive duplicate tests on all fuels.

Fuels

Five fuels were chosen for comparison as follows:

Fuel 1: Indolene

Fuel 2: 90% Indolene (same fuel batch as fuel no. 1) plus 10% Ethanol

Fuel 3: Summer grade gasoline (SG)

Fuel 4: 90% Fuel 3 plus 10% Ethanol

Fuel 5: Blended gasohol containing 10% Ethanol and approximating the RVP and distillation characteristics of fuel no. 3

The reason for running Fuels 1 and 2 was to show the changes in emissions which result when the certification fuel is combined with Ethanol thus increasing fuel volatility.

Fuel 3 was selected as a base fuel which might be representative of National average summer grade fuel.

Fuel 4 shows the effect on emissions when Ethanol is added to Fuel 3 as might be done by a fuel retailer or distributor. Fuel 4 volatility is higher than Fuel 3.

Fuel 5 was to be a gasohol blend with RVP and distillation curve similar to Fuel 3. It is not known if this fuel is representative of what a commercial gasohol would be if it were blended by the refiner to meet market requirements. Because Ethanol significantly alters the distillation curve it was difficult to blend a gasohol fuel to meet the distillation curve of a gasoline fuel.

All fuels were ordered by MSED from Howell Hydrocarbons. However, because of time constraints EPA-ECTD started testing on in-house Indolene (Fuel 1) and blended Fuel 2 using Fuel 1 and locally purchased Ethanol. Fuels 3,4, and 5 were supplied by Howell Hydrocarbons. Fuel 5 was found to be out of tolerance and was not used. It was replaced by Howell Hydrocarbons and the replacement was designated Fuel 6.

A fuel sample was drawn from a fuel cart each time the cart was refueled. Since the fuel cart capacity is 50 gallons there is at least one fuel sample for every 55 gallon drum of fuel supplied by MSED. About half of

these samples have been analyzed by EPA-MVEL, Ethyl Corporation, or Petroleum Specialities, Inc. Typical fuel inspection data is included in Appendix B. Figure 1 shows typical distillation data of the five fuels used at EPA-MVEL.

By comparing Fuel 2 with Fuel 1 or Fuel 4 with Fuel 3 the increase in volatility caused by the addition of 10% Ethanol can be seen. Fuel 6 compared with Fuel 3 illustrates the difficulty encountered in trying to blend a "gasohol" to the same distillation curve as a typical gasoline.

A comparison of volatility characteristics of the two gasolines used in this program with D.O.E. fuel survey inspection data for typical summer grade gasoline and for Southern California gasoline is shown in Figure 2.

Vehicles

All vehicles were supplied by the vehicle manufacturers. Ten 1978 and 1979 vehicles were to be run. To ensure completion of ten vehicles in the required time eleven were requested from manufacturers. All eleven were received and all completed the test sequence.

All eleven vehicles were catalyst equipped - 4 with three-way catalysts and 7 with oxidation catalysts. The vehicles included four from Ford (2 three-way catalysts and 2 oxidation catalysts); four from GM (2 three-way catalysts and 2 oxidation catalysts); two from Chrysler; and 1 from Toyota. Vehicle information sheets are included in Appendix C.

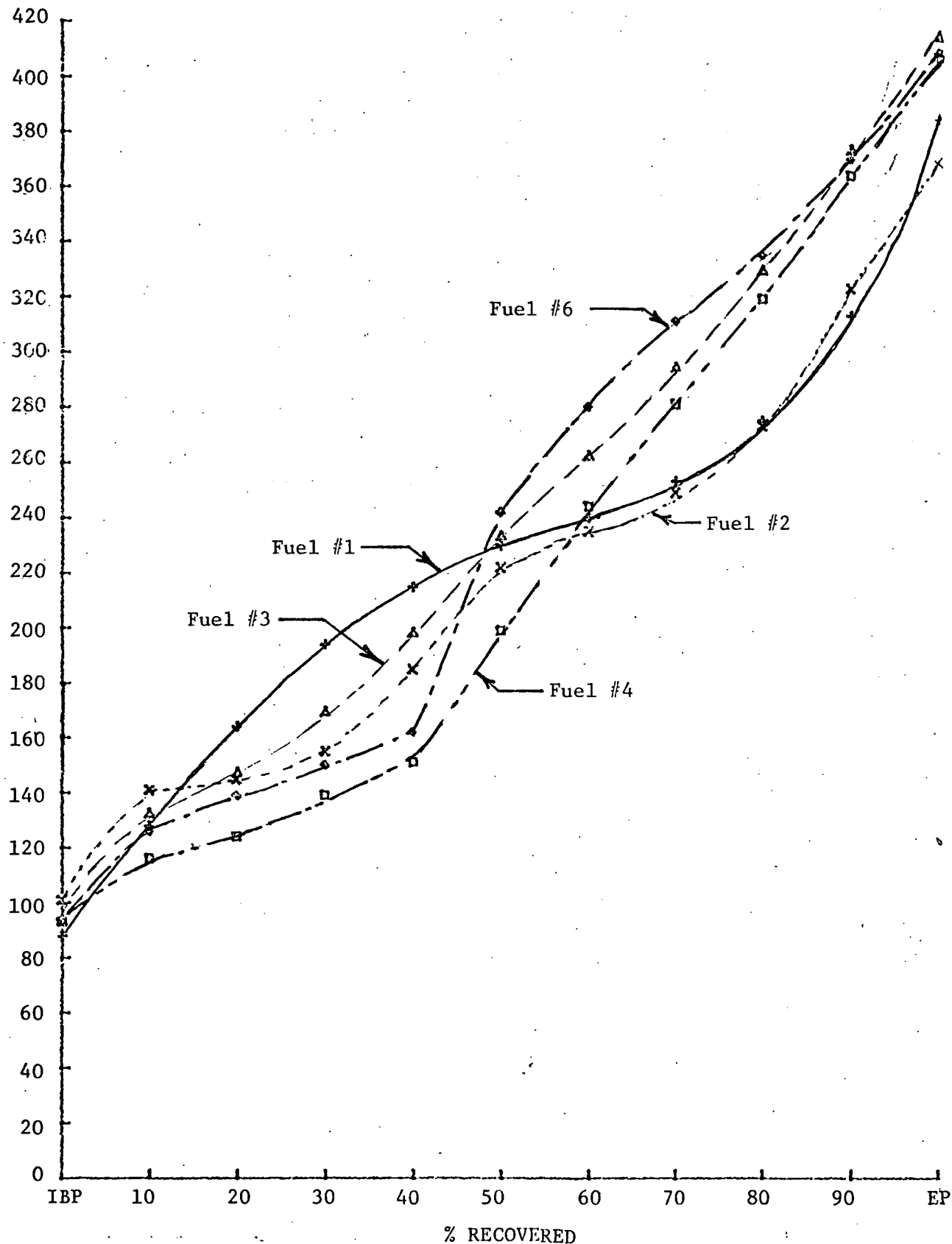
Data and Discussion

The data has been summarized and emissions on each gasoline and gasohol fuel are shown in Figures 3, 4, and 5. The total hydrocarbon exhaust plus evaporative emissions for 3.3 trips per day are designated "TOTHC". DEL, HSL, and TLOSS are the diurnal, hot soak, and total evaporative emissions, respectively.

Emissions and fuel economy for Indolene with 10 percent Ethanol are compared with Indolene and the two "commercial" gasohols are compared with the SG base fuel (Fuel 3) for all vehicles (Figure 6). The gasohol fuels increased both diurnal and hot soak evaporative emissions by 29 to 71 percent. Total evaporative emissions increased by 49 to 62 percent on gasohol fuels. Total HC emissions (evap. plus exhaust) increased by 11 to 32 percent on gasohol fuels. CO emissions decreased 20 to 34 percent and fuel economy decreased 1 to 5 percent on gasohol. NOx increased 6 to 11 percent on gasohol fuels.

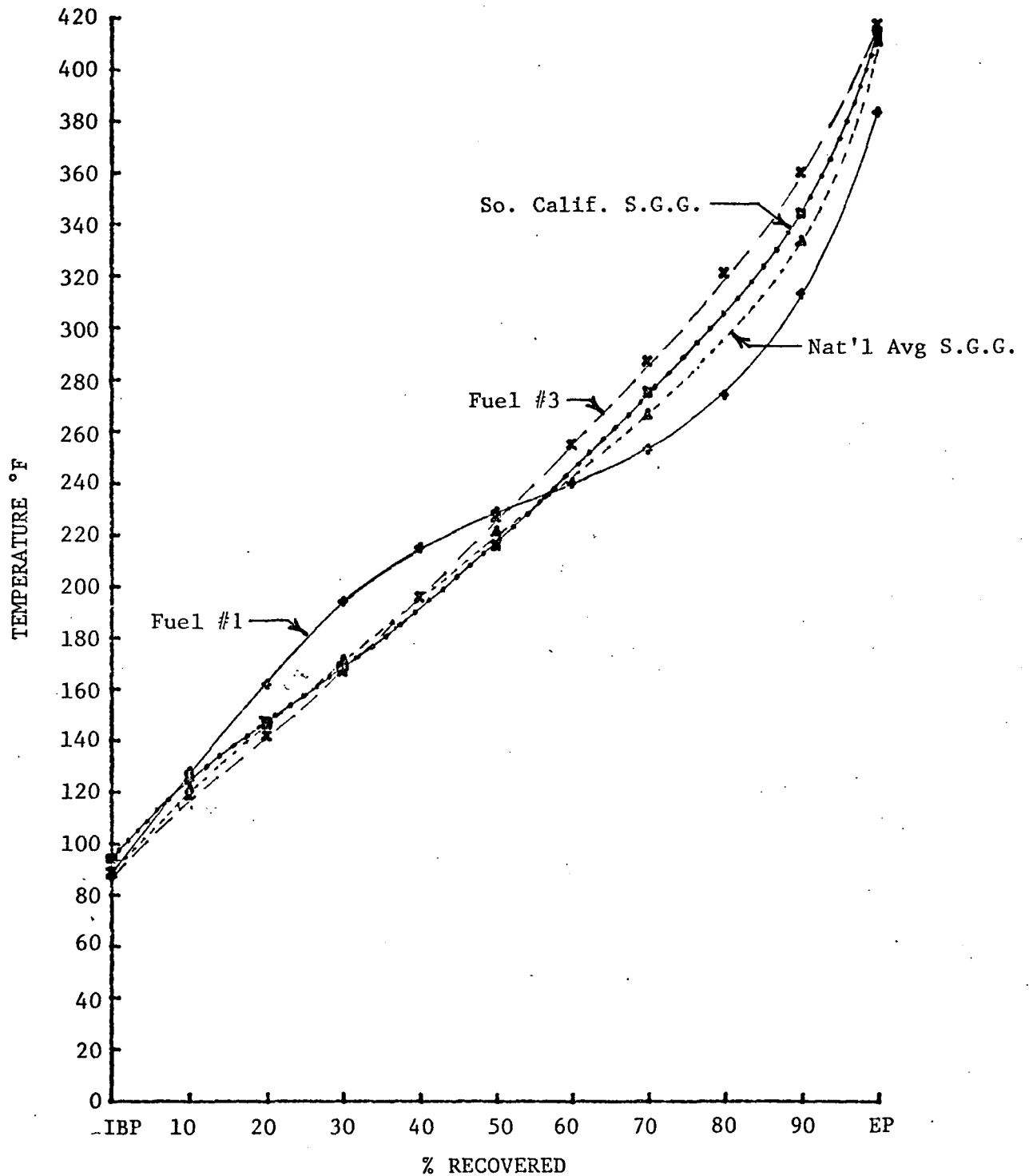
Evaporative emissions with Fuel 6 (blended gasohol) were slightly lower than with Fuel 4 but HC and CO exhaust emissions were higher on Fuel 6 than on Fuel 4. The total HC (exhaust plus evap) for 3.3 trips per day were higher. Fuel 4/3 showed an 18 percent increase and Fuel 6/3 showed a 32 percent increase in total HC emissions.

FIGURE 1. COMPARISONS OF DISTILLATION CURVES OF TEST FUELS



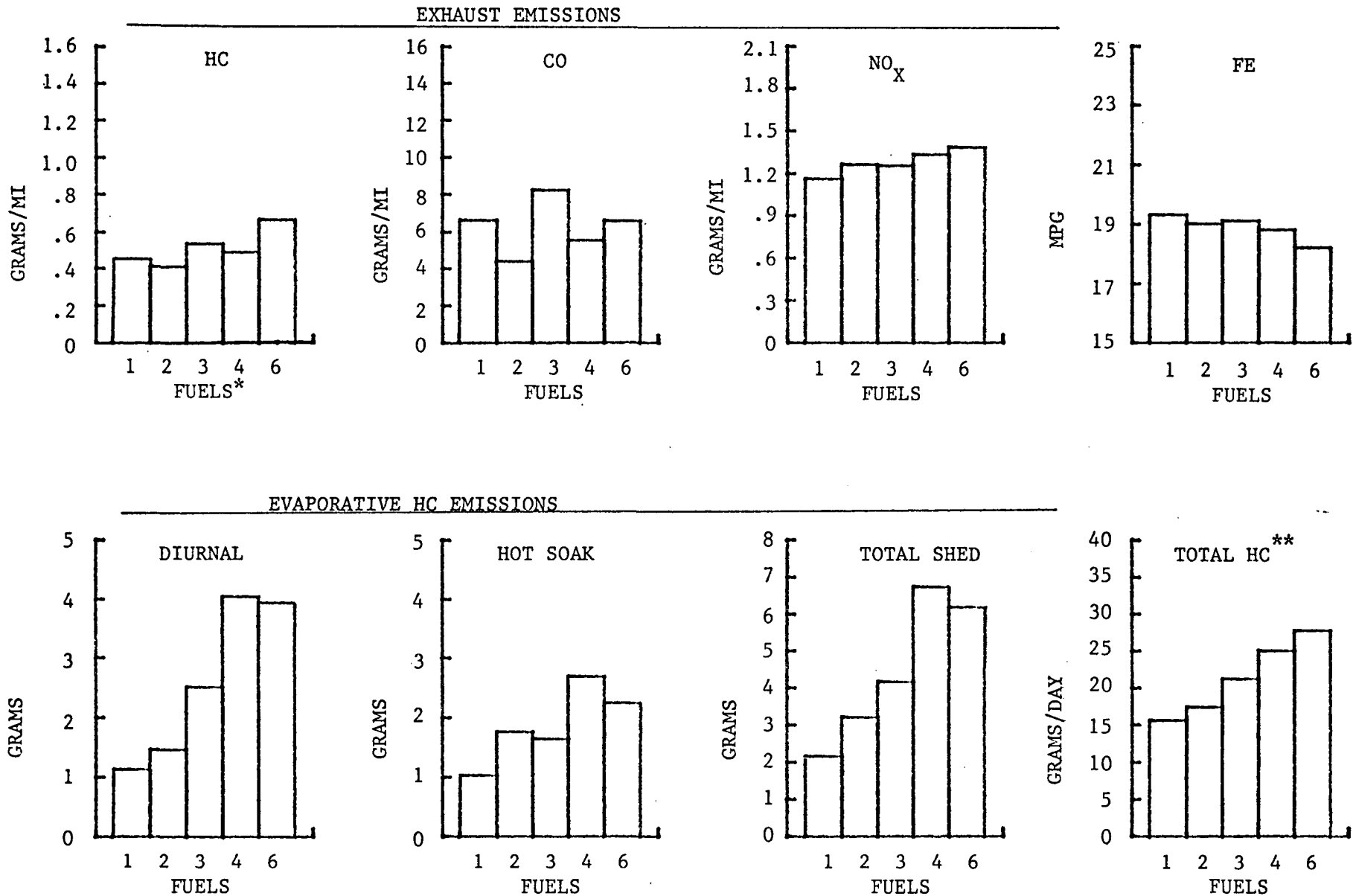
Fuels: 1. Indolene (RVP=9.0) 4. 90% Fuel 3 + 10% Ethanol (RVP=10.7)
 2. Indolene + 10% Ethanol (RVP=9.2) 6. Blended Gasohol containing
 3. Commercial Gasoline (RVP=10.0) 10% Ethanol (RVP=10.0)

FIGURE 2. COMPARISONS OF TEST FUELS WITH NATIONAL
AVERAGE DATA



Fuels: (Fuel 1.) Indolene (RVP=9.0)
(Fuel 3.) MS&ED Test Fuel (RVP=10.0)
DOE Nat'l Avg. Summer Grade Gasoline (RVP=9.8)
DOE Southern California Summer Grade Gasoline (RVP=8.4)

FIGURE 3. AVERAGE EMISSIONS OF 11 1978-79 CATALYST VEHICLES.

