Abstract

The vehicle correlation tests identified a 20% error in 50 mph dynamometer load with the 4500 lb. inertia load at the Fiat laboratory. However, even after this dynamometer was recalibrated, the CO_2, NOx and HC levels measured by Fiat on the hot-start 1975 FTP were still higher than the other test sites by about 8%, 18% and 28% respectively. The reason for these differences has not been determined.

Some rather small, but statistically significant, differences in CO_2 and NOx occurred between Mercedes and Ford and between Mercedes and EPA. It is believed that differences in dynamometer type (belt-driven inertia wheels at Mercedes and direct-drive inertia wheels at Ford and EPA) may be the cause of these descrepancies.

1. Introduction

In April, 1975, Mercedes-Benz of North America, Inc. requested an exhaust emission correlation study for the purpose of comparing test results at their Centerline, Michigan laboratory to the EPA facility. This Mercedes laboratory received EPA approval on February 19, 1975. Other test facilities which were also included in the study were Fiat in Dearborn and the Ford Emission Laboratory in Dearborn.

This report is a discussion of the correlation program. Testing was conducted from April 20 to May 3, 1975. Participants in the study and their designation code which is used in this report are:

E = EPA
F = Ford
I = Fiat
M = Mercedes-Benz

2. Technical Discussion

2.1 Program Objective

The purpose of this study is to compare the results of vehicle exhaust emission and fuel economy tests at the facilities of EPA, Mercedes - Benz (Centerline), Fiat (Dearborn) and Ford. In addition to comparing test results, this study also compares test equipment, procedures and conditions at each facility. If there are any real differences in emissions and/or fuel economy measurement, it is hopeful that the analysis of equipment, procedures, and conditions will reveal the cause of these differences.

2.2 Facilities and Equipment

2.2.1 Test Sites

The Mercedes and Fiat laboratories are one-cell test facilities. At the EPA test cell 5 was used which is the same cell used in the 1975 EPA-MVMA correlation study [1] and the EPA-BMW correlation study[2]. At the Ford Emission Laboratory test cell 4 was used, which is not the same cell used in the EPA-MVMA study. The equipment and instrumentation used within each test cell is listed in Table 2.2.1-1. One difference in instrumentation which might be expected to have an effect on emission levels is dynamometer type. Test sites E, I and F used direct-drive inertia wheel dynamometers and site M used a belt-driven inertia wheel dynamometer.

2.2.2 Test Vehicles

One test vehicle was used in the study. It was a 1974 Mercedes - Benz 450 SE with fuel injection and an automatic transmission. Exhaust

Table 2.2.1-1 Test Site Instrumentation

Instrumentation	Test Size			
	EPA	Fiat	Ford	Mercedes
Analyzers				
HC	Beckman 400; 0-50, 100 ppm; H_2/N_2 fuel	Horiba FIA 2A; 0-100 ppm; H_2/N_2 fuel	Beckman 400; 0-20 50 ppm; H_2/H_e fuel	Horiba 1A; 0-10, 30, 100 ppm; H_2/N_2 fuel
CO	Bendix 8501; 0-500, 1000 ppm	Horiba AIA-21 AS; 0-100, 500, 1000 ppm	Bendix; 0-100,250 ppm	Horiba AIA-21; 0-150, 400 ppm
NOx	TECO 10A; 0-100, 250 ppm; O_2 Ozone Source	TECO 10; 0-250 ppm; O_2 Ozone Source	Philco; 0-25, 100 ppm; O_2 Ozone Source	Scott CL 125; 0-50, 100, 500 ppm
CO_2	Beckman 315A; 0-3.3, 5.0%	Horiba AIA-21; 0-3, 7%	Beckman 315B; 0-4%	Horiba AIA- 21; 0-2, 5%
Analyzer Bench	Homebuilt according to Federal Resiter	Horiba	Philco	Homebuilt according to Federal Register
CO Conditioning Agents	None	Ice Bath	Ascarite, Silica Gel in common tube	None
CVS	Ford Philco, CFV	Horiba 45G, 6 Bag; ΔP = 42" H_2O	Ford Philco, CFV, 6 Bag	Horbia 45-G, 6 Bag
Dynamometer	Clayton CT-50, Direct-Drive Inertia, Auto Loading not used	Clayton EC 50, Direct-Drive Inertia, Auto Loading	Clayton CT-50, Direct-Drive Inertia, Auto-Loading not used	Clayton CTE 200, 0-20 hp., Belt-driven Inertia, Manual Loading
Driver's Aid	Varian, 5" = 60 mph, 4"/min. Preprinted Trace	HFE: Varian A4, 4" per min. FTP: PCS TV monitor	HP 7100, 5" = 60 mph, 4" per minute	HP 7100, 5" = 60 mph, 4" per minute
Computer	IBM 370, Off-line	PCS Automotive Emissions System	Xerox Sigma III	Hand-Calculated

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CO	Bendix 8501; 0-500, 1000 ppm	Horiba AIA-21 AS; 0-100, 500, 1000 ppm	Bendix; 0-100,250 ppm	Horiba AIA-21; 0-150, 400 ppm
NOx	TECO 10A; 0-100, 250 ppm; O_2 Ozone Source	TECO 10; 0-250 ppm; O_2 Ozone Source	Philco; 0-25, 100 ppm; O_2 Ozone Source	Scott CL 125; 0-50, 100, 500 ppm
CO_2	Beckman 315A; 0-3.3, 5.0%	Horiba AIA-21; 0-3, 7%	Beckman 315B; 0-4%	Horiba AIA- 21; 0-2, 5%
Analyzer Bench	Homebuilt according to Federal Resiter	Horiba	Philco	Homebuilt according to Federal Register
CO Conditioning Agents	None	Ice Bath	Ascarite, Silica Gel in common tube	None
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emission control equipment consisted of air injection, a catalytic reactor and exhaust recycle.

2.3 Program Design

The program was designed so there would be two days of testing at each facility. Each test site would run the same type and number of tests. Six types of tests were run at each facility. These included two 1975 cold-start FTPs, four 1975 hot-start FTPs, three highway fuel economys (HWFE), three 30 mph steady-states (SS-30), three 45 mph steady-states (SS-45) and three 60 mph steady-states (SS-60). This test design is shown in Table 2.3-1. The run numbers designate the sequence of testing for each test type. As shown in the table, tests 25 and 26 were not actually done because of lack of time.

Table 2.3-1. Sequence of Tests (Run Numbers)

	Test Site			
Test Type	E	M	F	I
1975 Cold-start	1, 2	3, 4	5, 6	7, 8
1975 Hot-start	11, 12, 13, 14	15, 16, 17, 18	19, 20, 21, 22	23, 24, 25[1], 26[1]
HWFE	34, 35, 36	37, 38, 39	40, 41, 42	31, 32, 33
SS-30	54, 55, 56	57, 58, 59	60, 61, 62[2]	51, 52, 53
SS-45	74, 75, 76	77, 78, 79	80, 81, 82	71, 72, 73
SS-60	94, 95, 96	97, 98, 99	100, 101, 102	91, 92, 93

1. Test not run because of lack of time.
2. Data from this test not used because of extremely low CO_2 value.

2.4 Test Procedure

2.4.1 Vehicle Preparation

Each day the 1975 cold-start FTP was the first test conducted. Prior to this test the vehicle was prepared according to the procedure in the Federal Register (without evaporative testing). Following the cold-start test two hot-start FTPs were conducted. On the first day of testing at each facility, the HWFE tests were done after the hot-start FTPs. On the second day of testing, the steady-state tests were conducted following the hot-start FTPs.

2.4.2 Emission Tests

Exhaust emissions were sampled and analyzed by the CVS method for all test runs. For the steady-state tests the vehicle speed and emissions where stablized for at least 30 seconds before sampling was started.

2.4.3 Fuel Economy Tests

For each FTP, HWFE and steady-state test, the fuel economy was calculated by the carbon balance technique as described in the Federal Register.

3. Data Analysis

A one-way analysis of variance (ANOVA) was used on test data in order to determine if the sites agreed in their measurements of HC, CO, CO_2, NOx and fuel economy (FC-C). If all test sites did not agree Scheffe allowances were calculated so that differences between individual test sites could be determined.

Also a one-way covariance analysis was done on the hot-start 1975 FTP data. HC, CO, CO_2 NOx and FC-C were treated as dependent variables and barometric pressure (BARO), dry bulb temperature (DB) and humidity (H) were random variables. The purpose of this analysis was to determine if the above mentioned random variables had an effect on emissions and fuel economy. If certain random variables were found to have a real effect, the data were corrected for this effect and the ANOVA was repeated.

4. Test Results

4.1 Emission and Fuel Consumption Tests

The data obtained from the 1975 cold-start FTP are contained in Appendix A. Table A-I lists the data for each of the test phases and for the composite (composite is designed as bag #4). Table A-II summarizes the composite cold-start data within each test site and over all the test sites (the grand). Figures A-1 through A-5 identify the composite emission and fuel economy data by run number and test site (the composite values are again designated as bag #4).

Appendix B contains the data obtained from the 1975 hot-start FTP and is organized the same as Appendix A. Appendix C contains the data for the HWFE and steady-state tests. Table C-I lists all these test data. Table C-II, C-III, C-IV and C-V are a site by site summary of the HWFE, SS-30, SS-45 and SS-60 data respectively. Figure C-1 through C-5 show the emission and fuel economy data by run number and test site for the HWFE and steady-state tests.

A summary of some of the Appendix data for the 1975 cold-start, 1975 hot-start and HWFE tests is compiled in Table 4.1-1. This table contains

Table 4.1-1. Mean ($\overline{X}$) and Standard Deviation (σ) of 1975 Cold-start, 1975 Hot-start, and HWFE Cycle Data

Test Type	Dependent Variable	Test Site E	M	F	I	Grand
1975 cold-start	HC $\overline{X}$, g/mi	.155	.168	.179	.155	.164
	σ, %	6.8	2.9	1.6	5.0	7.4
	CO $\overline{X}$, g/mi	.538	.844	.582	.681	.661
	σ, %	8.3	0.3	6.6	6.7	19.5
	CO_2 $\overline{X}$, g/mi	775	785	774	850	796
	σ, %	1.5	1.4	0.7	0.1	4.3
	NOx $\overline{X}$, g/mi	1.39	1.50	1.41	1.71	1.50
	σ, %	5.1	0.0	4.0	2.1	9.2
	FC-C $\overline{X}$, mi/gal	11.5	11.3	11.5	10.4	11.2
	σ, %	1.9	1.3	0.6	0.9	4.3
1975 hot-start	HC $\overline{X}$, g/mi	.108	.099	.108	.136	.109
	σ, %	1.8	4.8	4.6	12.0	12.1
	CO $\overline{X}$, g/mi	.052	.076	.068	.078	.067
	σ, %	46.2	29.8	16.9	2.7	31.0
	CO_2 $\overline{X}$, g/mi	720	753	707	786	735
	σ, %	1.1	0.7	2.1	2.3	4.1
	NOx $\overline{X}$, g/mi	1.37	1.43	1.27	1.61	1.39
	σ, %	1.9	5.2	1.4	1.8	8.5
	FC-C $\overline{X}$, mi/gal	12,3	11.8	12.6	11.3	12.1
	σ, %	1.0	0.8	2.1	2.5	4.1
HWFE	HC $\overline{X}$, g/mi	.043	.040	.040	.047	.043
	σ, %	13.3	9.5	4.3	14.3	11.6
	CO $\overline{X}$, g/mi	.040	.065	.061	.071	.059
	σ, %	25.0	20.8	7.6	1.6	24.0
	CO_2 $\overline{X}$, g/mi	519	520	488	611	534
	σ, %	1.7	0.8	1.8	1.8	9.1
	NOx $\overline{X}$, g/mi	2.06	1.83	1.76	2.91	2.14
	σ, %	2.3	5.8	5.1	2.5	2.3
	FC-C $\overline{X}$, mi/gal	17.1	17.1	18.2	14.5	16.7
	σ, %	1.8	0.9	1.8	1.7	8.4

the mean ($\bar{X}$) and standard deviation (σ) for each dependent variable at each test site. The emission levels of HC and CO for this vehicle were very low. On the hot-start tests, the range of CO exhaust sample concentration was about 1 to 5 ppm. This resulted in very small CO analyzer deflections. Consequently, the standard deviation of warmed - up CO emission levels was considerably greater than the other emission measurements. This is particularly true at site [illegible], which used a 500 ppm full-scale analyzer.

At this point it should be mentioned that an incorrect dynamometer horsepower setting was used at site [illegible] for the HWFE and steady-state tests. Manufacturer 1 does not market vehicles which require an inertia weight of [illegible] lbs. and therefore this setting is not typically used at their facility. The dynamometer was automatically loaded for all the correlation tests. When testing was completed the dynamometer horsepower was checked by running coast down tests and the 50 mph horsepower load was found to be approximately 20% too great. The cold-start and hot-start FTPs were rerun after calibration of the dynamometer; however, the HWFE and steady-state tests were not rerun. So the HWFE and steady-state data at site I were obtained with the incorrect dynamometer horsepower setting.

As earlier stated, the first step of the data analysis was an analysis of variance to determine if the test sites measured different levels of emissions and/or fuel economy. The results of this analysis are shown in Table [illegible]-2. As shown, the labs differed significantly in almost all measurements.

Table 4.2-2. Confidence Levels (above 90%) at which the Test Sites Measured Different Levels of Emissions and Fuel Economy (Analysis of Variance method)

Test Type	HC	CO	CO_2	NOx	FC-C
'75 Cold-start	93	99	99	99	99
'75 Hot-start	99		99	99	99
HWFE		98	99	99	99
SS-30	99	98	99	98	99
SS-45	99	98	99	98	99
SS-60	99		99	99	99

The next step in the analysis was to determine which particular sites differed significantly from each other. To do this, Scheffe confidence intervals at the 90%, 95% and 99% level of confidence were calculated. The results of this analysis for the 1975 cold-start and hot-start FTP's, are presented in Table 4.2-3. This table shows that, for the cold-start, site I measured significantly higher CO_2 and NOx (and lower FCC) than the other three sites. And on the hot-start test, site I measured higher HC levels as well as CO_2 and NOx. This suggests that perhaps, even after recalibration, the dynamometer load was still greater than that used by the other test facilities. Another interesting emission measurement difference was that site M measured significantly higher CO levels than the other sites on the cold-start test, but not on the hot-start. As previously mentioned, the differences in Table 4.2-3 are presently graphically in Appendix A (cold-start) and Appendix B (hot-start).

Table 4.2-3 1975 FTP Emissions and Fuel Economy Differences which were Statistically Significant at greater than a 90%, 95% and 99% Level of Confidence

Test Type	Site Contrast	HC		CO		CO_2		NOx		FCC	
		Δ, %[1]	C.L.[2]	Δ, %	C.L.	Δ, %	C.L.	Δ, %	C.L.	Δ, %	C.L.
1975 Cold-start	E M			-46	99						
	E F										
	E I			-22	90	-9	99	-21	95	+9	99
	M F			40	95						
	M I			25	90	-8	99	-14	90	+8	95
	F I					-9	99	-20	95	+9	99
1975 Hot-start	E M					-4	95			+4	95
	E F							7	90		
	E I	-26	99			-9	99	-17	99	+8	99
	M F					6	99	12	99	+6	99
	M I	-34	99			-4	95	-13	99	+4	90
	F I	-25	99			-11	99	-24	99	+10	99

1. Δ, % = Percentage difference between two test sites

2. C.L. = Confidence level based on Scheffe allowances

Table 4.2-4 lists the emission and fuel economy differences for the HWFE and steady-state tests. As previously stated, these tests at site I were conducted with approximately 20% too much road load horsepower at 50 mph cruise. Therefore, it is expected that the CO_2 and NOx levels at this facility would have been greater (and fuel economy poorer) than at the other test sites. Table 4.2-4 shows that this was generally true. Site I also generally measured higher HC than the other test sites, which might also be a dynamometer effect. These relationships are graphically presented in Appendix C.

