Technical Support for Regulatory Action

In-House Test Program
Report No. 2-
Vehicle Preconditioning:
LA-4 vs. HFET

November 1975

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Notice

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Standards Development and Support Branch
Emission Control Technology Division
Office of Mobile Source Air Pollution Control
Office of Air and Waste Management
U.S. Environmental Protection Agency

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1. Introduction

The preconditioning vehicle operation described in the Federal Register (1) requires that the test vehicle be driven over a prescribed mileage accumulation route for a period of one hour (this is usually called the AMA road route). The fuel tank is then drained and a specified type of test fuel is added. The vehicle is then driven over a simulated trip on a chassis dynamometer. The Urban Dynamometer Driving Schedule (usually called an LA-4) is used for this simulation. In the In-House Report No. 1 (2) the current preconditioning cycle consisting of both the AMA and LA-4 was evaluated to determine if the AMA segment of the cycle could be eliminated. It was shown in that report that similar exhaust and diurnal emission levels existed whether or not the AMA was conducted. Since the LA-4 is considered a typical urban driving cycle, it was concluded that the LA-4 prep cycle alone would be sufficient to precondition the vehicle. Further support of this conclusion can be drawn from another in-house study (3) conducted to determine the equivalency of an AMA + LA-4, three LA-4's + one LA-4, or one LA-4 preconditioning drive with respect to exhaust emissions. That study, based on ten (10) replicate tests on three vehicles concluded that equivalent exhaust results are achieved with any of the three preconditioning drives.

The purpose of vehicle preconditioning is to provide a relatively consistent starting base for all vehicles involved in emission testing. It is intended that this desired starting base be achieved by a preconditioning drive which tends to simulate a real-life condition that a vehicle would normally experience in its day-to-day operation. The basic vehicle preconditioning sequence involves soaking the vehicle (cold soak) prior to the diurnal test which allows the vehicle to reach a stabilized ambient temperature. The preconditioning drive is conducted prior to the cold soak, which conditions the evaporative control system (i.e. canister) and flushes out the old fuel. In addition, the preconditioning (prep) drive may standardize the vehicle if it has not been operated within a reasonable length of time.

The Highway Fuel Economy Test (HFET) cycle is a typical driving cycle for highway driving. The method of conducting the HFET test requires driving two identical cycles; the first intended to warm up the vehicle and the second cycle is used to measure the vehicle's highway fuel economy. If the LA-4 prep cycle and the two HFET prep cycles can be shown to condition the vehicle equivalently, then the HFET cycle could be used to replace the LA-4 prep.

Replacing the LA-4 prep with the HFET prep would likely have an economic advantage. Currently, if a HFET cycle is run, it is run at the end of the Hot Soak test and is an additional test. This additional test adds time to the overall procedure and requires further manpower.

An alternative to replacing the LA-4 with the HFET for vehicle preconditioning is the use of an LA-4 as a warm up cycle followed by one HFET data gathering cycle. This alternative would have the advantage of simulating both urban and rural driving.

The purpose of this study is, therefore, to examine whether or not the HFET driving cycle is equivalent to the LA-4 preconditioning cycle. This test program was designed to reveal if any significant differences existed in diurnal emissions or exhaust emissions when the vehicle underwent different preconditioning drives. It was assumed that, if significant differences in diurnal losses were exhibited, the effect of the different cycles on the evaporative control system could be responsible. For all vehicles tested the evaporative control system utilized a charcoal canister as a storage media for the generated fuel vapors. In order to determine what effect the prep cycles had on the generation of fuel vapors, canister weights were taken before and after the prep drive and before and after the diurnal test.

A small portion of the test program was designed to gain insight into the alternative of using one LA-4 plus one HFET as a preconditioning cycle. By recording canister weights before and after this combined preconditioning cycle, the cycle could be evaluated to determine if the purge characteristics were similar to either a single LA-4 cycle or 2 HFET cycles. Only the Matador was used during this portion of testing as its evaporative control system was the most sensitive to the different preconditioning cycles.

2. Summary and Conclusions

The purpose of this study was to determine whether or not the two HFET cycles used for measuring fuel economy would be suitable for a preconditioning driving cycle in place of one LA-4. The main concern with using the HFET was the possibility that the purge characteristics of the evaporative emission control system would allow for purging during preconditioning and not during the exhaust emission cycle which is essentially the same as an LA-4. If this were to occur then sufficient canister capacity would enable a vehicle to pass the evaporative emissions test, and the exhaust test would be easier to pass due to the fact that hydrocarbons from the canister would not be purging into the engine.

The results of the analysis indicate that this does in actuality occur, and that on the average lower diurnal evaporative emission levels occur following HFET preconditioning for all 5 vehicles. The alternative of using an LA-4 plus one HFET for preconditioning appears to have the same effect on canister purging for one of the test vehicles and thus its use as a preconditioning cycle would probably also result in abnormally low evaporative emission levels. Thus, the use of 2 HFET cycles or one LA-4 plus one HFET does not seem suitable as a replacement for the LA-4 cycle for preconditioning. These cycles could possibly be given further consideration for use in preconditioning if they were followed by a hot soak period followed by an additional LA-4 cycle. This possibility should in the future be given more consideration.

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3. Technical Discussion

Generally, a test procedure attempts to typify or simulate an actual condition. A concerted effort was expended to establish the Urban Dynamometer Driving Schedule (LA-4) as an average driving cycle (4). There was also a similar effort put forth to design the Highway cycle as a typical driving cycle (5). Each cycle is typical of a particular type of driving; the LA-4 is typical of urban driving, and the HFET is typical of rural driving. Of particular interest for either cycle is how the evaporative control system (i.e., canister) is conditioned. This conditioning is accomplished by purging (or loading, possibly) the canister during the prep drive to its normal working capacity. This allows the canister to accomodate the evaporative losses generated by the subsequent diurnal heat-build. If the LA-4 and HFET are to be considered equivalent preconditioning drives then equivalent diurnal losses and exhaust emissions should be exhibited for the two test sequences.

The exhaust emission test used during the Federal Test Procedure simulates a cold and hot start. The cold start test consists of running one LA-4 on the dynamometer. The hot start test consists of the first 505 seconds of the LA-4 cycle and is conducted after the cold start test with a 10 minute soak between tests. Since both the LA-4 and Federal Test Procedure exhaust cycles are basically the same, equal amounts of purging should occur during the preconditioning drive and exhaust test. The HFET on the other hand is an entirely different driving cycle from the exhaust cycle used, with the HFET cycle having a 29 mph higher average speed. It is conceivable that a system could be designed that would purge during the preconditioning drive and not during the exhaust test. This condition should be avoided.

The economic advantage of the HFET being used as a preconditioning driving cycle stems from the fact that the HFET, when conducted, is run after the hot soak and thus adds time to the overall sequence. It also requires the vehicle to be scheduled for dynamometer operation three separate times (preconditioning, exhaust test, and HFET). The HFET is currently an optional test which the manufacturers may choose to have run. It is conceivable that in the future it may be a standard part of the Federal Test Procedure. In either case, it would be cost effective to be able to gather data during the preconditioning drive which must be conducted regardless. This would mean that only 2 dynamometer operations would need to be scheduled (preconditioning and exhaust test). One issue that would still need to be resolved is whether or not the vehicle would need any additional preconditioning prior to the HFET preconditioning drive. The Federal Register (6) currently requires extensive preconditioning prior to the HFET if the vehicle has not been operated within a 24 hour period. If it is determined that this preconditioning is necessary, then the additional time to do this may make the use of the HFET a less cost-effective alternative.

It is reasonable to assume that either of the preconditioning cycles is capable of flushing out the old fuel in the system and also capable of standardizing vehicles which have not been operated within a reasonable length of time. Hot soak tests were not conducted.

The use of two HFET cycles as a preconditioning cycle would only simulate rural driving during preconditioning. The use of an LA-4 cycle to warm up the vehicle followed by an HFET data gathering cycle would have the same economic advantages as two HFET cycles but it would also simulate both urban and rural driving during preconditioning. This alternative combined cycle would, however, be somewhat longer than a single LA-4 cycle or 2 HFET cycles by approximately 10 minutes. This additional time during the preconditioning could allow the canister to abnormally purge.