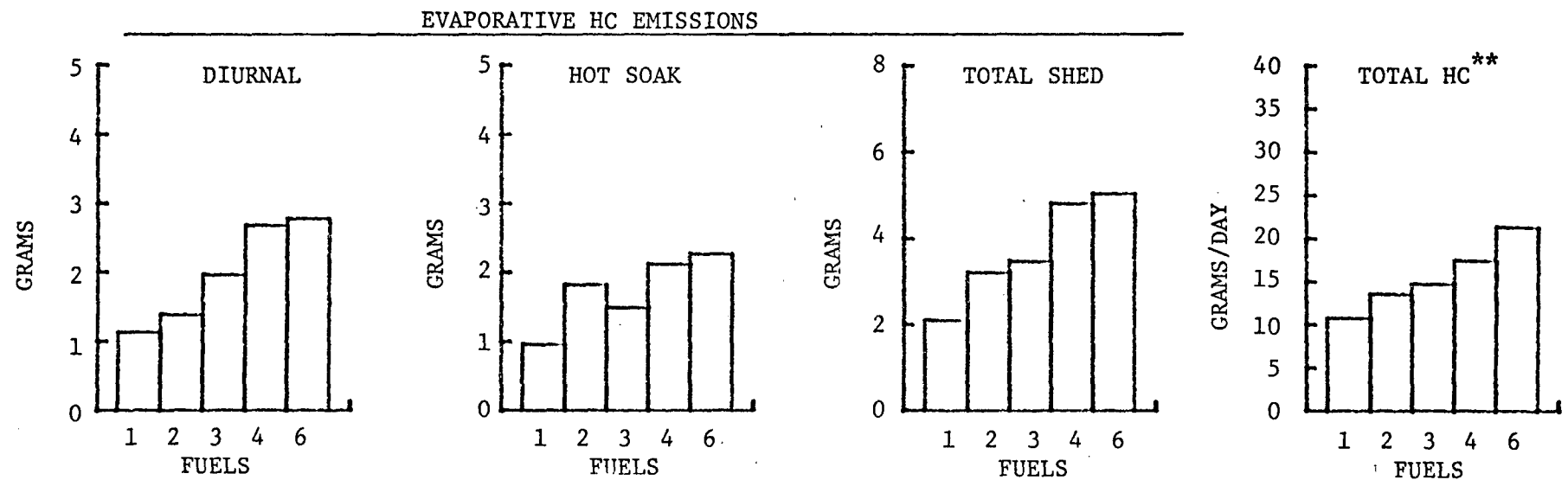
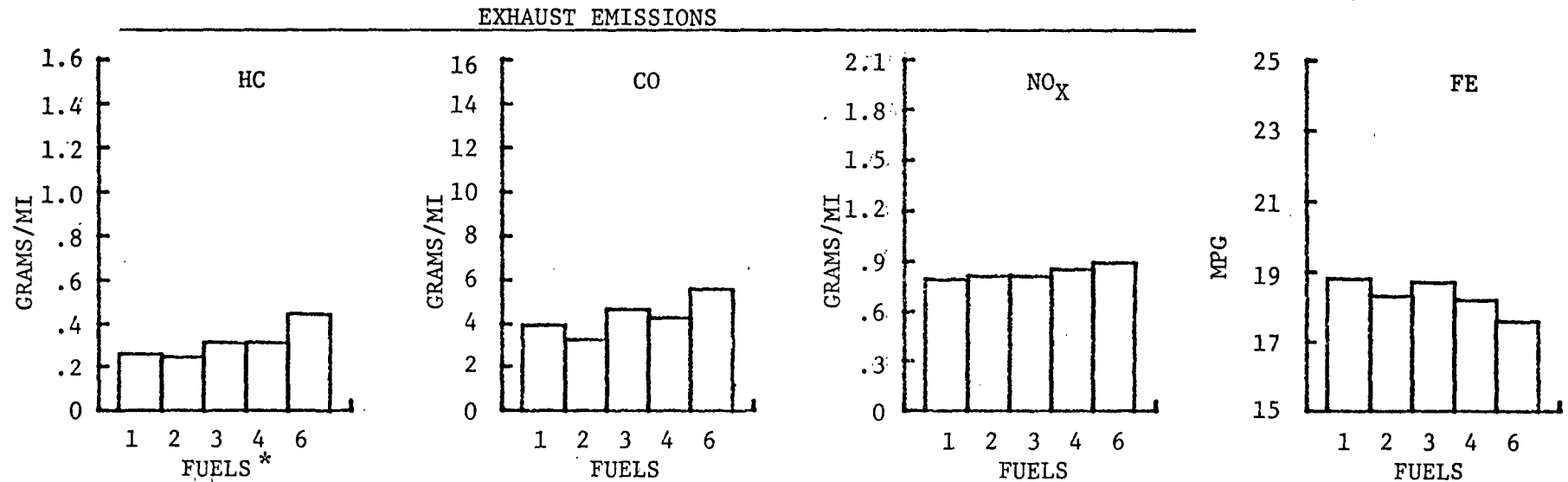


* Fuels: 1. Indolene
 2. Indolene plus 10% Ethanol
 3. Commercial Gasoline

4. 90% Fuel 3 + 10% Ethanol
 6. Blended Gasohol containing
 10% Ethanol

** Exhaust plus Evaporative
 Emissions for 3.3 trips
 per day.

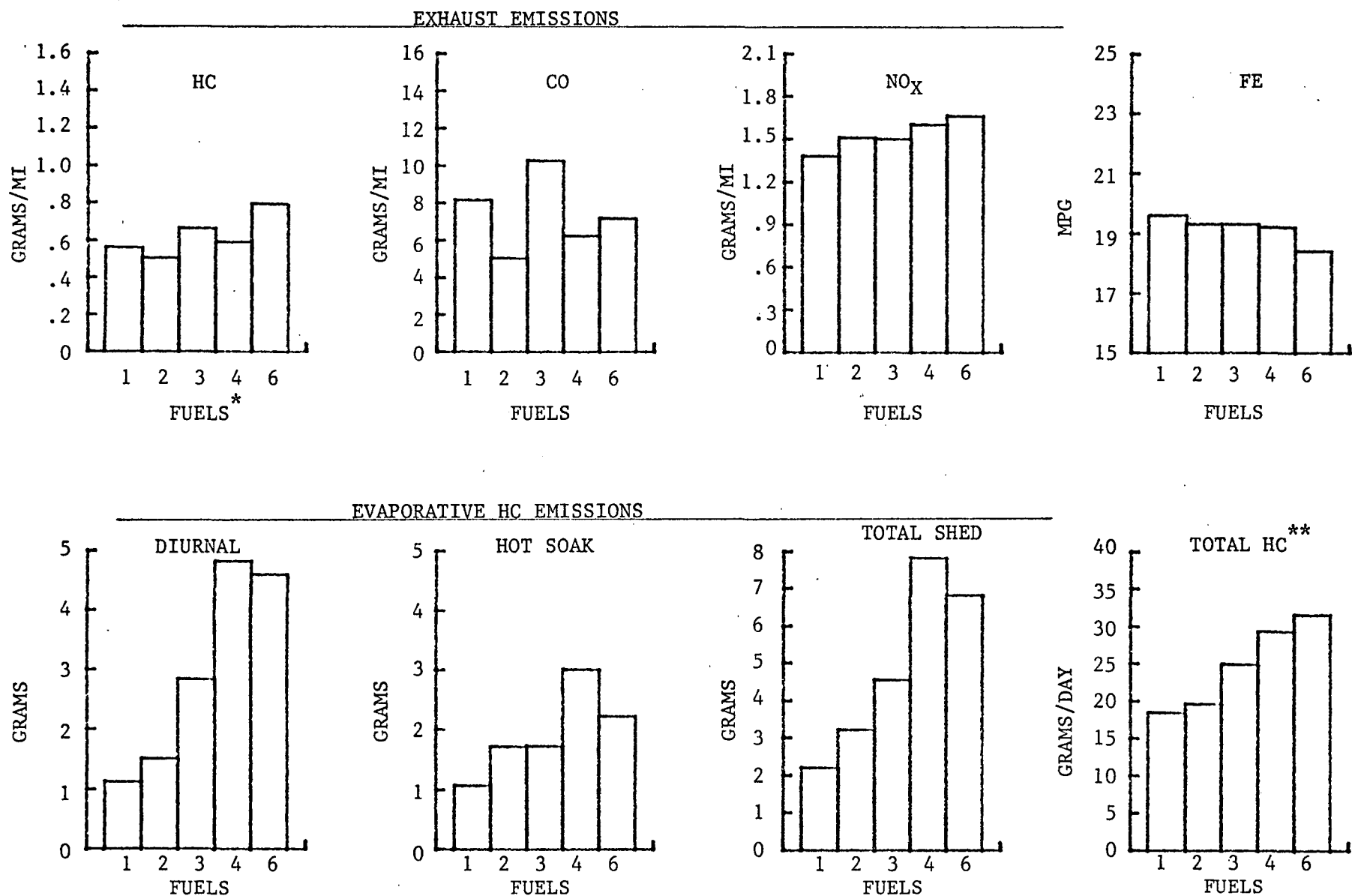
FIGURE 4. AVERAGE EMISSIONS OF 4 1978-79 THREE-WAY CATALYST VEHICLES



* Fuels: 1. Indolene
 2. Indolene plus 10% Ethanol
 3. Commercial Gasoline
 4. 90% Fuel 3 plus 10% Ethanol
 6. Blended Gasohol containing 10% Ethanol

** Exhaust plus Evaporative Emissions for 3.3 trips per day.

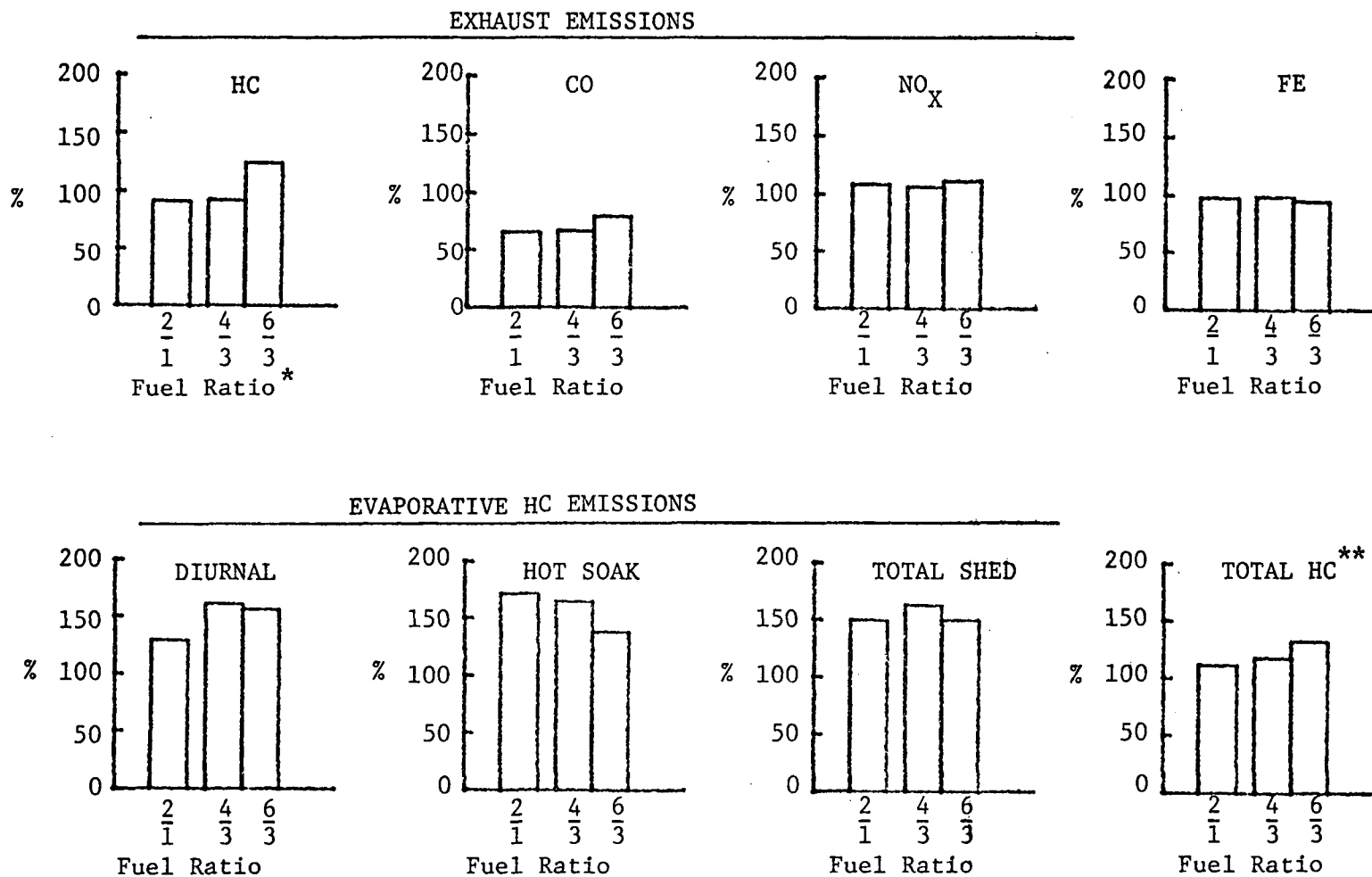
FIGURE 5. AVERAGE EMISSIONS OF 7 1978-79 OXIDATION CATALYST VEHICLES.



* Fuels: 1. Indolene
 2. Indolene plus 10% Ethanol
 3. Commercial Gasoline
 4. 90% Fuel 3 plus 10% Ethanol
 6. Blended Gasohol containing 10 % Ethanol

** Exhaust plus Evaporative Emissions for 3.3 trips per day.

FIGURE 6. RATIOS OF AVERAGE EMISSIONS OF 11 1978-79 CATALYST VEHICLES.



* Fuels: 1. Indolene
 2. Indolene plus 10% Ethanol
 3. Commercial Gasoline
 4. 90% Fuel 3 plus 10% Ethanol
 6. Blended Gasohol containing 10% Ethanol

** Exhaust plus Evaporative Emissions for 3.3 trips per day.

The fuel inspection data shows that gasohol fuels blended by adding Ethanol to a base gasoline are more volatile than the base fuel. The increased RVP and front end volatility of gasohol would be expected to increase diurnal and hot soak losses, respectively. The oxygen present in alcohol causes leaner operation and would be expected to decrease exhaust HC and CO, unless other fuel characteristic changes such as density, viscosity, or volatility were dominant.

Vehicle emission data supports the above relationships:

1. Higher RVP gave higher diurnal losses.
2. Increased front end volatility (up to 50% point) increased hot soak losses.
3. Gasohol generally gave lower HC and CO exhaust emissions than gasoline.

One exception was Fuel 6 - a blended gasohol. Driveability was poor with stumbling, hesitation and backfiring during acceleration on some vehicles. The HC emissions were 24% higher on this gasohol than on the base fuel. CO emissions were 20% lower but this is not as great as the 34% decrease in CO emissions seen with the other two gasohols.

The mean emissions, fuel economy, and cannister weights were determined for each vehicle on each fuel. These tables are presented in appendix D. Note that the fuels are shown in the order run in these tables. Summaries showing the average of vehicle means for all vehicles; for the TWC vehicles; and for the oxidation catalyst vehicles are shown in Tables 1,2, and 3, respectively. Here the means for the five fuels, the difference between selected fuels and ratios of the means of selected fuels is given.

The emissions and fuel economy data in these tables was presented in Figures 3,4, and 5. The last 5 columns of each table contain cannister weight data (grams):

BDBL = before diurnal test
ADBL = after diurnal test
AHSL = after hot soak test
DDBL = Δ diurnal (ADBL-BDBL)
DTEST = Δ test (AHSL-BDBL)

Cannister weights could not be measured before the hot soak test without interfering with the test.

The cannister weight gains during the diurnal breathing loss tests (DDBL) are related to the Reid Vapor Pressures of the fuels. The cannister weights before the diurnal test (BDBL) (which is after a 12-24 hour soak) are fuel related but it is not clear which fuel parameter(s) exert the strongest influence.

ENVIRONMENTAL PROTECTION AGENCY
MOTOR VEHICLE EMISSION LABORATORY
ANN ARBOR, MICHIGAN

Table 1.