Table 4.2-4. HWFE and Steady-State Data Differences which were Statistically Significant at greater than a 90%, 95% and 99% Level of Confidence

Test Type	Site Contrast		HC		CO		CO_2		NOx		FCC	
			Δ, %	C.L.	Δ, %	C.L.	Δ, %	C.L.	Δ, %	C.L.	Δ, %	C.L.
HWFE	E	M			-42	95			11	90		
		F					6	95	14	95	-6	99
		I			-51	95	-17	99	-40	99	+15	99
	M	F					6	95			-7	99
		I					-17	99	-51	99	+15	99
	F	I					-23	99	-54	99	+22	99
SS-30	E	M			-131	95						
		F	21	95								
		I	-44	99	-105	90	-14	99			+14	99
	M	F							19	90		
		I	-55	99			-13	99			+12	99
	F	I	-65	99			-12	99	-25	95	+11	99
SS-45	E	M	25	90	-76	95	3	90			-3	90
		F			-76	95						
		I			-64	90	-14	99			+13	99
	M	F										
		I	-36	95			-17	99	-36	90	+15	99
	F	I	-33	95			-16	99	-45	95	+15	99
SS-60	E	M	27	99			7	99	43	99	-8	99
		F	33	99					27	99		
		I	-23	99			-21	99	-36	99	+19	99
	M	F					-8	99	-16	95	+9	95
		I	-50	99			-28	99	-79	99	+26	99
	F	I	-56	99			-20	99	-63	99	+17	99

1. Δ, % = Percent difference between two test sites.

2. C.L. = Confidence level based on Scheffe allowances.

Table 4.2-4 shows that there were some very large percentage differences in CO measurement. This is because of the very low emission level of about 0.1 g/mi. Consequently, comparison of CO hot-start emissions between test sites is rather meaningless.

Other than the large descrepancy of the data at site I, which resulted from the incorrect dynamometer load, there are no other consistent differences in the data. However, some of the data seem to indicate that the dynamometer load curves may be substantially different between facilities. For example, Table 4.2-3 shows that site M measured 4% and 6% higher CO_2 than site E and F on the 1975 hot-start cycle. At the steady-state speed of 30 mph (Table 4.2-4) there was no significant difference in CO_2 measurement among these sites. However, at 60 mph, site M measured significantly less CO_2 (and NOx) than sites E and F. Such discrepancies might be explained by differences in dynamometer load vs. speed relationships.

As mentioned earlier, a final step in the data analysis was a covariance analysis of the 1975 hot-start data to determine any effect of ambient conditions on emission levels. Since testing at each facility occurred on two consecutive days, the change in ambient conditions within each test site was small. Consequently it was expected that any effect of ambient changes on emissions would be difficult to determine. The statistical analysis confirmed this belief. Only three ambient effects were significant at above the 80% confidence level and the most significant of these was at only a 91% level. These effects were (1) barometric pressure on HC, (2) humidity on HC and (3) humidity on NOx; and they are listed in Appendix D as Table D-I.

To determine if the three ambient effects in Table D-I had an effect on the measured HC and NOx differences between test sites, the 1975 hot-start data was corrected using the listed coefficients. An analysis of variance was then run on the corrected data. Results of this analysis are listed in Table D-II. Comparing this Table with the 1975 hot-start analysis in Table 4.2-3 reveals that the ambient corrections had only a slight effect on the differences between test sites. The only significant difference in the uncorrected data which was eliminated by the ambient corrections was the 7% discrepancy in NOx emissions between site E and F. Figures D-1, D-2 and D-3 show HC vs. barometer, HC vs. humidity and NOx vs. humidity, respectively, and contain the coefficients obtained by the covariance analysis. Wide scatter in the data points indicate the rather weak correlation obtained.

5. Conclusions

1. Site I differed significantly from the other test sites in the measurement of HC, CO_2, and NOx when tested on the HWFE and steady-state cycles. However, it was discovered that the dynamometer horsepower load was 20% greater than the proper value; and this is believed to be responsible for most of the observed difference.

2. After dynamometer recalibration, test site I measured approximately 8% higher CO_2 and 18% higher NOx than the other test sites for both cold-start and hot-start 1975 FTPs. HC was also higher on the 1975 hot-start This indicates that the dynamometer load at site I may still have been greater than at the other test sites.

3. On the 1975 cold-start FTP, site M measured significantly higher CO than the other 3 test sites.

4. Test sites can not be meaningfully compared for hot-start CO emissions because of the extremely low CO levels.

5. On hot-start 1975 FTPs site M measured about 5% more CO_2 than sites E and F, and 9% more NOx than site F. However at a 60 mph steady-state, site M measured about 7% less CO_2 and significantly less NOx than sites E and F. It is likely that these differences are due to a loading difference between the belt-driven dynamometer used by site M and the direct-drive unit used by the other test sites.

6. Recommendations

1. Lower range CO analyzers would improve the repeatability of CO measurements when a low emission vehicle such as used in this program is tested. This is particularly true for site E.

2. Dynamometer torque measurements during correlation program tests would be helpful in determining dynamometer effects.

3. Standardization of dynamometer type would probably improve correlation between emission laboratories.

4. Cylinder gas cross-checks would be helpful in determining any differences in analytical system performance.

5. Ambient effects could be better quantified if there were two rounds of testing, because this would most likely result in greater ambient variations within test sites.

References

1. Leiferman, M. and Wilson, G., "1975 EPA-U.S. MVMA Emission Laboratory Correlation Study", Environmental Protection Agency, Office of Air and Waste Management, Office of Mobile Source Air Pollution Control, Emission Control Technology Division, June, 1975.

2. Leiferman, M., "EPA-BMW Emission Laboratory Correlation Study," Environmental Protection Agency, Office of Air and Waste Management, Office of Mobile Source Air Pollution Control, Emission Control Technology Division, June, 1975.

Appendix A
Data from Cold-Start 1975 FTP

Table A-1 MERCEDES CORRELATION STUDY -- 1975 COLD START

TEST DATA BAG #1

SITE	RUN NO.	BAG NO.	H C	C O	CO2	NOX	FC-C	WB	DB	K	BARO	HUM
E1	1	1	0.350	2.180	803.	1.91		62.0	74.0	0.957	28.98	65.7
E1	2	1	0.400	2.610	830.	2.03		61.0	71.5	0.953	29.17	64.7
M2	3	1	0.386	3.769	820.	2.10		61.0	73.0	0.940	29.17	61.7
M2	4	1	0.406	3.827	827.	2.11		63.0	78.0	0.950	29.31	64.0
F3	5	1	0.398	2.373	806.	2.06		64.0	79.0	0.959	29.22	66.1
F3	6	1	0.441	2.677	813.	1.95		58.0	79.0	0.852	29.42	38.3
I4	7	1	0.318	2.895	926.	2.25		65.0	78.0	0.989	29.18	72.9
I4	8	1	0.359	3.270	984.	2.49		60.0	78.0	0.888	29.48	48.4

TEST DATA BAG #2

SITE	RUN NO.	BAG NO.	H C	C O	CO2	NOX	FC-C	WB	DB	K	BARO	HUM
E1	1	2	0.090	0.060	814.	0.93		62.0	74.0	0.957	28.98	65.7
E1	2	2	0.090	0.020	815.	0.99		61.0	71.5	0.953	29.17	64.7
M2	3	2	0.098	0.066	828.	1.20		61.0	73.0	0.940	29.17	61.7
M2	4	2	0.105	0.055	836.	1.16		63.0	78.0	0.950	29.31	64.0
F3	5	2	0.107	0.067	809.	0.97		64.0	79.0	0.959	29.22	66.1
F3	6	2	0.101	0.059	819.	0.93		58.0	79.0	0.852	29.42	38.3
I4	7	2	0.086	0.043	873.	1.19		65.0	78.0	0.989	29.18	72.9
I4	8	2	0.092	0.030	862.	1.17		60.0	78.0	0.888	29.48	48.4

TEST DATA BAG #3

SITE	RUN NO.	BAG NO.	H C	C O	CO2	NOX	FC-C	WB	DB	K	BARO	HUM
E1	1	3	0.110	0.100	648.	1.68		62.0	74.0	0.957	28.98	65.7
E1	2	3	0.130	0.080	685.	1.84		61.0	71.5	0.953	29.17	64.7
M2	3	3	0.124	0.116	647.	1.98		61.0	73.0	0.940	29.17	61.7
M2	4	3	0.121	0.105	687.	1.98		63.0	78.0	0.950	29.31	64.0
F3	5	3	0.146	0.115	669.	1.90		64.0	79.0	0.959	29.22	66.1
F3	6	3	0.136	0.098	674.	1.78		58.0	79.0	0.852	29.42	38.3
I4	7	3	0.141	0.109	745.	2.19		65.0	78.0	0.989	29.18	72.9
I4	8	3	0.139	0.082	728.	2.23		60.0	78.0	0.888	29.48	48.4

TEST DATA BAG #4

SITE	RUN NO.	BAG NO.	H C	C O	CO2	NOX	FC-C	WB	DB	K	BARO	HUM
E1	1	4	0.147	0.506	767.	1.34	11.6	62.0	74.0	0.957	28.98	65.7
E1	2	4	0.162	0.569	783.	1.44	11.3	61.0	71.5	0.953	29.17	64.7
M2	3	4	0.164	0.842	777.	1.50	11.4	61.0	73.0	0.940	29.17	61.7
M2	4	4	0.171	0.845	793.	1.50	11.2	63.0	78.0	0.950	29.31	64.0
F3	5	4	0.177	0.555	770.	1.45	11.5	64.0	79.0	0.959	29.22	66.1
F3	6	4	0.181	0.609	778.	1.37	11.4	58.0	79.0	0.852	29.42	38.3
I4	7	4	0.149	0.649	849.	1.68	10.4	65.0	78.0	0.989	29.18	72.9
I4	8	4	0.160	0.713	850.	1.73	10.4	60.0	78.0	0.888	29.48	48.4

Table A-II Summary of Composite 1975 Cold-Start FTP Data

DESCRIPTIVE MEASURES STRATUM = 1 = EPA

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	2	.15450	.10607 -1	.75000 -2	.14700	.16200
CO	2	.53750	.44548 -1	.31500 -1	.50600	.56900
CO2	2	775.00	11.314	8.0000	767.00	783.00
NOX	2	1.3900	.70711 -1	.50000 -1	1.3400	1.4400
FC-C	2	11.450	.21213	.15000	11.300	11.600
WB	2	61.500	.70711	.50000	61.000	62.000
DB	2	72.750	1.7678	1.2500	71.500	74.000
K	2	.95500	.28284 -2	.20000 -2	.95300	.95700
BARO	2	29.075	.13435	.95000 -1	28.980	29.170
HUM	2	65.200	.70711	.50000	64.700	65.700

DESCRIPTIVE MEASURES STRATUM = 2 = Mercedes

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	2	.16750	.49497 -2	.35000 -2	.16400	.17100
CO	2	.84350	.21213 -2	.15000 -2	.84200	.84500
CO2	2	785.00	11.314	8.0000	777.00	793.00
NOX	2	1.5000			1.5000	1.5000
FC-C	2	11.300	.14142	.10000	11.200	11.400
WB	2	62.000	1.4142	1.0000	61.000	63.000
DB	2	75.500	3.5355	2.5000	73.000	78.000
K	2	.94500	.70711 -2	.50000 -2	.94000	.95000
BARO	2	29.240	.98995 -1	.70000 -1	29.170	29.310
HUM	2	62.850	1.6263	1.1500	61.700	64.000

DESCRIPTIVE MEASURES STRATUM = 3 = Ford

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	2	.17900	.28284 -2	.20000 -2	.17700	.18100
CO	2	.58200	.38184 -1	.27000 -1	.55500	.60900
CO2	2	774.00	5.6569	4.0000	770.00	778.00
NOX	2	1.4100	.56569 -1	.40000 -1	1.3700	1.4500
FC-C	2	11.450	.70711 -1	.50000 -1	11.400	11.500
WB	2	61.000	4.2426	3.0000	58.000	64.000
DB	2	79.000			79.000	79.000
K	2	.90550	.75660 -1	.53500 -1	.85200	.95900
BARO	2	29.320	.14142	.10000	29.220	29.420
HUM	2	52.200	19.658	13.900	38.300	66.100

DESCRIPTIVE MEASURES STRATUM = 4 = Fiat

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	2	.15450	.77782 -2	.55000 -2	.14900	.16000
CO	2	.68100	.45255 -1	.32000 -1	.64900	.71300
CO2	2	849.50	.70711	.50000	849.00	850.00
NOX	2	1.7050	.35355 -1	.25000 -1	1.6800	1.7300
FC-C	2	10.400			10.400	10.400
WB	2	62.500	3.5355	2.5000	60.000	65.000
DB	2	78.000			78.000	78.000
K	2	.93850	.71418 -1	.50500 -1	.88800	.98900
BARO	2	29.330	.21213	.15000	29.180	29.480
HUM	2	60.650	17.324	12.250	48.400	72.900

DESCRIPTIVE MEASURES Grand

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	8	.16387	.12194 -1	.43113 -2	.14700	.18100
CO	8	.66100	.12867	.45492 -1	.50600	.84500
CO2	8	795.88	34.027	12.030	767.00	850.00
NOX	8	1.5012	.13830	.48896 -1	1.3400	1.7300
FC-C	8	11.150	.47809	.16903	10.400	11.600
WB	8	61.750	2.2520	.79620	58.000	65.000
DB	8	76.313	2.9873	1.0562	71.500	79.000
K	8	.93600	.44143 -1	.15607 -1	.85200	.98900
BARO	8	29.241	.15869	.56107 -1	28.980	29.480
HUM	8	60.225	11.226	3.9689	38.300	72.900

Figure A-1 (1975 COLD START) HC VS. RUN#(BAG4)
(Y VS. X) 06-10-75

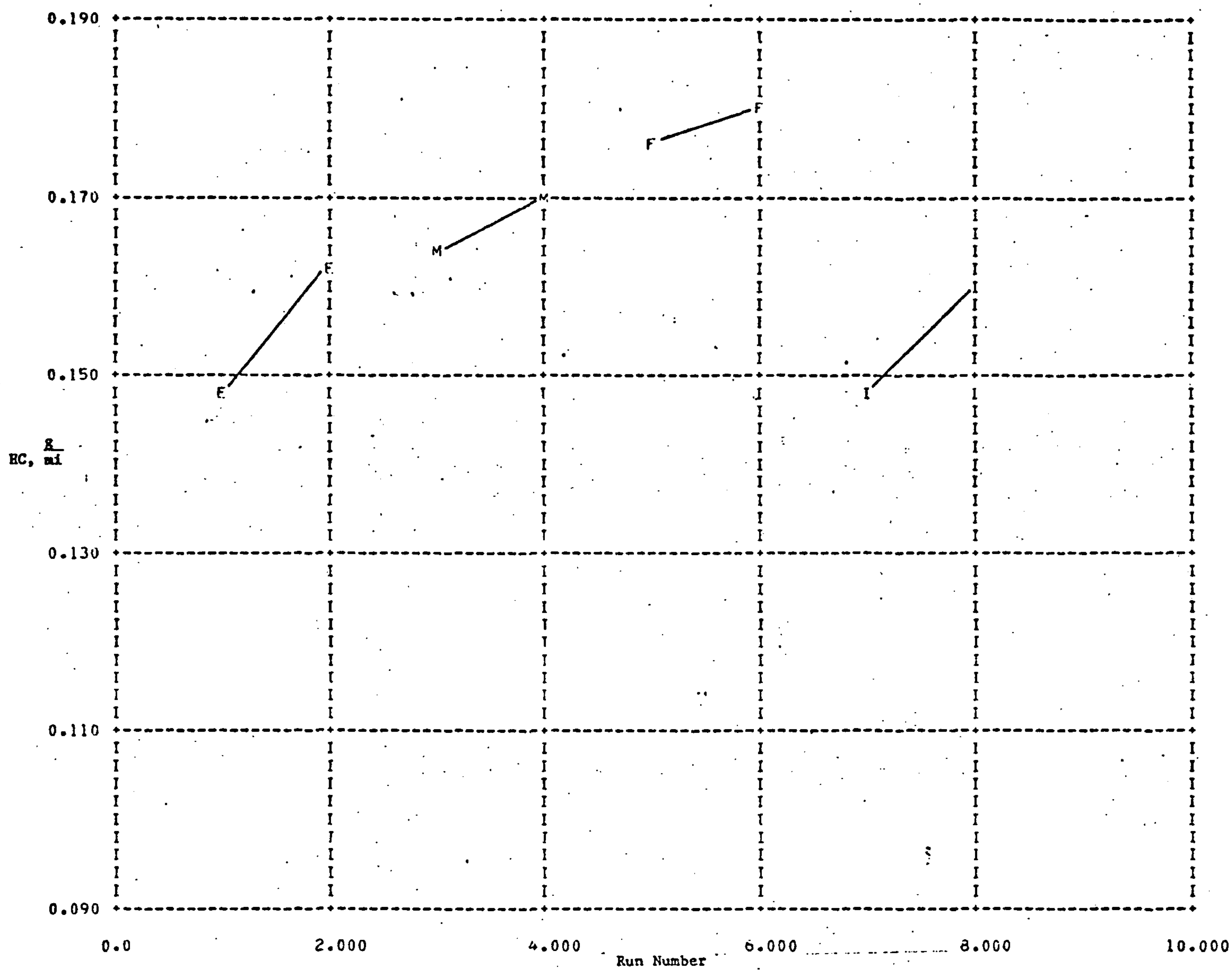


Figure A-2 (1975 COLD START) CO VS. RUN#(BAG4)