The Federal exhaust test simulates normal urban driving over a 7.5 mile trip. The amount of purging which takes place during this trip should be roughly the same as the amount of purging during the preconditioning cycle if the preconditioning and exhaust emission cycles are to be considered compatible for use in the same test procedure. If an abnormally large amount of purging is expected to take place during a preconditioning cycle, the vehicle could possibly be soaked for one hour following the HFET to load the canister again and an additional single LA-4 preconditioning drive conducted after the soak. This additional cycle should purge the canister equivalent to the purge expected during the exhaust emission cycle and thus the canister would be properly preconditioned. The use of this additional preconditioning would, however, greatly reduce the cost savings advantage of using the HFET for preconditioning.

3.1 Facilities and Equipment

The LDV Evaporative Enclosure as shown in Figures 3-1 and 3-2 was used for all evaporative emission tests. The SHED is nominally 8 feet high x 10 feet wide x 20 feet long and has a measured volume of 1540 ft^3. Calculation of the enclosure volume with a propane injection and recovery test compared within $\pm$ 2 percent. Propane retention tests of 2 and 4 hours were performed periodically and indicated a leakage rate of less than 0.1 g/hr.

3.1.1 Test Vehicles

Five 1975 MY vehicles were used in this evaluation. The criteria for selecting the vehicles was that they had accumulated 4000 miles and had been in use for over 90 days. Additional criteria were engine fuel tank configuration and exhaust control system. Specifics of each vehicle are shown in Table 3-1.

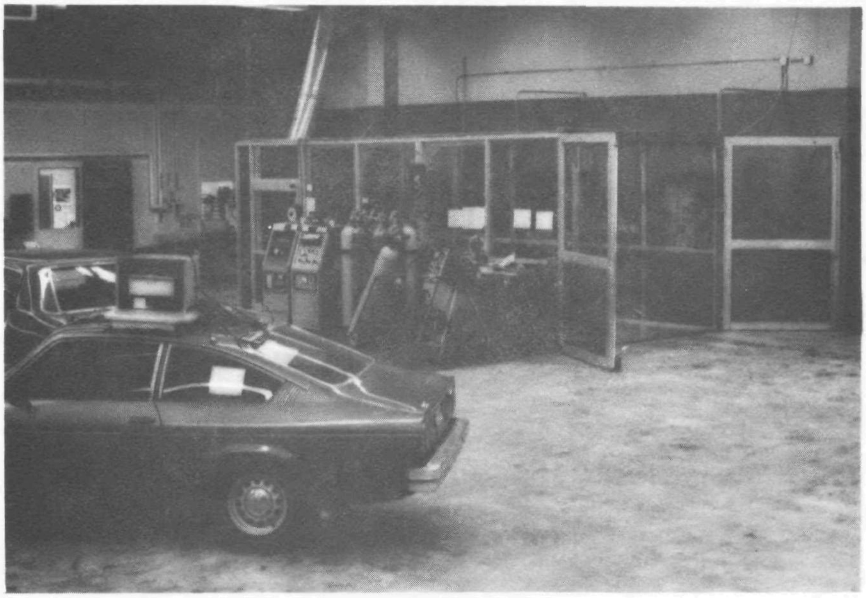


Figure 3-1 Evaporative Enclosure (front view).

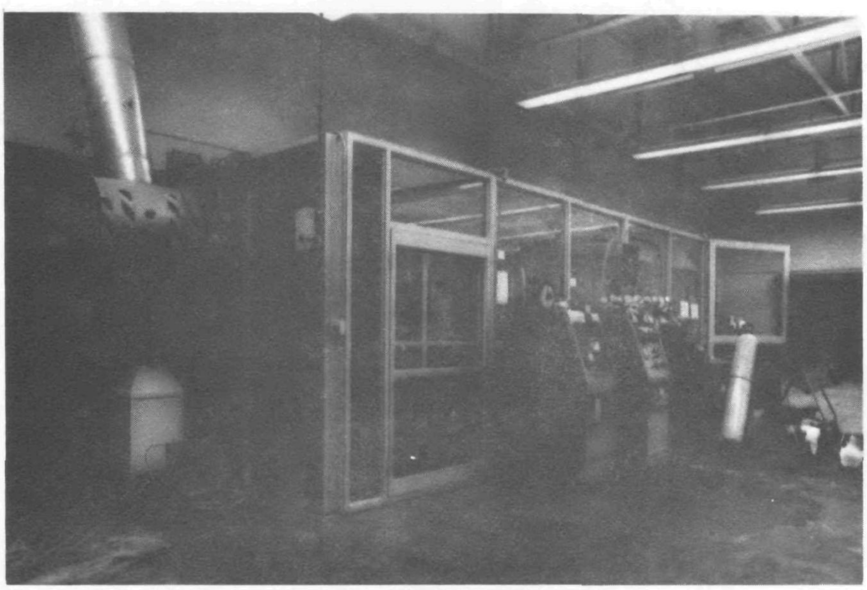


Figure 3-2 Evaporative Enclosure (rear view).

Make	Chevrolet	Chevrolet	Chrysler	AMC	Volkswagen
Model	Vega	Camaro	New Yorker	Matador	Beetle
VIN	IV77B5U113062	IQ87H5N511341	LS23T5C110951	A56167P15041	1352038245
Disp/Cyl Displacement	140-I4	350-V8	440-V8	360-V8	97 - I4
Transmission	4-speed	Automatic	Automatic	Automatic	4 - speed
Air Cond.	no	yes	yes	yes	No
Ign. Timing	10°BTDC	6°BTDC	8°BTDC	5°BTDC	5° ATDC
Idle RPM	700	600	750	700	875
Tires	A78-13	FR-7814	JR78-15	HR78-14	6.00 - 15L
Carb. Model	Holley	Rochester	Carter	Motorcraft	-
Venturis	2	2	4	4	-
Fuel Bowl Size	38.5 cc	72 cc	160 cc		-
Fuel Tank Vol.	16.0 gal	21.0 gal	26.5 gal	24.5 gal	11.0 gal
Inertia Wt.	2750	4000	5000	4500	2250
Dyno H.P.	9.9	12.0	13.4	12.7	8.8
Exhaust Sys.	EGR Catalytic Reactor	EGR Catalytic Reactor	EGR Catalytic Reactor (dual)	EGR-AIR Catalytic Reactor (dual)	EGR Fuel injection
Evap. Sys.	Canister	Canister	Canister	Canister	Canister

Table 3-1 Test Vehicle Descriptions

3.1.2 Test Fuel

Indolene Type HO lead-free test fuel was used throughout the program including vehicle preconditioning.

3.2 Test Procedures

Each of the five (5) vehicles underwent identical test sequences according to the flow diagram shown in figure 3-3. The comparative tests involved changes in the preconditioning drive only. In addition 4 preconditioning drives consisting of one LA-4 followed by one HFET cycle were conducted back to back with a one hour hot soak between each drive to evaluate the effect of the combined cycle. Only the Matador was used for this evaluation and only canister weight data were recorded during this evaluation with the Matador.

3.2.1 Vehicle Preconditioning

All vehicles except the 4 tests run on the Matador using the combined preconditioning cycle underwent a preconditioning drive followed by an 11 to 20 hour soak period at a temperature of 76 to 86°F.

