United States
Environmental Protection
Agency

Motor Vehicle Emission Lab
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EPA

Correlation Program Report

METFAC

AUDIT AND CORRELATION REPORT

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METFac

Audit and Correlation Report

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ABSTRACT

The Mobile Emission Test Facility (METFac) is a completely self-contained automotive emissions laboratory which allows the Agency to conduct the federal auto emission test anywhere in the nation. The laboratory is capable of determining the exhaust emissions and urban and highway fuel economy of light duty vehicles in accordance with a variety of driving cycles and procedures incuding the Federal Test Procedure.

The total facility consists of these major components: a Dynamometer Van, which contains a chassis dynamometer, a constant volume sampler and a heating-ventilating-air conditioning system with humidity control; a Mobile Laboratory which contains a complete exhaust gas analysis system along with a real-time data acquisition and control computer capable of doing bag or modal analysis; and, an inflatable Soak Tent in which test vehicles are stored under controlled temperature conditions.

Audit Summary

The audit performed on the Mobile Emission Testing Facility (METFac) on September 25, 1980 indicated that the facility had four Federal Register violations. Since September 25th, these problem areas have been corrected and verified and, therefore, METFac is capable of satisfying all Federal Register requirements for certification emission testing.

Correlation Summary

METFac's personnel and measurement hardware are capable of producing emission results and coefficients of variation "equivalent" to MVEL's "family" of testing sites. The repeatability of METFac is a very important factor which should be commended, as this is one of the prime goals in emission testing. Should the raw data be processed by MTS we would be completely confident in the final results.

Barring computer malfunctions and humidity control problems METFac, at present, fits within the MVEL "family" of test sites. METFac has established that it has the same measurement capabilities as any EOD site.

TABLE 1

LAB CORRELATION SUMMARY PROCESSED: OCT 17, 1980

METFAC81-80 VIN VC242 INERTIA WT 2250 ACTUAL HP 8.8

LAB	N		HC	CO	NOX	CO2	FE	BARO	HUM	NAFC	DBL	HSL	TLOSS
			(G/MI)	(G/MI)	(G/MI)	(G/MI)	(MPG)	(IN-HG)	(GRAINS/LB)		(GRAMS)	(GRAMS)	(GRAMS)
EPA	3	MEAN	1.117	11.73	2.49	391.	21.5	28.92	43.21	0.87			
		STANDARD DEV.	.0208	0.252	.061	1.	0.1	0.0	3.076	.011			
		C.V.%	1.9	2.1	2.5	0.1	0.3	0.0	7.12	1.27			
EPA-METFAC	6	MEAN	1.111	11.93	2.57	397.	21.1	29.01	51.84	0.90			
		STANDARD DEV.	.0282	0.367	.064	5.	0.6	0.242	11.428	.044			
		C.V.%	2.5	3.1	2.5	1.3	2.9	0.83	22.04	4.86			
		DIFF. %	-0.	2.	3.	1.	-2.	0.	20.	4.			

C.V.% IS THE COEFFICIENT OF VARIATION. (STD. DEV./MEAN *100).
DIFF.% IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LABS. (MFR-EPA/EPA *100).

If an offset is observed on any specific vehicle between METFac in its present configuration and EOD, it would likely be a vehicle emission difference between facilities as opposed to an emission measurement difference. As can be seen above in Table 1, the mean value percent differences and coefficients of variation for vehicle emissions during this program demonstrate excellent correlation.

The reason for METFac's "equivalence" to EOD sites is tied to the time and energy expended to duplicate the calibration procedures described in this report. Using METFac's present calibration techniques, also used by EOD, will minimize any changes which could be experienced in the facility measurements from relocating. This will require METFac to construct a master coastdown timer equivalent to EOD's for dynamometer calibrations (this is discussed in the audit section of this report). We further recommend, a series of correlation tests be run on METFac after it does move to determine if any problems occur after relocating.

We would like to thank the METFac personnel for their patience and cooperation throughout the correlation and audit process.

PART I

AUDIT REPORT

At the request of Gary Wilson of Manufacturers Operational Division (MOD), C. Paulina, M. Matichuk, and K. Reese-MacQueen of the Office of Air Noise and Radiation, Engineering Operations Division (EOD), Testing Programs Branch, Correlation Group performed an audit of Mobile Emission Testing Facility (METFac) on September 25, 1980 while it was located at the Ann Arbor laboratory. The purpose of the audit was to obtain a comprehensive and objective overview of the facility in the following areas:

1) compliance with Federal Register test procedure requirements,

2) differences in testing practices between EPA's Ann Arbor laboratory and MOD's METFac, and,

3) capability of the facility to perform pre-1978 and post-1978 Federal Test Procedures.

With these three objectives in mind, the main areas examined were the usage of the hardware; the audit emission test; and documentation concerning calibrations, procedures, maintenance schedules, etc. A specific break-down of these areas includes:

A. LFE calibration
B. CVS calibrations
C. Test fuel analysis
D. Test fuel storage and handling
E. Test cell and soak tent air handling
F. Barometric pressure measurement
G. Dynamometer calibration
H. CVS verification equipment and procedures
I. FID optimization procedures
J. Emission analyzer curves
K. Analyzer - interference checks
L. Zero air N_2 purity
M. NOx analyzer operational parameters
N. On-board computer and computer programs used for emission calculations
O. Test procedures
P. Peripheral equipment calibrations
Q. QC Test Void procedure
R. Calibration Gas Naming and NBS Traceability

Discussion

After reviewing the material collected during the audit, the following points were either in direct violation of the Federal Register or were suspected of unsound engineering practices.

Federal Register Violations:

1) Fuel cart out of calibration
2) Incorrect emission test driving distance due to computer malfunction
3) Strip chart recorder for emission test analysis out of calibration
4) CVS static pressure checks not performed

Engineering Practices:

1) Inspection scale out of calibration
2) Fuel storage and fuel transfer for testing
3) Unestablished maintenance schedule

A detailed discussion of these deficiencies and discrepancies is in the pages to follow.

Hardware

The following MVEL services were utilized by METFac: fuel for testing, gas cylinders, and technical support from other factions of EOD, including the Calibrations & Maintenance Group, the Electronics Support Team, and Craft Services. These support services will have to be assumed by METFac personnel on the road.

Most hardware problems have since been corrected. While METFac possesses all equipment necessary for a valid Federal Test Procedure (FTP) sequence, it must be pointed out that METFac would not pass an EOD audit for a certification valid test if they were "on the road." This is due to the fact that METFac either does not have all of the necessary equipment, that the equipment they do have is not functioning correctly, or is not calibrated. These areas will be discussed in the following paragraphs.

The Federal Register states in Sec. 86.142-79(f) that "The following information shall be recorded with respect to each test" . . . "Gross vehicle weight rating, Inertia weight class, Actual curb weight at zero miles" . . . "Idle rpm." METFac has a two-pad scale on which a vehicle is weighed during the inspection period; but the scale was not calibrated at the time of the audit. We recommend that METFac use a scale to verify the vehicle weight to insure the vehicles in use were not under-loaded during the vehicle certification emission test. To satisfy Federal Register requirements, the facility also needs a calibrated timing light, tachometer, and idle CO measurement device (Sec. 86.126-78) to verify the parameters in the manufacturers' recommended operating mode. Again, METFac could use the instruments available in Ann Arbor's inspection area while they are located here.

The facility has no means of measuring the evaporative emissions from a vehicle using a sealed housing [Sec. 86.107-78] comparable to that of EPA-Ann Arbor. According to Sec. 86.106-78(a(1)) of the Federal

Register, "unless the evaporative emission test is waived by the Administrator under Sec. 86.078-26, all gasoline-fueled vehicles must undergo both tests" ("both" meaning evaporative emission test and exhaust emission test). Tests have shown that the hydrocarbon emissions of a complete FTP are about twice that of an enclosure (SHED) test. Studies have also determined that hydrocarbons are a major contributor in smog. With these facts in mind, we feel that knowing what a stationary vehicle emits is just as relevant as an exhaust emission test when assessing the environmental impact of a vehicle.

The dynamometer has the capability of testing vehicles with equivalent inertia weights between 5625 lb. and 1750 lb. in 125 lb. increments as required for MY80 vehicles [Sec. 86.129-80]. METFac has the ability to test at any weight and horsepower setting within these limits satisfying the Federal Register requirements. In addition, they have adopted the dynamometer calibration procedures published by the Ann Arbor facility. Aside from using the calibration procedures, METFac also used a special piece of EOD's equipment to perform coastdowns. This apparatus will produce integrated speed counts, torque counts, and delta time during a dynamometer coastdown between 55 and 45 mph required in EPA TP-202 (Dynamometer Calibration - Frictional Horsepower). This procedure enables the user to evaluate a wide range of horsepower values for any inertia weight within the dynamometer's limits. At such a time when METFac leaves the Ann Arbor facility, it is suggested that integrators be purchased to maintain good correlation with EOD. The integrators are not required by the Federal Register, but they are necessary to perform EPA TP-202.

Test Procedures

METFac utilizes a soak tent to allow the vehicles to stabilize for 12 to 36 hours prior to emission testing required by Sec. 86.132-78(b). While located in Ann Arbor, METFac has not set up the tent, they have used available space inside the Ann Arbor facility. We have no way of assessing the capabilities of the tent until such a time when the tent is set up.

When using 50 gallon drums for fuel storage, the temperature at which a fuel is stored can potentially result in a problem. If the fuel drums are not maintained below 60°F, a pressure build will result. The higher storage temperature will also cause separation and loss of the fuel's "light end" hydrocarbons when the pressurized drum is opened, this in turn could affect emission test results.

The test fuel, when METFac is "on the road," is stored in fifty gallon drums which will be supplied by a contractor under Federal Register specifications. METFac intends to use storage and handling procedures documented in their contractual "Scope of Work" manual. We feel this document meets Federal Register requirements as long as all test fuel is treated as if it were for evaporative emission testing, specifically, fuel to be stored at 50°-60°F prior to testing.

At the time of the audit, METFac's fuel cart was inactive, so METFac used the Ann Arbor Laboratory's fuel and fuel carts. Before METFac relocates, they should attempt to minimize the storage temperature and subsequent possible transfer problems. Part of this could be resolved by drafting and following a specific fuel transfer procedure which in turn would reduce the chances of producing fuel influenced test results.

The analyzing equipment the lab uses is the same or better than that utilized by EPA Ann Arbor laboratory. The system hardware performs very well. When their on-board computer is operational, their facility produces results comparable to EOD, but the computer exhibited problems throughout the audit and correlation tests.

First of all, METFac did not use the actual distance for the audit test due to a malfunction which locked the computer into using the nominal distance of 7.5 miles for the results. This is a direct violation of the Federal Register as stated in Sec. 86.142-78(p), "The driving distance for each of the three phases of the test, calculated from the measured roll of shaft revolutions." Secondly, the computer was giving erroneous humidity readings (wet-bulb, dry-bulb) which in turn produced faulty NOx values. A sling psychrometer was used as a back-up to the computer in this case. The software problem was apparently repaired and a simulated cold start test was run on October 23, 1980 to check the validity of the humidity readings. The test results showed improvement, but the nominal distance was still used instead of actual distance. Also in the October 23rd test, a discrepancy was noticed between the strip chart analysis [Sec. 86.142-79(i)] and the values produced by the on-board computer. In some cases, the percent error between strip chart and computer was over fifty percent (NOx in particular). This leads us to believe that either the strip chart recorder (six channel) was not calibrated correctly on certain channels, or that once again the computer software was malfunctioning. The audit test run on September 25 was re-examined and the same conflict (Soltec recorder versus computer record for analyzer outputs) was seen. This was a result of lack calibration on the Soltec recorder. However, it must be stated that the fact that METFac has independent recordings and readouts enable us to verify the validity of the computer calculations when malfunctions did occur. The operation of METFac is not dependent on their on-board computer.

Documentation

For the most part, documentation was complete in the areas that were examined. But there were areas lacking in sufficient background. The categories that were deficient concern the void test procedure, calibrations, and an established maintenance schedule. These areas will be discussed in the following pages.

Void Test Procedures

At this time, METFac has not done enough testing to really show that they have a void procedure that will effectively invalidate any faulty emission test. This is critical to the nature of emission testing. Either a structured test void criteria or a historically established void test record documents the credibility of a facility's quality control program.

Calibrations

Until only recently, METFac had never done a calibration on their fuel cart. A calibration was done with the aid of the Calibration and Maintenance Group at EPA's Ann Arbor laboratory to correct the malfunction in the temperature controls and the fuel dispensing volume. Along with the fuel storage problem, this adds another possible area of error in previous test results using the METFac fuel cart.

The METFac PDP-CVS had never had a static pressure check at the vehicle tailpipe connection. Section 86.109-78(b(1)&c(1)) of the Federal Register states that . . . "Static pressure variations of the tailpipe(s) of the vehicle shall remain within $\pm$ 5 inches of water (1.2 kPa) of static pressure variations measured during a dynamometer driving cycle with no connection to the tailpipe(s)." This piece of information is a parameter that should be known to insure that the vehicle is not being adversely affected during an emission test. We consider this lack of documentation as a violation of the Federal Register requirement. Also, there has never been a static pressure check between the mixing point of the dilution air and at the exhaust sample. This is not a Federal Register requirement, but this check should be performed and should be less than 1" H_2O pressure below ambient at maximum CVS flowrate to insure that the filter is operating correctly.

Other than these outstanding areas, all other calibrations are either performed using EPA published procedures, manufacturer's recommended procedures, or METFac procedures that are comparable to standard EOD procedures.

Maintenance

To date, METFac does not have a formalized overall facility equipment maintenance program. This is vital to the performance of the facility.

A prime example of this shortcoming deals with the dynamometer. Prior to the installment of the new dynamometer in July, METFac was not implementing their preventative maintenance schedule for their old dynamometer on a regular basis. Part of the EPA Ann Arbor schedule includes a monthly greasing of couplings and flywheel clutches to eliminate frictional impairments. We cannot predict the possible effects on vehicles tested and thus it enters a possible variable difference in correlation assessment.

At the moment, an interim schedule is being used while the permanent maintenance schedule is being drafted and published.

PART II

METFac Correlation Report

The Correlation Group first began their efforts at evaluating the correlation between Environmental Protection Agency, Motor Vehicle Emission Laboratory, Engineering Operations Division (EOD) and METFac in May 1980. We initially planned to use two vehicles. We wanted to have both a "street" vehicle and a repeatable vehicle with a "baseline" data base built up for comparison of emission results. METFac personnel arranged for us to use Emission Control Technology Division's Volvo repeatable vehicle. This was advantageous because the Volvo not only was a repeatable vehicle, but had a four cylinder engine, and used 2250 lb. inertia weight. The trend in motor vehicles being toward smaller engines and lower inertia weight, this is a fairly "typical" vehicle than a larger 6 or 8 cylinder vehicle. The vehicles to be used then were:

1977 Chevrolet Nova	6 cylinder	3500#IW
1978 Volvo	4 cylinder	2250#IW

METFac had no dyno calibrations for the complete range of inertia weights contained in their dynamometer. The technicians on METFac had been occupied with facility organization, equipment fixes, and generally tracing through the facility assorted "bugs," safety hazards and oversights. It has taken the people working on it three years to resolve most design errors, oversights, and lack of coherent hardware, software or operational documentation.