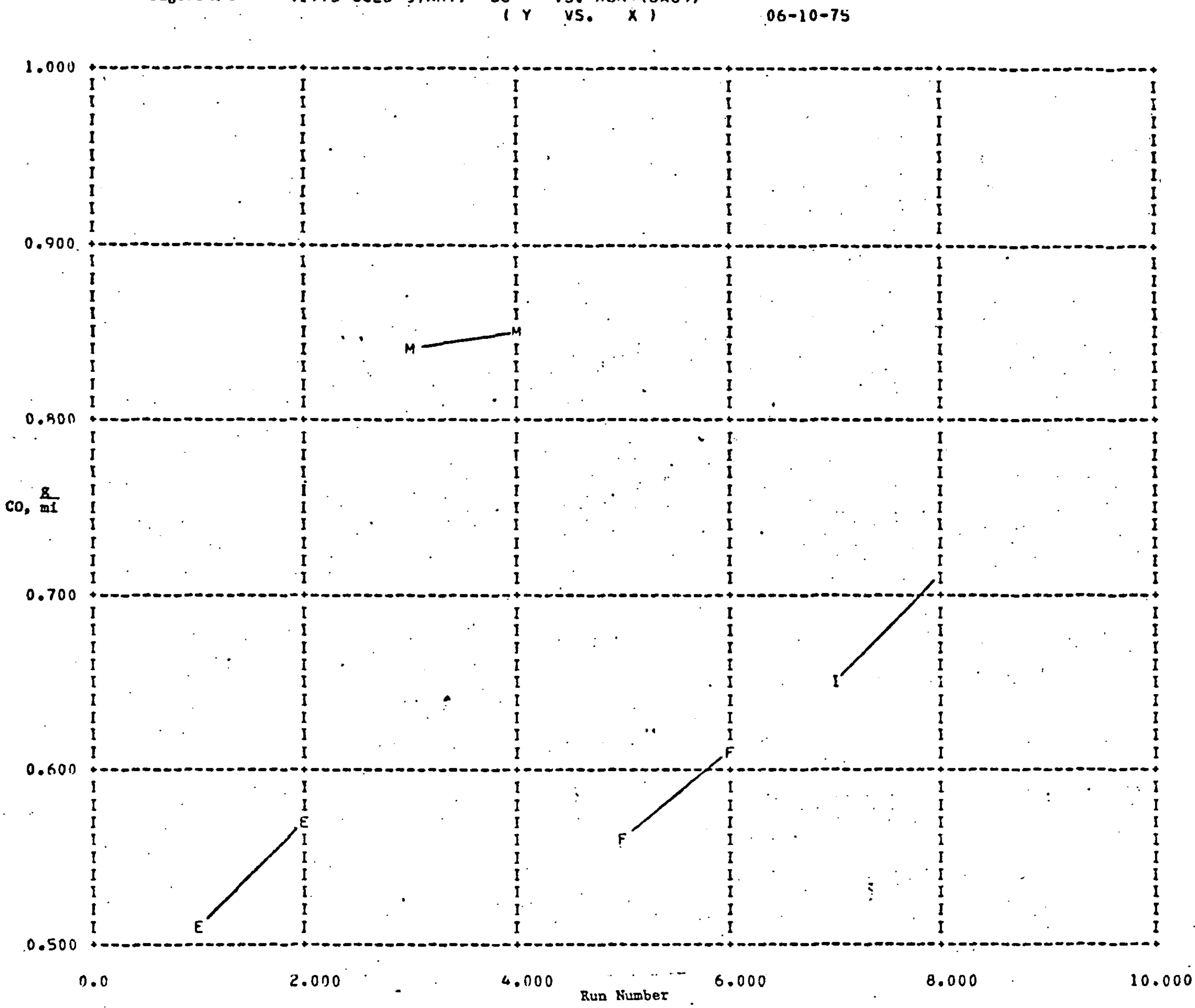


Figure A-3 (1975 COLD START) CO2 VS. RUN#(BAG4)
(Y VS. X) 06-10-75

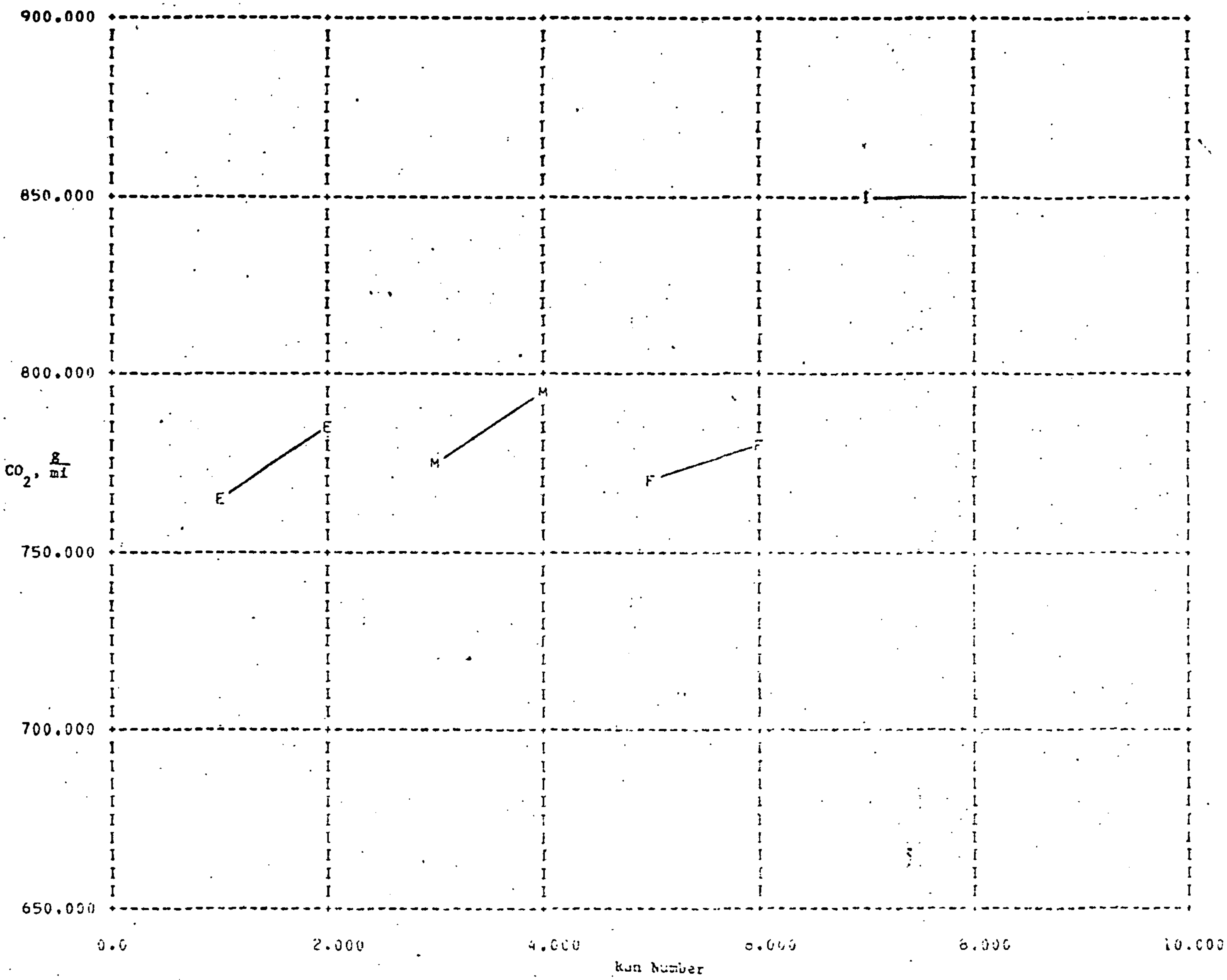


Figure A-4 (1975 COLD START) NOX VS. RUN#(BAG4)

(Y VS. X) 05-10-75

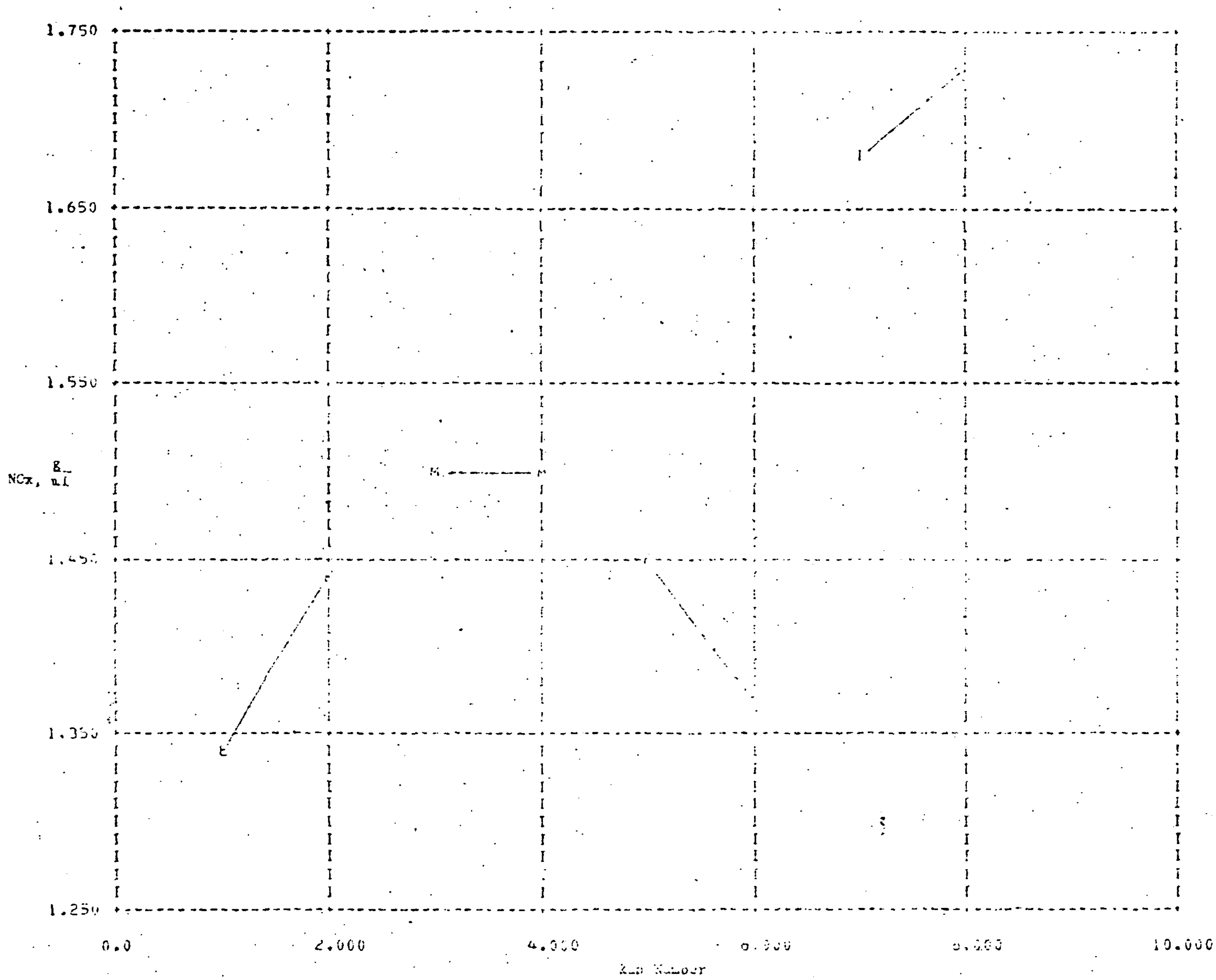
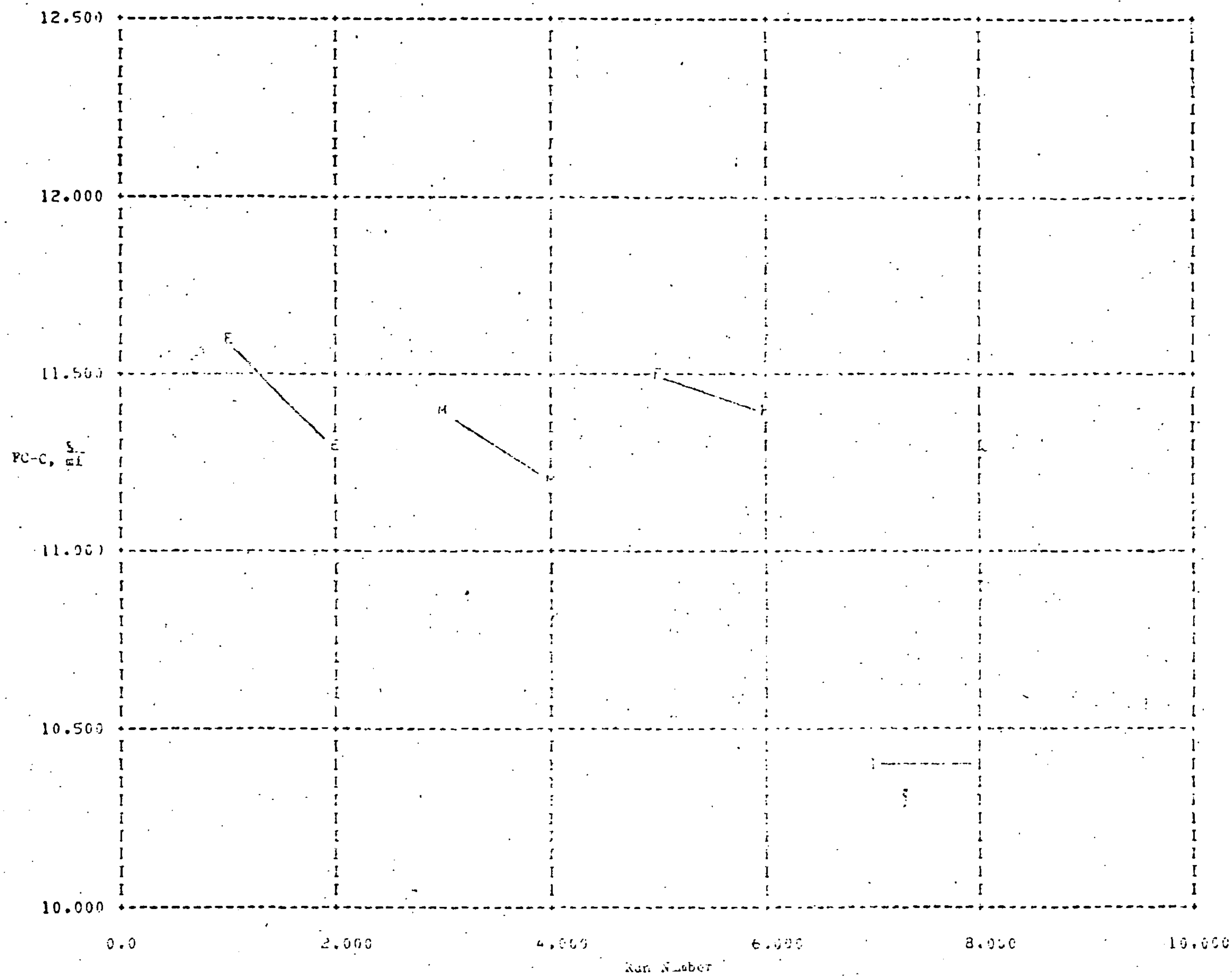