GASOHOL PROGRAM DATA SUMMARY

PROCESSED: DEC 15, 1978

(REVISION A: DEC. 27, 1978)

CATALYST TYPES: 3-WAYS AND OX-CATS
NUMBER OF VEHICLES: 11

MEANS OF ALL TESTS		HC	CO	NOX	CO2	FE	DHL	HSL	TLOSS	TOTHC	BDBL	ADBL	AHSL	DDBL	OTEST
		----- (GRAMS/MILE) -----					(MPG)	----- (GRAMS) -----							
FUEL	N														
FUEL 1	(19)	0.451	6.61	1.16	470.	19.3	1.12	1.02	2.14	15.60	890.	904.	885.	13.3	-4.9
FUEL 2	(21)	0.410	4.39	1.26	467.	19.0	1.45	1.75	3.20	17.35	891.	907.	892.	16.3	1.1
FUEL 3	(41)	0.535	8.20	1.25	472.	19.1	2.51	1.63	4.15	21.11	900.	919.	898.	19.4	-2.1
FUEL 4	(21)	0.490	5.51	1.33	468.	18.8	4.04	2.68	6.72	24.97	905.	927.	908.	21.5	2.7
FUEL 6	(25)	0.665	6.57	1.38	482.	18.2	3.93	2.24	6.17	27.76	905.	924.	905.	19.3	0.6
DIFFERENCES BETWEEN MEANS															
FUEL 2 - FUEL 1		-0.041	-2.23	0.09	-3.	-0.4	0.33	0.73	1.06	1.76	1.	4.	7.	3.0	6.0
FUEL 3 - FUEL 1		0.084	1.59	0.08	2.	-0.2	1.39	0.61	2.00	5.52	10.	16.	12.	6.1	2.9
FUEL 4 - FUEL 3		-0.045	-2.69	0.08	-4.	-0.3	1.53	1.04	2.57	3.86	5.	8.	10.	2.1	4.8
FUEL 6 - FUEL 3		0.130	-1.63	0.13	10.	-0.9	1.41	0.61	2.02	6.65	5.	5.	7.	-0.1	2.7
RATIOS OF MEANS (%)															
FUEL 2 / FUEL 1		91.	66.	108.	99.	98.	129.	171.	149.	111.	100.	100.	101.	122.	-23.
FUEL 3 / FUEL 1		119.	124.	107.	100.	99.	224.	160.	193.	135.	101.	102.	101.	145.	42.
FUEL 4 / FUEL 3		92.	67.	106.	99.	99.	161.	164.	162.	118.	101.	101.	101.	111.	-131.
FUEL 6 / FUEL 3		124.	80.	111.	102.	95.	156.	137.	149.	132.	101.	101.	101.	100.	-29.

NOTES: 1. TOTHC IS TOTAL HC EMISSIONS (EXHAUST + EVAPORATIVE) FOR 3.3 TRIPS PER DAY.

2. FUEL DESCRIPTIONS-

1. INDOLINE (RVP=9.0). SOURCE: EPA MVEL LAB FUEL IN USE FOR CERTIFICATION TESTING.
2. 90% INDOLINE + 10% ETHANOL (RVP=9.3). SOURCE: BLENDED USING FUEL NO. 1 AND 200 PROOF ETHANOL AT EPA MVEL
3. COMMERCIAL GASOLINE (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSED ORDER).
4. 90% FUEL NO. 3 + 10% ETHANOL (RVP=10.7). SOURCE: HOWELL HYDROCARBONS (MSED ORDER).
5. BLENDED GASOHOL CONTAINING 10% ETHANOL (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSED ORDER).

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Table 2.

GASOHOL PROGRAM DATA SUMMARY

PROCESSED: DEC 15, 1978
(REVISION A: DEC. 27, 1978)

CATALYST TYPE: 3-WAYS
NUMBER OF VEHICLES: 4

MEANS OF ALL TESTS		HC	CO	NOX	CO2	FE	DHL	HSL	TLOSS	TOTHC	BDBL	ADBL	AHSL	DBDL	DTST
		----- (GRAMS/MILE) -----				(MPG)	----- (GRAMS) -----								
FUEL	N														
FUEL 1	(9)	0.262	3.94	0.79	479.	18.8	1.13	0.95	2.08	10.75	954.	969.	948.	15.0	-6.4
FUEL 2	(10)	0.247	3.29	0.81	475.	18.3	1.38	1.81	3.19	13.49	958.	976.	959.	18.3	1.4
FUEL 3	(16)	0.314	4.64	0.81	479.	18.7	1.96	1.48	3.45	14.65	971.	993.	968.	21.7	-2.9
FUEL 4	(8)	0.314	4.26	0.85	477.	18.2	2.67	2.11	4.79	17.41	977.	1002.	979.	25.4	2.1
FUEL 6	(9)	0.445	5.57	0.89	488.	17.6	2.77	2.26	5.03	21.24	977.	999.	978.	21.9	1.1
DIFFERENCES BETWEEN MEANS															
FUEL 2 - FUEL 1		-0.015	-0.65	0.03	-4.	-0.5	0.25	0.86	1.11	2.74	3.	6.	11.	3.3	7.8
FUEL 3 - FUEL 1		0.053	0.70	0.02	1.	-0.1	0.83	0.53	1.36	3.90	17.	23.	20.	6.7	3.5
FUEL 4 - FUEL 3		-0.001	-0.38	0.04	-3.	-0.5	0.71	0.63	1.34	2.76	5.	9.	10.	3.7	5.1
FUEL 6 - FUEL 3		0.131	0.93	0.07	9.	-1.1	0.80	0.78	1.58	6.60	6.	6.	10.	0.3	4.0
RATIOS OF MEANS (%)															
FUEL 2 / FUEL 1		94.	83.	103.	99.	98.	122.	190.	153.	125.	100.	101.	101.	122.	-21.
FUEL 3 / FUEL 1		120.	118.	103.	100.	100.	174.	156.	165.	136.	102.	102.	102.	145.	46.
FUEL 4 / FUEL 3		100.	92.	105.	99.	97.	136.	142.	139.	119.	101.	101.	101.	117.	-72.
FUEL 6 / FUEL 3		142.	120.	109.	102.	94.	141.	152.	146.	145.	101.	101.	101.	101.	-38.

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NOTES: 1. TOTHC IS TOTAL HC EMISSIONS (EXHAUST + EVAPORATIVE) FOR 3.3 TRIPS PER DAY.

2. FUEL DESCRIPTIONS-

1. INDULENE (RVP=9.0). SOURCE: EPA MVEL LAB FUEL IN USE FOR CERTIFICATION TESTING.
2. 90% INDOLINE + 10% ETHANOL (RVP=9.3). SOURCE: BLENDED USING FUEL NO. 1 AND 200 PROOF ETHANOL AT EPA MVEL
3. COMMERCIAL GASOLINE (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
4. 90% FUEL NO. 3 + 10% ETHANOL (RVP=10.7). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
6. BLENDED GASOHOL CONTAINING 10% ETHANOL (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).

(5. OUT OF SPECIFICATIONS. NOT USED FOR VEHICLE TESTS.)

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Table 3.

GASOHOL PROGRAM DATA SUMMARY

PROCESSED: DEC 15, 1978

CATALYST TYPE: OX-CATS
NUMBER OF VEHICLES: 7

MEANS OF ALL TESTS		HC	CO	NOX	CO2	FE	DHL	HSL	TLOSS	TOTHC	BDBL	ADBL	AHSL	DDHL	UTEST
		----- (GRAMS/MILE) -----				(MPG)	----- (GRAMS) -----								
FUEL	N														
FUEL 1	(10)	0.559	8.14	1.38	465.	19.6	1.12	1.06	2.18	18.37	854.	866.	850.	12.3	-4.1
FUEL 2	(11)	0.503	5.01	1.51	463.	19.3	1.50	1.71	3.21	19.56	853.	868.	854.	15.1	1.0
FUEL 3	(25)	0.661	10.24	1.50	468.	19.3	2.83	1.72	4.54	24.81	859.	877.	858.	18.0	-1.6
FUEL 4	(13)	0.590	6.22	1.60	464.	19.2	4.82	3.00	7.82	29.29	865.	884.	868.	19.3	3.1
FUEL 6	(16)	0.791	7.14	1.66	479.	18.4	4.59	2.22	6.82	31.49	864.	881.	864.	17.8	0.2

DIFFERENCES BETWEEN MEANS

FUEL 2 - FUEL 1	-0.056	-3.13	0.13	-2.	-0.3	0.38	0.65	1.03	1.19	-1.	2.	4.	2.8	5.1
FUEL 3 - FUEL 1	0.102	2.10	0.12	3.	-0.4	1.71	0.66	2.37	6.44	5.	11.	8.	5.7	2.5
FUEL 4 - FUEL 3	-0.071	-4.02	0.11	-4.	-0.1	1.99	1.28	3.27	4.49	6.	7.	10.	1.2	4.6
FUEL 6 - FUEL 3	0.130	-3.10	0.17	11.	-0.8	1.76	0.51	2.27	6.68	4.	4.	6.	-0.2	1.8

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RATIOS OF MEANS (%)

FUEL 2 / FUEL 1	90.	62.	110.	99.	98.	134.	162.	147.	107.	100.	100.	101.	122.	-24.
FUEL 3 / FUEL 1	118.	126.	109.	101.	98.	252.	162.	209.	135.	101.	101.	101.	146.	39.
FUEL 4 / FUEL 3	89.	61.	107.	99.	99.	170.	175.	172.	118.	101.	101.	101.	107.	-195.
FUEL 6 / FUEL 3	120.	70.	111.	102.	96.	162.	130.	150.	127.	101.	100.	101.	99.	-14.

NOTES: 1. TOTHC IS TOTAL HC EMISSIONS (EXHAUST + EVAPORATIVE) FOR 3.3 TRIPS PER DAY.

2. FUEL DESCRIPTIONS-

1. INDULENE (RVP=9.0). SOURCE: EPA MVEL LAB FUEL IN USE FOR CERTIFICATION TESTING.
2. 90% INDULENE + 10% ETHANOL (RVP=9.3). SOURCE: BLENDED USING FUEL NO. 1 AND 200 PROOF ETHANOL AT EPA MVEL
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4. 90% FUEL NO. 3 + 10% ETHANOL (RVP=10.7). SOURCE: HOWELL HYDROCARBONS (MSED ORDER).
6. BLENDED GASOHOL CONTAINING 10% ETHANOL (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSED ORDER).

(5. OUT OF SPECIFICATIONS. NOT USED FOR VEHICLE TESTS.)

Vehicle operation on the FTP causes a net decrease in cannister weight from after the diurnal test to after the hot soak test (AHSL-ADBL). This indicates that the cannister is purging during the test and that there was plenty of cannister capacity available during the hot soak test. High hot soak losses then imply that the evaporative emission control systems do not effectively trap hot soak emissions on these vehicles. This is an important consideration since hot soak losses are more significant than diurnal losses from an air quality viewpoint. This is because there is only one diurnal per day but an average of 3.3 hot soaks per day per vehicle in "real world" use.

SHED Alcohol Data

Ethanol measurements were made on some evaporative emissions tests. Capability for Ethanol measurement did not exist at EPA-MVEL at the start of this program. The Laboratory Branch, in conjunction with EPA-ORD, was able to provide a gas chromatograph and procedure capable of measuring SHED Ethanol concentrations in time to obtain data part way through the program.

Ethanol emissions from gasohol fuels 4 and 6 for the diurnal and hot soak test ranged from .1 to .6 grams for each test. The average diurnal emissions were 0.26 grams Ethanol on 12 tests and the average hot soak emissions were 0.33 grams Ethanol on 10 tests. This amounts to 0.6 grams Ethanol for a complete test or 1.35 grams Ethanol for 3.3 trips*.

Correcting the SHED FID for response to Ethanol would result in a decrease in SHED HC of about 5 percent for the gasohol fuels. The Ethanol present as determined by the GC would then have to be added to the SHED HC to arrive at the total evaporative HC plus Ethanol emissions. This can not be done directly since HC is given in grams of $\text{CH}_{1.85}$ (MW=13.85) and Ethanol is given in grams of $\text{C}_2\text{H}_5\text{OH}$ (MW=46). The reported HC emissions (evaporative and exhaust) are not corrected for Ethanol response of the FID nor for measured Ethanol in the sample.

Driveability

Driveability experiments were not run. However, drivers were requested to note any driveability comments on the test data sheets. These comments indicate a slight degradation in driveability on some vehicles on Fuels 2, 3, and 4. A more severe degradation in driveability on Fuel 6 was noted, with occurrences of backfiring and poor acceleration on several vehicles.

Conclusion

The purpose of this test program was to evaluate the effect on emissions (evaporative and exhaust) that the use of gasohol would have. The data

*3.3 trips per day = DBL X 1.0 + HSL X 3.3

shows that gasohol increased total hydrocarbon emissions by 11 to 32 percent and NOx emissions by 6 to 11 percent while decreasing CO emissions by 20 to 34 percent on the eleven 1978 and 1979 vehicles tested.

Driveability on the blended gasohol (Fuel 6) degraded to the extent that if commercial fuel like Fuel 6 were used it is likely that persons using this fuel would either stop using it or would have their vehicles adjusted to compensate for the different fuel. This would most likely be an air-fuel ratio (A/F) adjustment towards richer operation. Once properly adjusted for gasohol fuel the vehicle exhaust emissions might be expected to be similar to emissions from a vehicle correctly adjusted for and running on gasoline, but evaporative emissions would remain high. However, if a vehicle adjusted for gasohol were then operated on gasoline a rich A/F ratio would result and would likely cause a marked increase in HC and CO emissions while not affecting driveability.

Driveability comments on Indolene plus 10 percent Ethanol compared with Indolene and on S.G. plus 10 percent Ethanol compared with S.G. indicated that the driveability was the same in some cases and slightly degraded (hard to start and stalling when cold) in other cases. Thus these "mixed" gasohols did not pose the driveability problem that the "blended" gasohol did.

It is not known if a decreased volatility gasohol could be blended which would not cause an increase in evaporative emissions or degradation in driveability on in-use vehicles. The "blended" gasohol (Fuel 6) used in this program did result in increased evaporative emissions over Fuel 3 even though its RVP and distillation curve were adjusted close to that of Fuel 3.

Other considerations regarding the use of Ethanol in gasoline, such as emission system deterioration, fuel system compatibility, or cost of production were beyond the scope of this program and were not addressed.

Appendix A.
Test Procedure

Gasohol Test Sequence

1. Drain and refuel to 20% tank capacity.
2. Run 1 LA-4 cycle.
 - a. Check idle CO and RPM first time on each fuel.
3. Hot soak one hour (key off to key on).
4. Drain and refuel to 40% tank capacity.
5. Run 1 LA-4 cycle.
6. Soak 12-24 hours @ 68-86F (key off to key on).
7. Run 1 FTP with SHED:
 - a. Drain and refuel to 40% tank capacity (leave fuel cap off).
 - b. Move vehicle to SHED.
 - c. Weigh cannister.
 - d. Check cannister lines.
 - e. Perform 1 hour diurnal heat build. (Fuel cap on @ 60°F.)
 - f. Immediately after heat build:
 - Remove heat blanket
 - Weigh cannister
 - Reinstall cannister & check cannister lines.
 - g. Run 3 bag FTP emissions test within 15-60 minutes of end of diurnal test.
 - h. Run 1 hour hot soak immediately following emissions test.
 - i. Weigh cannister immediately following hot soak test.
8. Precondition for next test:
 - a. If within 24 hours of FTP key off go to step 4.
 - b. If longer than 24 hours since FTP key off go to step 1.
 - c. If changing fuel type go to step 1.
9. Two tests for each fuel type with following sequence:
 - 1,2,3,4,6,3 for group 1 vehicles.
 - 3,4,6,3,1,2 for group 2 vehicles.
 - (6 fuel runs X 2 tests each X 11 vehicles = 132 tests)

Appendix B.
Test Fuel Data

B-1

Typical Fuel Inspection Data

ITEM	Analyzed by <u>1/</u>	Fuel 1 EPA	Fuel 2 EPA	Fuel 3 Howell	Fuel 4 Howell	Fuel 5 Howell	Fuel 6 Howell	Nat'l. Avg. <u>2/</u>	Calif. <u>2/</u>
1. API Gravity	H-3,4,5,6	-	-	57.5	56.5	61.0	52.6	59.3	57.7
2. Sp. Gr.	C	-	-	0.749	0.753	0.735	0.769	.742	.748
3. R.O.N.	E-1,2,3,4 H-5,6	98.0	100.5	92.0	95.4	95.5	96.4	92.9	93.2
4. M.O.N.	H-3,4,5,6	-	-	82.6	84.2	88.1	88.6	83.9	84.7
5. Ole. %	E-1 H-3,4,5,6	2.5	-	16.5	16.6	0.4	17.6	7.2 ^{4/}	-
6. Aro. %	E-1 H-3,4,5,6	24.0	-	28.5	28.9	23.0	34.6	30.8 ^{4/}	-
7. RVP, PSI	M-1-6	9.0	9.2	10.0	10.7	7.9	10.0	9.8	8.4
8. Dist., F, <u>3/</u>									
	IBP	87	94	89	86	107	94	89	94
	10%	128	130	119	118	126	126	121	126
	20%	162	147	142	132	136	139	146	147
	30%	194	156	167	144	145	150	171	168
	40%	215	179	196	154	152	162	-	-
	50%	229	220	227	201	205	242	221	216
	60%	240	234	255	243	232	280	-	-
	70%	253	245	287	272	260	311	266	275
	80%	274	265	321	314	295	335	-	-
	90%	313	309	360	355	321	370	333	344
	EP	383	386	417	413	337	408	410	413

1/ H = Howell Hydrocarbons, Ethyl = Ethyl Cord, M = EPA-MVEL, D = D.O.E. Fuel Survey,
C = Calculated value.