What METFac did was to calibrate the dynamometer for the inertia weights and horsepower of the vehicles we were going to use in the program. METFac used the criteria published in the Federal Register to establish the indicated power absorbtion unit (PAU) load necessary for the specific inertia weight and actual horsepower of each vehicle to be used.

In the past we have discovered that constant volume sampler (CVS) and laminar flow element (LFE) calibrations are a possible source of correlation differences just from data handling and curve fit program differences. METFac already uses EOD procedures for data handling of LFE and CVS calibration data.

We did not try to project possible flow measurement differences in CVS calibrations, since METFac uses a propane bomb weight injection verification technique and EOD prefers the use of critical flow orifices (CFO) for CVS verification. Because of past experience, we are aware of a one to two percent difference between these two techniques, when results are compared on the same CVS. We decided to take a first look at what the measured emission differences before anticipating problems.

The initial program was planned as a set of six hot tests consisting of bags 1 and 2 of the Federal Test Procedure(FTP) (hot LA-4s) on METFac, followed the next day with six hot LA-4s on an EOD dyno and then to repeat the sequence for each vehicle. This would provide an A-B, A-B sequence on two vehicles. This was expected to be a large enough sample group to give a statistical confidence in any offset observed. We needed a large enough sampling to be able to discount vehicle and/or ambient condition shifts by comparing the first A-B sequences, second A-B sequence and total A-B sequences on each vehicle, if necessary. It was decided not to run cold start tests because a valid cold start is much more variable and time consuming.

Table 2 contains a test results summary for the Nova. Although on the Nova there was a statistically significant offset on every emission but hydrocarbon, the Nova vehicle exhibited extreme variability on HC, CO and gave a NOx mean value percent difference which did not agree at all with those seen on the Volvo except in sign, as can be seen comparing Tables 2 and 3. We used the same driver for all tests and considered the vehicle's variability beyond what we would expect from driver influence.

TABLE 2

LAB CORRELATION SUMMARY   PROCESSED: FEB 11, 1981

NOVA TESTS   VIN 1X27   INERTIA WT 3500   ACTUAL HP 11.2

LAB	N		HC	CO	NOX	CO2	FE	BARO	HUM	NXFC	DBL	HSL	TLOSS
			(G/MI)				(MPG)	(IN-HG)	(GRAINS/LB)		(GRAMS)		
EPA	18	MEAN	0.383	3.75	1.26	438.	19.9	28.96	50.32	0.90			
		STANDARD DEV.	.1132	1.206	.110	10.	0.5	0.069	4.512	.017			
		C.V.%	29.5	32.2	8.7	2.3	2.5	0.24	8.97	1.85			
EPA-METFAC	12	MEAN	0.362	2.98	1.23	398.	21.9	28.94	50.67	0.90			
		STANDARD DEV.	.2079	2.267	.045	5.	0.3	0.305	6.565	.025			
		C.V.%	57.3	76.1	3.7	1.3	1.4	1.05	12.96	2.78			
		DIFF. %	-5.	-21.	-3.	-9.	10.	-0.	1.	0.			

C.V.% IS THE COEFFICIENT OF VARIATION. (STD. DEV./MEAN *100).
DIFF.% IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LABS. (MFR-EPA/EPA *100).

Complete Labcor evaluations of all the Nova test results are contained in Attachment A, but because of the excessive variability it was decided not to continue using the Nova.

The Volvo, however, appeared to give such excellent results (Table 3) from a repeatability point of view that we felt that we could compare all tests on EOD against all tests on METFac. The complete Volvo Labcor results for the first test sequence are contained in Attachment B. The results on the Volvo seemed to give us a few directions for investigation.

TABLE 3

LAB CORRELATION SUMMARY PROCESSED: JUL 22, 1980

METFACHP-HO VIN VC242 INERTIA WT 2250 ACTUAL HP 8.8

LAB	N		HC	CO	NOX	CO2	FE	BARO	HUM	NXFC	DHL	HSL	TLOSS
			(G/MI)				(MPG)	(IN-HG)	(GRAINS /LB)		(GRAMS)		
EPA	12	MEAN	1.047	12.26	2.99	399.	21.0	29.04	49.96	0.89			
		STANDARD DEV.	.0234	0.350	.069	2.	0.1	0.053	2.754	.010			
		C.V.%	2.2	2.9	2.3	0.6	0.5	0.18	5.51	1.14			
EPA-METFAC	12	MEAN	1.006	11.31	2.29	376.	22.4	29.02	34.01	0.84			
		STANDARD DEV.	.0181	0.358	.128	2.	0.1	0.065	9.113	.030			
		C.V.%	1.8	3.2	5.6	0.6	0.4	0.22	26.80	3.60			
		DIFF. %	-4.	-8.	-23.	-6.	6.	-0.	-32.	-6.			

C.V.% IS THE COEFFICIENT OF VARIATION. (STD. DEV./MEAN *100).
DIFF.% IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LABS. (MFR-EPA/EPA *100).

First, all the coefficients of variation on METFac sites were comparable to those on EOD sites, except for humidity and NOx. METFac had a major humidity level shift from the first set of tests on the Volvo to the last. The recorded humidity levels shifted from 42 grains/lb. to 25 grains/lb. Since humidity will have a direct effect on NOx (both emission and calculated result), this could have been the reason for the larger NOx coefficient of variation on METFac than EOD. Overall METFac seemed to exhibit good test repeatability, a prime requirement in emission testing. The fact that METFac had a different dynamometer calibration procedure, an older model dynamometer , and a consistently lower CO_2 and NOx emissions implied that METFac dynamometer loaded the Volvo less than EOD dynamometers. NOx also exhibited a much larger offset than the other emissions. This led us to think that there was an additional problem with NOx measurement or calculation which was independent of any factors which would affect all emissions, i.e. CVS, dynamometer, or ambient condition influence. Finally, we found that METFac used nominal distances for each phase of the LA-4. This was a problem which had to be corrected both to eliminate a possible correlation variable and satisfy a 1978 Federal Register requirement.

After the first set of correlation tests, METFac relocated to an off-site location in Ypsilanti, Michigan. A member of the Correlation Group accompanied METFac to run x-y plots on their dyno to check the power absorbtion unit load (PAU) versus front roll speed of METFac's dyno and to observe their soak tent in use. Originally, we had planned to include their soak tent conditions in the assessment of METFac as an emission testing facility. Continual use of the soak tent did not prove practical throughout the correlation program due to space problems at EOD and primarily, a lack of travel funds for METFac. We were unable to include any assessment of their "on road" vehicle soak capabilities.

With respect to dyno loading, the emission numbers appeared to indicate a loading difference. In addition, we also became aware the Clayton dyno used by METFac operated on different load cell voltages than the new

Clayton dynos equipped with ARLC. We were unaware of this difference when we made the x-y plots on METFac and discovered the difference too late to rerun comparably scaled x-y plots on METFac's dynamometer. This prevented us from making direct comparisons of x-y plots of METFac PAU load vs. speed curves against equivalent plots on an EOD dyno.

METFac was considering replacing their dynamometer with a new one and decided to go ahead after they returned from Ypsilanti. The replacement consisted of installing a new set of weights and rolls with 125 lb. increment capability in the old frame and installing automatic road load control (ARLC). This period was also used to investigate the problem of not being able to correctly read the dyno rear roll counts to calculate actual distances traveled.

The new dyno with ARLC made it possible to use EOD's 99 point (33 inertia weights with 3 horsepower settings per weight) calibration procedures, TP-202 Dynamometer Calibration - Frictional Horsepower (with EOD's Master Coastdown timer) and TP-207 Dynamometer Calibration-RLPC Electronics. We believe that duplicating calibration techniques eliminates a possible correlation variable. In this case it was necessary to modify TP-202 and the computer calculations which accompany it, because METFac's dyno does not have as large an inertia weight selection capability as EOD and METFac's trim wheel is 1750 lbs. as opposed to 1000 lbs. on the EOD. The reason for the weight differences is space limitations in METFac's test cell. We do not believe this to be of any major consequence. It was also necessary for METFac to install a magnetic pick-up on the front roll to supply EOD's Master Coastdown Timer with a frequency input for front roll speed. METFac personnel did an outstanding job of learning the new dyno calibration procedures and overcoming a multitude of minor setbacks in trying to implement the procedures. Besides the basic problem of becoming acquainted and competent at performing a new and involved calibration procedure, there were a number of calibration test equipment trial runs necessary before we were able to come up with a complete dyno calibration. One thing which was evident was that their dyno does exhibit a higher frictional horsepower variability than EOD dynos. For a while it appeared that it could be a result of electrical signal drifts which seemed to occur between the numerous electronic calibrations performed by METFac personnel. However, the signals seemed to stabilize when we began to monitor them from day to day. We suspect that when signal drifts did occur they were the result of equipment power shut downs in-between calibration checks. Plots of dyno load cell output versus dyno speed indicated that the ARLC circuit in METFac was not the source of the variability, as the plots were comparable to the same plots run on EOD dynos. However, frictional horsepower calibration printouts continued to exhibit a larger variability in dyno frictional horsepower than MVEL.

After all the recalibrations, the variabilities showed up consistently enough, at a few specific inertia weights to indicate that it was the result of dynamometer hardware, such as rolls, clutch, bearings, or inertia-weight assemblies; not the electronics. While these variabilities are greater than those in EOD's dynos, they are not large enough or predictable enough to either noticeably affect the correlation vehicle's emissions or to be quantified with diagnostic equipment at our disposal. We were unable to assess what effect reversing the dyno for front wheel drive vehicles has on the dyno calibration.

During the same period METFac discovered that their CVS PDP pressure measurement taps were not located as the Federal Register required. In Sec. 86.119-78(a)(2) the Register states - "pump pressures should be measured at taps on the pump rather than at the external piping on the pump inlet and outlet. Pressure taps that are mounted at the top center and bottom center of the pump drive headplate are exposed to the actual pump cavity pressures, and therefore, reflect the absolute pressure differentials." With the relocation of the pressure taps a new CVS calibration was needed. EOD prefers to have their LFEs calibrated against an NBS traceable independent primary such as a critical flow nozzle (CFN). Calibrating an LFE against a master LFE, which is traceable to NBS, may not agree exactly with an equivalent calibration using an NBS traceable CFN. To try and standardize all flow measurements within our lab EOD has all their LFE's calibrated by the same company using a NBS traceable CFN. METFac had already had their LFE calibrated by the same company which EOD uses. METFac's use of the same calibration company in conjunction with EOD data handling procedures, again, eliminated a possible correlation variable.

METFac had been supplied with a 30° elbow to use with their LFE because of physical obstructions prohibiting a straight run into the CVS. The recommended SAE practice for flow calibrations suggest that there be a distance of ten diameters between the flow element outlet and the CVS inlet as a flow straightener section. We found the flow element had slightly less than 10 diameters length before the 30° elbow, so METFac personnel modified their CVS piping to allow hooking up the LFE without using the elbow. METFac personnel continually made every effort to eliminate any possible correlation difference with EOD and to be technically correct.

After the CVS recalibration, we began a comparison of the two CVS calibration verification techniques, propane bomb weight versus critical flow orifice (CFO) injections on both METFac and a EOD site. The reason for comparison was to try and establish and quantify any possible flow calculation differences which might be covered up because of the use of the two different verification techniques employed by EOD and METFac. We ran propanes for two weeks because of incorrect results due to a calculator program error. When the calculation problem was resolved we were able to get an agreement between the two techniques within the expected one to two percent. Comparison of EOD results against METFac results indicated the flow calculations on each site to be equivalent.

Finally, while the dyno and CVS calibrations and verifications were taking place METFac appeared to resolve their humidity control deviations and rear dyno roll count problems. We did not devote much time to analyzer curve differences, because METFac uses both gases named at the EOD Master Naming Station and employs a least squares fit curve generation programs equivalent to EOD's. In fact, METFac repeats all points when generating an analyzer curve to verify repeatability, EOD only repeats the first gas concentration making METFac a little more thorough than EOD in this respect. We do not consider use of a gas blending device technically inferior to the use of discrete cylinders, therefore, we considered EOD and METFac already equivalent in this respect.

After the above mentioned efforts and changes, we began a second correlation program. We chose to continue using the Volvo because of its exhibited repeatability and it would remain a common "yard stick" between our first series of tests and the final series following the previously discussed facility modifications. Because the vehicle seemed to give extremely stable results at each test site we felt running three hot tests (consisting of bags one and two of the FTP sequence (hot LA-4) followed by three hot tests of only bag one of the FTP sequence (hot 505)) would be a sufficient indicator of each site's measurement capabilities. Again, we preferred to run a complete set on METFac followed by a set on a EOD site and concluded with a set on METFac to try and "window" any possible vehicle and/or ambient condition shifts or effects. The two bag hot LA-4 tests were for comparison with the first correlation tests. The three additional one bag hot 505 tests results would be used with the first bag results of the hot LA-4 tests to enlarge our sample group to eighteen tests total and increase our statistical confidence in this final set of correlation tests. Again, the use of hot tests only was because our main concern is with measurement capabilities, not possible specific vehicle changes and variabilities. We believe any vehicle is much more repeatable when warmed up than from cold start to cold start.

For the final set, we tried to choose the most "typical" site from our lab. By comparing the most recent vehicle crosscheck with sample analysis crosscheck (SAC) reports chose dyno four as the most "typical" in terms of dyno loading coupled with site analyzer gas naming comparisons. Choosing a site which appeared in the middle of the EOD "family" of test sites maximized the probability that would get as valid a comparison of METFac to the EOD lab as a whole as possible.

Once the tests were run we planned to generate confidence intervals at the 90% confidence level on the emission results. If the intervals appeared too wide we planned to run more tests to add to our sample group and hopefully reduce the confidence interval widths. Should any particular emission appear to have too large an offset we planned to investigate and use diagnostics to determine the reason. As it turned out, as can be seen in Table 4, we felt that there was only one emission with much cause for concern, NOx.