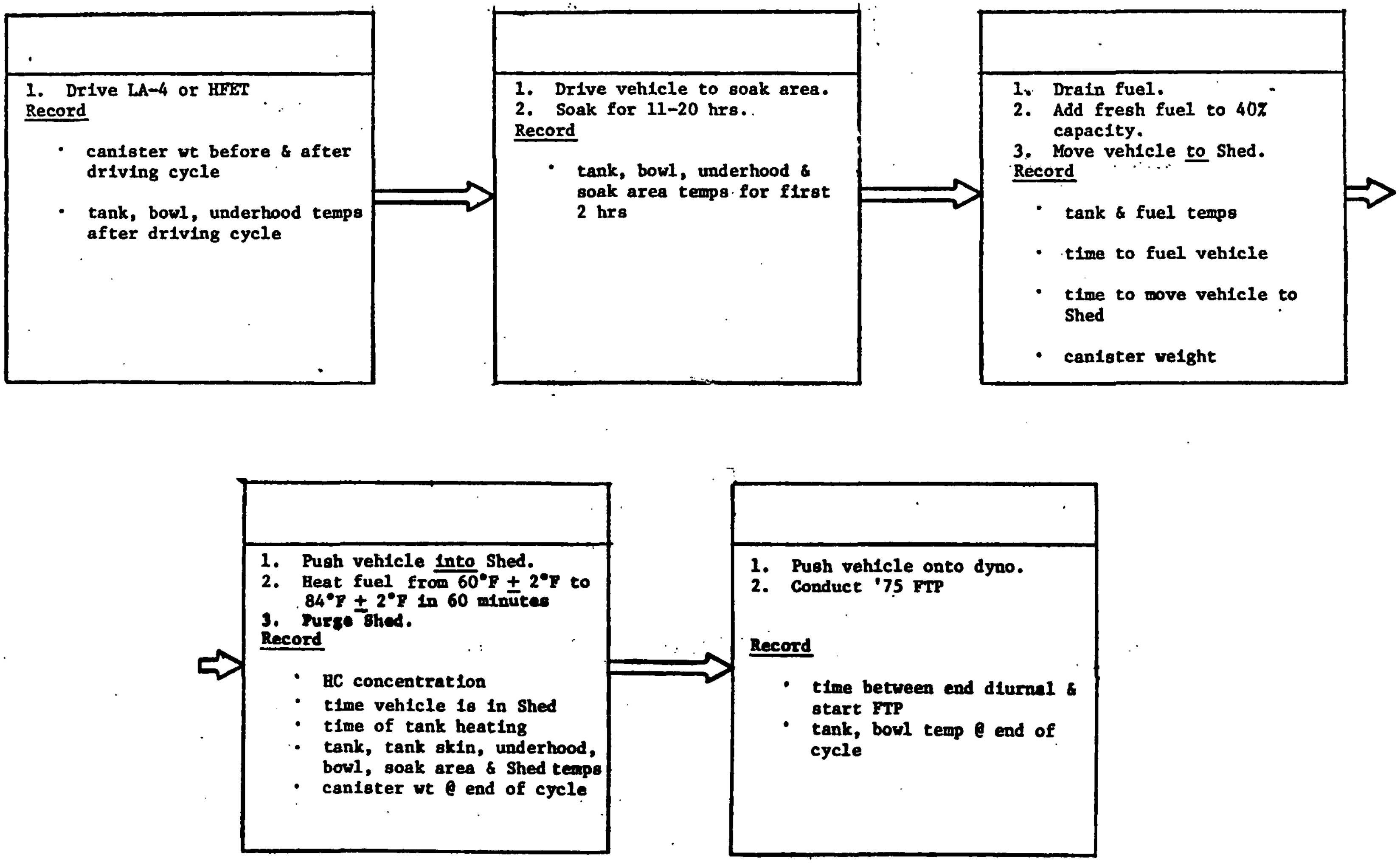


Figure 3-3. Sequence of Events

Since test fuel was being continuously used for the entire procedure, including the prep cycle, the fuel was not drained and replenished prior to the dynamometer prep cycle. Two different preconditioning driving cycles were used.

The first method was the 1975 Federal Procedure (1) without the AMA road route. The second was two Highway Fuel Economy Test (HFET) cycles as described in the Federal Register (6).

Canister weights were measured before and after each preconditioning cycle.

3.2.2 Evaporative Emissions

Evaporative emission measurements were determined using the SHED technique in accordance with the SAE J171a Recommended Practice (7) with the following modifications:

1. Vehicle background emissions were considered negligible based upon a previous study (8), and were therefore not determined. All test vehicles were over three (3) months old and had accumulated 4000 miles.

2. The 60 minute heat-build for the diurnal was held to ± 2 minutes.

3.2.3 Exhaust Emissions

Exhaust emissions were determined using the 1975 Federal Test Procedure. Since it is intended to integrate the evaporative procedure along with the exhaust test, it was decided to use the present (cold-hot) exhaust test procedure driving cycle rather than the cycle proposed in the SAE procedure.

4. Test Results

A total of 58 tests was conducted. Nineteen (19) tests were conducted with an LA-4 prep, thirty-five (35) tests were conducted using 2 HFET prep cycles, and four (4) tests using one LA-4 plus one HFET prep cycles were conducted. For a few tests, only the diurnal data were used due to void CVS tests and in a few other cases only the CVS test data were used due to void diurnal tests. The individual test results for the diurnal heat-build tests and exhaust emission tests are shown in Appendices A-1 and A-2 respectively. In addition to the diurnal test results, Appendix A-1 contains the canister weight data for all tests.

4.1 Evaporative Diurnal Emissions

The individual test results for evaporative emissions are shown in Appendix A-1 and the means of the diurnal losses for each of the vehicles along with a composite mean are shown in the bar graph, Figure 4-1.

The bar graph shows that for the Camaro, Vega and Volkswagen Beetle very little difference in diurnal loss levels was observed between the two prep cycles. However, for the Matador and New Yorker a sizable difference existed, with the test conducted with an HFET prep exhibiting lower diurnal losses. This would indicate that the HFET cycle may condition the canister more than does the LA-4 driving cycle. This would seem logical as the average speed of the HFET is approximately 29 mph higher than the LA-4 and therefore a greater potential for purging the canister exists with the HFET. Whether or not this will have an effect on the amount of purging is dependent on the characteristics of the individual purge systems, however.

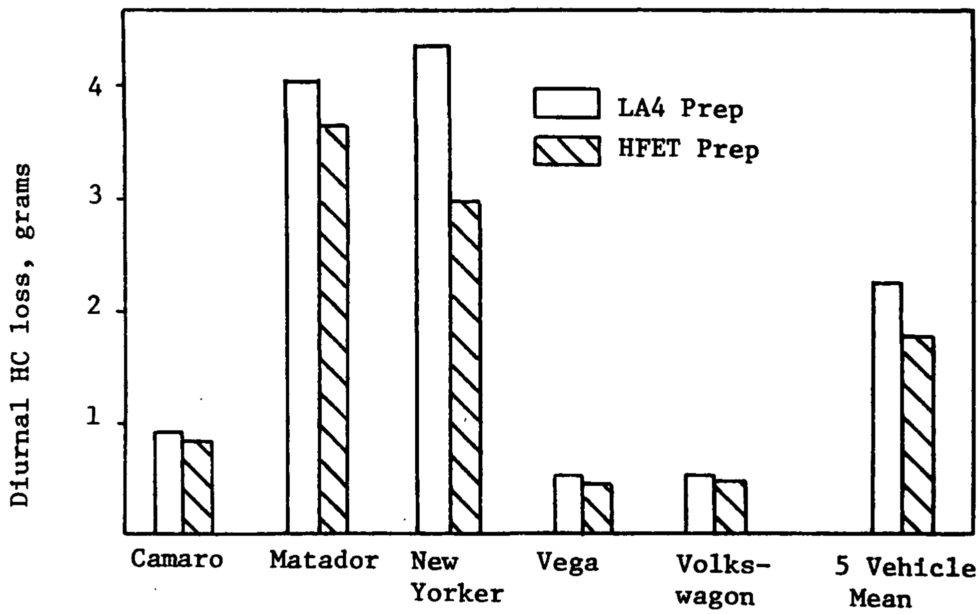


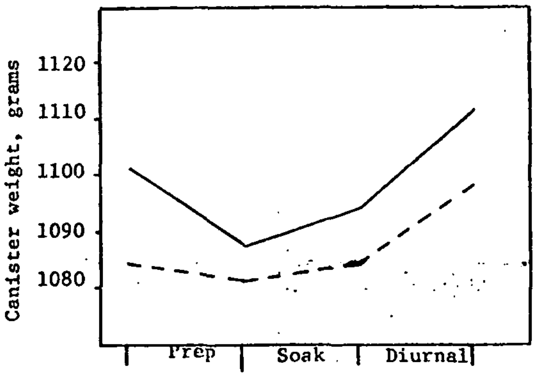
Figure 4-1 Diurnal HC Losses for LA4 and HFET Preps