2/ D.O.E. Fuel Survey, Summer, 1977.

3/ Fuels 1-6 were analyzed by EPA.

4/ MVMA Fuel Survey, Summer, 1977.

Appendix C.
Vehicle Specification Sheets

REPORT TIME 17:27:40
DATE NOV 22, 1978

VEHICLE SPECIFICATION REPORT - (STANDARD) - DATE OF ENTRY : 11/22/78

VEHICLE SPECIFICATIONS

MANUFACTURER		VEHICLE ID / VER		REPRESENTED CARLINE		MODEL CODE		DRIVE CODE		SOURCE	
FORD		71S42		0		THUNDERBIRD		SEDAN		MANUFACTURER	

VEHICLE TYPE	ACTUAL VEHICLE MODEL	MODEL YEAR	ACT YEAR	DRIVE AXLE WTS		CURB WEIGHT	INERTIA CLASS	O/D CDE	ACTUAL DYNO HP	TIRE - SPECIFICATIONS		SWL HLT PSI		
				FULL TANK	EMPTY TANK					MFR	CONSTR	N	M	N
THIRD		79	79				4500 P	2	13.1	GR78-14				

PRIMARY DURABILITY VEHICLE IDENTIFICATION OR ASSIGNED OF (IF APPLICABLE)

ALT. MANUFACTURER

ENGINE SPECIFICATIONS

DISPLACEMENT	BORF	STROKE	RATED HP	ENGINE TYPE	ENGINE CONFIGURATION	NO. CYL	NO. CARBS	TOTAL NO. BARRELS	FUEL SYSTEM MFR/MODEL	FUEL INJECTION	COMP. RATIO	COAST-DOWN TM
351. E	.	.		OTTO SPARK	V-FLUCK	08	01	02	FDBK CARB	NO	8.4	

IGNITION TIMING 1	IGNITION TIMING 2	TIM. TOL.	TIMING RPM	RPM TOL.	TIM. GEAR	% CO LEFT	% CO RIGHT	% CO COMB.	CO TOL.	IDLE RPM	IDLE TOL.	IDLE GEAR	ENGINE FAMILY	ENGINE CODE
308			550							550		DRIVE	351W	

DRIVE TRAIN AND CONTROL SYSTEM SPECIFICATIONS

AXLF RATIO	N/V RATIO	ODOMETER	A/C INSTALLED	EXHAUST TYPE	CRANKCASE SYSTEM	TRANSMISSION CONFIGURATION	CODE	EVAPORATION SYSTEM	FUEL TYPE
3.0	.	MILES	YES	SINGLE LEFT REAR	CLOSED	AUTO		CANISTER	IND UNLEADED, 91 OCT

MAIN-TANK CAPACITY	VOLUME	AUX.-TANK CAPACITY	VOLUME	SHIFT SPEED	EVAPORATIVE EMISSION FAMILY	CODE	SALES CLASS
22.06	8.96			DO NOT SHIFT MANUALLY			

CONTROL SYSTEM TYPES

AIR INJECTION

VEHICLE SPECIFICATION COMMENTS

REQUESTOR ID : 17245
NAME: S. DORFER

TEST # 79-5628 X

VEHICLE SPECIFICATION REPORT - (TESTING GEN) - DATE OF ENTRY : 10/16/78

VEHICLE SPECIFICATIONS

MANUFACTURER		VEHICLE ID / VER		REPRESENTED CAPLINE		MODEL CODE		DRIVE CODE		SOURCE	
FORD		8Y2-2.3-C-122 2		BOBCAT WAGON		WAGON		REAR DRIVE STR. LEFT		MANUFACTURER	

VEHICLE TYPE		ACTUAL VEHICLE MODEL		MODEL YEAR	ACT YEAR	DRIVE AXLE WTS FULL TANK EMPTY TANK		CURB WEIGHT	INERTIA CLASS	O/D CODE	ACTUAL DYNO HP	TIRE - SPECIFICATIONS TIRE & RIM SIZES MFR CONSTR		SWL BLT PSI N M N M F I RR
NON-CER		BOBCAT		78	78			2696P	3000P	1	10.3	8R/8X13		

PRIMARY DURABILITY VEHICLE IDENTIFICATION OR ASSIGNED DF (IF APPLICABLE) ALT. MANUFACTURER
#E22.31488080AXR

ENGINE SPECIFICATIONS

DISPLACEMENT	BORE	STROKE	RATED HP	ENGINE TYPE	ENGINE CONFIGURATION	NO. CYL	NO. CARBS	TOTAL NO. BARRELS	FUEL SYSTEM MFR/MODEL	FUEL INJECTION	COMP. RATIO	COAST-DOWN TM
149. E	3.6 E	3.1 E	92	OTTO SPARK	IN-LINE	4	1	2	HOLLEY6500	NO	9.0	

IGNITION TIMING 1	IGNITION TIMING 2	TIM. TOL.	TIMING RPM	RPM TOL.	TIM. GEAR	% CO LEFT	% CO RIGHT	% CO COMB.	CO TOL.	IDLE RPM	IDLE TOL.	IDLE GEAR	ENGINE FAMILY	ENGINE CODE
68			650							850	50	NEUTRAL	F2.3B1TR80XR80	8-2P-R10

DRIVE TRAIN AND CONTROL SYSTEM SPECIFICATIONS

AXLE RATIO	N/V RATIO	ODOMETER	A/C INSTALLED	EXHAUST TYPE	CRANKCASE SYSTEM	TRANSMISSION CONFIGURATION	CODE	EVAPORATION SYSTEM	FUEL TYPE
3.18	46.	MILES	NO	SINGLE LEFT REAR	CLOSED	M-4		CONISTER	IND UNLEADED, 100 OCT

MAIN-TANK CAPACITY	N/V VOLUME	AUX.-TANK CAPACITY	VOLUME	SHIFT SPEED	EVAPORATIVE EMISSION FAMILY	CODE	SALES CLASS
14.0G	5.6G			SPECIAL SHIFT SPDs (MAN OR S-A)			CALIF. LIGHT DUTY VEH

CONTROL SYSTEM TYPES

AIR INJECTION	CATALYTIC REACTOR	EXHAUST RECYCLE
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VEHICLE SPECIFICATION COMMENTS

GASOHOL PROJECT

ANAL./TEST VALID.

TEST VALID./DATA

DATA/CERT. (PRELIM.)

CERT./TEST VALID.

TEST VALID./CERT. (OFF.)

 VEHICLE SPECIFICATION REPORT - (STANDARD) - DATE OF ENTRY : 11/22/78

 VEHICLE SPECIFICATIONS

MANUFACTURER		VEHICLE ID / VER		REPRESENTED CARLINE		MODEL CODE		DRIVE CODE		SOURCE	
GENERAL MOTORS		80153		0		SUNBIRD		SEDAN		REAR DRIVE STR. LEFT	
										MANUFACTURER	

VEHICLE TYPE		ACTUAL VEHICLE MODEL		MODEL YEAR	ACT YEAR	DRIVE AAL VTS		CURB WEIGHT	INERTIA CLASS	O/D CODE	ACTUAL DYNO HP	TIRE - SPECIFICATIONS		SWL RLT PSI	
						FULL TANK	EMPTY TANK					TIRE & RIM SIZES	MFR	CONSTR N M N M FT RR	
NON-CER		SUNBIRD		78	78				3000		11.4				

 PRIMARY DURABILITY VEHICLE IDENTIFICATION OR ASSIGNED DF (IF APPLICABLE)

 ALT. MANUFACTURER

 ENGINE SPECIFICATIONS

DISPLACEMENT	BORE	STROKE	RATED HP	ENGINE TYPE	ENGINE CONFIGURATION	NO. CYL	NO. CARBS	TOTAL NO. BARRELS	FUEL SYSTEM MFR/MODEL	FUEL INJECTION	COMP. RATIO	COAST-DOWN TM
151.	.	.		OTTO SPARK	IN-LINE	4	1					
IGNITION TIMING 1	IGNITION TIMING 2	TIM. TOL.	TIMING RPM	RPM TOL.	TIM. GEAR	% CO LEFT	% CO RIGHT	% CO COMB.	CO TOL.	IDLE RPM	IDLE TOL.	IDLE GEAR
148			1000									DRIVE
									ENGINE FAMILY	ENGINE CODE		
									20X2CEU			

 DRIVE TRAIN AND CONTROL SYSTEM SPECIFICATIONS

AXLE RATIO	N/V RATIO	ODOMETER	A/C INSTALLED	EXHAUST TYPE	CRANKCASE SYSTEM	TRANSMISSION CONFIGURATION	EVAPORATION SYSTEM	FUEL TYPE
2.93	.	MILES	YES			AUTO	CANISTER	IND UNLEADED, 91 OCT

MAIN-TANK CAPACITY	VOLUME	AUX.-TANK CAPACITY	VOLUME	SHIFT SPEED	EVAPORATIVE EMISSION FAMILY	CODE	SALES CLASS
18.59	7.49			DO NOT SHIFT MANUALLY			CALIF. LIGHT DUTY VEHICLE

 CONTROL SYSTEM TYPES

 VEHICLE SPECIFICATION COMMENTS

REPORT TIME 16119:20
DATE NOV 29, 1978

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VEHICLE SPECIFICATION REPORT - (STANDARD) - DATE OF ENTRY : 11/29/78

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VEHICLE SPECIFICATIONS

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MANUFACTURER		VEHICLE ID / VER		REPRESENTED CARLINE		MODEL CODE		DRIVE CODE		SOURCE	
GENERAL MOTORS		48257 0		REGAL		SEDAN		REAR DRIVE STR. LEFT		MANUFACTURER	

										TIRE - SPECIFICATIONS				
VEHICLE TYPE	ACTUAL VEHICLE MODEL	MODEL YEAR	ACT YEAR	DRIVE FULL TANK	AXL EMPTY TANK	WTS CURB WEIGHT	INERTIA CLASS	O/D CODE	ACTUAL DYNO HP	TIRE & RIM SIZES	MFR	CONSTR	N M N M FT RR	SWL RLT PSI
NON-CER	HUICK-REGAL	78	78				3500		12.2	P95/75R14				

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PRIMARY DURABILITY VEHICLE IDENTIFICATION OR ASSIGNED DF (IF APPLICABLE)

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ALT. MANUFACTURER

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ENGINE SPECIFICATIONS

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DISPLACEMENT	BORE	STROKE	RATED HP	ENGINE TYPE	ENGINE CONFIGURATION	NO. CYL	NO. CARBS	TOTAL NO. BARRELS	FUEL SYSTEM MFR/MODEL	FUEL INJECTION	COMP. RATIO	COAST-DOWN TM
3800. M	.	.		OTTO SPARK	V-6LUCK	6	1	2			.	

IGNITION TIMING 1	IGNITION TIMING 2	TIM. TOL.	TIMING RPM	RPM TOL.	TIM. GEAR	% CO LEFT	% CO RIGHT	% CO COMB.	CO TOL.	IDLE RPM	IDLE TOL.	IDLE GEAR	ENGINE FAMILY	ENGINE CODE
158			600		DDRIVE					600		DRIVE	940E2CYU	

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DRIVE TRAIN AND CONTROL SYSTEM SPECIFICATIONS

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AXLE RATIO	N/V RATIO	ODOMETER	A/C INSTALLED	EXHAUST TYPE	CRANKCASE SYSTEM	TRANSMISSION CONFIGURATION	CODE	EVAPORATION SYSTEM	FUEL TYPE
2.73	.	MILES	YES	SINGLE RIGHT REAR		AUTO		CANISTER	IND UNLEADED, 100 OCT

MAIN-TANK CAPACITY	VOLUME	AUX.-TANK CAPACITY	VOLUME	SHIFT SPEED	EVAPORATIVE EMISSION FAMILY	CODE	SALES CLASS
18.16	7.26			DO NOT SHIFT MANUALLY			CALIF. LIGHT DUTY VEH

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CONTROL SYSTEM TYPES

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VEHICLE SPECIFICATION COMMENTS

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 VEHICLE SPECIFICATION REPORT - (TESTNO GEN) - DATE OF ENTRY : 10/16/78

 VEHICLE SPECIFICATIONS

MANUFACTURER		VEHICLE ID / VER		REPRESENTED CARLINE	MODEL CODE	DRIVE CODE	SOURCE
FORD		881-302-F-97 5		MAVERICK	SEDAN	REAR DRIVE STR. LEFT	MANUFACTURER

VEHICLE TYPE	ACTUAL VEHICLE MODEL	MODEL YEAR	ACT YEAR	DRIVE AXL WTS		CURB WEIGHT	INRTIA CLASS	O/D CDE	ACTUAL DYNO HP	TIRE - SPECIFICATIONS		SWL BLT PSI		
				FULL TANK	EMPTY TANK					TIRE & RIM SIZES	MFR	CONSTR	N	M
NON-CER	MAVERICK-Fox	78	78			3129P	3500P	1	9.7	DR76X14				

 PRIMARY DURABILITY VEHICLE IDENTIFICATION OR ASSIGNED DF (IF APPLICABLE)

701-302-4A5A

 ALT. MANUFACTURER

FORD

 ENGINE SPECIFICATIONS

DISPLACEMENT	BORE	STROKE	RATED HP	ENGINE TYPE	ENGINE CONFIGURATION	NO. CYL	NO. CARBS	TOTAL NO. BARRELS	FUEL SYSTEM MFR/MODEL	FUEL INJECTION	COMP. RATIO	COAST-DOWN TM
302. E	4. F	3. E	135	OTTO SPARK	V-BLOCK	8	1	2	CARBURETOR	NO	8.4	

IGNITION TIMING 1	IGNITION TIMING 2	TIM. TOL.	TIMING RPM	RPM TOL.	T.M. GEAR	% CO LEFT	% CO RIGHT	% CO COMB.	CO TOL.	IDLE RPM	IDLE TOL.	IDLE GEAR	ENGINE FAMILY	ENGINE CODE
6R				500	N					600	50	DRIVE	F302A1X95	8-11M-R17

 DRIVE TRAIN AND CONTROL SYSTEM SPECIFICATIONS

AXLE RATIO	N/V RATIO	ODOMETER	A/C INSTALLED	EXHAUST TYPE	CRANKCASE SYSTEM	TRANSMISSION CONFIGURATION	CODE	EVAPORATION SYSTEM	FUEL TYPE
2.47	34.	MILES	YES		CLOSED	A-3		CANISTER	IND UNLEADED, 100 OCT

MAIN-TANK CAPACITY	N/V VOLUME	AUX.-TANK CAPACITY	AUX.-TANK VOLUME	SHIFT SPEED	EVAPORATIVE EMISSION FAMILY	CODE	SALES CLASS
16. G	6.46			DO NOT SHIFT MANUALLY			49 STATE LIGHT DUTY VEH

 CONTROL SYSTEM TYPES

AIR INJECTION

CATALYTIC REACTOR

EXHAUST RECYCLE

 VEHICLE SPECIFICATION COMMENTS

GASOHOL PROJECT

ANAL./TEST VALID.

TEST VALID./DATA

DATA/CERT.(PRELIM.)

CERT./TEST VALID.

TEST VALID./CERT.(OFF.)