TABLE 4

LAB CORRELATION SUMMARY — PROCESSED: NOV 24, 1980

PRE-NOX/RECALC — VIN VC242 — INERTIA WT 2250 — ACTUAL HP 8.8

LAB	N		HC	CO	NOX	CO2	FE	BARO	HUM	NXFC	DHL	HSL	FLOSS
			(G/MI)	(G/MI)	(G/MI)	(G/MI)	(MPG)	(IN-HG)	(GRAINS /LB)		(GRAMS)	(GRAMS)	(GRAMS)
EPA	3	MEAN	1.117	11.73	2.49	391.	21.5	28.92	43.21	0.87			
		STANDARD DEV.	.0208	0.252	.061	1.	0.1	0.0	3.076	.011			
		C.V.%	1.9	2.1	2.5	0.1	0.3	0.0	7.12	1.27			
EPA-METFAC	6	MEAN	1.111	11.93	3.23	397.	21.1	29.01	100.01	1.15			
		STANDARD DEV.	.0282	0.367	.311	5.	0.6	0.242	22.477	.134			
		C.V.%	2.5	3.1	9.6	1.3	2.9	0.83	22.47	****			
		DIFF. %	-0.	2.	30.	1.	-2.	0.	131.	32.			

C.V.% IS THE COEFFICIENT OF VARIATION. (STD. DEV./MEAN *100).
DIFF.% IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LABS. (MFR-EPA/EPA *100).

Attachment C contains our complete Labcor results corresponding to Table 4 Labcor results. The NOx mean value offset between METFac and EOD was 30% on the hot LA-4 tests and 43% on the hot 505 comparisons. The calculated statistics on the hot LA-4's indicated that at a 90% confidence level the two sets of tests exhibited at least a 22% NOx offset on LA-4s and 39% minimum offset on the hot 505 tests. All of the other emission mean values' percent difference site to site were what we would consider exactly equivalent to EOD's "family" of test sites.

Examination of the results showed that the humidity difference recorded between METFac and EOD was extremely high and the NOx correction factors (K_h) were about as much different from EOD NOx correction factors as the NOx values themselves (Table 4). When the humidity and correction factors for METFac were investigated they were found to be erroneous. The test packs showed that the temperature traces for test cell wet and dry bulb temperatures were completely different from those recorded on the METFac computer print out.

TABLE 5

LAB CORRELATION SUMMARY — PROCESSED: OCT 17, 1980

METFAC01-80 — VIN VC242 — INERTIA WT 2250 — ACTUAL HP 8.8

LAB	N		HC	CO	NOX	CO2	FE	BARO	HUM	NAFC	DBL	HSL	TLOSS
			(G/MI)				(MPG)	(IN-HG)	(GRAINS /LB)		(GRAMS)		
EPA	3	MEAN	1.117	11.73	2.49	391.	21.5	28.92	43.21	0.87			
		STANDARD DEV.	.0208	0.252	.061	1.	0.1	0.0	3.076	.011			
		C.V.%	1.9	2.1	2.5	0.1	0.3	0.0	7.12	1.27			
EPA-METFAC	6	MEAN	1.111	11.93	2.57	397.	21.1	29.01	51.84	0.90			
		STANDARD DEV.	.0282	0.367	.064	5.	0.6	0.242	11.428	.044			
		C.V.%	2.5	3.1	2.5	1.3	2.9	0.83	22.04	4.86			
		DIFF. %	-0.	2.	3.	1.	-2.	0.	20.	4.			

C.V.% IS THE COEFFICIENT OF VARIATION. (STD. DEV./MEAN *100).
DIFF.% IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LABS. (MFR-EPA/EPA *100).

The test cell wet/dry bulb temperature traces proved to be accurate when checked against a sling psychrometer, and as can be seen in Table 5 the recalculated values exhibit good correlation. The complete results are contained in Attachment D. After we recalculated the NOx values and re-determined 90% confidence intervals, they indicated at most a 7.5% NOx offset on hot 505 tests. On the hot LA-4 tests we were only 89% confident that a real difference exists. If there is a difference it would not be greater than 6.6% at the 90% confidence level.

As Table 5 shows, NOx is still the emission with the largest mean value offset, but 3% on two bag hot LA-4s and 7% on hot 505 tests are both offsets which could be seen between two sites in EOD's "family" of test sites. NOx is influenced by vehicle loading as is CO_2, however, the fact that the humidity levels and correction factors are different, at present, prevent drawing any conclusions as to how much of the NOx offset is the result of loading differences between facilities. Because of the higher CO_2 and NOx levels on METFac we suspect that some of the present offset is due to loading differences. We do not at present have diagnostic equipment capable of quantifying this possible loading difference, but at least a portion of the NOX offset is a result of humidity control and/or software measurement and calculations problems which can be eliminated.

At this time we felt that the only "problem" was NOx offset and that the problem was the result of METFac's computer mis-reading the wet and dry bulb temperatures. The temperature strip chart recordings indicate that the wet and dry bulb thermocouples in the test cell were in fact registering correctly and when these values were used to recalculate the NOx results much better correlation was achieved as can be seen comparing Tables 4, 5, and 6. METFac did resolve this humidity recording error. We verified the fix by running a simulated FTP on the Volvo during an audit of the facility and compared the results to the correlation program results in Table 6.

TABLE 6

LAB CORRELATION SUMMARY   PROCESSED: OCT 24, 1980

METFACG1-80   VIN VC242   INERTIA WT 2250   ACTUAL HP 8.8

LAB	N		HC	CO	NOX	CO2	FE	BARO	HUM	NXFC	DBL	HSL	TLOSS
			(G/MI)				(MPG)	(IN-HG)	(GRAINS /LB)		(GRAMS)		
EPA	3	MEAN	1.117	11.73	2.49	391.	21.5	28.92	43.21	0.87			
		STANDARD DEV.	.0205	0.252	.061	1.	0.1	0.0	3.076	.011			
		C.V.%	1.9	2.1	2.5	0.1	0.3	0.0	7.12	1.27			
EPA-METFAC [1]	6	MEAN	1.111	11.93	2.57	397.	21.1	29.01	51.84	0.90			
		STANDARD DEV.	.0282	0.367	.064	5.	0.6	0.242	11.428	.044			
		C.V.%	2.5	3.1	2.5	1.3	2.9	0.83	22.04	4.86			
		DIFF. %	-0.	2.	3.	1.	-2.	0.	20.	4.			
METFAC-COMPUTER CHEC	1	MEAN	1.122	12.44	2.51	379.	22.2	29.20	27.76	0.82			
		STANDARD DEV.	.0	0.0	.0	0.	0.0	0.0	0.0	.0			
		C.V.%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
		DIFF. %	0.	6.	1.	-3.	3.	1.	-36.	-6.			

C.V.% IS THE COEFFICIENT OF VARIATION. (STD. DEV./MEAN *100).
DIFF.% IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LABS. (MFR-EPA/EPA *100).

The complete comparison is contained in Attachment E. The results indeed indicated that the 30% to 40% calculation offset on NOx observed was no longer there. However, humidity control appears to remain a problem and examination of the test package also indicated variable discrepencies between strip chart recordings of analyzer outputs and computer recordings of analyzer outputs. This was due to lack of calibration on the strip chart record which has been corrected.

On the final audit test the computer seemed to lock itself into 1975 FTP calculations. These calculations again used nominal distances traveled in each portion of the FTP, instead of actual distance calculated from rear roll revolutions as required by the Federal Register. This is a problem which can and will be fixed. Throughout this year METFac's computer and terminal has repeatedly malfunctioned and caused problems. We consider this and humidity control to be the least dependable aspect of the facility. The actual computer software is largely undocumented. The computer hardware has had problems with both program tape reading and final outputs. The malfunctions appear to be resolved at the time of this writing and as was stated in the audit section METFac has independent recordings and readouts which has enabled us to verify the validity of the computer calculations whenever a malfunction was suspected.

LAB CORRELATION SUMMARY   PROCESSED: FEB 11, 1981

NOVA TESTS   VIN 1X27   INERTIA WT 3500   ACTUAL HP 11.2

LAB	N		HC	CO	NOX	CO2	FE	BARO	HUM	NXFC	DBL	HSL	TLOSS
			|<------G/MI			------->|	(MPG)	(IN-HG)	(GRAINS /LB)		|<---(GRAMS)		--->|
EPA	12	MEAN	0.383	3.75	1.26	438.	19.9	28.96	50.32	0.90			
		STANDARD DEV.	.1132	1.206	.110	10.	0.5	0.069	4.512	.017			
		C.V.%	29.5	32.2	8.7	2.3	2.5	0.24	8.97	1.85			
EPA-METFAC	12	MEAN	0.362	2.98	1.23	398.	21.9	28.94	50.67	0.90			
		STANDARD DEV.	.2079	2.267	.045	5.	0.3	0.305	6.565	.025			
		C.V.%	57.3	76.1	3.7	1.3	1.4	1.05	12.96	2.78			
		DIFF. %	-5.	-21.	-3.	-9.	10.	-0.	1.	0.			

C.V.% IS THE COEFFICIENT OF VARIATION. (STD. DEV./MEAN *100).
DIFF.% IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LABS. (MFR-EPA/EPA *100).

ATTACHMENT A
(ORIGINAL NOVA TESTS)

LAB CORRELATION SUMMARY - TEST DATA   PROCESSED: FEB 11, 1981

LAB: EPA   VEH: NOVA TESTS   VIN: 1X27   INERTIA WT: 3500   ACTUAL HP: 11.2

DATE	TESTNO	TYPE	HC	CO	NOX	CO2	FE	DRIVER	DYNO	ODOM	IHP	BARO	HUM	NXFC	DBL	HSL	TLOSS
05-08-80	802488	HOT	0.480	4.50	1.08	429.	20.3	34797	D005	25315.0	9.0	28.90	41.02	0.86			
05-08-80	802484	HOT	0.390	3.00	1.20	439.	19.9	34797	D005	25280.0	9.0	28.92	51.41	0.90			
05-08-80	802489	HOT	0.370	3.70	1.16	432.	20.2	34797	D005	25324.0	9.0	28.90	41.02	0.86			
05-08-80	802485	HOT	0.360	3.00	1.21	436.	20.1	34797	D005	25288.0	9.0	28.91	51.81	0.90			
05-08-80	802486	HOT	0.570	5.20	1.21	435.	19.9	34797	D005	25297.0	9.0	28.90	52.30	0.90			
05-08-80	802487	HOT	0.560	5.40	1.15	466.	18.6	34797	D005	25306.0	9.0	28.90	49.29	0.89			
05-13-80	802491	HOT	0.270	2.70	1.39	440.	19.9	34797	D005	25508.0	9.1	29.00	51.75	0.90			
05-13-80	802492	HOT	0.430	4.90	1.38	438.	19.8	34797	D005	25516.0	9.1	29.00	52.56	0.90			
05-13-80	802493	HOT	0.380	4.70	1.36	437.	19.9	34797	D005	25524.0	9.0	29.00	52.56	0.90			
05-14-80	802494	HOT	0.330	3.90	1.41	439.	19.9	34797	D005	25532.0	9.0	29.03	52.82	0.91			
05-14-80	802495	HOT	0.230	2.00	1.27	424.	20.7	34797	D005	25541.0	9.0	29.03	54.70	0.91			
05-14-80	802490	HOT	0.230	2.00	1.34	436.	20.2	34797	D005	25500.0	9.0	29.00	52.56	0.90			
			<------(G/MI)------>				(MPG)					(IN-HG)	(GRAINS /LB)		<---(GRAMS)--->		
MEAN			0.383	3.75	1.26	438.	19.9					28.96	50.32	0.90			
STANDARD DEV.			.1132	1.206	.110	10.	0.5					0.069	4.512	.017			
C.V.%			29.5	32.2	8.7	2.3	2.5					0.2	9.0	1.9			

BAG DATA

DATE	TESTNO	TYPE	DYNO	SITE	HC	2	3	CO	2	3	NOX	2	3	CO2	2	3	FE	2	3
05-08-80	802488	HOT	D005	A003	0.293	0.660	0.0	2.36	6.43	0.0	1.26	0.91	0.0	426.	433.	0.	20.6	19.9	0.0
05-08-80	802484	HOT	D005	A003	0.361	0.423	0.0	2.56	3.41	0.0	1.52	0.89	0.0	438.	441.	0.	20.0	19.8	0.0
05-08-80	802489	HOT	D005	A003	0.201	0.520	0.0	2.02	5.20	0.0	1.39	0.94	0.0	428.	435.	0.	20.6	19.9	0.0
05-08-80	802485	HOT	D005	A003	0.258	0.448	0.0	2.68	3.30	0.0	1.43	1.00	0.0	439.	434.	0.	20.0	20.1	0.0
05-08-80	802486	HOT	D005	A003	0.362	0.776	0.0	3.61	6.66	0.0	1.48	0.95	0.0	430.	439.	0.	20.3	19.6	0.0
05-08-80	802487	HOT	D005	A003	0.308	0.799	0.0	3.37	7.26	0.0	1.45	0.87	0.0	428.	501.	0.	20.4	17.2	0.0
05-13-80	802491	HOT	D005	A003	0.174	0.369	0.0	2.03	3.36	0.0	1.64	1.15	0.0	441.	440.	0.	19.9	19.9	0.0
05-13-80	802492	HOT	D005	A003	0.237	0.611	0.0	2.70	6.86	0.0	1.71	1.07	0.0	443.	433.	0.	19.8	19.9	0.0
05-13-80	802493	HOT	D005	A003	0.258	0.498	0.0	3.43	5.95	0.0	1.64	1.09	0.0	437.	437.	0.	20.0	19.8	0.0
05-14-80	802494	HOT	D005	A003	0.152	0.502	0.0	1.69	5.98	0.0	1.75	1.10	0.0	439.	438.	0.	20.0	19.7	0.0
05-14-80	802495	HOT	D005	A003	0.113	0.340	0.0	0.59	3.38	0.0	1.56	1.00	0.0	423.	425.	0.	20.9	20.6	0.0
05-14-80	802490	HOT	D005	A003	0.169	0.287	0.0	1.83	2.23	0.0	1.58	1.12	0.0	431.	441.	0.	20.4	19.9	0.0
											(ALL G/MI)						<--(MPG)--->		
MEAN					0.240	0.519	0.0	2.41	5.00	0.0	1.53	1.01	0.0	434.	441.	0.	20.2	19.7	0.0
STANDARD DEV.					0.081	0.164	0.0	0.86	1.75	0.0	0.14	0.10	0.0	7.	19.	0.	0.3	0.8	0.0
C.V.%					33.7	31.6	0.0	35.5	35.0	0.0	9.2	9.6	0.0	1.5	4.4	0.0	1.7	4.2	0.0