Figure A-5 (1975 COLD START) FC-C VS. RUN#(BAG4)
(Y VS. X) 06-10-75



Appendix B
Data From Hot-Start 1975 FTP

Table B-I MERCEDES CORRELATION STUDY -- 1975 HOT START

TEST DATA BAG #1

SITE	RUN NO.	BAG NO.	H C	C O	CO2	NOX	FC-C	WB	DB	K	BARO	HUM
E1	11	1	0.090	0.060	665.	1.78		63.0	73.5	0.982	28.98	71.3
E1	12	1	0.100	0.060	691.	1.82		63.0	75.0	0.970	29.04	68.7
E1	13	1	0.080	0.020	665.	1.90		62.0	74.0	0.954	29.20	65.0
E1	14	1	0.080	0.050	658.	1.84		63.0	74.0	0.975	29.20	69.8
M2	15	1	0.089	0.090	691.	1.96		63.0	76.0	0.944	29.19	62.6
M2	16	1	0.078	0.037	688.	1.82		66.0	78.0	1.020	29.19	79.4
M2	17	1	0.071	0.059	684.	1.92		63.0	78.0	0.937	29.31	60.9
M2	18	1	0.071	0.079	679.	1.83		64.0	78.0	0.930	29.31	59.2
F3	19	1	0.066	0.074	661.	1.75		62.0	78.0	0.926	29.23	58.2
F3	20	1	0.079	0.074	652.	1.79		62.0	79.0	0.920	29.23	56.7
F3	21	1	0.086	0.084	657.	1.64		57.0	79.0	0.838	29.42	34.1
F3	22	1	0.082	0.078	650.	1.73		57.0	79.0	0.838	29.42	34.1
I4	23	1	0.112	0.087	748.	2.15		66.0	78.0	1.013	29.21	78.0
I4	24	1	0.118	0.080	712.	2.01		60.0	78.0	0.888	29.49	48.4

TEST DATA BAG #2

SITE	RUN NO.	BAG NO.	H C	C O	CO2	NOX	FC-C	WB	DB	K	BARO	HUM
E1	11	2	0.100	0.060	773.	1.00		63.0	73.5	0.982	28.98	71.3
E1	12	2	0.100	0.020	779.	0.93		63.0	75.0	0.970	29.04	68.7
E1	13	2	0.100	0.0	774.	0.99		62.0	74.0	0.954	29.20	65.0
E1	14	2	0.100	0.020	756.	0.96		63.0	74.0	0.975	29.20	69.8
M2	15	2	0.098	0.082	819.	1.18		63.0	76.0	0.944	29.19	62.6
M2	16	2	0.109	0.029	819.	1.16		66.0	78.0	1.020	29.19	79.4
M2	17	2	0.093	0.064	818.	1.12		63.0	78.0	0.937	29.31	60.9
M2	18	2	0.086	0.085	815.	1.12		64.0	78.0	0.930	29.31	59.2
F3	19	2	0.111	0.050	785.	0.90		62.0	78.0	0.926	29.23	58.2
F3	20	2	0.108	0.048	775.	0.90		62.0	79.0	0.920	29.23	56.7
F3	21	2	0.109	0.045	779.	0.89		57.0	79.0	0.838	29.42	34.1
F3	22	2	0.110	0.058	775.	0.89		57.0	79.0	0.838	29.42	34.1
I4	23	2	0.119	0.090	846.	1.11		66.0	78.0	1.013	29.21	78.0
I4	24	2	0.152	0.024	829.	1.13		60.0	78.0	0.888	29.49	48.4

TEST DATA BAG #3

SITE	RUN NO.	BAG NO.	H C	C O	CO2	NOX	FC-C	WB	DB	K	BARO	HUM
E1	11	3	0.130	0.140	656.	1.74		63.0	73.5	0.982	28.98	71.3
E1	12	3	0.140	0.120	663.	1.74		63.0	75.0	0.970	29.04	68.7
E1	13	3	0.130	0.060	664.	1.81		62.0	74.0	0.954	29.20	65.0
E1	14	3	0.130	0.100	623.	1.86		63.0	74.0	0.975	29.20	69.8
M2	15	3	0.117	0.089	677.	1.98		63.0	76.0	0.944	29.19	62.6
M2	16	3	0.114	0.070	688.	1.81		66.0	78.0	1.020	29.19	79.4
M2	17	3	0.125	0.144	687.	1.92		63.0	78.0	0.937	29.31	60.9
M2	18	3	0.122	0.109	663.	1.75		64.0	78.0	0.930	29.31	59.2
F3	19	3	0.115	0.065	572.	1.68		62.0	78.0	0.926	29.23	58.2
F3	20	3	0.106	0.073	548.	1.51		62.0	79.0	0.920	29.23	56.7
F3	21	3	0.137	0.096	658.	1.68		57.0	79.0	0.838	29.42	34.1
F3	22	3	0.136	0.142	656.	1.68		57.0	79.0	0.838	29.42	34.1
I4	23	3	0.145	0.101	742.	2.22		66.0	78.0	1.013	29.21	78.0
I4	24	3	0.160	0.125	711.	2.14		60.0	78.0	0.888	29.49	48.4

TEST DATA BAG #4

SITE	RUN NO.	BAG NO.	H C	C O	CO2	NOX	FC-C	WB	DB	K	BARO	HUM
E1	11	4	0.106	0.080	719.	1.36	12.3	63.0	73.5	0.982	28.98	71.3
E1	12	4	0.110	0.057	729.	1.34	12.2	63.0	75.0	0.970	29.04	68.7
E1	13	4	0.106	0.022	722.	1.40	12.3	62.0	74.0	0.954	29.20	65.0
E1	14	4	0.108	0.047	710.	1.38	12.5	63.0	74.0	0.975	29.20	69.8
M2	15	4	0.101	0.086	754.	1.47	11.8	63.0	76.0	0.944	29.19	62.6
M2	16	4	0.104	0.042	757.	1.51	11.7	66.0	78.0	1.020	29.19	79.4
M2	17	4	0.097	0.085	755.	1.41	11.7	63.0	78.0	0.937	29.31	60.9
M2	18	4	0.093	0.090	745.	1.34	11.9	64.0	78.0	0.930	29.31	59.2
F3	19	4	0.107	0.059	702.	1.29	12.6	62.0	78.0	0.926	29.23	58.2
F3	20	4	0.101	0.062	688.	1.25	12.9	62.0	79.0	0.920	29.23	56.7
F3	21	4	0.112	0.067	721.	1.26	12.3	57.0	79.0	0.838	29.42	34.1
F3	22	4	0.111	0.085	717.	1.28	12.4	57.0	79.0	0.838	29.42	34.1
I4	23	4	0.124	0.093	798.	1.63	11.1	66.0	78.0	1.013	29.21	78.0
I4	24	4	0.147	0.063	773.	1.59	11.5	60.0	78.0	0.888	29.49	48.4

Table B-II Summary of Composite 1975 Hot-Start FTP Data

DESCRIPTIVE MEASURES STRATUM = 1 = EPA

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	4	.10750	.19149 -2	.95743 -3	.10600	.11000
CO	4	.51500 -1	.24035 -1	.12017 -1	.22000 -1	.80000 -
CO2	4	720.00	7.8740	3.9370	710.00	729.00
NOX	4	1.3700	.25820 -1	.12910 -1	1.3400	1.4000
FC-C	4	12.325	.12583	.62915 -1	12.200	12.500
WB	4	62.750	.50000	.25000	62.000	63.000
DB	4	74.125	.62915	.31458	73.500	75.000
K	4	.97025	.11899 -1	.59494 -2	.95400	.98200
BARO	4	29.105	.11240	.56199 -1	28.980	29.200
HUM	4	68.700	2.6870	1.3435	65.000	71.300

DESCRIPTIVE MEASURES STRATUM = 2 = Mercedes

HC	4	.98750 -1	.47871 -2	.23936 -2	.93000 -1	.10400
CO	4	.75750 -1	.22603 -1	.11302 -1	.42000 -1	.90000 -
CO2	4	752.75	5.3151	2.6575	745.00	757.00
NOX	4	1.4325	.74106 -1	.37053 -1	1.3400	1.5100
FC-C	4	11.775	.95743 -1	.47871 -1	11.700	11.900
WB	4	64.000	1.4142	.70711	63.000	66.000
DB	4	77.500	1.0000	.50000	76.000	78.000
K	4	.95775	.41892 -1	.20946 -1	.93000	1.0200
BARO	4	29.250	.69282 -1	.34641 -1	29.190	29.310
HUM	4	65.525	9.3536	4.6768	59.200	79.400

DESCRIPTIVE MEASURES STRATUM = 3 = Ford

HC	4	.10775	.49917 -2	.24958 -2	.10100	.11200
CO	4	.68250 -1	.11644 -1	.58220 -2	.59000 -1	.85000 -1
CO2	4	707.00	15.078	7.5388	688.00	721.00
NOX	4	1.2700	.18257 -1	.91287 -2	1.2500	1.2900
FC-C	4	12.550	.26458	.13229	12.300	12.900
WB	4	59.500	2.8868	1.4434	57.000	62.000
DB	4	78.750	.50000	.25000	78.000	79.000
K	4	.88050	.49136 -1	.24568 -1	.83800	.92600
BARO	4	29.325	.10970	.54848 -1	29.230	29.420
HUM	4	45.775	13.495	6.7475	34.100	58.200

DESCRIPTIVE MEASURES STRATUM = 4 = Fiat

HC	2	.13550	.16263 -1	.11500 -1	.12400	.14700
CO	2	.78000 -1	.21213 -1	.15000 -1	.63000 -1	.93000 -1
CO2	2	785.50	17.678	12.500	773.00	798.00
NOX	2	1.6100	.28284 -1	.20000 -1	1.5900	1.6300
FC-C	2	11.300	.28284	.20000	11.100	11.500
WB	2	63.000	4.2426	3.0000	60.000	66.000
DB	2	78.000			78.000	78.000
K	2	.95050	.88388 -1	.62500 -1	.88800	1.0130
BARO	2	29.350	.19799	.14000	29.210	29.490
HUM	2	63.200	20.930	14.800	48.400	78.000

DESCRIPTIVE MEASURES Grand

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	14	.10907	.13182 -1	.35230 -2	.93000 -1	.14700
CO	14	.67000 -1	.20825 -1	.55658 -2	.22000 -1	.93000 -1
CO2	14	735.00	29.951	8.0048	688.00	798.00
NOX	14	1.3936	.11875	.31737 -1	1.2500	1.6300
FC-C	14	12.086	.48652	.13003	11.100	12.900
WB	14	62.214	2.6941	.72003	57.000	66.000
DB	14	76.964	2.0236	.54082	73.500	79.000
K	14	.93821	.55472 -1	.14825 -1	.83800	1.0200
BARO	14	29.244	.13971	.37339 -1	28.980	29.490
HUM	14	60.457	13.924	3.7213	34.100	79.400

Figure B-1

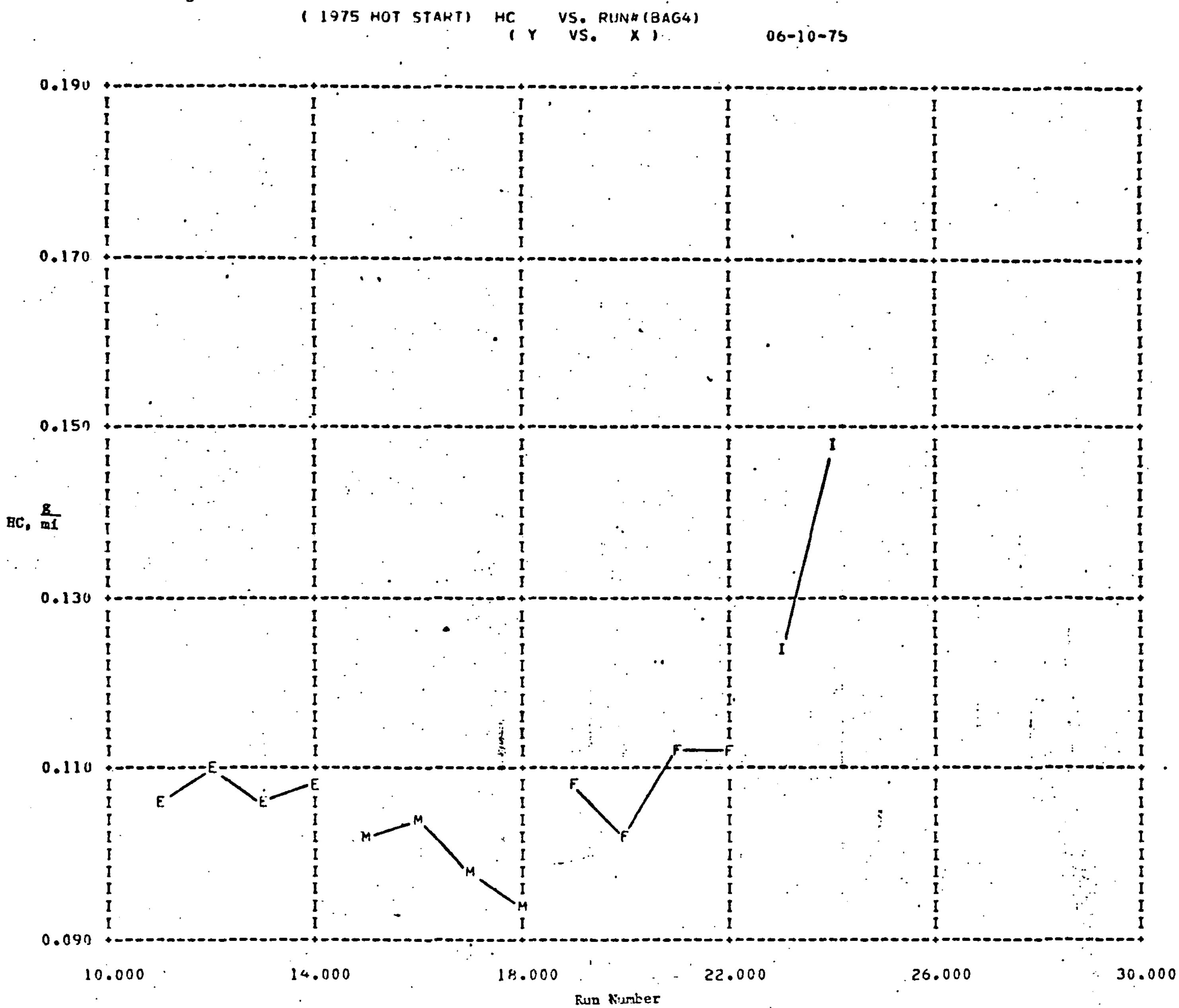

(1975 HOT START) HC VS. RUN#(BAG4)
(Y VS. X)
06-10-75
0.190
0.170
0.150
0.130
0.110
0.090
HC, g/mi
10.000
14.000
18.000
22.000
26.000
30.000
Run Number