 VEHICLE SPECIFICATION REPORT - (TESTNO GEN) - DATE OF ENTRY : 10/16/78

 VEHICLE SPECIFICATIONS

MANUFACTURER		VEHICLE ID / VER		REPRESENTED CARLINE		MODEL CODE		DRIVE CODE		SOURCE	
FORD		9E2-2.3-F-85		5 PINTO		SEDAN		REAR DRIVE STR. LEFT		MANUFACTURER	

VEHICLE TYPE	ACTUAL VEHICLE MODEL	MODEL YEAR	ACT YEAR	DRIVE AXL WTS		CURB WEIGHT	INRTIA CLASS	O/D CDE	ACTUAL DYNO HP	TIRE - SPECIFICATIONS			
				FULL TANK	EMPTY TANK					TIRE & RIM SIZES	MFK	CONSTR	N M N M FT RR
NON-CER	PINTO	79	79	1016P	1P	2494P	2750P	1	9.7	A70x13	FIRESTONE		

 PRIMARY DURABILITY VEHICLE IDENTIFICATION OR ASSIGNED DF (IF APPLICABLE)

7E1-2.3-4ADA

 ALT. MANUFACTURER

 ENGINE SPECIFICATIONS

DISPLACEMENT	BORE	STROKE	RATED HP	ENGINE TYPE	ENGINE CONFIGURATION	NO. CYL	NO. CARBS	TOTAL NO. BARRELS	FUEL SYSTEM MFR/MODEL	FUEL INJECTION	COMP. RATIO	COAST-DOWN TM
140. E	3.8 E	3.1 E	92	OTTO SPARK	IN-LINE	04	01	02	HOLLEY5200	NO	9.0	

IGNITION TIMING 1	IGNITION TIMING 2	TIM. TOL.	TIMING RPM	RPM TOL.	TIM. GEAR	% CO LEFT	% CO RIGHT	% CO COMB.	CO TOL.	IDLE RPM	IDLE TOL.	IDLE GEAR	ENGINE FAMILY	ENGINE CODE
68			550		NNEUTRAL					850	50	NEUTRAL	2.3A1X92	902AK00N

 DRIVE TRAIN AND CONTROL SYSTEM SPECIFICATIONS

AXLE RATIO	N/V RATIO	ODOMETER	A/C INSTALLED	EXHAUST TYPE	CRANKCASE SYSTEM	TRANSMISSION CONFIGURATION	EVAPORATION SYSTEM	FUEL TYPE
2.73	40.	MILES	YES	SINGLE LEFT REAR	CLOSED	M-4	CANISTER	IND UNLEADED, 100 OCT

MAIN-TANK CAPACITY	MAIN-TANK VOLUME	AUX.-TANK CAPACITY	AUX.-TANK VOLUME	SHIFT SPEED	EVAPORATIVE EMISSION FAMILY	EVAPORATIVE EMISSION CODE	SALES CLASS
11.76	4.76			15 - 25 - 40	BA	B-1-9AK0	49 STATE LIGHT DUTY VEH

 CONTROL SYSTEM TYPES

 EXHAUST RECYCLE

 AIR PUMP

 OXIDATION CATALYST

 VEHICLE SPECIFICATION COMMENTS

GASOHOL PROJECT

ANAL./TEST VALID.

TEST VALID./DATA

DATA/CERT.(PRELIM.)

CERT./TEST VALID.

TEST VALID./CERT.(OFF.)

 VEHICLE SPECIFICATION REPORT - (STANDARD) - DATE OF ENTRY : 11/27/78

 VEHICLE SPECIFICATIONS

MANUFACTURER		VEHICLE ID / VER		REPRESENTED CARLINE		MODEL CODE		DRIVE CODE		SOURCE	
GENERAL MOTORS		88042		0 IMPALA		SEDAN		REAR DRIVE STR. LEFT		MANUFACTURER	

VEHICLE TYPE		ACTUAL VEHICLE MODEL		MODEL YEAR	ACT YEAR	DRIVE FULL TANK	AXL WTS EMPTY TANK	CURB WEIGHT	INRTIA CLASS	O/D CDE	ACTUAL DYNO HP	TIRE & RIM SIZES	TIME - SPECIFICATIONS							
													MFR	CONSTR	N	M	M	FT	RR	
NON-CER		IMPALA		77	77				4000P		13.3	GR78/15								

 PRIMARY DURABILITY VEHICLE IDENTIFICATION OR ASSIGNED OF (IF APPLICABLE)

 ALT. MANUFACTURER

 ENGINE SPECIFICATIONS

DISPLACEMENT	BORE	STROKE	RATED HP	ENGINE TYPE	ENGINE CONFIGURATION	NO. CYL	NO. CARBS	TOTAL NO. BARRELS	FUEL SYSTEM MFR/MODEL	FUEL INJECTION	COMP. RATIO	COAST-DOWN TM
350. E	.	.		OTTO SPARK	V-BLOCK	8	1	4			.	

IGNITION TIMING 1	IGNITION TIMING 2	TIM. TOL.	TIMING RPM	RPM TOL.	TIM. GEAR	% CO LEFT	% CO RIGHT	% CO COMP.	CO TOL.	IDLE RPM	IDLE TOL.	IDLE GEAR	ENGINE FAMILY	ENGINE CODE
6B			500		DDRIVE					500		DRIVE	910L4-42	

 DRIVE TRAIN AND CONTROL SYSTEM SPECIFICATIONS

AXLE RATIO	N/V RATIO	ODOMETER	A/C INSTALLED	EXHAUST TYPE	CRANKCASE SYSTEM	TRANSMISSION CONFIGURATION	CODE	EVAPORATION SYSTEM	FUEL TYPE
.	.	MILES	YES	SINGLE RIGHT REAR		AUTO		CANISTER	IND UNLEADED, 100 OCT

MAIN-TANK CAPACITY		AUX.-TANK CAPACITY		SHIFT SPEED		EVAPORATIVE EMISSION FAMILY		SALES CLASS	
VOLUME		VOLUME				CODE			
20.7G	8.3G			DO NOT SHIFT MANUALLY				49 STATE LIGHT DUTY VEH	

 CONTROL SYSTEM TYPES

 VEHICLE SPECIFICATION COMMENTS

 VEHICLE SPECIFICATION REPORT - (STANDARD) - DATE OF ENTRY : 11/27/78

 VEHICLE SPECIFICATIONS

MANUFACTURER		VEHICLE ID / VER		REPRESENTED CARLINE	MODEL CODE	DRIVE CODE	SOURCE
GENERAL MOTORS		5944	0	REGAL	SEDAN	REAR DRIVE STR. LEFT	MANUFACTURER

VEHICLE TYPE	ACTUAL VEHICLE MODEL	MODEL YEAR	ACT YEAR	DRIVE AXL WTS		CURR WEIGHT	INRTIA CLASS	O/D CDE	ACTUAL DYNO HP	TIRE - SPECIFICATIONS								
				FULL TANK	EMPTY TANK					TIRE & RIM SIZES	MFR	CONSTR	N	M	M	FT	RR	
NON-CER	BUICK REGAL	78	78				3500P		12.2	P205/70R14								

 PRIMARY DURABILITY VEHICLE IDENTIFICATION OR ASSIGNED OF (IF APPLICABLE)

 ALT. MANUFACTURER

 ENGINE SPECIFICATIONS

DISPLACEMENT	BORE	STROKE	RATED HP	ENGINE TYPE	ENGINE CONFIGURATION	NO. CYL	NO. CARBS	TOTAL NO. BARRELS	FUEL SYSTEM MFR/MODEL	FUEL INJECTION	COMP. RATIO	COAST-DOWN TM
3800. M	.	.		OTTO SPARK	V-BLOCK	6	1	2			.	

IGNITION TIMING 1	IGNITION TIMING 2	TIM. TOL.	TIMING RPM	RPM TOL.	TIM. GEAR	% CO LEFT	% CO RIGHT	% CO COMB.	CO TOL.	IDLE RPM	IDLE TOL.	IDLE GEAR	ENGINE FAMILY	ENGINE CODE
158			600		DDRIVE					550		DRIVE	940B2	

 DRIVE TRAIN AND CONTROL SYSTEM SPECIFICATIONS

AXLE RATIO	N/V RATIO	ODOMETER	A/C INSTALLED	EXHAUST TYPE	CRANKCASE SYSTEM	TRANSMISSION CONFIGURATION	EVAPORATION SYSTEM	FUEL TYPE
2.41	.	MILES	YES	SINGLE RIGHT REAR		AUTO	CRANKCASE	IND UNLEADED, 100 OCT

MAIN-TANK CAPACITY	MAIN-TANK VOLUME	AUX.-TANK CAPACITY	AUX.-TANK VOLUME	SHIFT SPEED	EVAPORATIVE EMISSION FAMILY	EVAPORATIVE EMISSION CODE	SALES CLASS
18.1G	7.2G			DO NOT SHIFT MANUALLY			49 STATE LIGHT DUTY VEH

 CONTROL SYSTEM TYPES

 VEHICLE SPECIFICATION COMMENTS

 VEHICLE SPECIFICATION REPORT - (STANDARD) - DATE OF ENTRY : 11/27/78

 VEHICLE SPECIFICATIONS

MANUFACTURER		VEHICLE ID / VER		REPRESENTED CARLINE		MODEL CODE		DRIVE CODE		SOURCE	
CHRYSLER		ZL44A8D159064 0		OMNI		SEDAN		FRONT DRIVE STR. LEFT		MANUFACTURER	

										TIRE - SPECIFICATIONS			
VEHICLE TYPE	ACTUAL VEHICLE MODEL	MODEL YEAR	ACT YEAR	DRIVE FULL TANK	AXL WTS EMPTY TANK	CURB WEIGHT	INRTIA CLASS	O/D CDE	ACTUAL DYNO HP	TIRE & RIM SIZES	MFR	CONSTR	N M N M FT RR
NON-CER	OMNI	78	78				2500P		7.3	P165/75R13			

 PRIMARY DURABILITY VEHICLE IDENTIFICATION OR ASSIGNED DF (IF APPLICABLE)

 ALT. MANUFACTURER

 ENGINE SPECIFICATIONS

DISPLACEMENT	BORE	STROKE	RATED HP	ENGINE TYPE	ENGINE CONFIGURATION	NO. CYL	NO. CARBS	TOTAL NO. BARRELS	FUEL SYSTEM MFR/MODEL	FUEL INJECTION	COMP. RATIO	COAST-DOWN TM
105. E	.	.		OTTO SPARK	IN-LINE	4	1				.	

IGNITION TIMING 1	IGNITION TIMING 2	TIM. TOL.	TIMING RPM	RPM TOL.	TIM. GEAR	% CO LEFT	% CO RIGHT	% CO COMB.	CO TOL.	IDLE RPM	IDLE TOL.	IDLE GEAR	ENGINE FAMILY	ENGINE CODE
15B		2	900	100	NNEUTRAL					900	100	NEUTRAL	FG-105-2-KA	

 DRIVE TRAIN AND CONTROL SYSTEM SPECIFICATIONS

AXLE RATIO	N/V RATIO	ODOMETER	A/C INSTALLED	EXHAUST TYPE	CRANKCASE SYSTEM	TRANSMISSION CONFIGURATION	CODE	EVAPORATION SYSTEM	FUEL TYPE
.	.	MILES	YES	SINGLE RIGHT REAR		AUTO		CANISTER	IND UNLEADED, 100 OCT

MAIN-TANK CAPACITY	VOLUME	AUX.-TANK CAPACITY	VOLUME	SHIFT SPEED	EVAPORATIVE EMISSION FAMILY	CODE	SALES CLASS
13.0G	5.2G			DO NOT SHIFT MANUALLY			

 CONTROL SYSTEM TYPES

 VEHICLE SPECIFICATION COMMENTS

 VEHICLE SPECIFICATION REPORT - (STANDARD) - DATE OF ENTRY : 11/27/78

 VEHICLE SPECIFICATIONS

MANUFACTURER		VEHICLE ID / VER		REPRESENTED CARLINE		MODEL CODE		DRIVE CODE		SOURCE	
CHRYSLER		RH41G8A206799 0		SALON		SEDAN		REAR DRIVE STR. LEFT		MANUFACTURER	

VEHICLE TYPE	ACTUAL VEHICLE MODEL	MODEL YEAR	ACT YEAR	DRIVE AXL WTS		CURB WEIGHT	INRTIA CLASS	O/D COE	ACTUAL DYNO HP	TIRE - SPECIFICATIONS			
				FULL TANK	EMPTY TANK					TIRE & RIM SIZES	MFR	CONSTR	N M N M
NON-CER	PLYMOUTH-SALON	78	78				4500P		12.3	F78/15			

PRIMARY DURABILITY VEHICLE IDENTIFICATION OR ASSIGNED DF (IF APPLICABLE)										ALT. MANUFACTURER	

 ENGINE SPECIFICATIONS

DISPLACEMENT	BORE	STROKE	RATED HP	ENGINE TYPE	ENGINE CONFIGURATION	NO. CYL	NO. CARBS	TOTAL NO. BARRELS	FUEL SYSTEM MFR/MODEL	FUEL INJECTION	COMP. RATIO	COAST-DOWN TM
318.				OTTO SPARK	V-BLOCK	8	1					

IGNITION TIMING 1	IGNITION TIMING 2	TIM. TOL.	TIMING RPM	RPM TOL.	TIM. GEAR	% CO LEFT	% CO RIGHT	% CO COMB.	CO TOL.	IDLE RPM	IDLE TOL.	IDLE GEAR	ENGINE FAMILY	ENGINE CODE
168			2	750	100	NNEUTRAL				750	100	NEUTRAL	FD-318-2-CA	

 DRIVE TRAIN AND CONTROL SYSTEM SPECIFICATIONS

AXLE RATIO	N/V RATIO	ODOMETER	A/C INSTALLFD	EXHAUST TYPE	CRANKCASE SYSTEM	TRANSMISSION CONFIGURATION	EVAPORATION SYSTEM	FUEL TYPE
.	.	MILES	YES	SINGLE RIGHT REAR		AUTO	CANISTER	IND UNLEADED, 100 OCT

MAIN-TANK CAPACITY	TANK VOLUME	AUX.-TANK CAPACITY	TANK VOLUME	SHIFT SPEED	EVAPORATIVE EMISSION FAMILY	EMISSION CODE	SALES CLASS
25.56	10.26			DO NOT SHIFT MANUALLY			

 CONTROL SYSTEM TYPES

 VEHICLE SPECIFICATION COMMENTS

VEHICLE SPECIFICATION REPORT -(TESTING GEN)- DATE OF ENTRY : 6/26/78

VEHICLE SPECIFICATIONS

MANUFACTURER		VEHICLE ID / VER		REPRESENTED CARLINE		MODEL CODE		DRIVE CODE		SOURCE			
TOYOTA		79-FE-3		1		COROLLA		SEDAN		REAR DRIVE STR. LEFT		MANUFACTURER	
VEHICLE TYPE	ACTUAL VEHICLE MODEL	MODEL YEAR	ACT YEAR	DRIVE AXL WTS		CURB WEIGHT	INRTIA CLASS	O/D CDE	ACTUAL DYNO HP	TIRE - SPECIFICATIONS		SWL BLT PSI	
				FULL TANK	EMPTY TANK					TIRE & RIM SIZES	MFR CONSTR		
CERT EM	COROLLA LH SR5	79	79	1096P		2309P	2500P	2	09.0	165R13			
PRIMARY DURABILITY VEHICLE IDENTIFICATION OR ASSIGNED DF (IF APPLICABLE)											ALT. MANUFACTURER		
79-FD-2													

ENGINE SPECIFICATIONS

DISPLACEMENT	BORE	STROKE	RATED HP	ENGINE TYPE	ENGINE CONFIGURATION	NO. CYL	NO. CARBS	TOTAL NO. BARRELS	FUEL SYSTEM MFR/MODEL	FUEL INJECTION	COMP. RATIO	COAST-DOWN TM		
96.9E	3.35E	2.76E	075	OTTO SPARK	IN-LINE	04	01	02	AISAN	NO	9.0			
IGNITION TIMING 1	IGNITION TIMING 2	TIM. TOL.	TIMING RPM	RPM TOL.	TIM. GEAR	% CO LEFT	% CO RIGHT	% CO COMB.	CO TOL.	IDLE RPM	IDLE TOL.	IDLE GEAR	ENGINE FAMILY	ENGINE CODE
10R			900		NNEUTRAL	1.0			.5	850	150	NEUTRAL	21-C(F)	FMS-NL

DRIVE TRAIN AND CONTROL SYSTEM SPECIFICATIONS

AXLE RATIO	N/V RATIO	ODOMETER	A/C INSTALLED	EXHAUST TYPE	CRANKCASE SYSTEM	TRANSMISSION CONFIGURATION	CODE	EVAPORATION SYSTEM	FUEL TYPE	
3.73	51.3	MILES	NO	SINGLE LEFT REAR	CLOSED	M-5		CANISTER	IND UNLEADED, 100 OCT	
MAIN-TANK CAPACITY		VOLUME	AUX.-TANK CAPACITY		VOLUME	SHIFT SPEED		EVAPORATIVE EMISSION FAMILY	CODE	SALES CLASS
13.26		5.36				SPECIAL SHIFT SPD5 (MAN OR S-A)		EV-T	CC-2	49 STATE LIGHT DUTY VEH
CONTROL SYSTEM TYPES										
AIR INJECTION			CATALYTIC REACTOR			EXHAUST RECYCLE				

VEHICLE SPECIFICATION COMMENTS

1979FFDV-2500-M5
SHIFT PROCEDURE-15-25-40-45 TRACE PROVIDED

ANAL./TEST VALID. TEST VALID./DATA DATA/CERT.(PRELIM.) CERT./TEST VALID. TEST VALID./CERT.(OFF.)