LAB CORRELATION SUMMARY - TEST DATA

PROCESSED: FEB 11, 1981

LAB: EPA-METFAC VEH: NOVA TESTS VIN: 1X27 INERTIA WT: 3500 ACTUAL HP: 11.2

DATE	TESTNO	TYPE	HC	CO	NOX	CO2	FE	DRIVER	DYNO	ODOM	IHP	BARO	HUM	NXFC	DBL	HSL	TLOSS
05-13-80	10101	HOT	0.587	4.22	1.19	402.	21.6	34797	D401	0.0	9.1	28.66	51.36	0.90			
05-13-80	10102	HOT	0.531	4.24	1.17	399.	21.8	34797	D401	0.0	9.1	28.67	56.50	0.92			
05-13-80	10103	HOT	0.755	7.95	1.19	393.	21.7	34797	D401	0.0	9.1	28.64	59.72	0.93			
05-13-80	10104	HOT	0.554	5.22	1.22	395.	21.9	34797	D401	0.0	9.1	28.65	58.99	0.93			
05-13-80	10105	HOT	0.462	4.31	1.20	401.	21.7	34797	D401	0.0	9.1	28.63	56.50	0.92			
05-13-80	10106	HOT	0.358	3.18	1.23	397.	22.0	34797	D401	0.0	9.1	28.63	56.50	0.92			
05-16-80	10201	HOT	0.183	0.97	1.20	395.	22.3	34797	D401	0.0	9.1	29.24	45.99	0.88			
05-16-80	10202	HOT	0.186	1.25	1.25	412.	21.4	34797	D401	0.0	9.1	29.23	46.53	0.88			
05-16-80	10203	HOT	0.151	0.88	1.33	393.	22.4	34797	D401	0.0	9.1	29.23	45.16	0.88			
05-16-80	10204	HOT	0.235	1.82	1.21	396.	22.2	34797	D401	0.0	9.1	29.24	43.49	0.87			
05-16-80	10205	HOT	0.190	0.99	1.25	399.	22.1	34797	D401	0.0	9.1	29.23	43.21	0.87			
05-16-80	10206	HOT	0.158	0.72	1.28	399.	22.1	34797	D401	0.0	9.1	29.21	44.05	0.87			
			|<------(G/MI)-----			->|	(MPG)					(IN-HG)	(GRAINS /LB)		|<---(GRAMS)		--->|
MEAN			0.362	2.98	1.23	398.	21.9					28.94	50.67	0.90			
STANDARD DEV.			.2079	2.267	.045	5.	0.3					0.305	6.565	.025			
C.V.%			57.3	76.1	3.7	1.3	1.4					1.1	13.0	2.8			
DIFF. %			-5.	-21.	-3.	-9.	10.					-0.	1.	0.			

BAG DATA

DATE	TESTNO	TYPE	DYNO	SITE	HC	2	3	CO	2	3	NOX	2	3	CO2	2	3	FE	2	3
05-13-80	10101	HOT	D401	A401	0.430	0.732	0.0	2.57	5.74	0.0	1.23	0.93	0.0	412.	392.	0.	21.2	22.1	0.0
05-13-80	10102	HOT	D401	A401	0.318	0.726	0.0	2.71	5.65	0.0	1.32	0.89	0.0	411.	387.	0.	21.2	22.3	0.0
05-13-80	10103	HOT	D401	A401	0.448	1.040	0.0	4.61	11.04	0.0	1.35	0.89	0.0	407.	380.	0.	21.3	22.2	0.0
05-13-80	10104	HOT	D401	A401	0.365	0.728	0.0	3.34	6.96	0.0	1.31	0.96	0.0	403.	388.	0.	21.6	22.2	0.0
05-13-80	10105	HOT	D401	A401	0.245	0.663	0.0	2.35	6.11	0.0	1.29	0.93	0.0	403.	399.	0.	21.7	21.6	0.0
05-13-80	10106	HOT	D401	A401	0.173	0.529	0.0	0.98	5.21	0.0	1.33	0.94	0.0	411.	384.	0.	21.4	22.6	0.0
05-16-80	10201	HOT	D401	A401	0.166	0.199	0.0	0.80	1.13	0.0	1.34	1.08	0.0	400.	390.	0.	22.0	22.6	0.0
05-16-80	10202	HOT	D401	A401	0.140	0.228	0.0	0.89	1.58	0.0	1.42	1.09	0.0	407.	417.	0.	21.6	21.2	0.0
05-16-80	10203	HOT	D401	A009	0.119	0.180	0.0	0.60	1.13	0.0	1.45	1.21	0.0	405.	383.	0.	21.8	23.1	0.0
05-16-80	10204	HOT	D401	A401	0.175	0.290	0.0	1.55	2.07	0.0	1.33	1.10	0.0	405.	388.	0.	21.7	22.7	0.0
05-16-80	10205	HOT	D401	A401	0.129	0.246	0.0	0.36	1.57	0.0	1.39	1.12	0.0	406.	392.	0.	21.7	22.5	0.0
05-16-80	10206	HOT	D401	A401	0.114	0.199	0.0	0.28	1.13	0.0	1.07	1.16	0.0	405.	393.	0.	21.8	22.5	0.0
										(ALL G/MI)							|<--(MPG)		--->|
MEAN					0.235	0.480	0.0	1.75	4.11	0.0	1.32	1.02	0.0	406.	391.	0.	21.6	22.3	0.0
STANDARD DEV.					0.124	0.292	0.0	1.36	3.16	0.0	0.10	0.11	0.0	4.	10.	0.	0.3	0.5	0.0
C.V.%					52.5	60.8	0.0	77.5	77.0	0.0	7.4	11.0	0.0	0.9	2.5	0.0	1.2	2.3	0.0
DIFF. %					-2.	-8.	0.	-27.	-18.	0.	-14.	2.	0.	-6.	-11.	0.	7.	13.	0.

LAB CORRELATION SUMMARY   PROCESSED: JUL 22, 1980

METFACHP-80   VIN VC242   INERTIA WT 2250   ACTUAL HP 8.8

LAB	N		HC	CO	NOX	CO2	FE	BARO	HUM	NXFC	DBL	HSL	TLOSS
			<------G/MI-------			------->	(MPG)	(IN-HG)	(GRAINS /LB)		<---(GRAMS)--->		
EPA	12	MEAN	1.047	12.26	2.99	399.	21.0	29.04	49.96	0.89			
		STANDARD DEV.	.0234	0.350	.069	2.	0.1	0.053	2.754	.010			
		C.V.%	2.2	2.9	2.3	0.6	0.5	0.18	5.51	1.14			
EPA-METFAC	12	MEAN	1.006	11.31	2.29	376.	22.4	29.02	34.01	0.84			
		STANDARD DEV.	.0181	0.358	.128	2.	0.1	0.065	9.113	.030			
		C.V.%	1.8	3.2	5.6	0.6	0.4	0.22	26.80	3.60			
		DIFF.%	-4.	-8.	-23.	-6.	6.	-0.	-32.	-6.			

C.V.% IS THE COEFFICIENT OF VARIATION. (STD. DEV./MEAN *100).
DIFF.% IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LABS. (MFR-EPA/EPA *100).

ATTACHMENT B
(ORIGINAL VOLVO TESTS)

LAB CORRELATION SUMMARY - TEST DATA

PROCESSED: JUL 22, 1980

LAB: EPA VEH: MFTFACHP-[illegible] VIN: VC242 INERTIA WT: 2250 ACTUAL HP: 8.8

DATE	TESTNO	TYPE	HC	CO	NOX	CO2	FE	DRIVER	DYNO	ODOM	IHP	BARO	HUM	NXFC	DBL	HSL	TLOSS
05-14-80	803277	HOT	1.050	12.60	2.87	399.	21.0	34797	D005	0.0	6.7	29.03	43.43	0.87			
05-14-80	803278	HOT	1.070	12.60	2.97	395.	21.2	34797	D005	0.0	6.7	29.03	53.05	0.91			
05-14-80	803279	HOT	1.070	12.50	2.90	401.	20.9	34797	D005	0.0	6.7	29.04	51.62	0.90			
05-14-80	803280	HOT	1.060	12.50	2.93	396.	21.2	34797	D005	0.0	6.7	29.04	51.62	0.90			
05-14-80	803281	HOT	1.060	12.40	2.92	397.	21.1	34797	D005	0.0	6.7	29.04	48.62	0.89			
05-14-80	803282	HOT	1.090	12.30	3.01	402.	20.9	34797	D005	0.0	6.7	29.04	49.99	0.89			
05-19-80	803283	HOT	1.040	12.60	3.05	402.	20.9	34797	D005	0.0	6.7	29.04	46.78	0.88			
05-19-80	803284	HOT	1.030	12.30	3.03	398.	21.1	34797	D005	0.0	6.7	29.04	50.28	0.90			
05-19-80	803285	HOT	1.040	12.10	3.07	397.	21.1	34797	D005	0.0	6.7	29.04	52.46	0.90			
05-19-80	803286	HOT	1.020	11.70	2.98	400.	21.0	34797	D005	0.0	6.7	29.04	48.94	0.89			
05-19-80	803287	HOT	1.010	11.80	3.06	398.	21.1	34797	D005	0.0	6.7	29.04	50.28	0.90			
05-19-80	803288	HOT	1.030	11.70	3.05	401.	21.0	34797	D005	0.0	6.7	29.04	52.45	0.90			
			(G/MI)				(MPG)					(IN-HG)	(GRAINS/LB)		(GRAMS)		
MEAN			1.047	12.26	2.99	399.	21.0					29.04	49.96	0.89			
STANDARD DEV.			.0234	0.350	.069	2.	0.1					0.053	2.754	.010			
C.V.%			2.2	2.9	2.3	0.6	0.5					0.2	5.5	1.1			

BAG DATA

DATE	TESTNO	TYPE	DYNO	SITE	HC	2	3	CO	2	3	NOX	2	3	CO2	2	3	FE	2	3
05-14-80	803277	HOT	D005	A003	1.112	0.999	0.0	11.81	13.26	0.0	3.97	1.65	0.0	386.	411.	0.	21.7	20.4	0.0
05-14-80	803278	HOT	D005	A003	1.133	1.009	0.0	12.14	12.99	0.0	4.16	1.86	0.0	382.	407.	0.	21.9	20.6	0.0
05-14-80	803279	HOT	D005	A003	1.110	1.033	0.0	11.92	13.02	0.0	4.03	1.85	0.0	386.	414.	0.	21.7	20.3	0.0
05-14-80	803280	HOT	D005	A003	1.142	0.993	0.0	11.90	13.05	0.0	4.08	1.87	0.0	382.	409.	0.	21.9	20.5	0.0
05-14-80	803281	HOT	D005	A003	1.137	0.998	0.0	11.88	12.80	0.0	4.06	1.87	0.0	383.	410.	0.	21.9	20.5	0.0
05-14-80	803282	HOT	D005	A003	1.146	1.031	0.0	11.86	12.64	0.0	4.21	1.90	0.0	389.	415.	0.	21.6	20.3	0.0
05-19-80	803283	HOT	D005	A003	1.121	0.958	0.0	12.19	13.06	0.0	4.24	1.96	0.0	386.	416.	0.	21.7	20.2	0.0
05-19-80	803284	HOT	D005	A003	1.094	0.980	0.0	11.91	12.57	0.0	4.20	1.96	0.0	384.	412.	0.	21.8	20.4	0.0
05-19-80	803285	HOT	D005	A003	1.116	0.968	0.0	11.78	12.47	0.0	4.28	1.95	0.0	382.	410.	0.	21.9	20.5	0.0
05-19-80	803286	HOT	D005	A003	1.135	0.942	0.0	11.48	11.82	0.0	4.16	1.89	0.0	388.	412.	0.	21.7	20.5	0.0
05-19-80	803287	HOT	D005	A003	1.097	0.936	0.0	11.41	12.14	0.0	4.22	1.98	0.0	385.	410.	0.	21.8	20.5	0.0
05-19-80	803288	HOT	D005	A003	1.111	0.946	0.0	11.39	11.93	0.0	4.22	1.97	0.0	386.	416.	0.	21.8	20.3	0.0
										(ALL G/MI)							(MPG)		
MEAN					1.119	0.983	0.0	11.61	12.65	0.0	4.15	1.91	0.0	385.	412.	0.	21.8	20.4	0.0
STANDARD DEV.					0.017	0.033	0.0	0.26	0.48	0.0	0.10	0.05	0.0	2.	3.	0.	0.1	0.1	0.0
C.V.%					1.5	3.4	0.0	2.2	3.8	0.0	2.3	2.7	0.0	0.6	0.7	0.0	0.5	0.6	0.0

LAB CORRELATION SUMMARY - TEST DATA

PROCESSED: JUL 22, 1980

LAB: EPA-METFAC VEH: METFACHP-80 VIN: VC242 INERTIA WT: 2250 ACTUAL HP: 8.8

DATE	TESTNO	TYPE	HC	CO	NOX	CO2	FE	DRIVER	DYNO	ODOM	IHP	BARO	HUM	NXFC	DBL	HSL	TLOSS
05-15-80	20101	HOT	0.985	11.63	2.29	374.	22.4	34797	D401	0.0	7.5	29.09	44.60	0.88			
05-15-80	20102	HOT	1.009	11.79	2.43	377.	22.3	34797	D401	0.0	7.5	29.08	42.36	0.87			
05-15-80	20103	HOT	0.998	11.67	2.40	375.	22.4	34797	D401	0.0	7.5	29.08	40.94	0.86			
05-15-80	20104	HOT	0.978	11.63	2.41	372.	22.5	34797	D401	0.0	7.5	29.08	41.51	0.86			
05-15-80	20105	HOT	1.008	11.59	2.44	376.	22.3	34797	D401	0.0	7.5	29.08	43.21	0.87			
05-15-80	20106	HOT	0.995	11.55	2.46	379.	22.2	34797	D401	0.0	7.5	29.08	43.49	0.87			
05-20-80	20201	HOT	0.993	11.11	2.12	373.	22.5	34797	D401	0.0	7.5	28.97	25.09	0.81			
05-20-80	20202	HOT	1.000	10.93	2.18	376.	22.4	34797	D401	0.0	7.5	28.97	25.90	0.81			
05-20-80	20203	HOT	1.025	10.91	2.15	379.	22.3	34797	D401	0.0	7.5	28.95	25.90	0.81			
05-20-80	20204	HOT	1.019	10.89	2.20	375.	22.5	34797	D401	0.0	7.5	28.96	25.09	0.81			
05-20-80	20205	HOT	1.025	11.06	2.20	370.	22.4	34797	D401	0.0	7.5	28.95	25.25	0.81			
05-20-80	20206	HOT	1.039	10.95	2.21	376.	22.4	34797	D401	0.0	7.5	28.94	24.77	0.81			
			<-------(G/MI)------>				(MPG)					(IN-HG)	(GRAINS /LB)		<---(GRAMS)--->		
MEAN			1.006	11.31	2.29	376.	22.4					29.02	34.01	0.84			
STANDARD DEV.			.0181	0.358	.128	2.	0.1					0.065	9.113	.030			
C.V.%			1.8	3.2	5.6	0.6	0.4					0.2	26.8	3.6			
DIFF. %			-4.	-8.	-23.	-6.	6.					-0.	-32.	-6.			