4.2 Canister Weights

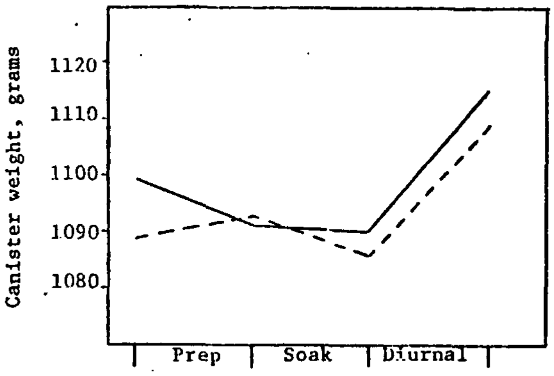
Figure 4-2 shows the mean canister weights for each vehicle and prep cycle through the test sequence. It should be remembered that different control systems and purge systems are represented by the different vehicles. This fact makes it somewhat difficult to evaluate differences between the two prep drives as the different control systems may react differently to either of the prep cycles. Three important facts do, however, emerge from studying these figures. First, the amount of purging appears to depend on the initial level of canister weight. In comparing the Camaro and Vega diagrams it can be seen that for the Camaro the HFET cycle purges the canister more than the LA-4 cycle, but for the Vega just the opposite is true. However, for all vehicles a greater amount of purging takes place when the canister is at an initially higher weight. Secondly, it is apparent that in spite of different amounts of purging some systems are still capable of storing roughly the same amounts of diurnal losses. The Camaro, Vega, and Volkswagen show different trends in the amount of purging for the two prep drives, but the diurnal losses appear very nearly the same. For the Matador and New Yorker, the diurnal loss levels are larger than for the other three vehicles and they both appear to do better with the HFET preconditioning drive. This fact may be due to the particular system designs. These facts indicate that although the two driving cycles are not totally equivalent some vehicle systems will react equivalently to them, whereas other vehicle systems will not with respect to their diurnal losses.

The third important fact that can be drawn from Figure 4-2 is that the Matador purge system reacts differently to the LA-4 and 2 HFET preconditiong cycles. The Matador canister is loaded during the LA-4 driving cycle and is purged during the HFET cycle. The figure shows, however, that the initial weight of the canister is higher on the average at the beginning of the tests conducted using 2 HFET cycles than at the beginning of tests in which one LA-4 preconditioning cycle was used. Closer examination of individual tests indicate that the canister always loads during an LA-4 preconditiong cycle regardless of its initial weight. The amount of purging appears to be more sensitive to the initial weight of the canister during the 2 HFET cycles, however. The greatest amount of purging generally takes place when the initial weight is the highest. Thus, the LA-4 cycle does not appear to be capable of purging the Matador's canister whereas the 2 HFET cycles have the ability to purge the canister and the amount of purging is somewhat dependent on the amount of hydrocarbons already stored in the canister.

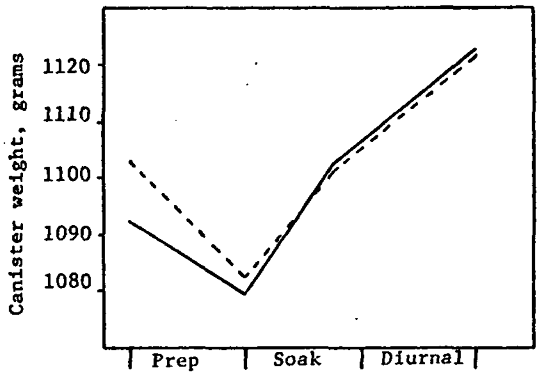
Canister weights during the combined preconditioning driving cycle of one LA-4 cycle plus one HFET cycle are presented in Table 4-1. These data are plotted as changes in canister weight during the preconditioning drive in Figure 4-3 along with the canister weight changes during one LA-4 cycle, two HFET cycles and an AMA drive plus one LA-4 cycle. The AMA + LA-4 preconditioning cycle data were taken from the "In-house Test Program Report No. 1" (2). Only data for the Matador are shown as



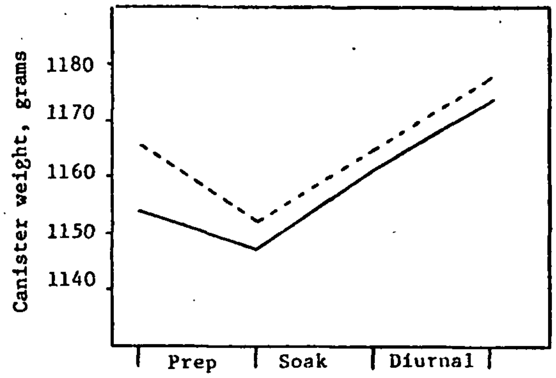
Test Sequence
Figure 4-2a Camaro



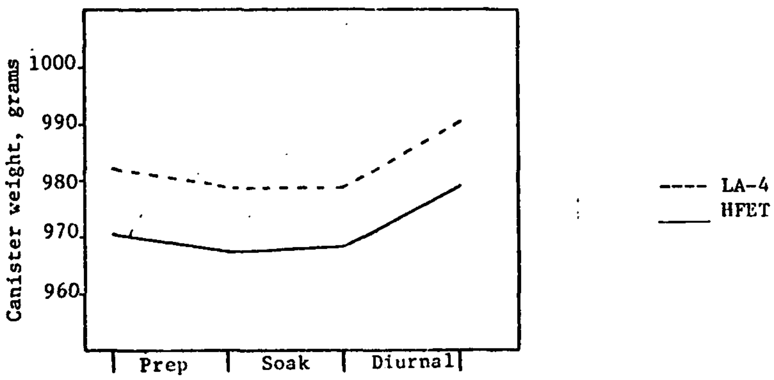
Test Sequence
Figure 4-2b Matador



Test Sequence
Figure 4-2c New Yorker



Test Sequence
Figure 4-2d Vega



Test Sequence
Figure 4-2e Volkswagen

Figure 4-2 Mean Canister Weights During Test Sequence
for LA-4 and HFET Prep Cycles

Test No.	Canister Weights, g		
	Before Prep.	After Prep.	After Hot Soak
1	1114	1113	1123
2	1123	1113	1122
3	1122	1114	1122
4	1122	1114	1120

Table 4-1 Canister Weights for LA-4+HFET Preconditioning Tests on Matador.

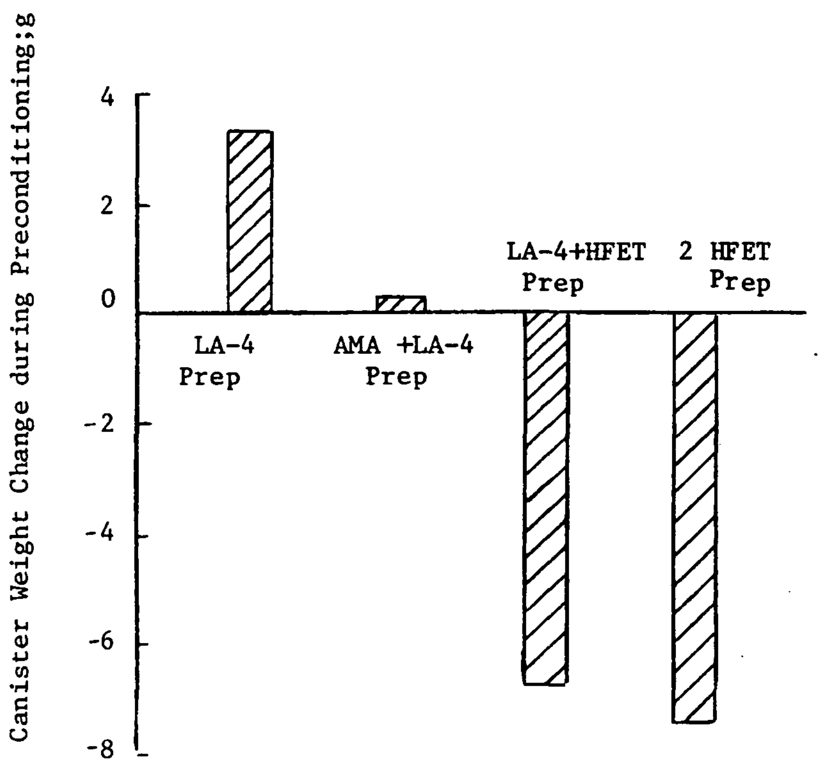


Figure 4-3 Canister Weight changes during Preconditiong Cycles.