Appendix D.
Test Result Tables

ENVIRONMENTAL PROTECTION AGENCY
MOTOR VEHICLE EMISSION LABORATORY
ANN ARBOR, MICHIGAN

GASOHOL PROGRAM
AVERAGE TEST RESULTS

PROCESSED: DEC 15, 1978

VEHICLE: FORD T-BIRD (3-WAY) VIN: 71S42 INERTIA WT: 4500 ACTUAL HP: 13.1
TEST TYPE: FTP

FUEL N		EXHAUST					AMBIENT			SHED			CANNISTER WEIGHTS					
		HC	CO	NOx	CO2	FE	BARO	HUM	NOxFC	DBL	HSL	TLOSS	TOTHC	BDL	ADBL	AHSL	DBL	DTEST
		GRAMS/MILE					(MPG) (IN-HG) (GRAINS/LH)			GRAMS								
1	2 MEAN	0.225	1.10	1.36	622.	14.2	29.32	63.15	0.95	1.29	0.80	2.09	9.51	1337.	1359.	1326.	21.4	-11.3
	STD. DEV	0.035	0.283	.255	1.	0.0	0.212	5.548	0.023	0.45	0.10	0.55	0.07	0.71	0.0	2.24	0.57	3.89
	C.V. %	15.7	25.7	18.7	0.1	0.0	0.7	8.78	2.47	35.1	12.4	26.4	0.70	0.05	0.0	0.17	2.64	0.0
2	3 MEAN	0.207	1.13	1.18	615.	13.9	29.10	72.32	0.99	1.30	1.82	3.11	12.41	1342.	1366.	1340.	23.7	-2.0
	STD. DEV	0.021	0.231	.015	4.	0.1	0.135	0.407	0.002	0.75	0.34	1.01	2.14	12.79	14.05	9.28	2.05	7.81
	C.V. %	10.1	20.4	1.3	0.6	0.8	0.5	0.56	0.18	57.7	18.6	32.6	17.28	0.95	1.03	0.69	8.66	0.0
3	2 MEAN	0.280	1.50	1.17	617.	14.3	28.78	80.30	1.03	2.48	1.70	4.18	15.01	1362.	1391.	1352.	29.0	-9.2
	STD. DEV	0.014	0.283	.001	4.	0.1	0.071	1.687	0.008	0.51	0.04	0.47	0.76	3.67	1.58	2.74	1.98	0.78
	C.V. %	5.1	18.9	0.1	0.6	1.0	0.2	2.10	0.81	20.5	2.1	11.3	5.05	0.27	0.11	0.20	6.83	0.0
4	1 MEAN	0.300	1.10	1.23	623.	13.7	29.23	81.18	1.03	1.78	1.88	3.66	15.38	1380.	1414.	1388.	34.0	7.7
6	3 MEAN	0.390	2.17	1.16	636.	13.3	29.13	73.91	1.00	1.25	1.97	3.23	17.35	1378.	1407.	1368.	29.3	-9.4
	STD. DEV	0.193	1.172	.035	3.	0.1	0.026	3.453	0.016	0.21	0.08	0.22	4.47	3.27	1.63	1.63	3.85	2.50
	C.V. %	49.5	54.1	3.0	0.4	0.4	0.1	4.67	1.61	17.1	3.8	6.8	25.74	0.24	0.12	0.12	13.12	0.0
3	2 MEAN	0.270	1.10	1.25	634.	13.9	29.04	78.66	1.02	1.60	1.65	3.26	13.74	1376.	1407.	1370.	30.8	-6.2
	STD. DEV	0.014	0.141	.127	4.	0.1	0.162	0.403	0.002	0.04	0.02	0.06	0.31	1.41	1.87	7.18	0.28	9.05
	C.V. %	5.2	12.9	10.1	0.7	0.5	0.6	0.51	0.17	2.2	1.3	1.7	2.22	0.10	0.13	0.52	0.92	0.0
4	1 MEAN	0.250	0.90	1.12	635.	13.4	29.38	71.76	0.99	0.95	1.62	2.57	12.49	1386.	1420.	1386.	34.1	-0.5

NOTES:

- FUELS ARE PRINTED IN THE ORDER THAT THEY WERE RUN.
- TOTHC IS THE TOTAL HYDROCARBONS EMITTED FOR 3.3 TRIPS/DAY. (NOT CORRECTED FOR ETHANOL RESPONSE OF FID.)
TOTHC = 3.3*(HC,G/MI)*DISTANCE + DBL + 3.3*HSL
THE FUELS USED WERE:

- INDOLENE (RVP=9.0). SOURCE: EPA MVEL LAB FUEL IN USE FOR CERTIFICATION TESTING.
- 90% INDOLENE + 10% ETHANOL (RVP=9.3). SOURCE: BLENDED USING FUEL NO. 1 AND 200 PROOF ETHANOL AT EPA MVEL
- COMMERCIAL GASOLINE (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
- 90% FUEL NO. 3 + 10% ETHANOL (RVP=10.7). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
- BLENDED GASOHOL CONTAINING 10% ETHANOL (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).

ENVIRONMENTAL PROTECTION AGENCY
MOTOR VEHICLE EMISSIONS LABORATORY
ANN ARBOR, MICHIGAN

GASOHOL PROGRAM
AVERAGE TEST RESULTS

PROCESSED: DEC 27, 1978

VEHICLE: FORD BOBCAT (3-WAY) VIN: RY2-2.3-C-122 INERTIA WT: 3000 ACTUAL HP: 10.3

TEST TYPE: FTP

FUEL N	EXHAUST					AMBIENT			SPEED			CONDENSER WEIGHTS					
	HC	CO	NOX	CO2	FE	BARO	HUM	NOXFC	DBL	HSL	TLOSS	TOTHC	SOBL	ANBL	ASHL	DOBL	DTST
	GRAMS/MILE					(MPG)	(IN-HG)	(GRAINS /LB)	GRAMS								
1 2 MEAN	0.245	2.10	0.94	399.	22.1	29.25	52.66	0.91	0.76	1.07	1.84	10.38	743.	753.	731.	9.6	-12.4
STD. DEV	0.021	0.283	.042	1.	0.1	0.296	****	0.046	0.45	0.13	0.58	0.32	3.67	0.71	1.41	4.03	2.19
C.V. %	8.7	13.5	4.5	0.2	0.3	1.0	****	5.10	58.2	12.5	31.5	3.09	0.49	0.09	0.19	42.20	0.0
2 3 MEAN	0.237	1.57	1.18	388.	21.9	29.13	72.29	0.99	1.07	2.19	3.27	14.19	740.	756.	733.	15.6	-7.4
STD. DEV	0.115	0.379	.066	1.	0.1	0.108	4.002	0.018	0.48	0.28	0.72	3.92	2.00	0.91	0.41	1.16	2.42
C.V. %	48.8	24.2	5.6	0.1	0.3	0.4	5.54	1.84	45.0	12.8	22.1	27.65	0.27	0.12	0.06	7.41	0.0
1 1 MEAN	0.190	1.80	0.96	396.	22.2	29.16	74.70	1.00	0.81	1.35	2.16	9.94	739.	751.	728.	12.4	-10.4
3 2 MEAN	0.270	2.35	1.11	397.	22.1	28.80	80.15	1.02	1.09	1.73	2.82	13.49	736.	753.	728.	17.2	-7.5
STD. DEV	0.000	0.212	.021	3.	0.1	0.043	0.455	0.002	0.03	0.30	0.28	0.95	0.0	0.0	2.55	0.21	2.48
C.V. %	0.1	9.0	1.9	0.7	0.6	0.1	0.57	0.20	2.6	17.5	9.8	7.02	0.0	0.0	0.35	1.24	0.0
4 2 MEAN	0.240	1.85	1.32	396.	21.4	29.11	80.36	1.03	3.14	3.11	6.25	19.34	739.	760.	730.	21.0	-9.1
STD. DEV	0.0	0.071	.064	0.	0.0	0.155	0.670	0.003	0.38	0.04	0.34	0.20	1.00	0.0	0.71	0.25	0.79
C.V. %	0.0	3.8	4.8	0.0	0.0	0.5	0.33	0.32	12.2	1.4	5.4	1.02	0.14	0.0	0.10	1.34	0.0
6 2 MEAN	0.335	2.10	1.32	411.	20.6	29.16	71.21	0.98	2.92	2.66	5.59	20.02	744.	761.	733.	16.7	-11.1
STD. DEV	0.021	0.0	.042	3.	0.1	0.011	3.023	0.014	0.13	0.12	0.25	0.02	0.71	0.71	1.41	0.14	1.63
C.V. %	6.3	0.0	3.2	0.7	0.7	0.0	4.24	1.40	4.4	4.5	4.4	0.08	0.10	0.09	0.19	0.84	0.0
3 2 MEAN	0.250	2.10	1.05	411.	21.4	29.05	75.30	1.00	2.27	1.96	4.23	14.94	739.	756.	728.	17.0	-13.7
STD. DEV	0.028	0.424	.014	8.	0.4	0.141	2.909	0.014	0.29	0.30	0.59	2.00	1.73	2.35	1.00	0.71	0.49
C.V. %	11.3	20.2	1.3	1.9	1.7	0.5	3.86	1.37	12.8	15.2	13.9	13.39	0.23	0.31	0.14	4.16	0.0

NOTES:

- FUELS ARE PRINTED IN THE ORDER THAT THEY WERE RUN.
- TOTHC IS THE TOTAL HYDROCARBONS EMITTED FOR 3.3 TRIPS/DAY. (NOT CORRECTED FOR ETHANOL RESPONSE OF FI.)
TOTHC = 3.3*(HC.G/MILE)*DISTANCE + DBL + 3.3*HSL
THE FUELS USED WERE:

- INDOLENE (RVP=9.0). SOURCE: EPA MVEL LAB FUEL IN USE FOR CERTIFICATION TESTING.
- 90% INDOLENE + 10% ETHANOL (RVP=9.3). SOURCE: BLENDED USING FUEL NO. 1 AND 200 PROOF ETHANOL AT EPA MVE.
- COMMERCIAL GASOLINE (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
- 90% FUEL NO. 3 + 10% ETHANOL (RVP=10.7). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
- BLENDED GASOHOL CONTAINING 10% ETHANOL (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).

ENVIRONMENTAL PROTECTION AGENCY
MOTOR VEHICLE EMISSION LABORATORY
ANN ARBOR, MICHIGAN

GASOHOL PROGRAM
AVERAGE TEST RESULTS

PROCESSED: DEC 15, 1977

VEHICLE: GM-SUNBIRD (3-WAY) VIN: 80151 INERTIA WT: 3000 ACTUAL HP: 11.4

TEST TYPE: FTP

FUEL N	EXHAUST					AMBIENT			SHED			CANNISTER WEIGHTS					
	HC	CO	NOX	CO2	FE	BARO	HUM	NOXFC	DBL	HSL	TLOSS	TOTHC	BOBL	AHBL	AHSL	DBBL	DTEST
	GRAMS/MILE					(MPG)	(IN-HG)	(GRAINS/LB)	GRAMS								
1 1 MEAN	0.210	4.50	0.65	428.	20.4	29.41	68.83	0.97	0.51	0.87	1.38	8.56	795.	807.	798.	12.0	3.0
2 2 MEAN	0.230	4.10	0.66	434.	19.4	29.04	68.10	0.97	0.69	1.88	2.57	12.62	812.	827.	824.	15.1	12.1
STD. DEV	0.014	0.141	0.042	10.	0.4	0.155	7.148	0.032	0.07	0.21	0.28	1.12	5.92	4.95	5.92	0.99	0.01
C.V. %	6.1	3.4	6.4	2.3	2.2	0.5	****	3.25	10.2	10.9	10.7	8.92	0.73	0.60	0.72	6.56	0.09
1 1 MEAN	0.230	4.90	0.67	424.	20.5	29.09	74.02	1.00	0.56	0.87	1.43	9.14	810.	824.	811.	13.9	1.2
3 2 MEAN	0.335	5.90	0.69	418.	20.8	28.77	79.91	1.02	0.79	1.09	1.88	12.69	823.	841.	830.	18.3	7.3
STD. DEV	0.021	0.141	0.007	1.	0.1	0.070	4.679	0.023	0.17	0.07	0.24	0.15	4.64	4.69	4.69	0.07	0.07
C.V. %	6.3	2.4	1.0	0.2	0.3	0.2	5.86	2.25	21.5	6.5	12.8	1.14	0.56	0.56	0.57	0.38	0.08
4 2 MEAN	0.360	6.40	0.71	416.	20.1	28.89	77.26	1.01	1.13	2.06	3.19	16.85	824.	846.	839.	21.9	15.1
STD. DEV	0.057	0.707	0.014	3.	0.1	0.085	3.107	0.015	0.24	0.04	0.28	1.80	6.00	5.00	1.87	0.99	4.83
C.V. %	15.7	11.0	2.0	0.7	0.3	0.3	4.02	1.48	21.3	1.7	8.6	10.68	0.73	0.59	0.22	4.52	24.78
6 2 MEAN	0.500	7.40	0.76	430.	19.3	29.13	77.13	1.01	1.30	2.34	3.64	21.37	835.	855.	845.	20.2	9.8
STD. DEV	0.071	0.283	0.014	5.	0.2	0.016	1.960	0.009	0.08	0.78	0.71	0.72	0.71	1.00	1.00	0.64	1.41
C.V. %	14.1	3.8	1.9	1.2	1.1	0.1	2.54	0.92	6.0	33.6	19.4	3.37	0.08	0.12	0.12	3.16	14.43
3 2 MEAN	0.290	5.75	0.74	428.	20.3	29.03	77.49	1.01	0.94	1.16	2.10	11.95	834.	853.	840.	19.3	6.3
STD. DEV	0.0	0.071	0.014	6.	0.3	0.155	2.982	0.014	0.03	0.08	0.06	0.27	1.87	2.35	3.61	0.49	1.70
C.V. %	0.0	1.2	1.9	1.5	1.4	0.5	3.85	1.42	3.0	7.3	2.7	2.26	0.22	0.27	0.43	2.57	24.74

NOTES:

- FUELS ARE PRINTED IN THE ORDER THAT THEY WERE RUN.
- TOTHC IS THE TOTAL HYDROCARBONS EMITTED FOR 3.3 TRIPS/DAY. (NOT CORRECTED FOR ETHANOL RESPONSE OF FID.)

$$\text{TOTHC} = 3.3 \cdot (\text{HC/G/MI}) \cdot \text{DISTANCE} \cdot \text{DBL} + 3.3 \cdot \text{HSL}$$

THE FUELS USED WERE:

- INDOLENE (RVP=9.0). SOURCE: EPA MVE LAB FUEL IN USE FOR CERTIFICATION TESTING.
- 90% INDOLENE + 10% ETHANOL (RVP=9.3). SOURCE: BLENDED USING FUEL NO. 1 AND 200 PROOF ETHANOL AT EPA MVE
- COMMERCIAL GASOLINE (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
- 90% FUEL NO. 3 + 10% ETHANOL (RVP=10.7). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
- BLENDED GASOHOL CONTAINING 10% ETHANOL (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).