Figure B-2 (1975 HOT START) CO VS. RUN#(BAG4)
(Y VS. X) 06-10-75

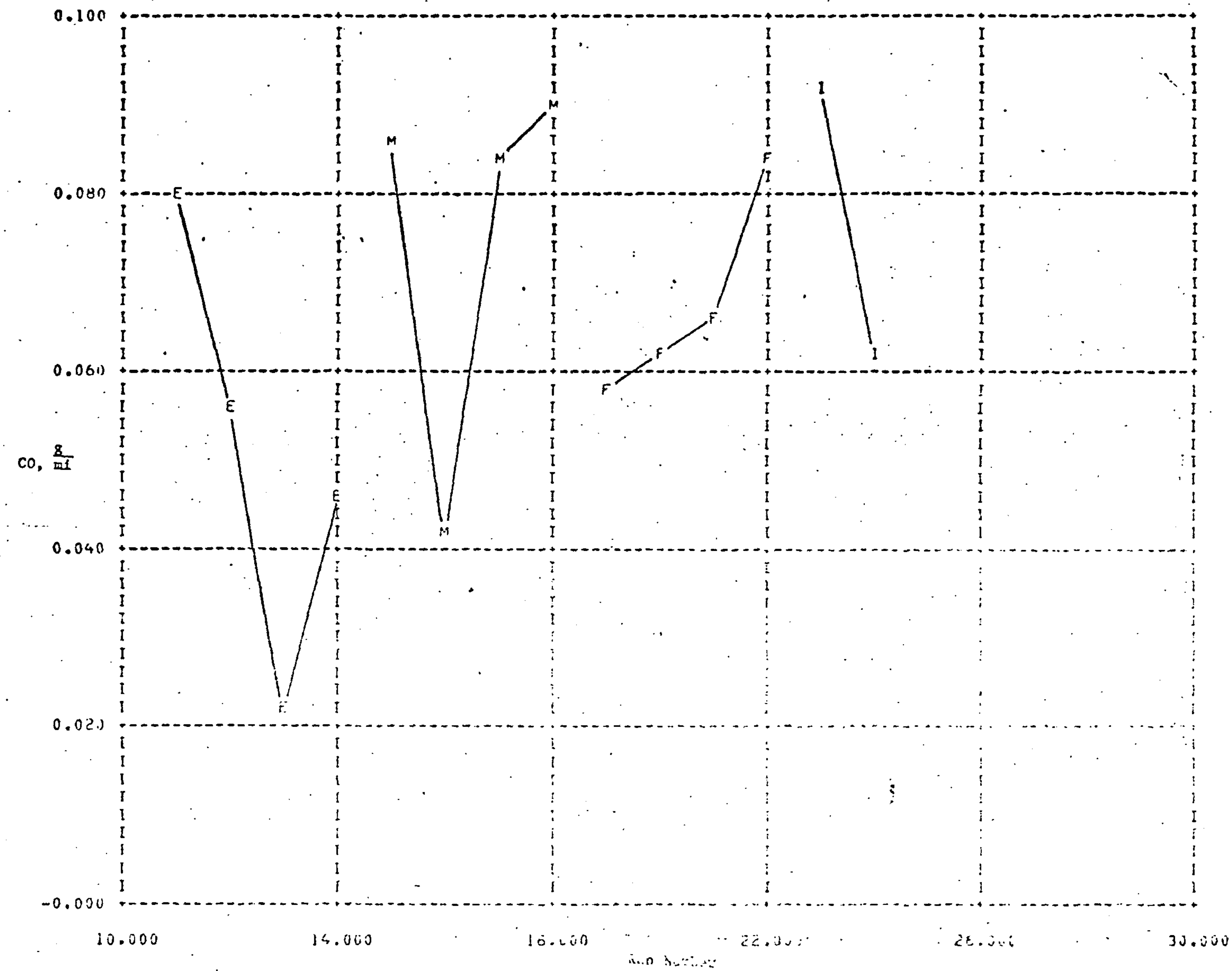


Figure B-3 (1975 HOT START) CO2 VS. RUN#(BAG4)
(Y VS. X) 06-10-75

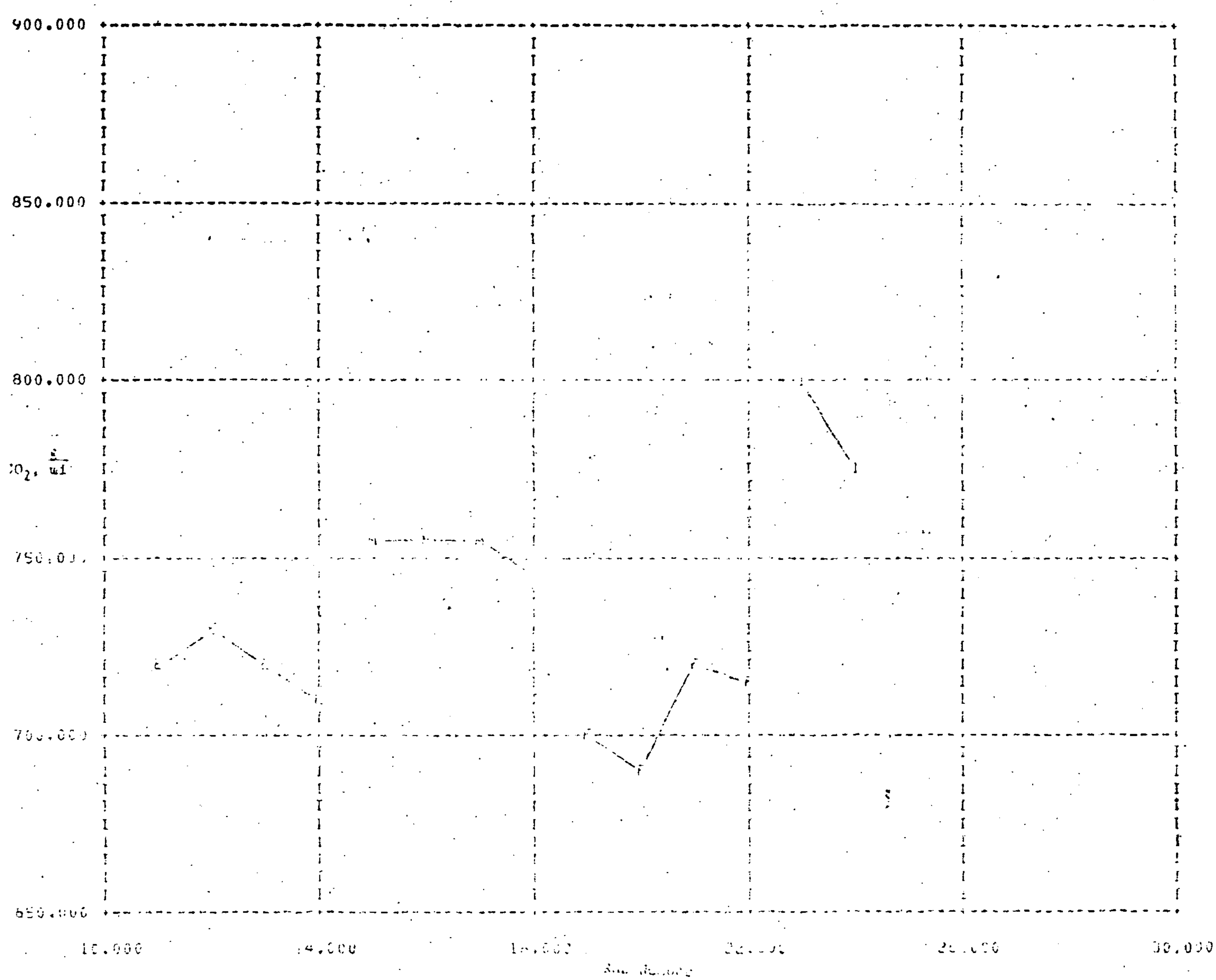


Figure B-4 (1975 HOT START) NOX VS. RUN#(BAG4)
(Y VS. X) 06-10-75

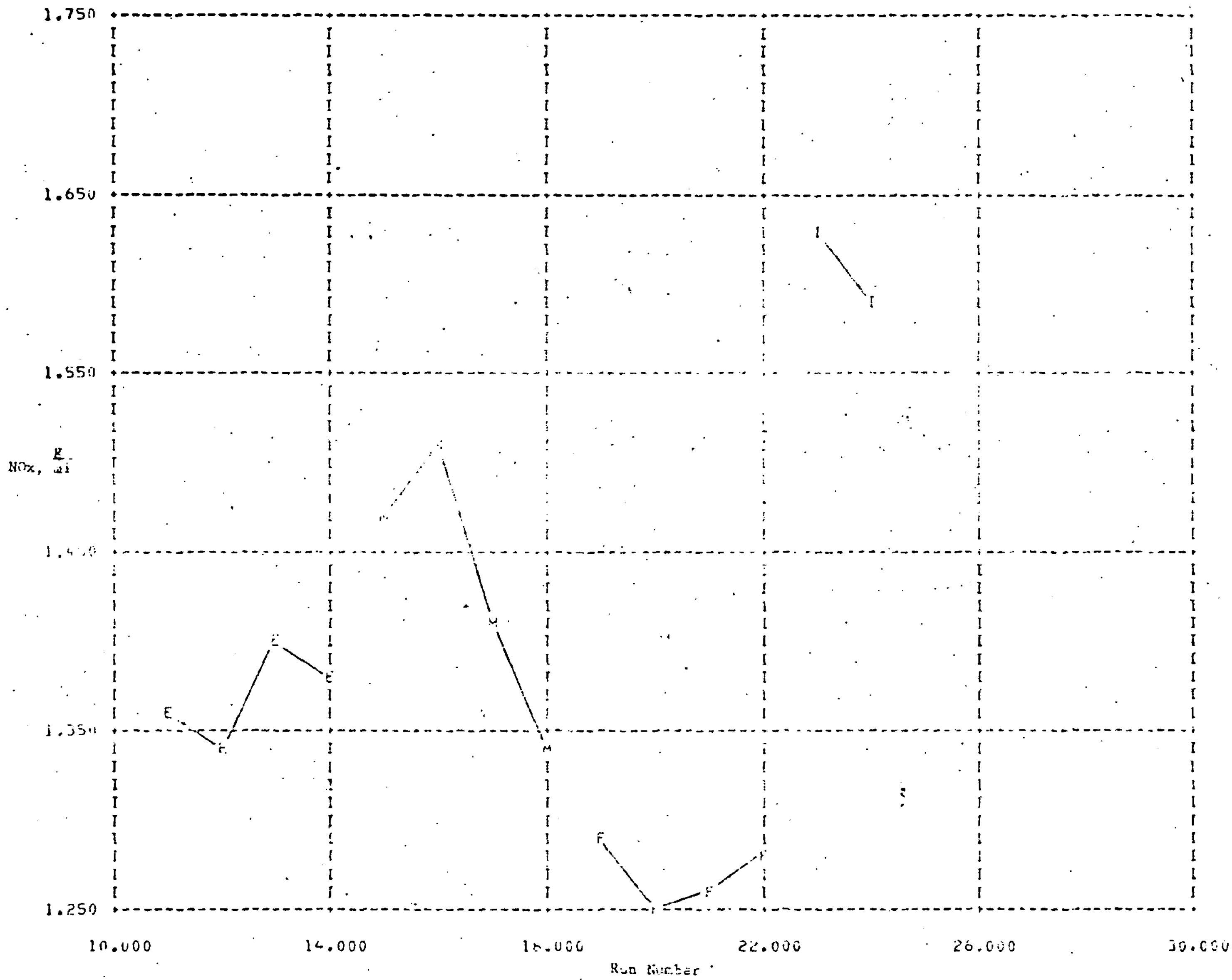
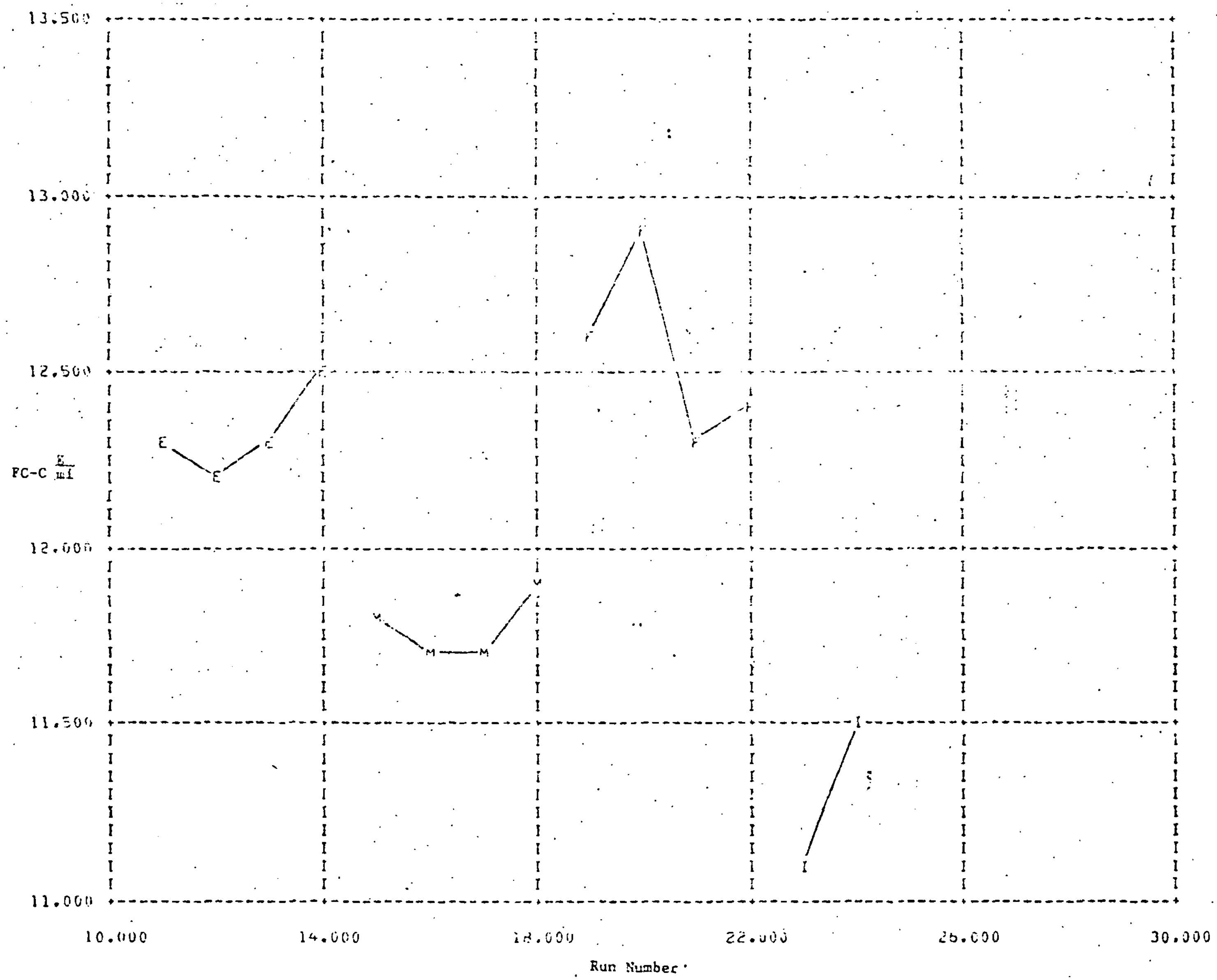


Figure B-5



13.500
13.000
12.500
12.000
11.500
11.000
FC-C g/ml
10.000
14.000
18.000
22.000
26.000
30.000
Run Number

Appendix C
Data From HWFE and Steady-State Tests

Table C-I MERCEDES CORRELATION STUDY -- HWFE

TEST DATA BAG #1

SITE	RUN NO.	BAG NO.	H C	C O	CO2	NOX	FC-C	WB	DB	K	BARO	HUM
I4	31	1	0.051	0.072	614.	2.97	14.5				29.75	
I4	32	1	0.050	0.070	599.	2.94	14.8				29.75	
I4	33	1	0.039	0.070	620.	2.83	14.3				29.75	
E1	34	1	0.050	0.050	528.	2.11	16.8	62.5	74.0	0.964	29.21	67.3
E1	35	1	0.040	0.040	517.	2.04	17.1	62.5	74.0	0.964	29.21	67.3
E1	36	1	0.040	0.030	511.	2.02	17.4	62.5	74.0	0.964	29.21	67.3
M2	37	1	0.043	0.061	524.	1.95	16.9	65.0	75.0	1.005	29.17	76.3
M2	38	1	0.036	0.080	520.	1.77	17.1	63.5	75.0	0.974	29.18	69.6
M2	39	1	0.042	0.054	515.	1.76	17.2	63.0	73.0	0.979	29.18	70.7
F3	40	1	0.042	0.058	498.	1.85	17.8	61.0	79.0	0.901	29.25	51.9
F3	41	1	0.039	0.058	484.	1.76	18.3	61.0	79.0	0.901	29.25	51.9
F3	42	1	0.039	0.066	482.	1.67	18.4	61.0	79.0	0.901	29.25	51.9