the Matador was the only vehicle which had a purge system which reacted differently to different cycles. However, the fact that a system can be designed which reacts as the Matador system does is an important consideration. The figure shows that the Matador system is purged to similar levels for either the LA-4 + HFET or 2 HFET preconditioning drives which implies that only a single HFET is needed to purge the canister. The canister weight data for the AMA + LA-4 prep showed that purging did take place during the AMA road route drive but due to the loading of the canister during the LA-4 cycle which followed, the overall effect on the canister during the preconditioning was a slight increase in canister weight. This fact reemphasizes the fact that the Matador canister cannot purge during an LA-4 cycle.

4.3 Exhaust Emission Results

It is felt that in order to conclude that the two preconditioning driving cycles are equivalent, similar exhaust results should also be exhibited regardless of prep cycle used. It was assumed that if any differences in exhaust emission levels existed they would be most noticeable in Bag 1 of the exhaust test. Therefore, both Bag 1 and composite exhaust results were analyzed. Mean Bag 1 exhaust levels are shown in Figure 4-4 and mean composite exhaust levels are shown in Figure 4-5.

The results from the Bag 1 exhaust analysis shown in Figure 4-4 indicate that, for the Camaro, Vega and Volkswagen, no large differences in exhaust emissions exist. This is also the case for those vehicles for composite exhaust results as indicated by Figure 4-5.

The Matador and New Yorker do show somewhat larger differences for some exhaust components between the two prep cycles. The New Yorker has higher HC and CO emissions for both Bag 1 and composite tests when the HFET is used as a preconditioning drive when compared to emissions levels seen when an LA-4 prep is used. Looking closer at individual data shows that the differences in CO levels are not statistically significant. However, differences in HC levels are statistically significant. A look at the individual test data reveals that HC levels increased with successive tests run with an LA-4 prep and that the HC level measured during the last test was as high as HC levels measured during the HFET preconditioning tests which were run some time later. The differences in exhaust HC and CO levels could have been due to a deterioration with time or other unaccounted for influences. The effect of the different preconditioning drives cannot be discounted as a possible cause, but an adequate explanation of why this should have the effect indicated cannot be found. The HC and CO emissions for Bag 1 and composite samples for the Matador show just the opposite trend with the higher emissions resulting when an LA-4 preconditioning drive is used. This result is strongly influenced by test No. 142 in which high HC and CO emissions occurred. The day after this test was conducted a recall notice was received for the Matador describing the need to have the