ENVIRONMENTAL PROTECTION AGENCY
MOTOR VEHICLE EMISSION LABORATORY
ANN ARBOR, MICHIGAN

GASOHOL PROGRAM
AVERAGE TEST RESULTS

PROCESSED: DEC 15, 1977

VEHICLE: GM REGAL #2 (3-WAY) VIN: 48257 INERTIA WT: 3500 ACTUAL HP: 12.2
TEST TYPE: FTP

FUEL	N	EXHAUST					AMBIENT			SHED				CANNISTER WEIGHTS					
		HC	CO	NOX	CO2	FE	BARO	HUM	NOXFC	DBL	HSL	TLOSS	TOTHC	BDRL	ADRL	AHSL	DBRL	OTEST	
		GRAMS/MILE					(MPG)	(IN-HG)	(GRAINS/LR)	GRAMS									
3	2	MEAN	0.390	8.35	0.19	462.	18.6	29.36	76.14	1.01	3.63	1.14	4.77	17.06	956.	975.	955.	20.0	-0.3
		STD. DEV	0.028	1.061	0.028	0.	0.1	0.090	1.369	0.006	0.39	0.13	0.25	0.65	1.58	0.71	2.65	0.78	1.06
		C.V. %	7.3	12.7	14.9	0.0	0.4	0.3	1.80	0.64	10.7	11.7	5.3	3.80	0.17	0.07	0.28	3.90	0.0
4	2	MEAN	0.405	7.90	0.25	459.	18.1	29.29	70.54	0.98	5.47	1.66	7.14	20.95	957.	981.	960.	24.5	3.1
		STD. DEV	0.035	0.283	0.007	0.	0.0	0.120	3.324	0.015	0.97	0.39	1.36	3.12	0.0	2.45	1.00	1.48	0.07
		C.V. %	8.7	3.6	2.9	0.0	0.1	0.4	4.71	1.53	17.7	23.4	19.0	14.90	0.0	0.25	0.10	6.07	2.32
6	2	MEAN	0.555	10.60	0.31	476.	17.3	29.12	73.86	0.99	5.59	2.08	7.66	26.23	952.	973.	951.	21.5	-0.4
		STD. DEV	0.007	0.011	0.014	4.	0.1	0.098	1.855	0.009	0.22	0.20	0.42	1.05	0.0	0.71	1.22	0.42	1.77
		C.V. %	1.3	0.1	4.6	0.9	0.8	0.3	2.51	0.86	3.9	9.5	5.4	4.02	0.0	0.07	0.13	1.97	0.0
3	2	MEAN	0.430	10.05	0.27	469.	18.3	29.02	73.91	1.00	2.91	1.42	4.34	18.28	945.	967.	945.	21.7	-0.3
		STD. DEV	0.071	0.354	0.007	1.	0.1	0.091	4.103	0.019	1.35	0.08	1.27	0.55	1.00	0.71	1.41	0.99	2.83
		C.V. %	16.4	3.5	2.6	0.2	0.4	0.3	5.55	1.92	46.3	5.5	29.3	3.01	0.11	0.07	0.15	4.56	0.0
1	1	MEAN	0.400	8.30	0.16	470.	18.3	29.37	72.28	0.99	2.06	0.84	2.90	14.69	934.	949.	930.	15.3	-3.9
2	2	MEAN	0.315	6.35	0.24	462.	18.1	29.09	80.39	1.03	2.46	1.35	3.81	14.73	937.	956.	940.	18.8	2.7
		STD. DEV	0.007	0.212	0.014	1.	0.0	0.474	****	0.061	0.33	0.07	0.25	0.26	2.35	4.06	1.00	1.77	1.13
		C.V. %	2.2	3.3	5.9	0.2	0.1	1.6	****	5.90	13.2	5.2	6.7	1.75	0.25	0.43	0.11	9.43	41.41
1	1	MEAN	0.350	7.60	0.22	469.	18.4	29.58	74.91	1.00	1.77	1.12	2.89	14.13	939.	954.	934.	14.2	-5.5

NOTES:

- FUELS ARE PRINTED IN THE ORDER THAT THEY WERE RUN.
- TOTHC IS THE TOTAL HYDROCARBONS EMITTED FOR 3.3 TRIPS/DAY. (NOT CORRECTED FOR ETHANOL RESPONSE OF FI.)
TOTHC= 3.3*(HC,G/MI)*DISTANCE + DBL + 3.3*HSL

THE FUELS USED WERE:

- INDOLENE (RVP=9.0). SOURCE: EPA MVEL LAB FUEL IN USE FOR CERTIFICATION TESTING.
- 90% INDOLENE + 10% ETHANOL (RVP=9.3). SOURCE: BLENDED USING FUEL NO. 1 AND 200 PROOF ETHANOL AT EPA MVI
- COMMERCIAL GASOLINE (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
- 90% FUEL NO. 3 + 10% ETHANOL (RVP=10.7). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
- BLENDED GASOHOL CONTAINING 10% ETHANOL (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).

ENVIRONMENTAL PROTECTION AGENCY
MOTOR VEHICLE EMISSION LABORATORY
ANN ARBOR, MICHIGAN

GASOHOL PROGRAM
AVERAGE TEST RESULTS

PROCESSED: DEC 15, 1978

VEHICLE: FORD MAVERICK (GX-C) VIN: 8H1-302-F-97 INERTIA WT: 3500 ACTUAL MP: 9.7

TEST TYPE: FTP

FUEL N	EXHAUST					AMBIENT			SHED			CANNISTER WEIGHTS					
	HC	CO	NOX	CO2	FE	BARO	HUM	NOXFC	DBL	MSL	TLOSS	TOTHC	BOBL	ADBL	AHSL	DOBL	DTEST
	GRAMS/MILE					(MPG)	(IN-HG)	(GRAINS/LH)	GRAMS								
1 2 MEAN	0.660	5.05	1.36	547.	15.9	29.32	63.15	0.95	0.35	0.75	1.10	19.14	743.	755.	733.	12.5	-9.6
STD. DEV	0.057	1.061	.042	8.	0.2	0.212	5.548	0.023	0.10	0.0	0.10	1.62	10.89	10.44	7.91	0.42	2.97
C.V. %	8.6	21.0	3.1	1.6	1.3	0.7	8.78	2.47	28.3	0.0	9.0	8.47	1.47	1.38	1.08	3.39	0.0
2 2 MEAN	0.730	3.50	1.46	535.	15.8	29.13	72.27	0.99	1.73	1.27	3.01	24.01	759.	772.	754.	12.6	-5.8
STD. DEV	0.099	0.707	.071	4.	0.1	0.169	0.568	0.002	0.79	0.36	1.15	4.45	7.25	8.51	4.24	1.27	3.04
C.V. %	13.6	20.2	4.8	0.7	0.4	0.6	0.79	0.25	45.8	28.3	38.4	18.53	0.95	1.10	0.56	10.10	0.0
3 2 MEAN	0.830	9.40	1.39	539.	15.9	28.78	80.30	1.03	3.48	1.40	4.88	28.69	762.	777.	754.	14.7	-7.8
STD. DEV	0.001	0.283	.014	0.	0.0	0.071	1.687	0.008	0.35	0.09	0.26	0.28	1.41	2.00	2.74	0.57	1.20
C.V. %	0.1	3.0	1.0	0.0	0.1	0.2	2.10	0.81	10.2	6.5	5.4	0.99	0.19	0.26	0.36	3.85	0.0
4 2 MEAN	0.825	4.75	1.55	535.	15.8	29.11	82.54	1.04	6.05	3.48	9.53	37.95	769.	783.	767.	14.3	-1.8
STD. DEV	0.035	0.495	.035	4.	0.1	0.170	1.930	0.010	0.35	2.23	2.57	6.78	3.67	3.24	0.0	0.49	2.83
C.V. %	4.3	10.4	2.3	0.7	0.4	0.6	2.34	0.94	5.7	63.9	27.0	17.87	0.48	0.41	0.0	3.47	0.0
6 3 MEAN	1.570	8.20	1.55	541.	15.3	29.11	74.20	1.00	6.31	1.97	8.28	51.79	771.	784.	765.	12.9	-6.1
STD. DEV	0.798	3.470	.095	7.	0.0	0.072	3.506	0.016	0.51	0.21	0.68	18.74	2.52	1.91	1.58	0.79	1.00
C.V. %	50.8	42.3	6.1	1.3	0.1	0.2	4.72	1.63	8.1	10.7	8.2	36.19	0.33	0.24	0.21	6.15	0.0
3 2 MEAN	0.740	7.05	1.40	550.	15.8	28.97	82.47	1.04	2.67	1.23	3.90	26.03	759.	776.	755.	17.0	-4.0
STD. DEV	0.042	0.636	.085	6.	0.2	0.063	4.985	0.025	1.53	0.24	1.77	1.30	5.66	3.94	1.22	1.70	4.24
C.V. %	5.4	9.0	6.1	1.0	1.3	0.2	6.04	2.43	57.2	19.5	45.3	5.00	0.75	0.51	0.16	9.98	0.0

NOTES:

- FUELS ARE PRINTED IN THE ORDER THAT THEY WERE RUN.
- TOTHC IS THE TOTAL HYDROCARBONS EMITTED FOR 3.3 TRIPS/DAY. (NOT CORRECTED FOR ETHANOL RESPONSE OF FID.)
TOTHC = 3.3*(HC,G/MI)*DISTANCE + DBL + 3.3*MSL

THE FUELS USED WERE:

- INDOLENE (RVP=9.0). SOURCE: EPA MVEL LAB FUEL IN USE FOR CERTIFICATION TESTING.
- 90% INDOLENE + 10% ETHANOL (RVP=9.3). SOURCE: BLENDED USING FUEL NO. 1 AND 200 PROOF ETHANOL AT EPA MVE
- COMMERCIAL GASOLINE (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
- 90% FUEL NO. 3 + 10% ETHANOL (RVP=10.7). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
- BLENDED GASOHOL CONTAINING 10% ETHANOL (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).

ENVIRONMENTAL PROTECTION AGENCY
MOTOR VEHICLE EMISSION LABORATORY
ANN ARBOR, MICHIGAN

GASOHOL PROGRAM
AVERAGE TEST RESULTS

PROCESSED: DEC 15, 1978

VEHICLE: FORD PINTO (OX-C) VIN: 9E2-2.3-F-85 INERTIA WT: 2750 ACTUAL HP: 9.7
TEST TYPE: FTP

FUEL N		EXHAUST					AMBIENT			SHED			CANNISTER WEIGHTS					
		HC	CO	NOX	CO2	FE	BARO	HUM	NOXFC	DHL	HSL	TLOSS	TOTHC	BDL	ADL	AMSL	DBL	DTEST
		GRAMS/MILE					(MPG) (IN-HG) (GRAINS/LH)			GRAMS								
1	2 MEAN	0.515	2.40	1.64	378.	23.1	29.25	52.66	0.91	1.07	0.52	1.65	15.64	783.	792.	772.	9.2	-10.8
	STD. DEV	0.007	0.283	.064	1.	0.1	0.296	****	0.046	0.12	0.04	0.08	0.15	4.06	3.39	3.24	0.71	0.78
	C.V. %	1.4	11.8	3.9	0.4	0.3	1.0	****	5.10	11.2	7.3	4.7	0.96	0.52	0.43	0.42	7.69	0.0
2	3 MEAN	0.473	1.90	1.87	373.	22.7	29.13	72.29	0.99	1.12	0.79	1.91	15.38	782.	792.	766.	10.6	-15.6
	STD. DEV	0.059	0.361	.105	3.	0.2	0.108	4.002	0.018	0.33	0.07	0.38	1.50	1.00	2.16	10.70	1.31	11.23
	C.V. %	12.4	19.0	5.6	0.7	0.9	0.4	5.54	1.84	29.6	8.5	20.2	9.76	0.13	0.27	1.40	12.35	0.0
3	1 MEAN	0.650	3.50	1.78	378.	23.0	28.83	80.47	1.03	1.37	0.65	2.02	19.56	783.	795.	759.	12.1	-24.1
4	2 MEAN	0.600	2.65	1.89	377.	22.4	29.11	80.36	1.03	2.63	0.90	3.53	20.45	785.	801.	778.	16.0	-6.2
	STD. DEV	0.057	0.636	.001	7.	0.4	0.155	0.670	0.003	0.40	0.08	0.31	1.20	1.73	0.71	1.41	1.13	0.28
	C.V. %	9.4	24.0	0.1	1.9	1.6	0.5	0.83	0.32	15.1	9.4	8.8	5.88	0.22	0.09	0.18	7.07	0.0
6	2 MEAN	0.760	2.70	1.99	397.	21.2	29.16	71.21	0.98	1.89	1.03	2.93	24.03	783.	799.	775.	16.3	-8.2
	STD. DEV	0.028	0.566	.049	6.	0.3	0.011	3.023	0.014	0.11	0.01	0.11	0.69	1.22	2.12	0.71	3.75	1.41
	C.V. %	3.7	21.0	2.5	1.4	1.3	0.0	4.24	1.40	6.0	0.7	3.6	2.88	0.16	0.27	0.09	22.92	0.0
3	2 MEAN	0.685	3.45	1.96	396.	22.0	29.06	75.30	1.00	1.55	0.88	2.42	19.37	777.	797.	770.	20.1	-7.0
	STD. DEV	0.035	0.071	.042	2.	0.1	0.141	2.909	0.014	0.37	0.11	0.47	0.12	1.00	0.71	0.0	1.98	0.85
	C.V. %	5.8	2.0	2.2	0.5	0.6	0.5	3.86	1.37	23.7	12.1	19.5	0.64	0.13	0.09	0.0	9.85	0.0

NOTES:

- FUELS ARE PRINTED IN THE ORDER THAT THEY WERE RUN.
- TOTHC IS THE TOTAL HYDROCARBONS EMITTED FOR 3.3 TRIPS/DAY. (NOT CORRECTED FOR ETHANOL RESPONSE OF FI...)
TOTHC = 3.3*(HC/G/MI)*DISTANCE + DBL + 3.3*HSL

THE FUELS USED WERE:

- INDOLENE (RVP=9.0). SOURCE: EPA MVEL LAB FUEL IN USE FOR CERTIFICATION TESTING.
- 90% INDOLENE + 10% ETHANOL (RVP=9.3). SOURCE: BLENDED USING FUEL NO. 1 AND 200 PROOF ETHANOL AT EPA MVE
- COMMERCIAL GASOLINE (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
- 90% FUEL NO. 3 + 10% ETHANOL (RVP=10.7). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
- BLENDED GASOHOL CONTAINING 10% ETHANOL (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).

ENVIRONMENTAL PROTECTION AGENCY
MOTOR VEHICLE EMISSION LABORATORY
ANN ARBOR, MICHIGAN

GASOHOL PROGRAM
AVERAGE TEST RESULTS

PROCESSED: DEC 15, 1978

VEHICLE: GM-IMPALA (0X-C) VIN: 8H042 INERTIA WT: 4000 ACTUAL HP: 13.3
TEST TYPE: FTP

FUEL N	EXHAUST					AMBIENT			SHEED				CANNISTER WEIGHTS					
	HC	CO	NOX	CO2	FE	BARO	HUM	NOXFC	DBL	HSL	TLOSS	TOTHC	BDBL	AHBL	AHSL	DBDL	DTEST	
	GRAMS/MILE					(MPG)	(IN-HG)	(GRAINS/L3)	GRAMS									
1 1 MEAN	0.400	6.20	1.61	603.	14.4	29.20	69.34	0.97	0.94	1.42	2.36	15.36	895.	909.	887.	13.6	-8.1	
2 1 MEAN	0.340	3.30	1.31	609.	13.9	29.21	70.95	0.98	0.77	1.56	2.33	15.49	878.	898.	884.	20.1	6.0	
3 2 MEAN	0.500	6.35	1.80	603.	14.4	29.38	75.99	1.01	1.77	1.47	3.24	18.95	897.	920.	894.	23.2	-3.1	
STD. DEV	0.014	0.212	.021	1.	0.0	0.083	6.853	0.033	0.14	0.04	0.18	0.65	0.71	0.0	0.0	0.14	0.71	
C.V. %	2.8	3.3	1.2	0.1	0.1	0.3	9.02	3.23	8.0	2.9	5.7	3.42	0.08	0.0	0.0	0.61	0.0	
4 2 MEAN	0.495	5.10	1.48	610.	13.8	29.31	73.71	0.99	3.45	1.84	5.30	21.76	904.	932.	907.	27.6	2.8	
STD. DEV	0.092	1.131	.001	0.	0.0	0.113	1.369	0.006	0.23	0.04	0.27	1.91	1.00	2.00	2.65	0.85	1.63	
C.V. %	18.6	22.2	0.0	0.0	0.1	0.4	1.86	0.64	6.8	1.9	5.1	8.77	0.11	0.21	0.29	3.07	57.07	
6 3 MEAN	0.543	5.50	1.52	624.	13.5	29.13	72.76	0.99	4.16	2.03	6.18	24.22	902.	929.	903.	26.8	0.4	
STD. DEV	0.046	0.400	.006	9.	0.2	0.081	7.461	0.034	1.55	0.05	1.59	2.72	3.21	4.28	2.92	3.74	0.42	
C.V. %	8.5	7.3	0.4	1.4	1.3	0.3	***	3.44	37.2	2.4	25.7	11.24	0.36	0.46	0.32	13.99	96.86	
3 1 MEAN	0.470	6.80	1.76	604.	14.4	29.04	69.57	0.98	2.26	1.43	3.69	15.53	902.	926.	900.	24.5	-2.3	

NOTES:

1. FUELS ARE PRINTED IN THE ORDER THAT THEY WERE RUN.
2. TOTHC IS THE TOTAL HYDROCARBONS EMITTED FOR 3.3 TRIPS/DAY. (NOT CORRECTED FOR ETHANOL RESPONSE OF FI.)
TOTHC = 3.3 * (HC, G/MI) * DISTANCE * DBL + 3.3 * HSL
THE FUELS USED WERE:

1. INDOLINE (RVP=9.0). SOURCE: EPA MVEL LAB FUEL IN USE FOR CERTIFICATION TESTING.
2. 90% INDOLINE + 10% ETHANOL (RVP=9.3). SOURCE: BLENDED USING FUEL NO. 1 AND 200 PROOF ETHANOL AT EPA MVEL
3. COMMERCIAL GASOLINE (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
4. 90% FUEL NO. 3 + 10% ETHANOL (RVP=10.7). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
6. BLENDED GASOHOL CONTAINING 10% ETHANOL (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).