BAG DATA

DATE	TESTNO	TYPE	DYNO	SITE	HC	2	3	CO	2	3	NOX	2	3	CO2	2	3	FE	2	3
05-15-80	20101	HOT	D401	A401	1.051	0.924	0.0	11.34	11.89	0.0	3.23	1.43	0.0	366.	382.	0.	22.8	22.0	0.0
05-15-80	20102	HOT	D401	A401	1.053	0.967	0.0	11.35	12.20	0.0	3.44	1.50	0.0	369.	384.	0.	22.7	21.9	0.0
05-15-80	20103	HOT	D401	A401	1.053	0.948	0.0	11.31	12.01	0.0	3.40	1.47	0.0	368.	382.	0.	22.7	22.0	0.0
05-15-80	20104	HOT	D401	A401	1.034	0.927	0.0	11.25	11.98	0.0	3.46	1.44	0.0	368.	376.	0.	22.7	22.3	0.0
05-15-80	20105	HOT	D401	A401	1.048	0.971	0.0	11.25	11.90	0.0	3.43	1.52	0.0	368.	384.	0.	22.7	21.9	0.0
05-15-80	20106	HOT	D401	A401	1.074	0.923	0.0	11.18	11.90	0.0	3.23	1.50	0.0	371.	385.	0.	22.6	21.8	0.0
05-20-80	20201	HOT	D401	A401	1.043	0.947	0.0	10.57	11.62	0.0	2.98	1.33	0.0	365.	380.	0.	22.9	22.1	0.0
05-20-80	20202	HOT	D401	A401	1.042	0.951	0.0	10.65	11.20	0.0	3.09	1.34	0.0	366.	384.	0.	22.9	21.9	0.0
05-20-80	20203	HOT	D401	A401	1.069	0.934	0.0	10.73	11.07	0.0	3.03	1.34	0.0	366.	391.	0.	22.9	21.6	0.0
05-20-80	20204	HOT	D401	A401	1.055	0.986	0.0	10.70	11.07	0.0	3.07	1.39	0.0	367.	382.	0.	22.9	22.1	0.0
05-20-80	20205	HOT	D401	A401	1.051	1.001	0.0	10.70	11.38	0.0	3.06	1.41	0.0	367.	384.	0.	22.9	22.0	0.0
05-20-80	20206	HOT	D401	A401	1.078	1.003	0.0	10.65	11.23	0.0	3.11	1.38	0.0	368.	383.	0.	22.8	22.0	0.0
										(ALL G/MI)							<--(MPG)--->		
MEAN					1.054	0.962	0.0	10.97	11.62	0.0	3.21	1.42	0.0	367.	383.	0.	22.8	22.0	0.0
STANDARD DEV.					0.013	0.029	0.0	0.33	0.41	0.0	0.18	0.07	0.0	2.	3.	0.	0.1	0.2	0.0
C.V.%					1.3	3.0	0.0	3.0	3.5	0.0	5.6	4.7	0.0	0.4	0.9	0.0	0.5	0.8	0.0
DIFF. %					-5.	-2.	0.	-7.	-8.	0.	-23.	-26.	0.	-5.	-7.	0.	5.	8.	0.

C.V.% IS THE COEFFICIENT OF VARIATION.(STD. DEV./MEAN *100).
DIFF. % IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LAB. (MFR-EPA/EPA *100).
NOTE: THE COMMENTS PERTINENT TO THESE TESTS ARE LOCATED IN THE LAST TABLE OF THIS APPENDIX.

LAB CORRELATION SUMMARY - COMMENTS

METFAC8P-R0	VIN VC242	INERTIA WT 2250	ACTUAL HP 8.8

803277	FIRST HOT START-DYNO 5 METFAC CORRELATION
803278	SECOND HOT START-DYNO 5 METFAC CORRELATION
803279	THIRD HOT START-DYNO 5 METFAC CORRELATION
803280	FOURTH HOT START-DYNO 5 METFAC CORRELATION
803281	FIFTH HOT START-DYNO 5 METFAC CORRELATION
803282	SIXTH HOT START-DYNO 5 METFAC CORRELATION
803283	2ND SET-1ST HOT START-DYNO 5 METFAC CORR
803284	2ND SET-2ND HOT START-DYNO 5 METFAC CORR
803285	2ND SET-3RD HOT START-DYNO 5 METFAC CORR
803286	2ND SET-4TH HOT START -DYNO 5 METFAC CORR
803287	2ND SET-5TH HOT START-DYNO 5 METFAC CORR
803288	2ND SET-6TH HOT START DYNO 5 METFAC CORR

LAB CORRELATION SUMMARY   PROCESSED: NOV 24, 1980

PRE-NOX/RECALC   VIN VC242   INERTIA WT 2250   ACTUAL HP 8.8

LAB	N		HC	CO	NOX	CO2	FE	BARO	HUM	NXFC	DBL	HSL	TLOSS
			|<------G/MI-------			>|	(MPG)	(IN-HG)	(GRAINS /LB)		|<---(GRAMS)		--->|
EPA	3	MEAN	1.117	11.73	2.49	391.	21.5	28.92	43.21	0.87			
		STANDARD DEV.	.0208	0.252	.061	1.	0.1	0.0	3.076	.011			
		C.V.%	1.9	2.1	2.5	0.1	0.3	0.0	7.12	1.27			
EPA-METFAC	6	MEAN	1.111	11.93	3.23	397.	21.1	29.01	100.01	1.15			
		STANDARD DEV.	.0282	0.367	.311	5.	0.6	0.242	22.477	.134			
		C.V.%	2.5	3.1	9.6	1.3	2.9	0.83	22.47	****			
		DIFF. %	-0.	2.	30.	1.	-2.	0.	131.	32.			

C.V.% IS THE COEFFICIENT OF VARIATION. (STD. DEV./MEAN *100).
DIFF.% IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LABS. (MFR-EPA/EPA *100).

ATTACHMENT C

(2nd SET HOT LA-4 PRE-NOx RECALCULATION)

LAB: EPA VEH: PRE-NOX/RECALC VIN: VC242 INERTIA WT: 2250 ACTUAL HP: 8.8

DATE	TESTNO	TYPE	HC	CO	NOX	CO2	FE	DRIVER	DYNO	ODOM	IHP	BARO	HUM	NXFC	UBL	HSL	TLOSS
09-30-80	806224	HOT	1.140	12.00	2.44	391.	21.4	34797	0004	9445.0	6.9	28.92	41.65	0.86			
09-30-80	806225	HOT	1.100	11.70	2.56	391.	21.5	34797	0004	9460.0	6.9	28.92	46.75	0.88			
09-30-80	806226	HOT	1.110	11.50	2.48	390.	21.5	34797	0004	9475.0	6.9	28.92	41.22	0.86			
			<------(G/MI)------>				(MPG)					(IN-HG)	(GRAINS /LB)		<---(GRAMS)--->		
MEAN			1.117	11.73	2.49	391.	21.5					28.92	43.21	0.87			
STANDARD DEV.			.0208	0.252	.061	1.	0.1					0.0	3.076	.011			
C.V.%			1.9	2.1	2.5	0.1	0.3					0.0	7.1	1.3			

BAG DATA

DATE	TESTNO	TYPE	DYNO	SITE	HC	2	3	CO	2	3	NOX	2	3	CO2	2	3	FE	2	3
09-30-80	806224	HOT	0004	A002	1.223	1.071	0.0	11.41	12.58	0.0	3.36	1.59	0.0	370.	410.	0.	22.7	20.5	0.0
09-30-80	806225	HOT	0004	A002	1.174	1.033	0.0	11.21	12.23	0.0	3.54	1.64	0.0	373.	408.	0.	22.5	20.6	0.0
09-30-80	806226	HOT	0004	A002	1.143	1.075	0.0	11.07	11.86	0.0	3.43	1.60	0.0	371.	407.	0.	22.6	20.7	0.0
					(ALL G/MI)												<--(MPG)--->		
MEAN					1.180	1.060	0.0	11.23	12.22	0.0	3.44	1.61	0.0	371.	408.	0.	22.6	20.6	0.0
STANDARD DEV.					0.040	0.023	0.0	0.17	0.36	0.0	0.09	0.03	0.0	2.	2.	0.	0.1	0.1	0.0
C.V.%					3.4	2.2	0.0	1.5	2.9	0.0	2.6	1.6	0.0	0.4	0.4	0.0	0.4	0.5	0.0

C.V.% IS THE COEFFICIENT OF VARIATION.(STD. DEV./MEAN *100).
DIFF. % IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LAB. (MFR-EPA/EPA *100).
NOTE: THE COMMENTS PERTINENT TO THESE TESTS ARE LOCATED IN THE LAST TABLE OF THIS APPENDIX.

LAB CORRELATION SUMMARY - TEST DATA

PROCESSED: NOV 24, 1980

LAB: EPA-METFAC VEH: PRE-NOX/RECALC VIN: VC242 INERTIA WT: 2250 ACTUAL HP: 8.8

DATE	TESTNO	TYPE	HC	CO	NOX	CO2	FE	DRIVER	DYNO	ODOM	IHP	BARO	HUM	NXFC	DBL	HSL	TLOSS
9-26-80	20301	HOT	1.164	12.36	2.89	400.	20.0	34797	D401	0.0	7.0	29.23	74.57	1.00			
9-26-80	20302	HOT	1.096	12.22	2.92	403.	20.9	34797	D401	0.0	7.0	29.23	70.66	0.98			
9-26-80	20303	HOT	1.107	12.09	3.33	400.	21.1	34797	D401	0.0	7.0	29.23	109.50	1.19			
10-02-80	20401	HOT	1.119	11.91	3.25	392.	21.5	34797	D401	0.0	7.0	28.78	107.84	1.18			
10-02-80	20402	HOT	1.095	11.55	3.28	391.	21.6	34797	D401	0.0	7.0	28.79	109.72	1.19			
10-02-80	20403	HOT	1.086	11.44	3.74	393.	21.5	34797	D401	0.0	7.0	28.79	127.79	1.33			
			<------(G/MI)----->				(MPG)					(IN-HG)	(GRAINS /LB)		<---(GRAMS)--->		
MEAN			1.111	11.93	3.23	397.	21.1					29.01	100.01	1.15			
STANDARD DEV.			.0282	0.367	.311	5.	0.6					0.242	22.477	.134			
C.V.%			2.5	3.1	9.6	1.3	2.9					0.8	22.5	11.7			
DIFF. %			-0.	2.	30.	1.	-2.					0.	131.	32.			

BAG DATA

DATE	TESTNO	TYPE	DYNO	SITE	HC	2	3	CO	2	3	NOX	2	3	CO2	2	3	FE	2	3
9-26-80	20301	HOT	D401	A401	1.280	1.056	0.0	11.85	12.83	0.0	4.10	1.76	0.0	383.	417.	0.	21.9	20.2	0.0
9-26-80	20302	HOT	D401	A401	1.184	1.015	0.0	11.69	12.70	0.0	4.19	1.75	0.0	384.	420.	0.	21.8	20.0	0.0
9-26-80	20303	HOT	D401	A401	1.186	1.034	0.0	11.58	12.56	0.0	4.16	2.56	0.0	378.	421.	0.	22.2	20.0	0.0
10-02-80	20401	HOT	D401	A401	1.124	1.115	0.0	11.42	12.37	0.0	4.61	1.99	0.0	371.	412.	0.	22.ô	20.4	0.0
10-02-80	20402	HOT	D401	A401	1.124	1.069	0.0	11.18	11.89	0.0	4.57	2.07	0.0	370.	411.	0.	22.7	20.5	0.0
10-02-80	20403	HOT	D401	A401	1.129	1.047	0.0	11.11	11.74	0.0	5.36	2.27	0.0	377.	407.	0.	22.3	20.7	0.0
											(ALL G/MI)						<--(MPG)--->		
MEAN					1.171	1.056	0.0	11.47	12.35	0.0	4.50	2.07	0.0	377.	415.	0.	22.3	20.3	0.0
STANDARD DEV.					0.061	0.034	0.0	0.29	0.44	0.0	0.48	0.31	0.0	6.	6.	0.	0.4	0.3	0.0
C.V.%					5.2	3.3	0.0	2.5	3.6	0.0	10.6	15.1	0.0	1.5	1.3	0.0	1.6	1.4	0.0
DIFF. %					-1.	-0.	0.	2.	1.	0.	31.	28.	0.	2.	2.	0.	-2.	-1.	0.

C.V.% IS THE COEFFICIENT OF VARIATION.(STD. DEV./MEAN *100).
DIFF. % IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LAB. (MFR-EPA/EPA *100).
NOTE: THE COMMENTS PERTINENT TO THESE TESTS ARE LOCATED IN THE LAST TABLE OF THIS APPENDIX.

LAB CORRELATION SUMMARY - COMMENTS

PRE-NOX/RECALC	VIN VC242	INERTIA WT 2250	ACTUAL HP 8.8

806224

806225

806226

METFAC CORRELATION USING VOLVO REPCA -- TEST #1, FIRST SET	020301
METFAC CORRELATION USING VOLVO REPCA -- TEST #2, FIRST SET	020302
METFAC CORRELATION USING VOLVO REPCA -- TEST #3, FIRST SET	020303
METFAC CORRELATION USING VOLVO REPCA -- TEST #1,SECOND SET	020401
METFAC CORRELATION USING VOLVO REPCA -- TEST #2,SECOND SET	020402
METFAC CORRELATION USING VOLVO REPCA-- TEST #3,SECOND SET	020403

LAB CORRELATION SUMMARY PROCESSED: NOV 24, 1980

PRE-NOX/RECALC VIN VC242 INERTIA WT 2250 ACTUAL HP 8.8

LAB	N		HC	CO	NOX	CO2	FE	BARO	HUM	NXFC	DBL	HSL	TLOSS
			|<-------G/MI			-------->|	(MPG)	(IN-HG)	(GRAINS /LB)		|<---(GRAMS)		--->|
EPA	6	MEAN	1.182	11.28	3.43	370.	22.7	28.92	41.03	0.86			
		STANDARD DEV.	.0293	0.211	.061	2.	0.1	0.034	3.147	.011			
		C.V.%	2.5	1.9	1.8	0.5	0.5	0.12	7.67	1.29			
EPA-METFAC	12	MEAN	1.147	11.43	4.90	376.	22.3	29.01	112.58	1.23			
		STANDARD DEV.	.0497	0.258	.614	4.	0.3	0.239	21.905	.146			
		C.V.%	4.3	2.3	12.5	1.2	1.2	0.83	19.46	****			
		DIFF. %	-3.	1.	43.	2.	-2.	0.	174.	43.			