Figure 4-4 Bag 1 Exhaust Emission Results

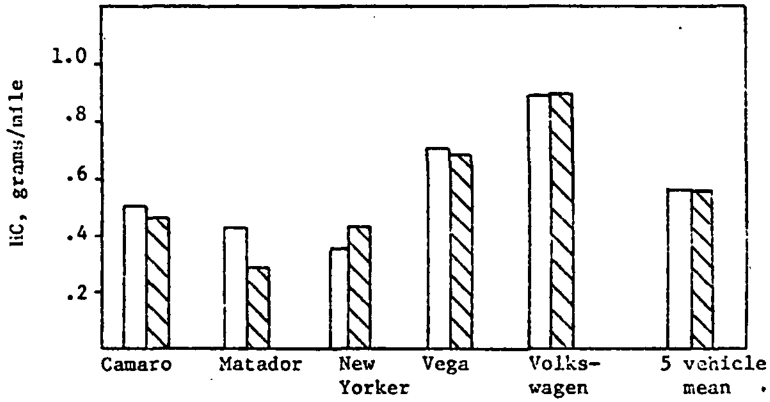


Figure 4-5a HC emissions

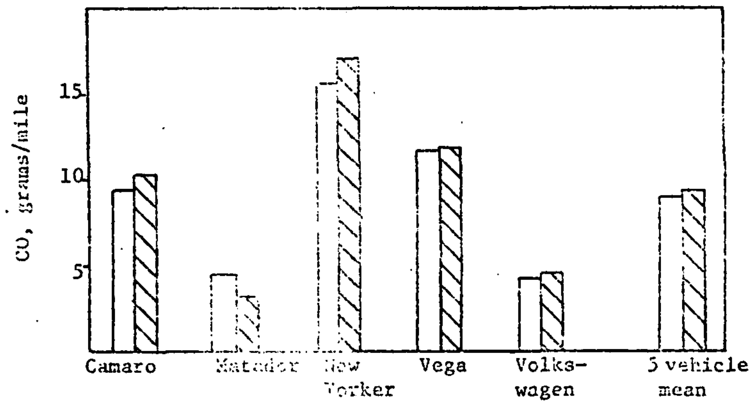


Figure 4-5b CO emissions

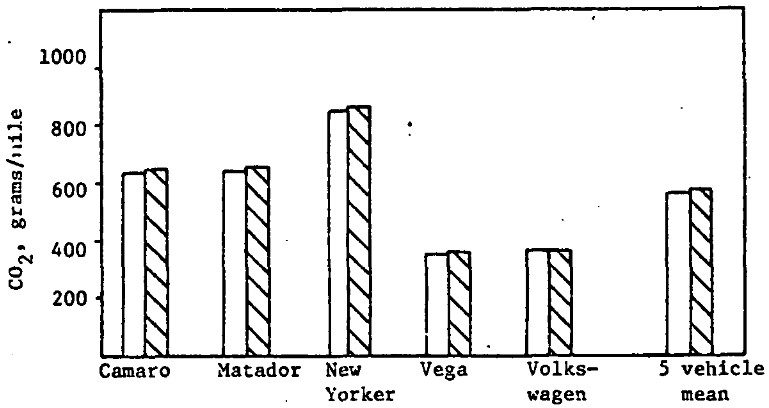


Figure 4-5c CO_2 emissions

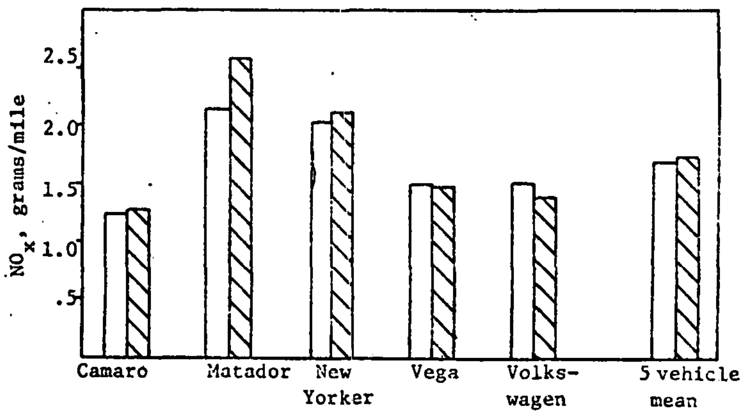


Figure 4-5d NO_x emissions

LA-4 Prep
HFET Prep

Figure 4-5 Composite Exhaust Emission Results

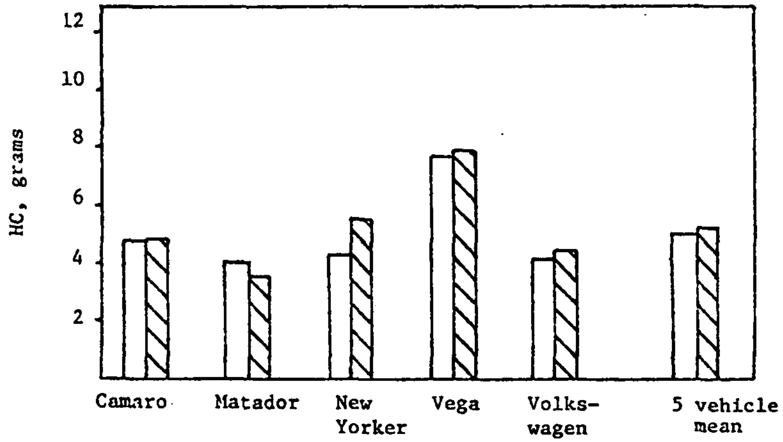


Figure 4-4a HC emissions

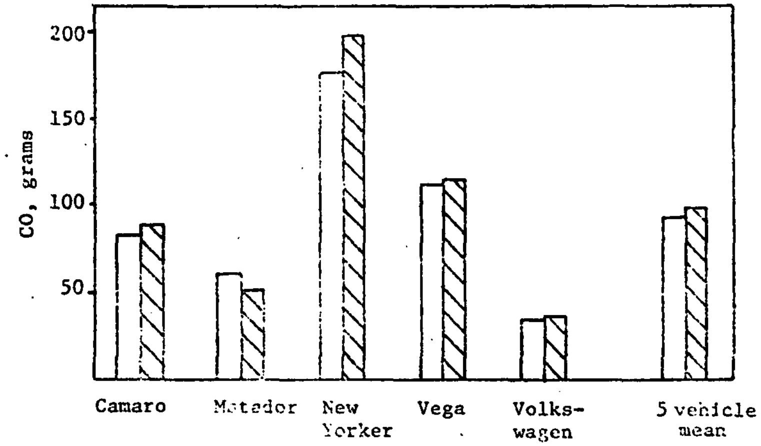


Figure 4-4b CO emissions

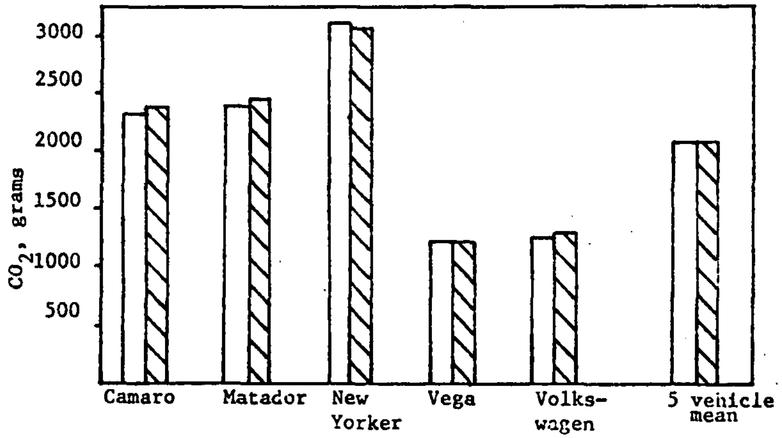


Figure 4-4c CO_2 emissions

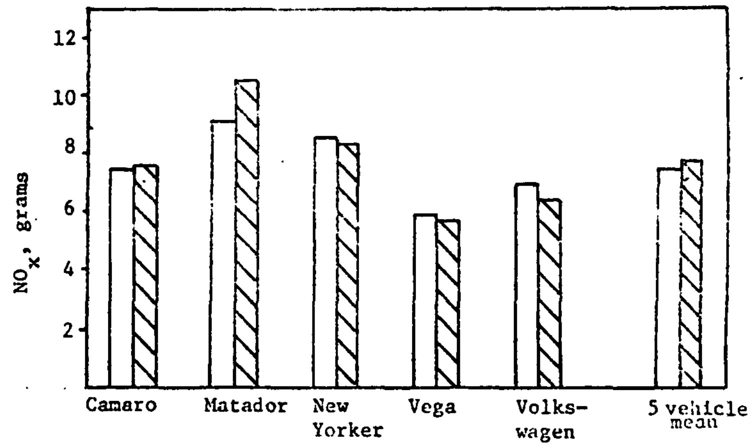


Figure 4-4d NO_x emissions

LA-4 Prep
HFET Prep

carburetor fuel inlet sealing plug and secondary throttle lockout level replaced. One effect of this condition is to cause the throttle plates to stick open if a cold engine is accelerated to an open throttle position during the choking cycle. This particular test was run sometime after the first two tests on the Matador were conducted using an LA-4 prep. For this reason the exhaust emissions results of the Matador tests are somewhat questionable. The only other large difference in exhaust emissions was the difference in NOx levels between the two preps for the Matador. Again, the above mentioned problem could have been responsible for this result.

The figures also show that an average of all 5 vehicles tested shows very little difference for the different preconditioning drives.

5. Data Analysis

In order to determine if a statistically significant difference exists for mean diurnal or exhaust emission levels for tests conducted with either an LA-4 or HFET preconditioning drive, an analysis of variance test was performed. The analyses are shown in Appendix B to this report.

The analyses were based on the following hypotheses:

HOa: There is no statistically significant difference in emission levels between the five vehicles tested.

HOb: There is no statistically significant difference in emission levels between the two test sequences; one with an LA-4 and the other with an HFET preconditioning drive.

HCc: There is no statistically significant difference in emission levels due to the interaction of the test vehicle and the test sequence used.

The analysis of variance test requires that the number of replicate tests be the same for all tests. Three test results were chosen for each vehicle and test sequence. When it was necessary to eliminate test data, the middle values were used because only three tests were available for some of the vehicles. For example, if there were five test results, the high and low values were omitted and the remaining three values used.

The results of the analysis of variance tests are shown in Table 5-1. For both evaporative and exhaust emission tests the levels exhibited by the different vehicles were found to be different. A high level of confidence (90%) can be placed on this conclusion. The type of preconditiong drive used was found to significantly affect the diurnal emission levels only. A high level of confidence (95%) can be placed on the conclusion that the type of preconditioning drive used does have an effect on the diurnal losses encountered.

Test Type		Hypothesis HOa	HOb	HOc
Diurnal		Rejected	Rejected	Accepted
Bag 1	HC	Rejected	Accepted	Accepted
	CO	Rejected	Accepted	Accepted
	CO_2	Rejected	Accepted	Accepted
	NOx	Rejected	Accepted	Rejected
Composite	HC	Rejected	Accepted	Accepted
	CO	Rejected	Accepted	Accepted
	CO_2	Rejected	Accepted	Accepted
	NOx	Rejected	Accepted	Accepted

Table 5-1 Summary of Analysis of Variance Evaluation

6. References

1. Federal Register, Vol. 39, No. 133, Section 85.076-12, July 10, 1974.

2. EPA In-House Test Program Report No. 1 - Vehicle Preconditioning: AMA + LA-4 vs. LA-4, June 1975.

3. Vehicle Preconditioning Study, EPA-MSAPC In-House study conducted by MSAPC Ann Arbor, Michigan.

4. R. E. Kruse and T. A. Huls, "Development of the Federal Urban Driving Schedule." Paper 730553 presented at SAE Automotive Engineering Meeting, Detroit, May 1973.

5. T. C. Austin, K. H. Hellman, and C. Don Paulsell, "Passenger Car Fuel Economy During Non-Urban Driving". Paper 740592 presented at SAE West Coast Meeting, Anaheim, California, August 1974.

6. Federal Register, Volume 39, No. 200, "Voluntary Fuel Economy Labeling," October 15, 1974.

7. "Measurement of Fuel Evaporative Emissions from Gasoline Powered Passenger Cars and Light Trucks Using the Enclosure Technique", SAE Recommended Practice, SAE J171a, 1973 SAE handbook.

8. S. W. Martens and K. W. Thurston, "Measurement of Total Vehicle Emissions". Paper 680125 presented at the SAE Annual Meeting, Detroit, Michigan, January 1968.