MERCEDES CORRELATION STUDY -- SS-30

TEST DATA BAG #1

SITE	RUN NO.	BAG NO.	H C	C O	CO2	NOX	FC-C	WB	DB	K	BARO	HUM
I4	51	1	0.044	0.021	567.	0.43	15.7				29.73	
I4	52	1	0.044	0.042	586.	0.39	15.1				29.73	
I4	53	1	0.044	0.040	585.	0.38	15.2				29.73	
E1	54	1	0.030	0.010	506.	0.35	17.5	63.0	74.5	0.971	29.20	68.9
E1	55	1	0.030	0.0	505.	0.33	17.6	62.5	74.5	0.961	29.20	66.6
E1	56	1	0.030	0.010	499.	0.34	17.8	62.5	74.5	0.961	29.20	66.6
M2	57	1	0.024	0.030	513.	0.41	17.3	63.5	74.0	0.974	29.31	69.6
M2	58	1	0.027	0.056	512.	0.35	17.3	71.0	80.5	1.202	29.29	111.0
M2	59	1	0.029	0.038	504.	0.38	17.6	65.0	74.0	1.002	29.28	75.7
F3	60	1	0.026	0.017	517.	0.33	17.2	56.0	77.0	0.836	29.37	33.5
F3	61	1	0.021	0.027	512.	0.29	17.3	58.0	81.0	0.842	29.35	35.3

MERCEDES CORRELATION STUDY -- SS-45

TEST DATA BAG #1

SITE	RUN NO.	BAG NO.	H C	C O	CO2	NOX	FC-C	WB	DB	K	BARO	HUM
I4	71	1	0.043	0.040	541.	1.15	16.4				29.73	
I4	72	1	0.040	0.053	545.	1.03	16.3				29.73	
I4	73	1	0.039	0.051	546.	1.02	16.2				29.73	
E1	74	1	0.040	0.030	483.	1.04	18.4	63.0	74.5	0.971	29.20	68.9
E1	75	1	0.030	0.0	467.	0.82	19.0	62.5	74.5	0.961	29.20	66.6
E1	76	1	0.040	0.030	482.	1.10	18.4	62.5	74.5	0.961	29.20	66.6
M2	77	1	0.029	0.052	464.	0.87	19.1	65.5	78.0	1.040	29.30	83.4
M2	78	1	0.027	0.050	464.	0.52	19.1	69.0	79.0	1.080	29.29	91.0
M2	79	1	0.029	0.057	459.	0.82	19.2	67.0	76.0	1.044	29.29	84.2
F3	80	1	0.030	0.042	469.	0.76	18.9	56.0	77.0	0.836	29.37	33.5
F3	81	1	0.028	0.053	467.	0.66	19.0	58.0	81.0	0.842	29.35	35.3
F3	82	1	0.031	0.064	460.	0.62	19.3	59.0	83.0	0.845	29.33	36.2

MERCEDES CORRELATION STUDY -- SS-60

TEST DATA BAG #1

SITE	RUN NO.	BAG NO.	H C	C O	CO2	NOX	FC-C	WB	DB	K	BARO	HUM
I4	91	1	0.036	0.067	630.	4.23	14.1				29.73	
I4	92	1	0.036	0.065	622.	4.24	14.3				29.73	
I4	93	1	0.037	0.057	627.	4.06	14.2				29.73	
E1	94	1	0.030	0.040	505.	3.07	17.6	63.0	74.5	0.971	29.20	68.9
E1	95	1	0.030	0.020	516.	3.18	17.2	62.5	74.5	0.961	29.20	66.6
E1	96	1	0.030	0.050	515.	3.16	17.2	62.5	74.5	0.961	29.20	66.6
M2	97	1	0.023	0.066	493.	1.90	18.0	68.0	82.0	1.025	29.30	80.4
M2	98	1	0.022	0.023	468.	2.11	19.0	70.0	81.0	1.080	29.29	91.0
M2	99	1	0.023	0.048	471.	1.68	18.8	69.0	79.0	1.071	29.29	89.3
F3	100	1	0.019	0.054	516.	2.37	17.2	56.0	77.0	0.836	29.37	33.5
F3	101	1	0.020	0.058	519.	2.41	17.1	58.0	81.0	0.842	29.35	35.3
F3	102	1	0.024	0.064	519.	2.28	17.1	59.0	83.0	0.845	29.33	36.2

Table C-III Summary of SS-30 Data

DESCRIPTIVE MEASURES STRATUM = 1 = EPA

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	3	.30000 -1			.30000 -1	.30000 -1
CO	3	.66667 -2	.57735 -2	.33333 -2	0.	.10000 -1
CO2	3	503.33	3.7859	2.1858	499.00	506.00
NOX	3	.34000	.10000 -1	.57735 -2	.33000	.35000
FC-C	3	17.633	.15275	.88192 -1	17.500	17.800
WB	3	62.667	.28868	.16667	62.500	63.000
DB	3	74.500			74.500	74.500
K	3	.96433	.57735 -2	.33333 -2	.96100	.97100
BARO	3	29.200			29.200	29.200
HUM	3	67.367	1.3279	.76667	66.600	68.900

DESCRIPTIVE MEASURES STRATUM = 2 = Mercedes

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	3	.26667 -1	.25166 -2	.14530 -2	.24000 -1	.29000 -1
CO	3	.41333 -1	.13317 -1	.76884 -2	.30000 -1	.56000 -1
CO2	3	509.67	4.9329	2.8480	504.00	513.00
NOX	3	.38000	.30000 -1	.17321 -1	.35000	.41000
FC-C	3	17.400	.17321	.10000	17.300	17.600
WB	3	66.500	3.9686	2.2913	63.500	71.000
DB	3	76.167	3.7528	2.1667	74.000	80.500
K	3	1.0593	.12434	.71790 -1	.97400	1.2020
BARO	3	29.293	.15275 -1	.88192 -2	29.280	29.310
HUM	3	85.433	22.350	12.904	69.600	111.00

DESCRIPTIVE MEASURES STRATUM = 3 = Ford

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	2	.23500 -1	.35355 -2	.25000 -2	.21000 -1	.26000 -1
CO	2	.22000 -1	.70711 -2	.50000 -2	.17000 -1	.27000 -1
CO2	2	514.50	3.5355	2.5000	512.00	517.00
NOX	2	.31000	.28284 -1	.20000 -1	.29000	.33000
FC-C	2	17.250	.70711 -1	.50000 -1	17.200	17.300
WB	2	57.000	1.4142	1.0000	56.000	58.000
DB	2	79.000	2.8284	2.0000	77.000	81.000
K	2	.83900	.42426 -2	.30000 -2	.83600	.84200
BARO	2	29.360	.14142 -1	.10000 -1	29.350	29.370
HUM	2	34.400	1.2728	.90000	33.500	35.300

DESCRIPTIVE MEASURES STRATUM = 4 = Fiat

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	3	.44000 -1			.44000 -1	.44000 -1
CO	3	.34333 -1	.11590 -1	.66916 -2	.21000 -1	.42000 -1
CO2	3	579.33	10.693	6.1734	567.00	586.00
NOX	3	.40000	.26458 -1	.15275 -1	.38000	.43000
FC-C	3	15.333	.32146	.18559	15.100	15.700
WB	0					
DB	0					
K	0					
BARO	3	29.730			29.730	29.730
HUM	0					

DESCRIPTIVE MEASURES Grand

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	11	.31727 -1	.83557 -2	.25193 -2	.21000 -1	.44000 -1
CO	11	.26455 -1	.16747 -1	.50495 -2	0.	.56000 -1
CO2	11	527.82	33.796	10.190	499.00	586.00
NOX	11	.36182	.40452 -1	.12197 -1	.29000	.43000
FC-C	11	16.873	1.0140	.30573	15.100	17.800
WB	8	62.688	4.5035	1.5922	56.000	71.000
DB	8	76.250	2.9399	1.0394	74.000	81.000
K	8	.96862	.11298	.39945 -1	.83600	1.2020
BARO	11	29.399	.22016	.66380 -1	29.200	29.730
HUM	8	65.900	24.319	8.5980	33.500	111.00

Table C-II Summary of HWFE Data

DESCRIPTIVE MEASURES   STRATUM = 1 = EPA

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	3	.43333 -1	.57735 -2	.33333 -2	.40000 -1	.50000 -1
CO	3	.40000 -1	.10000 -1	.57735 -2	.30000 -1	.50000 -1
CO2	3	518.67	8.6217	4.9777	511.00	528.00
NOX	3	2.0567	.47258 -1	.27285 -1	2.0200	2.1100
FC-C	3	17.100	.30000	.17321	16.800	17.400
WB	3	62.500			62.500	62.500
DB	3	74.000			74.000	74.000
K	3	.96400			.96400	.96400
BARO	3	29.210			29.210	29.210
HUM	3	67.300			67.300	67.300

DESCRIPTIVE MEASURES   STRATUM = 2 = Mercedes

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	3	.40333 -1	.37859 -2	.21858 -2	.36000 -1	.43000 -1
CO	3	.65000 -1	.13454 -1	.77675 -2	.54000 -1	.80000 -1
CO2	3	519.67	4.5092	2.6034	515.00	524.00
NOX	3	1.8267	.10693	.61734 -1	1.7600	1.9500
FC-C	3	17.067	.15275	.88192 -1	16.900	17.200
WB	3	63.833	1.0408	.60093	63.000	65.000
DB	3	74.333	1.1547	.66667	73.000	75.000
K	3	.98600	.16643 -1	.96090 -2	.97400	1.0050
BARO	3	29.177	.57735 -2	.33333 -2	29.170	29.180
HUM	3	72.200	3.5930	2.0744	69.600	76.300

DESCRIPTIVE MEASURES   STRATUM = 3 = Ford

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	3	.40000 -1	.17321 -2	.10000 -2	.39000 -1	.42000 -1
CO	3	.60667 -1	.46188 -2	.26667 -2	.58000 -1	.66000 -1
CO2	3	488.00	8.7178	5.0332	482.00	498.00
NOX	3	1.7600	.90000 -1	.51962 -1	1.6700	1.8500
FC-C	3	18.167	.32146	.18559	17.800	18.400
WB	3	61.000			61.000	61.000
DB	3	79.000			79.000	79.000
K	3	.90100			.90100	.90100
BARO	3	29.250			29.250	29.250
HUM	3	51.900			51.900	51.900

DESCRIPTIVE MEASURES   STRATUM = 4 = Fiat

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	3	.46667 -1	.66583 -2	.38442 -2	.39000 -1	.51000 -1
CO	3	.70667 -1	.11547 -2	.66667 -3	.70000 -1	.72000 -1
CO2	3	611.00	10.817	6.2450	599.00	620.00
NOX	3	2.9133	.73711 -1	.42557 -1	2.8300	2.9700
FC-C	3	14.533	.25166	.14530	14.300	14.800
WB	0					
DB	0					
K	0					
BARO	3	29.750			29.750	29.750
HUM	0					

DESCRIPTIVE MEASURES   Grand

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	12	.42583 -1	.50174 -2	.14484 -2	.36000 -1	.51000 -1
CO	12	.59083 -1	.14190 -1	.40963 -2	.30000 -1	.80000 -1
CO2	12	534.33	48.646	14.043	482.00	620.00
NOX	12	2.1392	.48590	.14027	1.6700	2.9700
FC-C	12	16.717	1.4135	.40803	14.300	18.400
WB	9	62.444	1.3333	.44444	61.000	65.000
DB	9	75.778	2.4889	.82962	73.000	79.000
K	9	.95033	.39102 -1	.13034 -1	.90100	1.0050
BARO	12	29.347	.24474	.70650 -1	29.170	29.750
HUM	9	63.800	9.3480	3.1160	51.900	76.300

Table C-V Summary of SS-60 Data

DESCRIPTIVE MEASURES STRATUM = 1 = EPA

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	3	.30000 -1			.30000 -1	.30000 -1
CO	3	.36667 -1	.15275 -1	.88192 -2	.20000 -1	.50000 -1
CO2	3	512.00	6.0828	3.5119	505.00	516.00
NOX	3	3.1367	.58595 -1	.33830 -1	3.0700	3.1800
FC-C	3	17.333	.23094	.13333	17.200	17.600
WB	3	62.667	.28868	.16667	62.500	63.000
DB	3	74.500			74.500	74.500
K	3	.96433	.57735 -2	.33333 -2	.96100	.97100
BARO	3	29.200			29.200	29.200
HUM	3	67.367	1.3279	.76667	66.600	68.900

DESCRIPTIVE MEASURES STRATUM = 2 = Mercedes

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	3	.22667 -1	.57735 -3	.33333 -3	.22000 -1	.23000 -1
CO	3	.45667 -1	.21595 -1	.12468 -1	.23000 -1	.66000 -1
CO2	3	477.33	13.650	7.8811	468.00	493.00
NOX	3	1.8967	.21502	.12414	1.6800	2.1100
FC-C	3	18.600	.52915	.30551	18.000	19.000
WB	3	69.000	1.0000	.57735	68.000	70.000
DB	3	80.667	1.5275	.88192	79.000	82.000
K	3	1.0587	.29501 -1	.17033 -1	1.0250	1.0800
BARO	3	29.293	.57735 -2	.33333 -2	29.290	29.300
HUM	3	86.900	5.6930	3.2868	80.400	91.000

DESCRIPTIVE MEASURES STRATUM = 3 = Ford

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	3	.21000 -1	.26458 -2	.15275 -2	.19000 -1	.24000 -1
CO	3	.58667 -1	.50332 -2	.29059 -2	.54000 -1	.64000 -1
CO2	3	518.00	1.7321	1.0000	516.00	519.00
NOX	3	2.3533	.66583 -1	.38442 -1	2.2800	2.4100
FC-C	3	17.133	.57735 -1	.33333 -1	17.100	17.200
WB	3	57.667	1.5275	.88192	56.000	59.000
DB	3	80.333	3.0551	1.7638	77.000	83.000
K	3	.84100	.45826 -2	.26458 -2	.83600	.84500
BARO	3	29.350	.20000 -1	.11547 -1	29.330	29.370
HUM	3	35.000	1.3748	.79373	33.500	36.200

DESCRIPTIVE MEASURES STRATUM = 4 = Fiat

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	3	.36333 -1	.57735 -3	.33333 -3	.36000 -1	.37000 -1
CO	3	.63000 -1	.52915 -2	.30551 -2	.57000 -1	.67000 -1
CO2	3	626.33	4.0415	2.3333	622.00	630.00
NOX	3	4.1767	.10116	.58405 -1	4.0600	4.2400
FC-C	3	14.200	.10000	.57735 -1	14.100	14.300
WB	0					
DB	0					
K	0					
BARO	3	29.730			29.730	29.730
HUM	0					

DESCRIPTIVE MEASURES Grand

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	12	.27500 -1	.65017 -2	.18769 -2	.19000 -1	.37000 -1
CO	12	.51000 -1	.16000 -1	.46188 -2	.20000 -1	.67000 -1
CO2	12	533.42	58.706	16.947	468.00	630.00
NOX	12	2.8908	.90964	.26259	1.6800	4.2400
FC-C	12	16.817	1.7023	.49142	14.100	19.000
WB	9	63.111	5.0049	1.6683	56.000	70.000
DB	9	78.500	3.4551	1.1517	74.500	83.000
K	9	.95467	.95746 -1	.31915 -1	.83600	1.0800
BARO	12	29.393	.21077	.60844 -1	29.200	29.730
HUM	9	63.089	22.899	7.6330	33.500	91.000