C.V.% IS THE COEFFICIENT OF VARIATION. (STD. DEV./MEAN *100).
DIFF.% IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LABS. (MFR-EPA/EPA *100).

(2nd SET HOT 505s PRE-NOx RECALCULATION)

LAB CORRELATION SUMMARY - TEST DATA

PROCESSED: NOV 24, 1980

LAB: EPA

VEH: PRE-NOX/RECALC

VIN: VC242

INERTIA WT: 2250

ACTUAL HP: 8.8

DATE	TESTNO	TYPE	HC	CO	NOX	CO2	FE	DRIVER	DYNO	ODOM	IHP	BARO	HUM	NXFC	DBL	HSL	TLOSS
09-30-80	806224-1	BBB	1.223	11.41	3.36	370.	22.7	34797	D004	9445.0	6.9	28.92	41.65	0.86			
09-30-80	806225-1	BBB	1.174	11.21	3.54	373.	22.5	34797	D004	9460.0	6.9	28.92	46.75	0.88			
09-30-80	806226-1	BBB	1.143	11.07	3.43	371.	22.6	34797	D004	9475.0	6.9	28.92	41.22	0.86			
09-30-80	806227-1	BBB	1.161	11.19	3.43	370.	22.7	34797	D004	9490.0	6.9	28.92	39.96	0.86			
09-30-80	806228-1	BBB	1.186	11.14	3.40	370.	22.7	34797	D004	9500.0	6.9	28.92	37.89	0.85			
09-30-80	806229-1	BBB	1.206	11.64	3.41	367.	22.8	34797	D004	9510.0	6.9	28.92	38.71	0.85			
			|<------(G/MI)------>|				(MPG)					(IN-HG)	(GRAINS /LB)		|<---(GRAMS)--->|		
MEAN			1.182	11.28	3.43	370.	22.7					28.92	41.03	0.86			
STANDARD DEV.			.0293	0.211	.061	2.	0.1					0.034	3.147	.011			
C.V.%			2.5	1.9	1.8	0.5	0.5					0.1	7.7	1.3			

LAB: EPA-METFAC VEH: PRE-NOX/RECALC VIN: VC242 INERTIA WT: 2250 ACTUAL HP: 8.8

DATE	TESTNO	TYPE	HC	CO	NOX	CO2	FE	DRIVER	DYNO	ODOM	IHP	BARO	HUM	NXFC	DBL	HSL	TLOSS
9-26-80	20301-1	888	1.280	11.85	4.10	383.	21.9	34797	D401	0.0	7.0	29.23	74.57	1.00			
9-26-80	20302-1	888	1.184	11.69	4.19	384.	21.8	34797	D401	0.0	7.0	29.23	70.66	0.98			
9-26-80	20303-1	888	1.186	11.58	4.16	378.	22.2	34797	D401	0.0	7.0	29.23	109.50	1.19			
9-26-80	20304-1	888	1.102	11.57	6.10	377.	22.2	34797	D401	0.0	7.0	29.23	145.64	1.50			
9-26-80	20305-1	888	1.108	11.42	4.87	375.	22.4	34797	D401	0.0	7.0	29.23	110.76	1.20			
9-26-80	20306-1	888	1.109	11.76	4.84	371.	22.6	34797	D401	0.0	7.0	29.23	110.76	1.20			
10-02-80	20401-1	888	1.124	11.42	4.61	371.	22.6	34797	D401	0.0	7.0	28.78	107.84	1.18			
10-02-80	20402-1	888	1.124	11.18	4.57	370.	22.7	34797	D401	0.0	7.0	28.79	109.72	1.19			
10-02-80	20403-1	888	1.129	11.11	5.36	377.	22.3	34797	D401	0.0	7.0	28.79	127.79	1.33			
10-02-80	20404-1	888	1.138	11.17	5.41	378.	22.2	34797	D401	0.0	7.0	28.78	127.91	1.33			
10-02-80	20405-1	888	1.140	11.14	5.38	374.	22.4	34797	D401	0.0	7.0	28.79	127.91	1.33			
10-02-80	20406-1	888	1.137	11.26	5.23	375.	22.4	34797	D401	0.0	7.0	28.79	127.91	1.33			
			|<------(G/MI)------>|				(MPG)					(IN-HG)	(GRAINS /LB)		|<---(GRAMS)--->|		
MEAN			1.147	11.43	4.90	376.	22.3					29.01	112.58	1.23			
STANDARD DEV.			.0497	0.258	.614	4.	0.3					0.239	21.905	.146			
C.V.%			4.3	2.3	12.5	1.2	1.2					0.8	19.5	11.9			
DIFF. %			-3.	1.	43.	2.	-2.					0.	174.	43.			

LAB CORRELATION SUMMARY - COMMENTS

PRE-NOX/RECALC   VIN VC242   INERTIA WT 2250   ACTUAL HP 8.8

806224

806225

806226

806227 METFAC HC-98.5 NOX-62.7 CO-447.0 CO2-9944.6 (PPM)

806228 METFAC HC-99.0 NOX-67.9 CO-443.0 CO2-9897.5 (PPM)

806229 METFAC HC-101.3 NOX-66.7 CO-466.5 CO2-9808.3 (PPM)

METFAC CORRELATION USING VOLVO REPCA -- TEST #1. FIRST SET	020301
METFAC CORRELATION USING VOLVO REPCA -- TEST #2. FIRST SET	020302
METFAC CORRELATION USING VOLVO REPCA -- TEST #3. FIRST SET	020303
METFAC CORRELATION USING VOLVO REPCA -- TEST #4. FIRST SET	020304
METFAC CORRELATION USING VOLVO REPCA -- TEST #5. FIRST SET	020305
METFAC CORRELATION USING VOLVO REPCA -- TEST#6. FIRST SET	020306
METFAC CORRELATION USING VOLVO REPCA -- TEST #1.SECOND SET	020401
METFAC CORRELATION USING VOLVO REPCA -- TEST #2.SECOND SET	020402
METFAC CORRELATION USING VOLVO REPCA-- TEST #3.SECOND SET	020403
METFAC CORRELATION USING VOLVO REPCA -- TEST #4.SECOND SET	020404
METFAC CORRELATION USING VOLVO REPCA -- TEST #5.SECOND SET	020405
METFAC CORRELATION USING VOLVO REPCA -- TEST #6.SECOND SET	020406
BAG CROSS-CHECK ON A002 HC=151.83 PPM. CO=576.5 PPM	020406
NOX=119.77 PPM. CO2=1.217 %	020406

LAB CORRELATION SUMMARY   PROCESSED: OCT 17, 1980

METFAC61-80   VIN VC242   INERTIA WT 2250   ACTUAL HP 8.8

Units: HC, CO, NOX, CO2 |<-------G/MI------->| ; FE (MPG) ; BARO (IN-HG) ; HUM (GRAINS/LB) ; DBL, HSL, TLOSS |<---(GRAMS)--->|

LAB	N		HC	CO	NOX	CO2	FE	BARO	HUM	NXFC	DBL	HSL	TLOSS
EPA	3	MEAN	1.117	11.73	2.49	391.	21.5	28.92	43.21	0.87			
		STANDARD DEV.	.0208	0.252	.061	1.	0.1	0.0	3.076	.011			
		C.V.%	1.9	2.1	2.5	0.1	0.3	0.0	7.12	1.27			
EPA-METFAC	6	MEAN	1.111	11.93	2.57	397.	21.1	29.01	51.84	0.90			
		STANDARD DEV.	.0282	0.367	.064	5.	0.6	0.242	11.428	.044			
		C.V.%	2.5	3.1	2.5	1.3	2.9	0.83	22.04	4.86			
		DIFF. %	-0.	2.	3.	1.	-2.	0.	20.	4.			

C.V.% IS THE COEFFICIENT OF VARIATION. (STD. DEV./MEAN *100).
DIFF.% IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LABS. (MFR-EPA/EPA *100).

ATTACHMENT D
(2nd SET HOT LA-4 POST NOx RECALCULATION)

LAB CORRELATION SUMMARY - TEST DATA

PROCESSED: OCT 17, 1980

LAB: EPA   VEH: METRAC61-80   VIN: VC242   INERTIA WT: 2250   ACTUAL HP: 8.8

DATE	TESTNO	TYPE	HC	CO	NOX	CO2	FE	DRIVER	DYNO	ODOM	IHP	BARO	HUM	NXFC	DBL	HSL	TLOSS
09-30-80	806224	HOT	1.140	12.00	2.44	391.	21.4	34797	0004	9445.0	6.9	28.92	41.65	0.86			
09-30-80	806225	HOT	1.100	11.70	2.56	391.	21.5	34797	0004	9460.0	6.9	28.92	46.75	0.88			
09-30-80	806226	HOT	1.110	11.50	2.48	390.	21.5	34797	0004	9475.0	6.9	28.92	41.22	0.86			
			<------(G/MI)----->				(MPG)					(IN-HG)	(GRAINS /LB)		<---(GRAMS)--->		
MEAN			1.117	11.73	2.49	391.	21.5					28.92	43.21	0.87			
STANDARD DEV.			.0208	0.252	.061	1.	0.1					0.0	3.076	.011			
C.V.%			1.9	2.1	2.5	0.1	0.3					0.0	7.1	1.3			

BAG DATA

DATE	TESTNO	TYPE	DYNO	SITE	HC	2	3	CO	2	3	NOX	2	3	CO2	2	3	FE	2	3
09-30-80	806224	HOT	D004	A002	1.223	1.071	0.0	11.41	12.58	0.0	3.36	1.59	0.0	370.	410.	0.	22.7	20.5	0.0
09-30-80	806225	HOT	D004	A002	1.174	1.033	0.0	11.21	12.23	0.0	3.54	1.64	0.0	373.	408.	0.	22.5	20.6	0.0
09-30-80	806226	HOT	D004	A002	1.143	1.075	0.0	11.07	11.86	0.0	3.43	1.60	0.0	371.	407.	0.	22.6	20.7	0.0
										(ALL G/MI)							<--(MPG)--->		
MEAN					1.180	1.060	0.0	11.23	12.22	0.0	3.44	1.61	0.0	371.	408.	0.	22.6	20.6	0.0
STANDARD DEV.					0.040	0.023	0.0	0.17	0.36	0.0	0.09	0.03	0.0	2.	2.	0.	0.1	0.1	0.0
C.V.%					3.4	2.2	0.0	1.5	2.9	0.0	2.6	1.6	0.0	0.4	0.4	0.0	0.4	0.5	0.0

C.V.% IS THE COEFFICIENT OF VARIATION.(STD. DEV./MEAN *100).
DIFF. % IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LAB. (MFR-EPA/EPA *100).
NOTE: THE COMMENTS PERTINENT TO THESE TESTS ARE LOCATED IN THE LAST TABLE OF THIS APPENDIX.

LAB CORRELATION SUMMARY - TEST DATA

PROCESSED: OCT 17, 1980

LAB: EPA-METFAC   VEH: METFACG1-80   VIN: VC242   INERTIA WT: 2250   ACTUAL HP: 8.8

DATE	TESTNO	TYPE	HC	CO	NOX	CO2	FE	DRIVER	DYNO	ODOM	IHP	BARO	HUM	NXFC	DHL	HSL	TLOSS
9-26-80	20301	HOT	1.164	12.36	2.46	400.	20.0	34797	D401	0.0	7.0	29.23	38.01	0.85			
9-26-80	20302	HOT	1.096	12.22	2.53	403.	20.9	34797	D401	0.0	7.0	29.23	41.99	0.87			
9-26-80	20303	HOT	1.107	12.09	2.60	400.	21.1	34797	D401	0.0	7.0	29.23	46.01	0.88			
10-02-80	20401	HOT	1.119	11.91	2.63	392.	21.5	34797	D401	0.0	7.0	28.78	66.00	0.96			
10-02-80	20402	HOT	1.095	11.55	2.61	391.	21.6	34797	D401	0.0	7.0	28.79	62.00	0.94			
10-02-80	20403	HOT	1.086	11.44	2.59	393.	21.5	34797	D401	0.0	7.0	28.79	57.03	0.92			
			|<------(G/MI)------>|				(MPG)					(IN-HG)	(GRAINS /LB)		|<---(GRAMS)--->|		
MEAN			1.111	11.93	2.57	397.	21.1					29.01	51.84	0.90			
STANDARD DEV.			.0282	0.367	.064	5.	0.6					0.242	11.428	.044			
C.V.%			2.5	3.1	2.5	1.3	2.9					0.8	22.0	4.9			
DIFF. %			-0.	2.	3.	1.	-2.					0.	20.	4.			

BAG DATA

DATE	TESTNO	TYPE	DYNO	SITE	HC	2	3	CO	2	3	NOX	2	3	CO2	2	3	FE	2	3
9-26-80	20301	HOT	D401	A401	1.280	1.056	0.0	11.85	12.83	0.0	3.49	1.51	0.0	383.	417.	0.	21.9	20.2	0.0
9-26-80	20302	HOT	D401	A401	1.184	1.015	0.0	11.69	12.70	0.0	3.63	1.52	0.0	384.	420.	0.	21.8	20.0	0.0
9-26-80	20303	HOT	D401	A401	1.186	1.034	0.0	11.58	12.56	0.0	3.65	1.63	0.0	378.	421.	0.	22.2	20.0	0.0
10-02-80	20401	HOT	D401	A401	1.124	1.115	0.0	11.42	12.37	0.0	3.73	1.62	0.0	371.	412.	0.	22.6	20.4	0.0
10-02-80	20402	HOT	D401	A401	1.124	1.069	0.0	11.18	11.89	0.0	3.66	1.64	0.0	370.	411.	0.	22.7	20.5	0.0
10-02-80	20403	HOT	D401	A401	1.129	1.047	0.0	11.11	11.74	0.0	3.71	1.57	0.0	377.	407.	0.	22.3	20.7	0.0
										(ALL G/MI)							|<--(MPG)--->|		
MEAN					1.171	1.056	0.0	11.47	12.35	0.0	3.64	1.58	0.0	377.	415.	0.	22.3	20.3	0.0
STANDARD DEV.					0.061	0.034	0.0	0.29	0.44	0.0	0.08	0.06	0.0	6.	6.	0.	0.4	0.3	0.0
C.V.%					5.2	3.3	0.0	2.5	3.6	0.0	2.3	3.6	0.0	1.5	1.3	0.0	1.6	1.4	0.0
DIFF. %					-1.	-0.	0.	2.	1.	0.	6.	-2.	0.	2.	2.	0.	-2.	-1.	0.

C.V.% IS THE COEFFICIENT OF VARIATION.(STD. DEV./MEAN *100).
DIFF. % IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LAB. (MFR-EPA/EPA *100).
NOTE: THE COMMENTS PERTINENT TO THESE TESTS ARE LOCATED IN THE LAST TABLE OF THIS APPENDIX.