Appendix A-1a Evaporative Emission Results and Canister Weights for Tests Conducted with an LA-4 Prep.

Test No.	Vehicle	Diurnal Loss, grams	Canister Weights, grams				
			Initial LA-4	Final LA-4	Initial Diurnal	Final Diurnal	Final Hot Soak
0014	Camaro	0.47	1080	1076	1079	1096	1088
0015	Camaro		1088	1081	1081	1084	1082
0016	Camaro	0.80	1080	1082	1084	1103	1090
0017	Camaro	1.48	1088	1085	1092	1109	
0024	Matador	4.19	1078	1081	1078	1102	1086
0025	Matador	4.37	1086	1088	1078	1103	1089
0026	Matador	5.07	1085	1090	1082	1105	1096
0142	Matador	2.47	1104	1110	1105	1124	
0030	New Yorker	6.49	1090	1075	1094	1116	1106
0032	New Yorker	6.81	1108	1078	1104	1124	1112
0034	New Yorker	3.94	1108	1084	1108	1128	
0036	New Yorker	3.10	1110	1085	1092	1114	1109
0134	New Yorker	1.47	1097	1088	1108	1128	
0102	Vega	.692	1167	1157	1170	1182	1168
0114	Vega	.450	1168	1150	1163	1176	
0117	Vega	.480	1161	1149	1162	1175	
0094	Volkswagen	1.075	985	982	984	996	983
0097	Volkswagen	.931	983	979	979	989	977
0101	Volkswagen	.835	978	974	974	986	974

Appendix A-1b Evaporative Emission Results and Canister Weights for Tests conducted with an HFET Prep.

Test No.	Vehicle	Diurnal Loss, grams	Canister Weights, grams				
			Initial HFET	Final HFET	Initial Diurnal	Final Diurnal	Final FTP
0031	Camaro	1.73	1114	1090	1098	1115	1098
0035	Camaro	1.08	1092	1113	1094		
0044	Camaro	0.54	1099	1088	1092	1110	
0047	Camaro	0.53	1097	1086	1093	1110	1100
0049	Camaro	0.61	1100	1084	1087	1105	
0060	Camaro	1.01			1102	1117	1110
0063	Camaro	0.51	1101	1091	1095	1112	1103
0033	Matador	5.34	1088	1091	1088	1113	1103
0037	Matador	2.91	1091	1090	1085	1110	1104
0046	Matador	4.05	1098	1088	1089	1116	1109
0048	Matador	2.50	1109	1090	1087	1112	1110
0050	Matador	5.30	1110	1089	1094	1119	1112
0061	Matador	3.99	1100	1099	1096	1119	1118
0065	Matador	1.77	1094	1092	1093	1114	1110
0059	New Yorker	2.51	1098	1079	1097	1120	1097
0062	New Yorker	3.68	1099	1081	1102	1124	1096
0067	New Yorker	2.68	1080	1076	1106	1125	1093
0119	Vega	0.52	1165	1152	1167	1179	1154
0120	Vega	0.43	1154	1148	1159	1171	1151
0123	Vega	0.52	1151	1145	1160	1174	1151
0126	Vega	0.45	1148	1142	1158	1171	1149
0112	Volkswagen	1.16	964	961	961	973	963
0113	Volkswagen	0.96	974	969	969	980	970
0115	Volkswagen	0.75	970	966	966	978	968
0116	Volkswagen	0.91	968	964	966	978	968
0118	Volkswagen	0.78	969	967	968	980	970
0121	Volkswagen	0.77	970	968	968	980	971
0122	Volkswagen	0.82	971	969	969	981	971
0127	Volkswagen	0.72	976	971	972	983	973

Appendix A-2a Exhaust Emission Test Results for Tests Conducted with an LA-4 Prep.

Test No.	Vehicle	Bag 1 Exhaust results (grams)				Composite exhaust results (g/mi)			
		HC	CO	CO_2	NOx	HC	CO	CO_2	NOx
0014	Camaro	4.88	84.8	2334	7.27	.528	9.32	647	1.24
0015	Camaro	4.54	72.6	2317	7.71	.459	7.44	643	1.38
0016	Camaro	4.83	93.6	2325	7.22	.524	11.10	645	1.16
0017	Camaro	4.96	84.6	2301	7.89	.507	9.91	637	1.21
0024	Matador	3.35	48.9	2380	9.19	.284	3.06	649	2.27
0026	Matador	3.50	49.0	2331	8.69	.283	3.01	637	1.99
0142	Matador	5.46	82.0	2478	9.29	.703	7.29	671	2.28
0030	New Yorker	4.04	173.3	3083	8.13	.210	10.4	818	1.72
0036	New Yorker	4.06	157.6	3102	9.61	.372	14.5	879	2.46
0134	New Yorker	4.79	203.6	3100	7.63	.462	21.6	858	1.88
0102	Vega	9.27	117	1210	5.61	.765	11.5	358	1.46
0114	Vega	7.27	105	1218	6.10	.675	10.6	353	1.60
0117	Vega	6.64	115	1188	5.89	.679	13.3	348	1.46
0094	Volkswagen	4.61	35.4	1223	8.02	.892	4.27	361	1.79
0097	Volkswagen	3.83	36.1	1299	6.26	.832	4.39	368	1.37
0101	Volkswagen	4.06	34.0	1241	6.71	.941	4.31	358	1.42

Appendix A-2b Exhaust Emission Test Results for Tests Conducted with an HFET Prep.

Test No.	Vehicle	Bag 1 exhaust (grams)				Composite exhaust (grams/mile)			
		HC	CO	CO_2	NOx	HC	CO	CO_2	NOx
0031	Camaro	4.17	76.2	2335	7.84	.370	6.80	649	1.31
0035	Camaro	5.16	86.7	2340	7.22	.514	9.23	640	1.23
0044	Camaro	5.99	115.2	2372	7.89	.568	14.3	640	1.21
0047	Camaro	4.79	91.1	2397	8.15	.524	13.4	657	1.41
0060	Camaro	4.62	91.6	2435	6.96	.431	10.5	674	1.12
0063	Camaro	4.24	73.6	2303	7.46	.374	8.07	637	1.37
0037	Matador	3.61	55.0	2466	9.52	.297	3.57	657	2.44
0045	Matador	3.83	57.0	2520	10.33	.310	3.51	644	2.34
0046	Matador	3.36	55.7	2390	10.90	.302	3.48	651	2.70
0048	Matador	3.66	60.6	2463	11.17	.294	3.55	667	2.77
0050	Matador	3.23	54.0	2548	12.23	.274	3.99	669	2.85
0061	Matador	3.24	40.8	2450	10.01	.268	2.41	661	2.52
0065	Matador	3.59	51.3	2351	10.61	.303	3.07	637	2.60
0066	Matador	3.76	45.0	2404	9.64	.296	2.60	677	2.54
0052	New Yorker	6.60	222	3128	10.07	.525	20.4	882	2.61
0054	New Yorker	5.46	205	3041	8.86	.419	15.8	853	2.37
0059	New Yorker	6.03	232	3092	7.43	.489	20.2	867	1.89
0062	New Yorker	5.29	177	3073	7.53	.388	14.8	868	1.88
0064	New Yorker	4.21	161	3003	7.86	.359	14.3	848	1.89
0119	Vega	6.60	111.9	1208	5.84	.630	11.3	358	1.48
0123	Vega	7.02	116.2	1212	6.19	.606	11.7	362	1.54
0124	Vega	9.01	100.4	1227	5.19	.748	11.9	359	1.47
0126	Vega	9.01	128.2	1173	5.75	.754	12.9	354	1.52
0112	Volkswagen	5.17	36.9	1265	6.20	1.07	4.73	360	1.34
0113	Volkswagen	4.14	35.0	1262	5.95	.891	4.49	365	1.34
0115	Volkswagen	4.44	37.0	1251	6.98	.741	4.50	353	1.51
0116	Volkswagen	4.02	39.2	1254	6.61	.930	5.00	361	1.45
0118	Volkswagen	4.35	39.2	1298	6.28	.860	4.78	369	1.40