ENVIRONMENTAL PROTECTION AGENCY
MOTOR VEHICLE EMISSION LABORATORY
ANN ARBOR, MICHIGAN

GASOHOL PROGRAM
AVERAGE TEST RESULTS

PROCESSED: DEC 15, 1978

VEHICLE: BUICK REGAL (OX-C) VIN: S944 INERTIA WT: 3500 ACTUAL HP: 12.2
TEST TYPE: FTP

FUEL	N	EXHAUST					AMBIENT			SHED			CANNISTER WEIGHTS						
		HC	CO	NOX	CO2	FE	BARO	HUM	NOXFC	DBL	HSL	TLOSS	TOTHC	BDRL	ABDL	AHSL	DBDL	DESL	
		GRAMS/MILE					(MPG) (IN-HG) (GRAINS/Lb)			GRAMS									
2	1	MEAN	0.530	4.50	1.27	467.	18.0	29.16	74.70	1.00	1.55	2.00	3.55	21.11	824.	844.	829.	20.2	5.3
3	2	MEAN	0.620	7.35	1.43	462.	18.6	29.38	75.99	1.01	3.09	1.22	4.32	22.37	836.	860.	838.	24.8	2.4
		STD. DEV	0.014	0.495	.014	3.	0.1	0.083	6.853	0.033	0.13	0.13	0.27	0.89	3.54	0.71	0.71	3.54	3.54
		C.V. %	2.3	6.7	1.0	0.6	0.4	0.3	9.02	3.23	4.3	11.0	6.2	3.98	0.42	0.08	0.08	14.26	****
4	1	MEAN	0.570	5.00	1.36	469.	17.9	29.23	74.68	1.00	6.03	1.27	7.30	24.22	844.	871.	851.	27.0	6.9
6	2	MEAN	0.730	6.70	1.46	479.	17.4	29.15	72.12	0.99	5.74	1.72	7.47	29.52	844.	867.	848.	23.8	4.3
		STD. DEV	0.028	0.005	.021	1.	0.0	0.105	****	0.048	0.62	0.15	0.76	0.47	0.71	1.73	2.65	0.92	1.70
		C.V. %	3.9	0.1	1.4	0.3	0.0	0.4	****	4.84	10.7	8.6	10.2	1.58	0.08	0.20	0.31	3.87	39.47
3	1	MEAN	0.550	7.00	1.51	472.	18.3	29.04	69.57	0.98	3.70	1.13	4.83	20.99	838.	862.	840.	23.9	2.0
1	1	MEAN	0.600	6.60	1.27	469.	18.4	29.37	72.28	0.99	1.43	1.25	2.68	20.28	827.	844.	828.	16.7	0.5

NOTES:

- FUELS ARE PRINTED IN THE ORDER THAT THEY WERE RUN.
- TOTHC IS THE TOTAL HYDROCARBONS EMITTED FOR 3.3 TRIPS/DAY. (NOT CORRECTED FOR ETHANOL RESPONSE OF FI.)
TOTHC = 3.3*(HC.G/MI)*DISTANCE + DBL + 3.3*HSL

THE FUELS USED WERE:

- INDOLENE (RVP=9.0). SOURCE: EPA MVEL LAB FUEL IN USE FOR CERTIFICATION TESTING.
- 90% INDOLENE + 10% ETHANOL (RVP=9.3). SOURCE: BLENDED USING FUEL NO. 1 AND 200 PROOF ETHANOL AT EPA MVE
- COMMERCIAL GASOLINE (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
- 90% FUEL NO. 3 + 10% ETHANOL (RVP=10.7). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
- BLENDED GASOHOL CONTAINING 10% ETHANOL (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).

ENVIRONMENTAL PROTECTION AGENCY
MOTOR VEHICLE EMISSION LABORATORY
ANN ARBOR, MICHIGAN

GASOHOL PROGRAM
AVERAGE TEST RESULTS

PROCESSED: DEC 15, 1978

VEHICLE: CHRY. OMNI (OX-C) VIN: ZL44A8D1E9064 INERTIA WT: 2500 ACTUAL HP: 7.3

TEST TYPE: FTP

FUEL	N	EXHAUST					AMBIENT			SHED				CANNISTER WEIGHTS					
		HC	CO	NOX	CO2	FE	BARO	HUM	NOXFC	DBL	HSL	TLOSS	TOTHC	BNBL	ADBL	AHSL	DBBL	DTEST	
		GRAMS/MILE					(MPG)	(IN-HG)	(GRAINS/LH)	GRAMS									
2	2	MEAN	0.300	8.20	1.38	318.	25.8	29.04	68.10	0.97	1.55	4.06	5.61	22.42	562.	574.	570.	12.1	8.1
		STD. DEV	0.014	0.849	.049	0.	0.1	0.155	7.148	0.032	0.04	1.04	1.00	3.80	1.87	1.00	2.24	0.64	0.42
		C.V. %	4.7	10.3	3.6	0.0	0.5	0.5	***	3.25	2.7	25.6	17.8	16.94	0.33	0.17	0.39	5.28	5.24
1	1	MEAN	0.430	12.60	1.08	322.	25.8	29.09	74.02	1.00	1.02	1.57	2.59	16.85	557.	568.	560.	10.4	3.2
3	2	MEAN	0.575	19.55	1.06	321.	25.1	28.77	79.91	1.02	2.70	5.24	7.95	34.17	561.	575.	567.	13.6	6.1
		STD. DEV	0.021	0.778	.042	2.	0.3	0.070	4.679	0.023	0.64	0.15	0.49	0.47	1.22	1.41	0.0	0.35	1.06
		C.V. %	3.7	4.0	4.0	0.7	1.1	0.2	5.86	2.25	23.8	2.8	6.2	1.37	0.22	0.25	0.0	2.61	17.53
4	2	MEAN	0.340	10.35	1.34	324.	25.1	29.10	76.55	1.01	3.49	10.10	13.59	45.24	563.	578.	574.	14.8	11.3
		STD. DEV	0.042	1.909	.071	7.	0.3	0.212	2.104	0.010	0.25	0.44	0.69	0.61	2.35	2.00	1.87	0.28	0.35
		C.V. %	12.5	18.4	5.3	2.2	1.1	0.7	2.75	1.00	7.1	4.3	5.0	1.34	0.42	0.35	0.33	1.91	3.14
6	2	MEAN	0.375	8.65	1.44	338.	24.3	29.13	77.13	1.01	2.95	5.73	8.69	31.11	562.	575.	571.	13.4	9.2
		STD. DEV	0.021	0.213	.035	1.	0.1	0.016	1.960	0.009	0.30	0.08	0.23	0.67	2.00	1.87	0.71	0.28	1.56
		C.V. %	5.7	2.5	2.4	0.2	0.6	0.1	2.54	0.92	10.3	1.4	2.6	2.17	0.36	0.33	0.12	2.11	14.41
3	2	MEAN	0.475	16.45	1.05	325.	25.2	29.03	77.49	1.01	2.55	4.47	7.02	29.05	561.	574.	567.	12.8	6.0
		STD. DEV	0.007	0.919	.007	1.	0.1	0.155	2.982	0.014	0.33	0.58	0.91	2.06	1.41	1.58	1.22	0.21	0.07
		C.V. %	1.5	5.6	0.7	0.2	0.6	0.5	3.85	1.42	13.0	13.0	13.0	7.10	0.25	0.28	0.22	1.65	1.17
1	1	MEAN	0.410	12.50	1.00	331.	25.2	29.38	71.76	0.99	1.35	1.91	3.26	17.83	558.	569.	563.	10.9	4.4

NOTES:

- FUELS ARE PRINTED IN THE ORDER THAT THEY WERE RUN.
- TOTHC IS THE TOTAL HYDROCARBONS EMITTED FOR 3.3 TRIPS/DAY. (NOT CORRECTED FOR ETHANOL RESPONSE OF FID.)
TOTHC = 3.3*(HC,G/MI)*DISTANCE + DBL + 3.3*HSL

THE FUELS USED WERE:

- INDOLENE (RVP=9.0). SOURCE: EPA MVEL LAB FUEL IN USE FOR CERTIFICATION TESTING.
- 90% INDOLENE + 10% ETHANOL (RVP=9.3). SOURCE: BLENDED USING FUEL NO. 1 AND 200 PROOF ETHANOL AT EPA MVE
- COMMERCIAL GASOLINE (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
- 90% FUEL NO. 3 + 10% ETHANOL (RVP=10.7). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
- BLENDED GASOHOL CONTAINING 10% ETHANOL (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).

ENVIRONMENTAL PROTECTION AGENCY
MOTOR VEHICLE EMISSION LABORATORY
ANN ARBOR, MICHIGAN

GASOHOL PROGRAM
AVERAGE TEST RESULTS

PROCESSED: DEC 15, 197

VEHICLE: PLY. SALON (OX-C) VIN: RH41GRA206799 INERTIA WT: 4500 ACTUAL MP: 12.3

TEST TYPE: FTP

FUEL N	EXHAUST					AMBIENT			SHED			CANNISTER WEIGHTS						
	HC	CO	NOX	CO2	FE	BARO	HUM	NOXFC	DBL	HSL	TLOSS	TOTHC	BDRL	ADBL	AHSL	DDRL	DTEST	
	GRAMS/MILE					(MPG)	(IN-HG)	(GRAINS/LH)	GRAMS									
1 1 MEAN	0.770	17.10	1.65	607.	13.9	29.24	72.28	0.99	1.49	1.06	2.95	24.26	744.	760.	743.	15.7	-1.0	
2 1 MEAN	0.530	8.80	1.93	613.	13.6	29.04	76.27	1.01	2.44	1.61	4.45	21.24	742.	762.	754.	19.8	11.2	
3 2 MEAN	0.765	17.10	1.85	609.	13.9	29.36	76.14	1.01	5.87	1.40	7.27	29.40	758.	777.	760.	18.8	2.3	
STD. DEV	0.007	0.0	.007	1.	0.0	0.090	1.369	0.006	0.88	0.40	0.48	0.32	0.0	0.71	2.24	0.07	1.4	
C.V. %	0.9	0.0	0.4	0.2	0.1	0.3	1.80	0.64	14.9	28.3	6.6	1.09	0.0	0.09	0.29	0.36	84.85	
4 2 MEAN	0.590	9.90	2.14	609.	13.6	29.29	70.54	0.98	10.06	2.38	12.43	32.54	765.	785.	774.	20.1	8.8	
STD. DEV	0.001	0.566	.028	1.	0.1	0.120	3.324	0.015	0.0	0.16	0.16	0.56	3.46	2.45	1.87	1.06	1.48	
C.V. %	0.2	5.7	1.3	0.2	0.5	0.4	4.71	1.53	0.0	6.8	1.3	1.72	0.45	0.31	0.24	5.29	14.78	
6 2 MEAN	0.760	11.55	2.19	634.	13.1	29.12	73.86	0.99	9.28	1.86	11.14	34.16	763.	782.	767.	18.8	3.5	
STD. DEV	0.071	1.344	.071	2.	0.1	0.098	1.855	0.009	0.65	0.03	0.68	1.14	1.73	0.0	0.0	1.06	1.06	
C.V. %	9.3	11.6	3.2	0.3	1.1	0.3	2.51	0.86	7.0	1.5	6.1	3.33	0.23	0.0	0.0	5.66	29.88	
3 2 MEAN	0.860	21.25	1.63	618.	13.5	29.02	73.91	1.00	5.45	1.45	7.40	31.91	754.	775.	757.	20.7	3.2	
STD. DEV	0.014	0.778	.021	1.	0.1	0.091	4.103	0.019	0.59	0.16	0.74	0.76	2.45	0.71	0.71	2.55	2.40	
C.V. %	1.6	3.7	1.3	0.1	0.5	0.3	5.55	1.92	9.9	10.7	10.0	2.38	0.32	0.09	0.09	12.30	92.03	

NOTES:

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$$\text{TOTHC} = 3.3 * (\text{HC, G/MILE}) * \text{DISTANCE} + \text{DBL} + 3.3 * \text{HSL}$$
 THE FUELS USED WERE:

- INDOLENE (RVP=9.0). SOURCE: EPA MVEL LAB FUEL IN USE FOR CERTIFICATION TESTING.
- 90% INDOLENE + 10% ETHANOL (RVP=9.3). SOURCE: BLENDED USING FUEL NO. 1 AND 200 PROOF ETHANOL AT EPA MVE
- COMMERCIAL GASOLINE (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
- 90% FUEL NO. 3 + 10% ETHANOL (RVP=10.7). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).
- BLENDED GASOHOL CONTAINING 10% ETHANOL (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).

ENVIRONMENTAL PROTECTION AGENCY
MOTOR VEHICLE EMISSION LABORATORY
ANN ARBOR, MICHIGAN

GASOHOL PROGRAM
AVERAGE TEST RESULTS

PROCESSED: DEC 15, 1978

VEHICLE: TOY. COROLLA (GX-C) VIN: 79-FE-1 INERTIA WT: 2500 ACTUAL HP: 0.0

TEST TYPE: FTP

FUEL/N	EXHAUST					AMBIENT			SHED			CANNISTER WEIGHTS					
	HC	CO	NOX	CO2	FE	BARO	HUM	NOXFC	DBL	MSL	TLOSS	TOTHC	BDRL	ADBL	AHSL	DDBL	DTEST
	GRAMS/MILE					(MPG)	(IN-HG)	(GRAINS/LH)	GRAMS								
1 1 MEAN	0.550	7.10	1.06	326.	26.2	29.24	72.28	0.99	0.98	0.60	1.58	16.53	1427.	1435.	1423.	8.1	-3.5
2 1 MEAN	0.570	4.90	1.36	326.	25.5	29.04	76.27	1.01	0.92	0.67	1.59	17.28	1425.	1435.	1422.	10.4	-2.4
3 2 MEAN	0.775	8.85	1.27	336.	25.2	29.32	73.25	0.99	1.39	0.89	2.28	23.50	1426.	1438.	1425.	11.6	-1.5
STD. DEV	0.021	0.071	0.007	0.	0.0	0.062	2.859	0.013	0.06	0.06	0.11	0.23	1.00	1.00	1.22	0.01	0.21
C.V. %	2.7	0.8	0.6	0.0	0.0	0.2	3.90	1.33	4.1	6.4	5.0	0.98	0.07	0.07	0.09	0.10	0.0
4 2 MEAN	0.710	5.80	1.44	324.	25.6	29.24	71.91	0.99	2.05	0.99	3.04	22.91	1425.	1440.	1424.	15.1	-0.3
STD. DEV	0.057	0.0	0.014	1.	0.1	0.112	1.641	0.008	0.12	0.11	0.23	0.96	0.0	0.0	1.00	0.57	0.42
C.V. %	8.0	0.0	1.0	0.2	0.3	0.4	2.28	0.77	5.9	10.7	7.4	4.18	0.0	0.0	0.07	3.75	0.0
6 2 MEAN	0.800	6.70	1.47	338.	24.3	29.07	74.69	1.00	1.81	1.20	3.01	25.60	1422.	1434.	1420.	12.7	-1.6
STD. DEV	0.001	0.283	0.014	3.	0.2	0.112	0.188	0.001	0.10	0.06	0.04	0.06	0.0	1.00	0.0	0.71	0.07
C.V. %	0.1	4.2	1.0	0.8	0.9	0.4	0.25	0.10	5.5	5.3	1.2	0.22	0.0	0.07	0.0	5.57	0.0
3 2 MEAN	0.780	9.30	1.01	339.	24.9	29.07	79.67	1.02	1.53	1.03	2.57	24.23	1421.	1433.	1421.	12.3	0.3
STD. DEV	0.028	0.142	0.346	4.	0.2	0.069	8.943	0.044	0.19	0.02	0.17	0.78	0.0	1.00	0.0	0.21	1.34
C.V. %	3.6	1.5	34.1	1.0	0.8	0.2	****	4.30	12.4	2.0	6.6	3.20	0.0	0.07	0.0	1.72	****

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- BLENDED GASOHOL CONTAINING 10% ETHANOL (RVP=10.0). SOURCE: HOWELL HYDROCARBONS (MSD ORDER).