Table C-IV Summary of SS-45 Data

DESCRIPTIVE MEASURES   STRATUM = 1 = EPA

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	3	.36667 -1	.57735 -2	.33333 -2	.30000 -1	.40000 -1
CO	3	.20000 -1	.17321 -1	.10000 -1	0.	.30000 -1
CO2	3	477.33	8.9629	5.1747	467.00	483.00
NOX	3	.98667	.14742	.85114 -1	.82000	1.1000
FC-C	3	18.600	.34641	.20000	18.400	19.000
WB	3	62.667	.28868	.16667	62.500	63.000
DB	3	74.500			74.500	74.500
K	3	.96433	.57735 -2	.33333 -2	.96100	.97100
BARO	3	29.200			29.200	29.200
HUM	3	67.367	1.3279	.76667	66.600	68.900

DESCRIPTIVE MEASURES   STRATUM = 2 = Mercedes

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	3	.28333 -1	.11547 -2	.66667 -3	.27000 -1	.29000 -1
CO	3	.53000 -1	.36056 -2	.20817 -2	.50000 -1	.57000 -1
CO2	3	462.33	2.8868	1.6667	459.00	464.00
NOX	3	.73667	.18930	.10929	.52000	.87000
FC-C	3	19.133	.57735 -1	.33333 -1	19.100	19.200
WB	3	67.167	1.7559	1.0138	65.500	69.000
DB	3	77.667	1.5275	.88192	76.000	79.000
K	3	1.0547	.22030 -1	.12719 -1	1.0400	1.0800
BARO	3	29.293	.57735 -2	.33333 -2	29.290	29.300
HUM	3	86.200	4.1761	2.4111	83.400	91.000

DESCRIPTIVE MEASURES   STRATUM = 3 = Ford

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	3	.29667 -1	.15275 -2	.88192 -3	.28000 -1	.31000 -1
CO	3	.53000 -1	.11000 -1	.63509 -2	.42000 -1	.64000 -1
CO2	3	465.33	4.7258	2.7285	460.00	469.00
NOX	3	.68000	.72111 -1	.41633 -1	.62000	.76000
FC-C	3	19.067	.20817	.12019	18.900	19.300
WB	3	57.667	1.5275	.88192	56.000	59.000
DB	3	80.333	3.0551	1.7638	77.000	83.000
K	3	.84100	.45826 -2	.26458 -2	.83600	.84500
BARO	3	29.350	.20000 -1	.11547 -1	29.330	29.370
HUM	3	35.000	1.3748	.79373	33.500	36.200

DESCRIPTIVE MEASURES   STRATUM = 4 = Fiat

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	3	.40667 -1	.20817 -2	.12019 -2	.39000 -1	.43000 -1
CO	3	.48000 -1	.70000 -2	.40415 -2	.40000 -1	.53000 -1
CO2	3	544.00	2.6458	1.5275	541.00	546.00
NOX	3	1.0667	.72342 -1	.41767 -1	1.0200	1.1500
FC-C	3	16.300	.10000	.57735 -1	16.200	16.400
WB	0					
DB	0					
K	0					
BARO	3	29.730			29.730	29.730
HUM	0					

DESCRIPTIVE MEASURES   Grand

VARIABLE	N	MEAN	STD DEV	SE OF MEAN	MINIMUM	MAXIMUM
HC	12	.33833 -1	.59518 -2	.17181 -2	.27000 -1	.43000 -1
CO	12	.43500 -1	.17123 -1	.49429 -2	0.	.64000 -1
CO2	12	487.25	35.028	10.112	459.00	546.00
NOX	12	.86750	.20325	.58674 -1	.52000	1.1500
FC-C	12	18.275	1.2234	.35315	16.200	19.300
WB	9	62.500	4.2793	1.4264	56.000	69.000
DB	9	77.500	3.0516	1.0172	74.500	83.000
K	9	.95333	.93611 -1	.31204 -1	.83600	1.0800
BARO	12	29.393	.21077	.60844 -1	29.200	29.730
HUM	9	62.856	22.544	7.5147	33.500	91.000