LAB CORRELATION SUMMARY - COMMENTS

METFACGI-80	VIN VC242	INERTIA WT 2250	ACTUAL HP 8.8

806224

806225

806226

METFAC CORRELATION USING VOLVO REPCA -- TEST #1, FIRST SET	020301
METFAC CORRELATION USING VOLVO REPCA -- TEST #2, FIRST SET	020302
METFAC CORRELATION USING VOLVO REPCA -- TEST #3, FIRST SET	020303
METFAC CORRELATION USING VOLVO REPCA -- TEST #1.SECOND SET	020401
METFAC CORRELATION USING VOLVO REPCA -- TEST #2.SECOND SET	020402
METFAC CORRELATION USING VOLVO REPCA-- TEST #3.SECOND SET	020403

LAB CORRELATION SUMMARY   PROCESSED: OCT 17, 1980

METFACG1-80   VIN VC242   INERTIA WT 2250   ACTUAL HP 8.8

LAB	N		HC	CO	NOX	CO2	FE	BARO	HUM	NXFC	DBL	HSL	TLOSS
			|<------G/MI			------->|	(MPG)	(IN-HG)	(GRAINS /LB)		|<---(GRAMS)		--->|
EPA	6	MEAN	1.182	11.28	3.43	370.	22.7	28.92	41.03	0.86			
		STANDARD DEV.	.0293	0.211	.061	2.	0.1	0.034	3.147	.011			
		C.V.%	2.5	1.9	1.8	0.5	0.5	0.12	7.67	1.29			
EPA-METFAC	12	MEAN	1.147	11.43	3.65	376.	22.3	29.01	52.76	0.91			
		STANDARD DEV.	.0497	0.258	.080	4.	0.3	0.239	8.662	.033			
		C.V.%	4.3	2.3	2.2	1.2	1.2	0.83	16.42	3.67			
		DIFF. %	-3.	1.	7.	2.	-2.	0.	29.	5.			

C.V.% IS THE COEFFICIENT OF VARIATION. (STD. DEV./MEAN *100).
DIFF.% IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LABS. (MFR-EPA/EPA *100).

(2nd SET HOT 505s POST NOx RECALCULATION)

LAB CORRELATION SUMMARY - TEST DATA   PROCESSED: OCT 17, 1980

LAB: EPA   VEH: METFAC01-HC   VIN: VC242   INERTIA WT: 2250   ACTUAL HP: 8.8

DATE	TESTNO	TYPE	HC	CO	NOX	CO2	FE	DRIVER	DYNO	ODOM	IHP	BARO	HUM	NXFC	DBL	HSL	TLOSS
09-30-80	806224-1	8H8	1.223	11.41	3.36	370.	22.7	34797	D004	9445.0	6.9	28.92	41.65	0.86			
09-30-80	806225-1	8H8	1.174	11.21	3.54	373.	22.5	34797	D004	9460.0	6.9	28.92	46.75	0.88			
09-30-80	806226-1	8H8	1.143	11.07	3.43	371.	22.6	34797	D004	9475.0	6.9	28.92	41.22	0.86			
09-30-80	806227-1	8H8	1.161	11.19	3.43	370.	22.7	34797	D004	9490.0	6.9	28.92	39.96	0.86			
09-30-80	806228-1	8H8	1.186	11.14	3.40	370.	22.7	34797	D004	9500.0	6.9	28.92	37.89	0.85			
09-30-80	806229-1	8H8	1.206	11.64	3.41	367.	22.8	34797	D004	9510.0	6.9	28.92	38.71	0.85			
			|<------(G/MI)			------>|	(MPG)					(IN-HG)	(GRAINS /LB)		|<---(GRAMS)		--->|
MEAN			1.182	11.28	3.43	370.	22.7					28.92	41.03	0.86			
STANDARD DEV.			.0293	0.211	.061	2.	0.1					0.034	3.147	.011			
C.V.%			2.5	1.9	1.8	0.5	0.5					0.1	7.7	1.3			

LAB CORRELATION SUMMARY - TEST DATA PROCESSED: OCT 17, 1980

LAB: EPA-METFAC VEH: METFACG1-80 VIN: VC242 INERTIA WT: 2250 ACTUAL HP: 8.8

DATE	TESTNO	TYPE	HC	CO	NOX	CO2	FE	DRIVER	DYNO	ODOM	IHP	BARO	HUM	NXFC	DBL	HSL	TLOSS
9-26-80	20301-1	BBB	1.260	11.85	3.49	383.	21.9	34797	D401	0.0	7.0	29.23	38.01	0.85			
9-26-80	20302-1	BBB	1.184	11.69	3.63	384.	21.8	34797	D401	0.0	7.0	29.23	41.99	0.87			
9-26-80	20303-1	BBB	1.186	11.58	3.65	378.	22.2	34797	D401	0.0	7.0	29.23	46.01	0.88			
9-26-80	20304-1	BBB	1.102	11.57	3.62	377.	22.2	34797	D401	0.0	7.0	29.23	48.03	0.89			
9-26-80	20305-1	BBB	1.108	11.42	3.59	375.	22.4	34797	D401	0.0	7.0	29.23	48.03	0.89			
9-26-80	20306-1	BBB	1.109	11.76	3.60	371.	22.6	34797	D401	0.0	7.0	29.23	50.01	0.89			
10-02-80	20401-1	BBB	1.124	11.42	3.73	371.	22.6	34797	D401	0.0	7.0	28.78	66.00	0.96			
10-02-80	20402-1	BBB	1.124	11.18	3.66	370.	22.7	34797	D401	0.0	7.0	28.79	62.00	0.94			
10-02-80	20403-1	BBB	1.129	11.11	3.71	377.	22.3	34797	D401	0.0	7.0	28.79	57.03	0.92			
10-02-80	20404-1	BBB	1.136	11.17	3.80	378.	22.2	34797	D401	0.0	7.0	28.78	59.99	0.93			
10-02-80	20405-1	BBB	1.140	11.14	3.71	374.	22.4	34797	D401	0.0	7.0	28.79	55.99	0.92			
10-02-80	20406-1	BBB	1.137	11.26	3.63	375.	22.4	34797	D401	0.0	7.0	28.79	59.99	0.93			
			|<------(G/MI)-----			->|	(MPG)					(IN-HG)	(GRAINS /LB)		|<---(GRAMS)		--->|
MEAN			1.147	11.43	3.65	376.	22.3					29.01	52.76	0.91			
STANDARD DEV.			.0497	0.258	.080	4.	0.3					0.239	8.662	.033			
C.V.%			4.3	2.3	2.2	1.2	1.2					0.8	16.4	3.7			
DIFF. %			-3.	1.	7.	2.	-2.					0.	29.	5.			

LAB CORRELATION SUMMARY - COMMENTS

METFAC01-80	VIN VC242	INERTIA WT 2250	ACTUAL HP 8.8

806224

806225

806226

806227 METFAC HC-98.5 NOX-62.7 CO-447.0 CO2-9944.6 (PPM)

806228 METFAC HC-99.0 NOX-67.9 CO-443.0 CO2-9897.5 (PPM)

806229 METFAC HC-101.3 NOX-66.7 CO-466.5 CO2-9808.3 (PPM)

METFAC CORRELATION USING VOLVO REPCA -- TEST #1, FIRST SET	020301
METFAC CORRELATION USING VOLVO REPCA -- TEST #2, FIRST SET	020302
METFAC CORRELATION USING VOLVO REPCA -- TEST #3, FIRST SET	020303
METFAC CORRELATION USING VOLVO REPCA -- TEST #4, FIRST SET	020304
METFAC CORRELATION USING VOLVO REPCA -- TEST #5, FIRST SET	020305
METFAC CORRELATION USING VOLVO REPCA -- TEST#6, FIRST SET	020306
METFAC CORRELATION USING VOLVO REPCA -- TEST #1,SECOND SET	020401
METFAC CORRELATION USING VOLVO REPCA -- TEST #2,SECOND SET	020402
METFAC CORRELATION USING VOLVO REPCA-- TEST #3,SECOND SET	020403
METFAC CORRELATION USING VOLVO REPCA -- TEST #4,SECOND SET	020404
METFAC CORRELATION USING VOLVO REPCA -- TEST #5,SECOND SET	020405
METFAC CORRELATION USING VOLVO REPCA -- TEST #6,SECOND SET	020406
BAG CROSS-CHECK ON A002 HC=151.83 PPM, CO=575.5 PPM	020406
NOX=119.77 PPM, CO2=1.217 %	020406

LAB CORRELATION SUMMARY   PROCESSED: OCT 24, 1980

METFACG1-80   VIN VC242   INERTIA WT 2250   ACTUAL HP 8.8

LAB	N		HC	CO	NOX	CO2	FE	BARO	HUM	NXFC	DBL	HSL	TLOSS
			<------G/MI--------			>	(MPG)	(IN-HG)	(GRAINS /LB)		<---(GRAMS)		--->
EPA	3	MEAN	1.117	11.73	2.49	391.	21.5	28.92	43.21	0.87			
		STANDARD DEV.	.0205	0.252	.061	1.	0.1	0.0	3.076	.011			
		C.V.%	1.9	2.1	2.5	0.1	0.3	0.0	7.12	1.27			
EPA-METFAC	6	MEAN	1.111	11.93	2.57	397.	21.1	29.01	51.84	0.90			
		STANDARD DEV.	.0282	0.367	.064	5.	0.6	0.242	11.428	.044			
		C.V.%	2.5	3.1	2.5	1.3	2.9	0.83	22.04	4.86			
		DIFF. %	-0.	2.	3.	1.	-2.	0.	20.	4.			
METFAC-COMPUTER CHEC	1	MEAN	1.122	12.44	2.51	379.	22.2	29.20	27.76	0.82			
		STANDARD DEV.	.0	0.0	.0	0.	0.0	0.0	0.0	.0			
		C.V.%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
		DIFF. %	0.	6.	1.	-3.	3.	1.	-36.	-6.			

C.V.% IS THE COEFFICIENT OF VARIATION. (STD. DEV./MEAN *100).
DIFF.% IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LABS. (MFR-EPA/EPA *100).

ATTACHMENT E

(HOT LA-4 COMPUTOR FIX CHECK)

LAB CORRELATION SUMMARY - TEST DATA

PROCESSED: OCT 24, 1980

LAB: EPA   VEH: METFACG1-80   VIN: VC242   INERTIA WT: 2250   ACTUAL HP: 8.8

DATE	TESTNO	TYPE	HC	CO	NOX	CO2	FE	DRIVER	DYNO	ODOM	IHP	BARO	HUM	NXFC	DBL	HSL	TLOSS
09-30-80	806224	HOT	1.140	12.00	2.44	391.	21.4	34797	D004	9445.0	6.9	28.92	41.65	0.86			
09-30-80	806225	HOT	1.100	11.70	2.56	391.	21.5	34797	D004	9460.0	6.9	28.92	46.75	0.88			
09-30-80	806226	HOT	1.110	11.50	2.48	390.	21.5	34797	D004	9475.0	6.9	28.92	41.22	0.86			
			|<------(G/MI)----->|				(MPG)					(IN-HG)	(GRAINS /LB)		|<---(GRAMS)--->|		
MEAN			1.117	11.73	2.49	391.	21.5					28.92	43.21	0.87			
STANDARD DEV.			.0208	0.252	.061	1.	0.1					0.0	3.076	.011			
C.V.%			1.9	2.1	2.5	0.1	0.3					0.0	7.1	1.3			

BAG DATA

DATE	TESTNO	TYPE	DYNO	SITE	HC	2	3	CO	2	3	NOX	2	3	CO2	2	3	FE	2	3
09-30-80	806224	HOT	D004	A002	1.223	1.071	0.0	11.41	12.58	0.0	3.36	1.59	0.0	370.	410.	0.	22.7	20.5	0.0
09-30-80	806225	HOT	D004	A002	1.174	1.033	0.0	11.21	12.23	0.0	3.54	1.64	0.0	373.	408.	0.	22.5	20.6	0.0
09-30-80	806226	HOT	D004	A002	1.143	1.075	0.0	11.07	11.86	0.0	3.43	1.60	0.0	371.	407.	0.	22.6	20.7	0.0
										(ALL G/MI)							|<--(MPG)--->|		
MEAN					1.180	1.060	0.0	11.23	12.22	0.0	3.44	1.61	0.0	371.	408.	0.	22.6	20.6	0.0
STANDARD DEV.					0.040	0.023	0.0	0.17	0.36	0.0	0.09	0.03	0.0	2.	2.	0.	0.1	0.1	0.0
C.V.%					3.4	2.2	0.0	1.5	2.9	0.0	2.6	1.6	0.0	0.4	0.4	0.0	0.4	0.5	0.0

C.V.% IS THE COEFFICIENT OF VARIATION.(STD. DEV./MEAN *100).
DIFF. % IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LAB. (MFR-EPA/EPA *100).
NOTE: THE COMMENTS PERTINENT TO THESE TESTS ARE LOCATED IN THE LAST TABLE OF THIS APPENDIX.

LAB CORRELATION SUMMARY - TEST DATA PROCESSED: OCT 24, 1980

LAB: EPA-METFAC VEH: METFACG1-80 VIN: VC242 INERTIA WT: 2250 ACTUAL HP: 8.8

DATE	TESTNO	TYPE	HC	CO	NOX	CO2	FE	DRIVER	DYNO	ODOM	IHP	BARO	HUM	NXFC	DBL	HSL	TLOSS
9-26-80	20301	HOT	1.164	12.36	2.46	400.	20.0	34797	D401	0.0	7.0	29.23	38.01	0.85			
9-26-80	20302	HOT	1.096	12.22	2.53	403.	20.9	34797	D401	0.0	7.0	29.23	41.99	0.87			
9-26-80	20303	HOT	1.107	12.09	2.60	400.	21.1	34797	D401	0.0	7.0	29.23	46.01	0.88			
10-02-80	20401	HOT	1.119	11.91	2.63	392.	21.5	34797	D401	0.0	7.0	28.78	66.00	0.96			
10-02-80	20402	HOT	1.095	11.55	2.61	391.	21.6	34797	D401	0.0	7.0	28.79	62.00	0.94			
10-02-80	20403	HOT	1.086	11.44	2.59	393.	21.5	34797	D401	0.0	7.0	28.79	57.03	0.92			
			|<------(G/MI)----->|				(MPG)					(IN-HG)	(GRAINS /LB)		|<---(GRAMS)--->|		
MEAN			1.111	11.93	2.57	397.	21.1					29.01	51.84	0.90			
STANDARD DEV.			.0282	0.367	.064	5.	0.6					0.242	11.428	.044			
C.V.%			2.5	3.1	2.5	1.3	2.9					0.8	22.0	4.9			
DIFF. %			-0.	2.	3.	1.	-2.					0.	20.	4.			