Figure C-1 (HWFE,SS-30,45,60) HC VS. RUN# (Y VS. X) 06-10-75

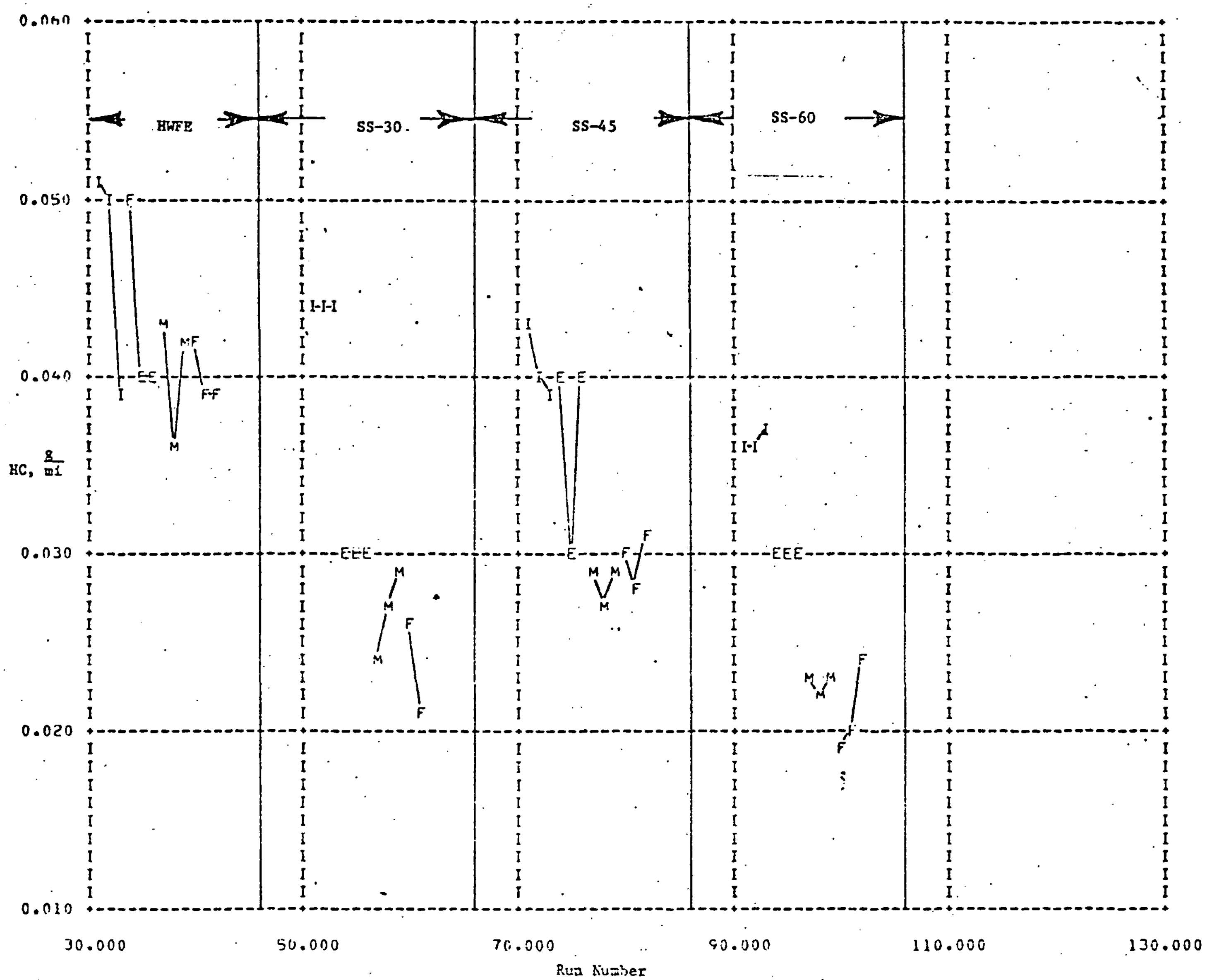


Figure C-2 (HWFE,SS-30,45,60) CO VS. RUN#
(Y VS. X) 06-10-75

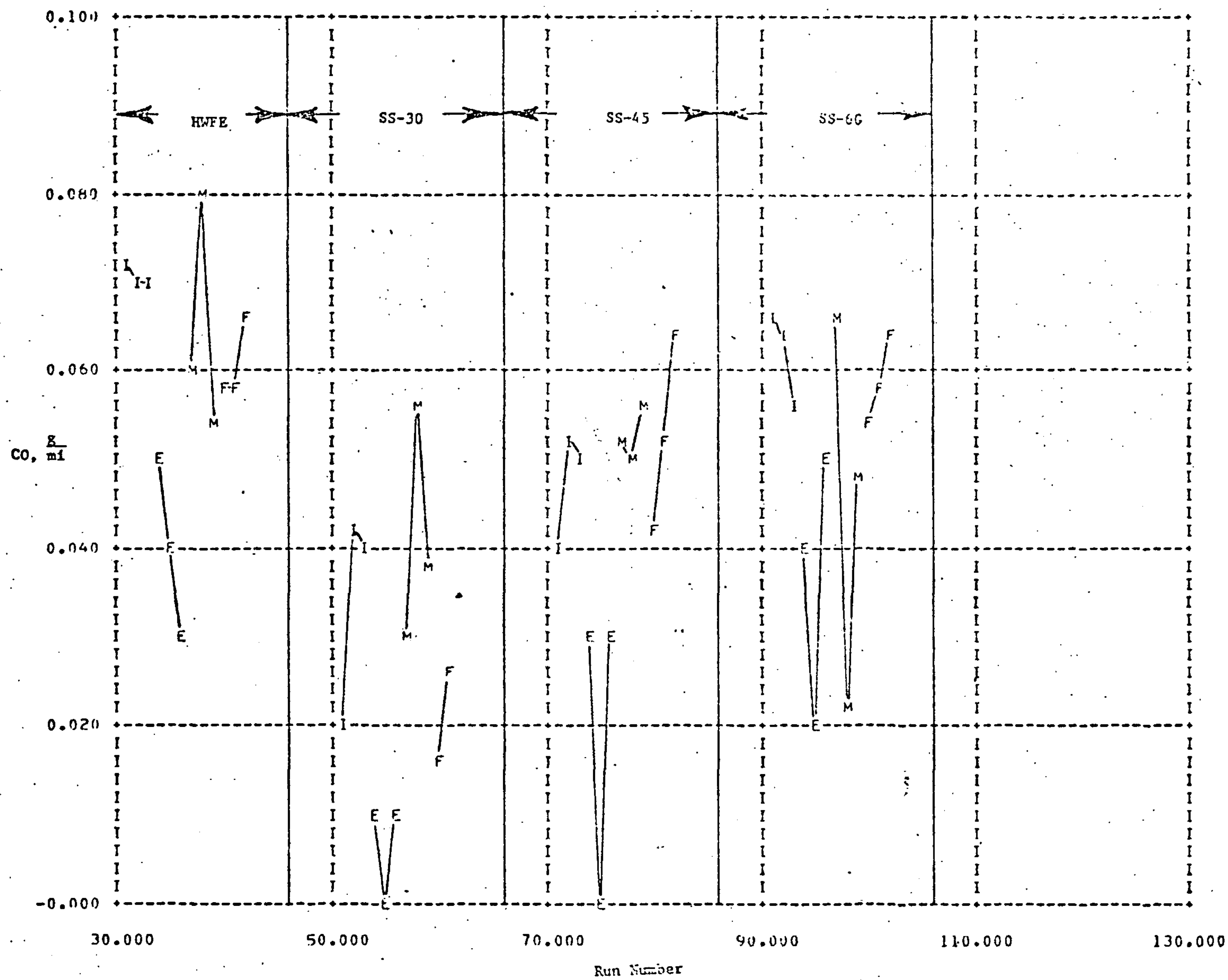


Figure C-3 (HWFE,SS-30,45,60) CO2 VS. RUN# (Y VS. X) 06-10-75

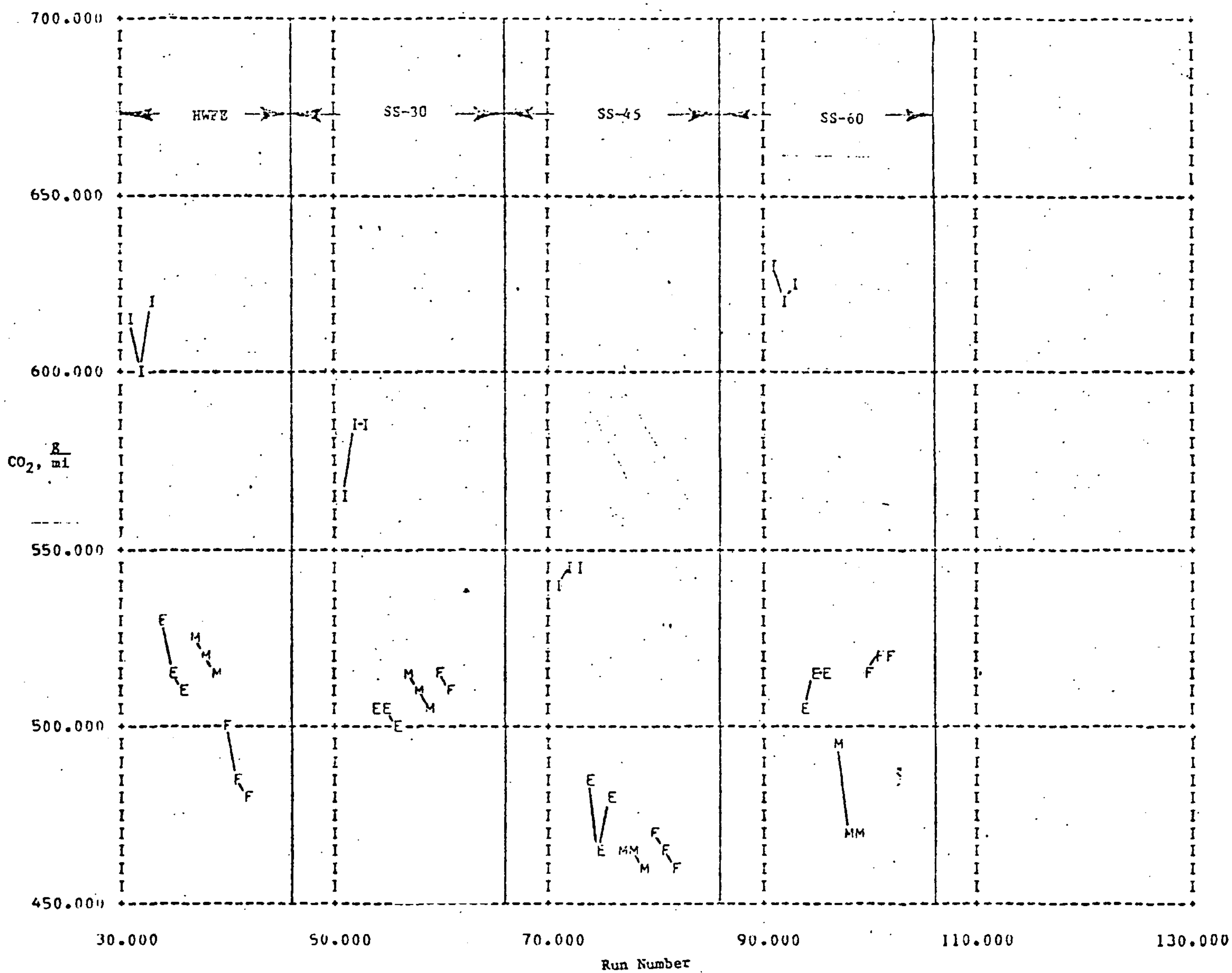


Figure C-4 (HWFE,SS-30,45,60) NOX VS. RUN#
(Y VS. X) 06-10-75

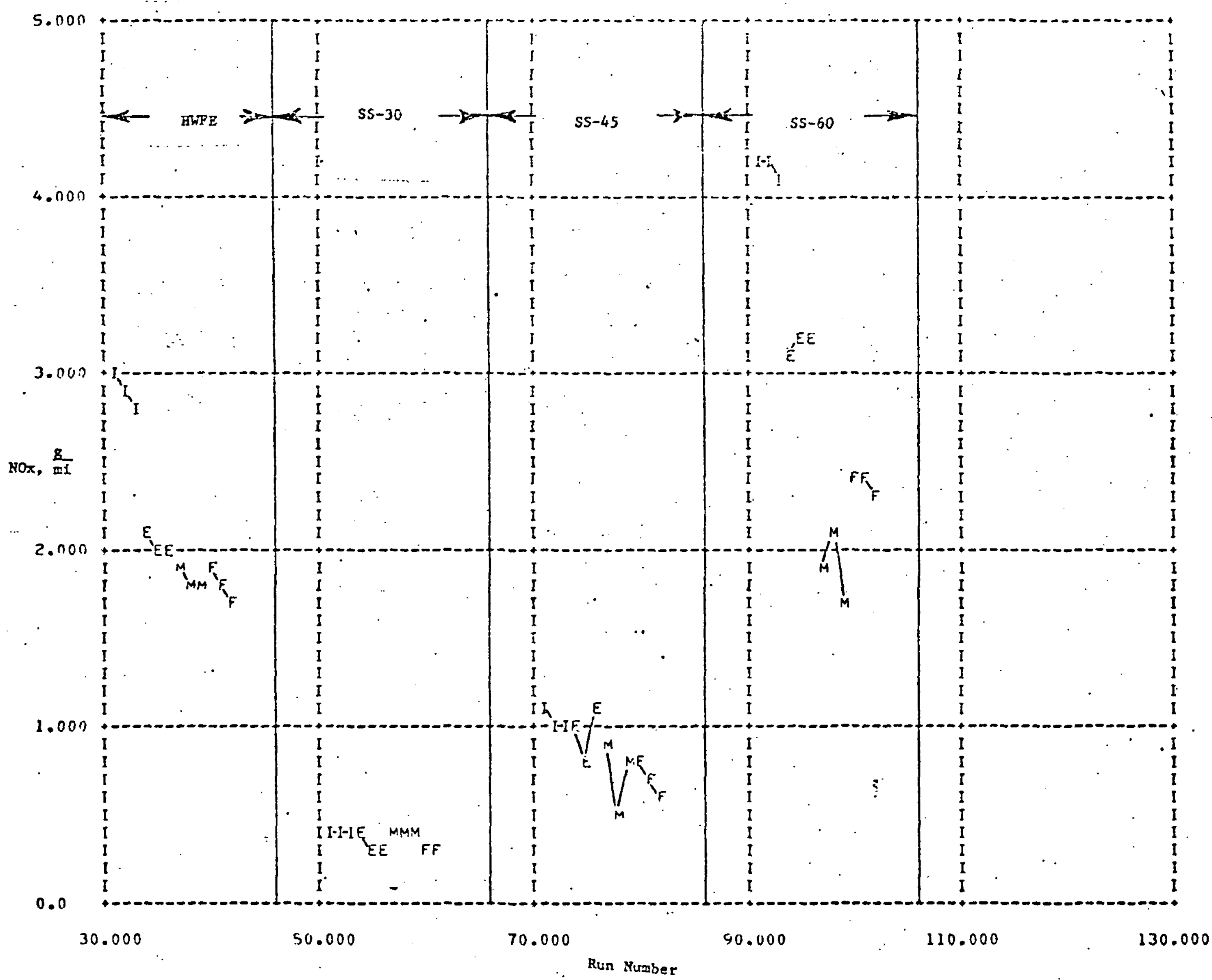
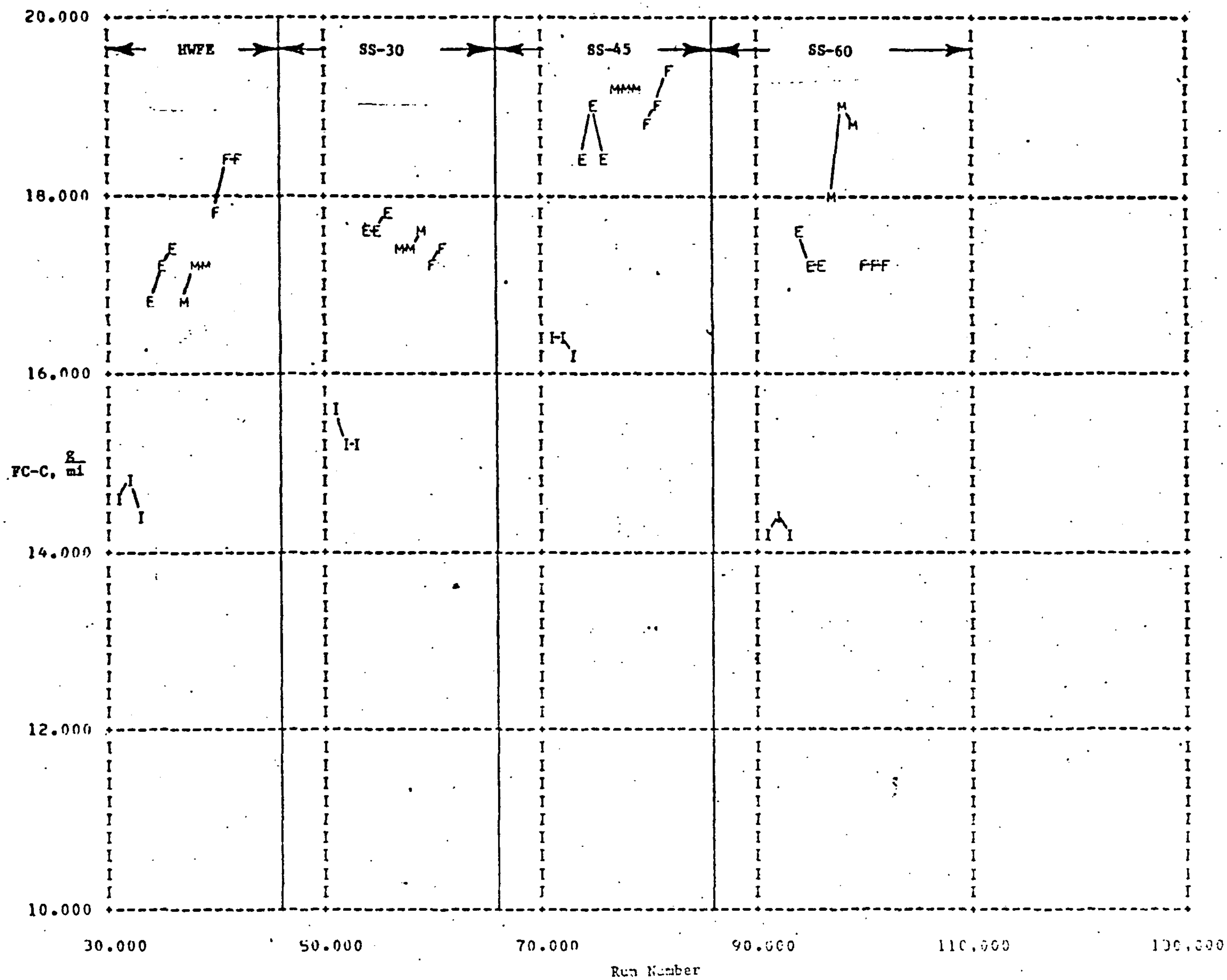


Figure C-5 (HwFE,SS-30,45,60) FC-C VS. RUN# (Y VS. X) 06-10-75



Appendix D

Effect of Ambient Conditions On Hot-Start 1975 FTP Emission Levels

Table D-1. Confidence Level (C.L.) and Coefficients of Ambient Effects on 1975 Hot-start Emissions and Fuel Economy

Random Variable	Dependent Variable HC	CO	CO_2	NOx	FC-C
Dry Bulb					
C.L., %					
Coefficient					
Barometer					
C.L., %	88				
Coefficient	.0288[1]				
Humidity					
C.L., %	91			80	
Coefficient	.000314[2]			.00170[2]	

1. g/mi per in. of Hg

2. g/mi per $\frac{\text{gr. } H_2O}{\text{lb. dry air}}$

Table D-2. Emission Differences which were Statistically Significant at greater than the 90%, 95% and 99% Level of Confidence. Data from 1975 Hot-start procedure, Corrected for Ambient Conditions as Indicated.

Site Contrast		HC corrected for Barometer		HC corrected for Humidity		NOx corrected for Humidity	
E	M						
	F						
	I	-19	90	-24	99	-18	99
M	F					9	90
	I	-31	99	-33	99	-13	99
F	I	-24	99	-30	99	-22	99

Figure D-1 (1975 HOT START) HC VS. BARO(BAG4)
(Y VS. X) 06-10-75

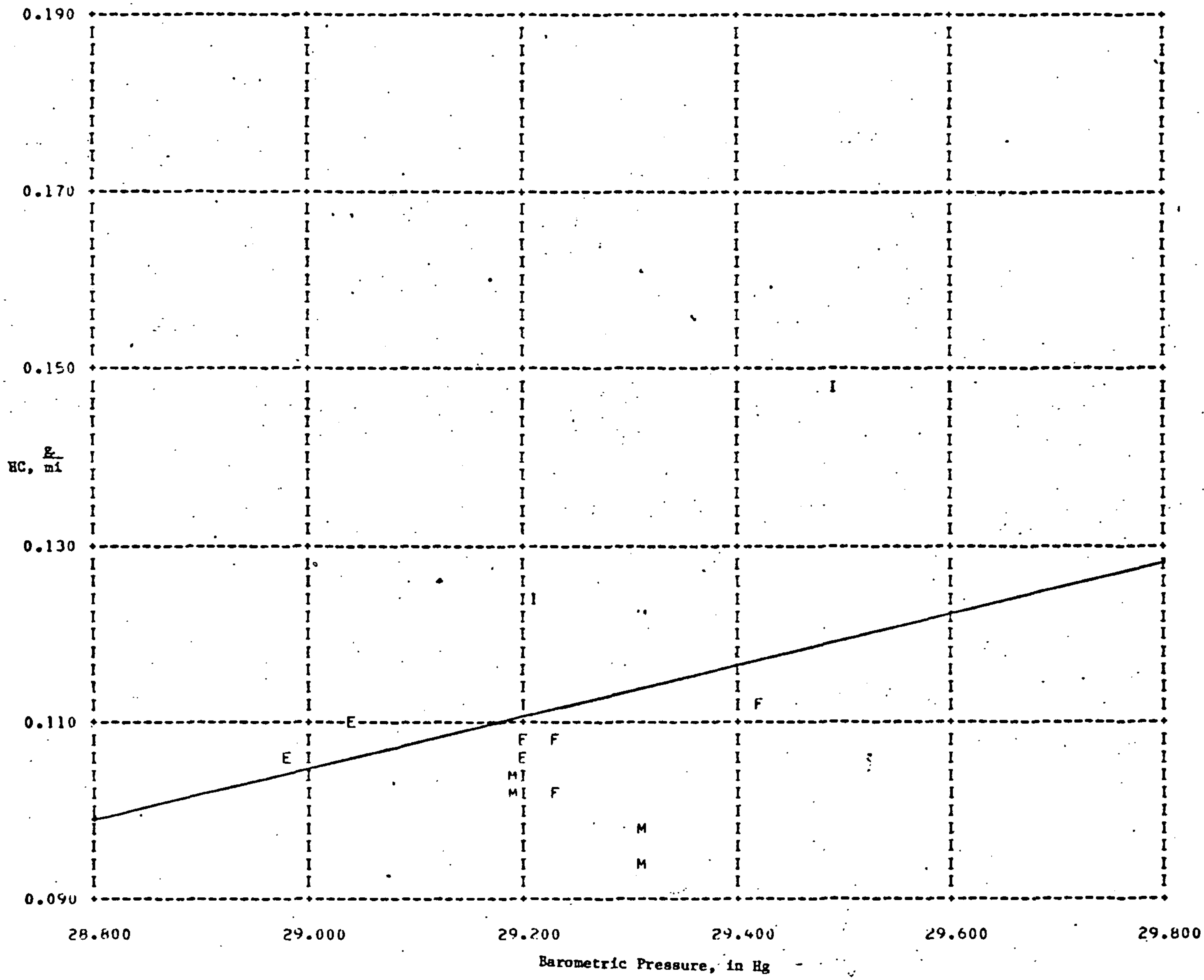


Figure D-2 (1975 HOT START) HC VS. H (BAG4)
(Y VS. X) 06-10-75

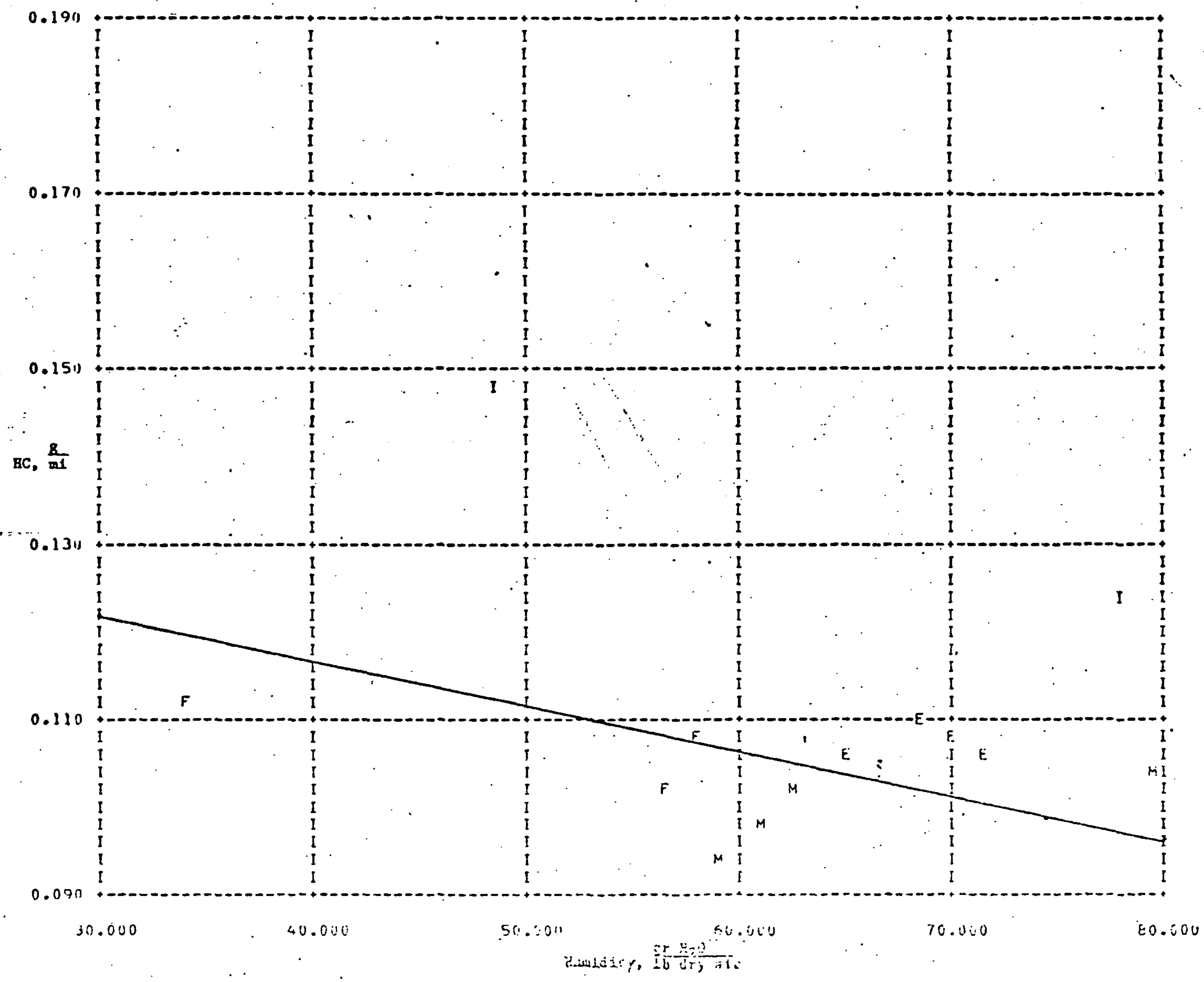


Figure D-3 (1975 HOT START) NOX VS. H (BAG4)
(Y VS. X) 06-10-75