BAG DATA

DATE	TESTNO	TYPE	DYNO	SITE	HC	2	3	CO	2	3	NOX	2	3	CO2	2	3	FE	2	3
9-26-80	20301	HOT	D401	A401	1.280	1.056	0.0	11.85	12.83	0.0	3.49	1.51	0.0	383.	417.	0.	21.9	20.2	0.0
9-26-80	20302	HOT	D401	A401	1.184	1.015	0.0	11.69	12.70	0.0	3.63	1.52	0.0	384.	420.	0.	21.8	20.0	0.0
9-26-80	20303	HOT	D401	A401	1.186	1.034	0.0	11.58	12.56	0.0	3.65	1.63	0.0	378.	421.	0.	22.2	20.0	0.0
10-02-80	20401	HOT	D401	A401	1.124	1.115	0.0	11.42	12.37	0.0	3.73	1.62	0.0	371.	412.	0.	22.6	20.4	0.0
10-02-80	20402	HOT	D401	A401	1.124	1.069	0.0	11.18	11.89	0.0	3.66	1.64	0.0	370.	411.	0.	22.7	20.5	0.0
10-02-80	20403	HOT	D401	A401	1.129	1.047	0.0	11.11	11.74	0.0	3.71	1.57	0.0	377.	407.	0.	22.3	20.7	0.0
									(ALL G/MI)								|<--(MPG)--->|		
MEAN					1.171	1.056	0.0	11.47	12.35	0.0	3.64	1.58	0.0	377.	415.	0.	22.3	20.3	0.0
STANDARD DEV.					0.061	0.034	0.0	0.29	0.44	0.0	0.08	0.06	0.0	6.	6.	0.	0.4	0.3	0.0
C.V.%					5.2	3.3	0.0	2.5	3.6	0.0	2.3	3.6	0.0	1.5	1.3	0.0	1.6	1.4	0.0
DIFF. %					-1.	-0.	0.	2.	1.	0.	6.	-2.	0.	2.	2.	0.	-2.	-1.	0.

C.V.% IS THE COEFFICIENT OF VARIATION.(STD. DEV./MEAN *100).
DIFF. % IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LAB. (MFR-EPA/EPA *100).
NOTE: THE COMMENTS PERTINENT TO THESE TESTS ARE LOCATED IN THE LAST TABLE OF THIS APPENDIX.

LAB CORRELATION SUMMARY - TEST DATA

LAB: METFAC-COMPUTER CHEC VEH: METFACGI-80 VIN: VC242 INERTIA WT: 2250 ACTUAL HP: 8.8

DATE	TESTNO	TYPE	HC	CO	NOX	CO2	FE	DRIVER	DYNO	ODOM	IHP	BARO	HUM	NXFC	DBL	HSL	TLOSS
10-22-80	20501	HOT	1.122	12.44	2.51	379.	22.2	34797	D401	0.0	7.0	29.20	27.76	0.82			
			|<------(G/MI)------>|				(MPG)					(IN-HG)	(GRAINS /LB)		|<---(GRAMS)--->|		
MEAN			1.122	12.44	2.51	379.	22.2					29.20	27.76	0.82			
STANDARD DEV.			.0	0.0	.0	0.	0.0					0.0	0.0	.0			
C.V.%			0.0	0.0	0.0	0.0	0.0					0.0	0.0	0.0			
DIFF. %			0.	6.	1.	-3.	3.					1.	-36.	-6.			

BAG DATA

DATE	TESTNO	TYPE	DYNO	SITE	HC	2	3	CO	2	3	NOX	2	3	CO2	2	3	FE	2	3
0-22-80	20501	HOT	D401	A401	1.149	1.096	0.0	11.65	13.17	0.0	3.55	1.55	0.0	353.	404.	0.	23.7	20.7	0.0
									(ALL G/MI)								|<--(MPG)--->|		
MEAN					1.149	1.096	0.0	11.65	13.17	0.0	3.55	1.55	0.0	353.	404.	0.	23.7	20.7	0.0
STANDARD DEV.					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	0.	0.	0.0	0.0	0.0
C.V.%					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DIFF. %					-3.	3.	0.	4.	8.	0.	3.	-4.	0.	-5.	-1.	0.	5.	0.	0.

C.V.% IS THE COEFFICIENT OF VARIATION.(STD. DEV./MEAN *100).
DIFF. % IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LAB. (MFR-EPA/EPA *100).
NOTE: THE COMMENTS PERTINENT TO THESE TESTS ARE LOCATED IN THE LAST TABLE OF THIS APPENDIX.

LAB CORRELATION SUMMARY - COMMENTS

METFACG1-80	VIN VC242	INERTIA WT 2250	ACTUAL HP 8.8

806224

806225

806226

METFAC CORRELATION USING VOLVO REPCA -- TEST #1, FIRST SET	020301
METFAC CORRELATION USING VOLVO REPCA -- TEST #2, FIRST SET	020302
METFAC CORRELATION USING VOLVO REPCA -- TEST #3, FIRST SET	020303
METFAC CORRELATION USING VOLVO REPCA -- TEST #1,SECOND SET	020401
METFAC CORRELATION USING VOLVO REPCA -- TEST #2,SECOND SET	020402
METFAC CORRELATION USING VOLVO REPCA-- TEST #3,SECOND SET	020403
METFAC CORRELATION -- COLD START TO VERIFY ON-BOARD COMPUTER	020501

LAB CORRELATION SUMMARY   PROCESSED: OCT 24, 1980

METFACGI-80   VIN VC242   INERTIA WT 2250   ACTUAL HP 8.8

LAB	N		HC	CO	NOX	CO2	FE	BARO	HUM	NXFC	DBL	HSL	TLOSS
			|<-------G/MI			-------->|	(MPG)	(IN-HG)	(GRAINS /LB)		|<---(GRAMS)		--->|
EPA	6	MEAN	1.182	11.28	3.43	370.	22.7	28.92	41.03	0.86			
		STANDARD DEV.	.0293	0.211	.061	2.	0.1	0.034	3.147	.011			
		C.V.%	2.5	1.9	1.8	0.5	0.5	0.12	7.67	1.29			
EPA-METFAC	12	MEAN	1.147	11.43	3.65	376.	22.3	29.01	52.76	0.91			
		STANDARD DEV.	.0497	0.258	.080	4.	0.3	0.239	8.662	.033			
		C.V.%	4.3	2.3	2.2	1.2	1.2	0.83	16.42	3.67			
		DIFF. %	-3.	1.	7.	2.	-2.	0.	29.	5.			
METFAC-COMPUTER CHEC	1	MEAN	1.149	11.65	3.55	353.	23.7	29.20	27.76	0.82			
		STANDARD DEV.	.0	0.0	.0	0.	0.0	0.0	0.0	.0			
		C.V.%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
		DIFF. %	-3.	3.	4.	-5.	5.	1.	-32.	-5			

C.V.% IS THE COEFFICIENT OF VARIATION. (STD. DEV./MEAN *100).
DIFF.% IS THE DIFFERENCE OF THE MEANS BETWEEN THE MFR AND EPA LABS. (MFR-EPA/EPA *100).

(HOT 505 COMPUTOR FIX CHECK)

LAB CORRELATION SUMMARY - TEST DATA   PROCESSED: OCT 24, 1980

LAB: EPA   VEH: METFACG1-80   VIN: VC242   INERTIA WT: 2250   ACTUAL HP: 8.8

DATE	TESTNO	TYPE	HC	CO	NOX	CO2	FE	DRIVER	DYNO	ODOM	IHP	BARO	HUM	NXFC	DBL	HSL	TLOSS
09-30-80	806224-1	BBB	1.223	11.41	3.36	370.	22.7	34797	D004	9445.0	6.9	28.92	41.65	0.86			
09-30-80	806225-1	BBB	1.174	11.21	3.54	373.	22.5	34797	D004	9460.0	6.9	28.92	46.75	0.88			
09-30-80	806226-1	BBB	1.143	11.07	3.43	371.	22.6	34797	D004	9475.0	6.9	28.92	41.22	0.86			
09-30-80	806227-1	BBB	1.161	11.19	3.43	370.	22.7	34797	D004	9490.0	6.9	28.92	39.96	0.86			
09-30-80	806228-1	BBB	1.186	11.14	3.40	370.	22.7	34797	D004	9500.0	6.9	28.92	37.89	0.85			
09-30-80	806229-1	BBB	1.206	11.64	3.41	367.	22.8	34797	D004	9510.0	6.9	28.92	38.71	0.85			
			<------(G/MI)----->				(MPG)					(IN-HG)	(GRAINS /LB)		<---(GRAMS)--->		
MEAN			1.182	11.28	3.43	370.	22.7					28.92	41.03	0.86			
STANDARD DEV.			.0293	0.211	.061	2.	0.1					0.034	3.147	.011			
C.V.%			2.5	1.9	1.8	0.5	0.5					0.1	7.7	1.3			

LAB CORRELATION SUMMARY - TEST DATA

PROCESSED: OCT 24, 1980

LAB: EPA-METFAC   VEH: METFACGI-80   VIN: VC242   INERTIA WT: 2250   ACTUAL HP: 8.8

DATE	TESTNO	TYPE	HC	CO	NOX	CO2	FE	DRIVER	DYNO	ODOM	IHP	BARO	HUM	NXFC	DBL	HSL	TLOSS
9-26-80	20301-1	BBB	1.280	11.85	3.49	383.	21.9	34797	D401	0.0	7.0	29.23	38.01	0.85			
9-26-80	20302-1	BBB	1.184	11.69	3.63	384.	21.8	34797	D401	0.0	7.0	29.23	41.99	0.87			
9-26-80	20303-1	BBB	1.186	11.58	3.65	378.	22.2	34797	D401	0.0	7.0	29.23	46.01	0.88			
9-26-80	20304-1	BBB	1.102	11.57	3.62	377.	22.2	34797	D401	0.0	7.0	29.23	48.03	0.89			
9-26-80	20305-1	BBB	1.108	11.42	3.59	375.	22.4	34797	D401	0.0	7.0	29.23	48.03	0.89			
9-26-80	20306-1	BBB	1.109	11.76	3.60	371.	22.6	34797	D401	0.0	7.0	29.23	50.01	0.89			
10-02-80	20401-1	BBB	1.124	11.42	3.73	371.	22.6	34797	D401	0.0	7.0	28.78	66.00	0.96			
10-02-80	20402-1	BBB	1.124	11.18	3.66	370.	22.7	34797	D401	0.0	7.0	28.79	62.00	0.94			
10-02-80	20403-1	BBB	1.129	11.11	3.71	377.	22.3	34797	D401	0.0	7.0	28.79	57.03	0.92			
10-02-80	20404-1	BBB	1.138	11.17	3.80	378.	22.2	34797	D401	0.0	7.0	28.78	59.99	0.93			
10-02-80	20405-1	BBB	1.140	11.14	3.71	374.	22.4	34797	D401	0.0	7.0	28.79	55.99	0.92			
10-02-80	20406-1	BBB	1.137	11.26	3.63	375.	22.4	34797	D401	0.0	7.0	28.79	59.99	0.93			
			<------(G/MI)----->				(MPG)					(IN-HG)	(GRAINS /LB)		<---(GRAMS)--->		

	HC	CO	NOX	CO2	FE	BARO	HUM	NXFC
MEAN	1.147	11.43	3.65	376.	22.3	29.01	52.76	0.91
STANDARD DEV.	.0497	0.258	.080	4.	0.3	0.239	8.662	.033
C.V.%	4.3	2.3	2.2	1.2	1.2	0.8	16.4	3.7
DIFF. %	-3.	1.	7.	2.	-2.	0.	29.	5.

LAB CORRELATION SUMMARY - TEST DATA   PROCESSED: OCT 24, 1980

LAB: METFAC-COMPUTER CHEC   VEH: METFACG1-80   VIN: VC242   INERTIA WT: 2250   ACTUAL HP: 8.8

DATE	TESTNO	TYPE	HC	CO	NOX	CO2	FE	DRIVER	DYNO	ODOM	IHP	BARO	HUM	NXFC	DBL	HSL	TLOSS
10-22-80	20501-1	888	1.149	11.65	3.55	353.	23.7	34797	D401	0.0	7.0	29.20	27.76	0.82			
			|<------(G/MI)			----->|	(MPG)					(IN-HG)	(GRAINS /LB)		|<---(GRAMS)		--->|
MEAN			1.149	11.65	3.55	353.	23.7					29.20	27.76	0.82			
STANDARD DEV.			.0	0.0	.0	0.	0.0					0.0	0.0	.0			
C.V.%			0.0	0.0	0.0	0.0	0.0					0.0	0.0	0.0			
DIFF. %			-3.	3.	4.	-5.	5.					1.	-32.	-5.			

LAB CORRELATION SUMMARY - COMMENTS

METFACG1-80 VIN VC242 INERTIA WT 2250 ACTUAL HP 8.8

806224

806225

806226

806227 METFAC HC-98.5 NOX-62.7 CO-447.0 CO2-9944.6 (PPM)

806228 METFAC HC-99.0 NOX-67.9 CO-443.0 CO2-9897.5 (PPM)

806229 METFAC HC-101.3 NOX-66.7 CO-466.5 CO2-9808.3 (PPM)

METFAC CORRELATION USING VOLVO REPCA -- TEST #1, FIRST SET	020301
METFAC CORRELATION USING VOLVO REPCA -- TEST #2, FIRST SET	020302
METFAC CORRELATION USING VOLVO REPCA -- TEST #3, FIRST SET	020303
METFAC CORRELATION USING VOLVO REPCA -- TEST #4, FIRST SET	020304
METFAC CORRELATION USING VOLVO REPCA -- TEST #5, FIRST SET	020305
METFAC CORRELATION USING VOLVO REPCA -- TEST#6, FIRST SET	020306
METFAC CORRELATION USING VOLVO REPCA -- TEST #1.SECOND SET	020401
METFAC CORRELATION USING VOLVO REPCA -- TEST #2.SECOND SET	020402
METFAC CORRELATION USING VOLVO REPCA-- TEST #3.SECOND SET	020403
METFAC CORRELATION USING VOLVO REPCA -- TEST #4.SECOND SET	020404
METFAC CORRELATION USING VOLVO REPCA -- TEST #5.SECOND SET	020405
METFAC CORRELATION USING VOLVO REPCA -- TEST #6.SECOND SET	020406
BAG CROSS-CHECK ON A002 HC=151.83 PPM, CO=576.5 PPM	020406
NOX=119.77 PPM, CO2=1.217 %	020406
METFAC CORRELATION -- COLD START TO VERIFY ON-BOARD COMPUTER	020501