Appendix B Analysis of Variance

Analysis of Variance For Diurnal Loss Results

Vehicle / Test	Camaro	Matador	New Yorker	Vega	Volkswagen	T_r
LA-4 Prep	0.47 0.80 1.48	4.19 4.37 5.07	6.49 3.94 3.10	0.69 0.45 0.48	1.08 0.93 0.84	34.38
HFET Prep	0.61 1.01 0.54	2.91 4.05 3.99	2.51 3.68 2.68	0.52 0.52 0.45	0.78 0.82 0.91	25.98
T_c	4.91	24.58	22.40	3.11	5.36	T= 60.36

No. of columns, c = 5
No. of rows, r = 2

No. of replicates, n = 3
Total No. of tests, N = 30

T^2/N = 121.44

Σx^2 = 208.66

ΣTc^2 = 1168.45

ΣTr^2 = 1856.94

ΣTcr^2 = 598.91

$SS_c = \Sigma Tc^2/n \cdot r - T^2/N$ = 73.30

$SS_r = \Sigma Tr^2/n \cdot c - T^2/N$ = 2.35

$SS_{cr} = \Sigma T_{cr}^2/n - T^2/N - SS_c - SS_r$ = 2.54

$SS_t = \Sigma X^2 - T^2/N$ = 87.22

$SS_{res} = SS_t - SS_c - SS_r - SS_{cr}$ = 9.03

Source of Variation	SS	DF	M S, (SS/DF)	MSR, (MS/MS res)	< >	F (α = 0.05)
Vehicles	73.30	5-1 = 4	18.33	40.73	>	2.87
Test Type	2.35	2-1 = 1	2.35	5.22	>	4.35
Vehicle-Test Interaction	2.54	(4) (1) = 4	0.64	1.42	<	2.87
Residual	9.02	29 - 9 = 20	0.45			
Total	87.22	30 - 1 = 29				

Hoa: Rejected α 95% C.L.
Hob: Rejected α 95% C.L.
Hoc: Accepted

Analysis of Variance for Bag 1 HC Results

Vehicle / Test	Camaro	Matador	New Yorker	Vega	Volkswagen	T_r
LA-4 Prep	4.88 4.83 4.96	3.35 3.50 5.46	4.04 4.06 4.79	9.27 7.27 6.64	4.61 3.83 4.06	75.55
HFET Prep	5.16 4.79 4.24	3.61 3.66 3.59	5.46 6.03 5.29	7.02 9.01 9.01	4.14 4.44 4.35	79.80
T_c	28.86	23.17	29.67	48.22	25.43	T= 155.35

No. of columns, c = 5
No. of rows, r = 2

No. of replicates, n = 3
Total No. of tests, N = 30

T^2/N = 804.45

Σx^2 = 884.49

ΣTc^2 = 5221.9

ΣTr^2 = 12076

ΣTcr^2 = 2621.5

$SS_c = \Sigma Tc^2/n \cdot r - T^2/N$ = 65.87

$SS_r = \Sigma Tr^2/n \cdot c - T^2/N$ = 0.62

$SS_{cr} = \Sigma T_{cr}^2/n - T^2/N - SS_c - SS_r$ = 2.89

$SS_t = \Sigma X^2 - T^2/N$ = 80.04

$SS_{res} = SS_t - SS_c - SS_r - SS_{cr}$ = 10.66

Source of Variation	SS	DF	M S, (SS/DF)	MSR, (MS/MS res)	< >	F (α = 0.10)
Vehicles	65.87	5-1 = 4	16.47	30.90	>	2.25
Test Type	0.62	2-1 = 1	0.62	1.17	<	2.97
Vehicle-Test Interaction	2.89	(4) (1) = 4	0.72	1.36	<	2.25
Residual	10.66	29 - 9 = 20	0.53			
Total	80.04	30 - 1 = 29				

Hoa: Rejected a 90% C.L.
Hob: Accepted
Hoc: Accepted

Analysis of Variance for Bag 1 CO Results

Vehicle / Test	Camaro	Matador	New Yorker	Vega	Volkswagen	T_r
LA-4 Prep	84.8 93.6 84.6	48.9 49.0 82.0	173 158 204	117 105 115	35.4 36.1 34.0	1420
HFET Prep	86.7 91.1 91.6	55.0 55.7 54.0	222 205 177	112 116 128	36.9 37.0 39.2	1507
T_c	532	344	1139	693	219	T= 2927

No. of columns, c = 5
No. of rows, r = 2

No. of replicates, n = 3
Total No. of tests, N = 30

T^2/N = 2.8558 x 10^5

Σx^2 = 3.7533 x 10^5

ΣTc^2 = 2.2269 x 10^6

ΣTr^2 = 4.2874 x 10^6

ΣTcr^2 = 1.1163 x 10^6

$SS_c = \Sigma Tc^2/n \cdot r - T^2/N$ = 8.557 x 10^4

$SS_r = \Sigma Tr^2/n \cdot c - T^2/N$ = 2.467 x 10^2

$SS_{cr} = \Sigma T_{cr}^2/n - T^2/N - SS_c - SS_r$ = 7.0330 x 10^2

$SS_t = \Sigma X^2 - T^2/N$ = 8.975 x 10^4

$SS_{res} = SS_t - SS_c - SS_r - SS_{cr}$ = 3.230 x 10^3

Source of Variation	SS	DF	M S, (SS/DF)	MSR, (MS/MS res)	< >	F (α = 0.10)
Vehicles	85570	5-1 = 4	21390	132.4	>	2.25
Test Type	246.7	2-1 = 1	246.7	1.53	<	2.97
Vehicle-Test Interaction	703.3	(4) (1) = 4	175.8	1.09	<	2.25
Residual	3230	29 - 9 = 20	161.5			
Total	89750	30 - 1 = 29				

Hoa: Rejected α 90% C.L.
Hob: Accepted
Hoc: Accepted

Analysis of Variance for Bag 1 CO_2 Results

Test \ Vehicle	Camaro	Matador	New Yorker	Vega	Volkswagen	T_r
LA-4 Prep	2334 2317 2325	2380 2331 2478	3083 3102 3100	1210 1218 1188	1223 1229 1241	30759
HFET Prep	2340 2372 2397	2466 2463 2450	3041 3092 3073	1208 1212 1227	1265 1262 1254	31122
T_c	14085	14568	18491	7263	7474	T= 61881

No. of columns, c = 5
No. of rows, r = 2

No. of replicates, n = 3
Total No. of tests, N = 30

$T^2/N = 1.276 \times 10^8$

$\Sigma x^2 = 1.436 \times 10^8$

$\Sigma Tc^2 = 8.611 \times 10^8$

$\Sigma Tr^2 = 1.915 \times 10^9$

$\Sigma Tcr^2 = 4.306 \times 10^8$

$SS_c = \Sigma Tc^2/n \cdot r - T^2/N = 1.592 \times 10^7$

$SS_r = \Sigma Tr^2/n \cdot c - T^2/N = 4.392 \times 10^3$

$SS_{cr} = \Sigma T_{cr}^2/n - T^2/N - SS_c - SS_r = 8.941 \times 10^3$

$SS_t = \Sigma X^2 - T^2/N = 1.600 \times 10^7$

$SS_{res} = SS_t - SS_c - SS_r - SS_{cr} = 6.667 \times 10^4$

Source of Variation	SS	DF	M S, (SS/DF)	MSR, (MS/MS res)	< >	F (α = 0.10)
Vehicles	1.592×10^7	5-1 = 4	3.980×10^6	1194	>>	2.25
Test Type	4.392×10^3	2-1 = 1	4.392×10^3	1.318	<	2.97
Vehicle-Test Interaction	8.941×10^3	(4) (1) = 4	2.235×10^3	.671	<	2.25
Residual	6.667×10^4	29 - 9 = 20	3.333×10^3			
Total	1.600×10^7	30 - 1 = 29				

Hoa: Rejected α 90% C.L.
Hob: Accepted
Hoc: Accepted

Analysis of Variance for Bag 1 NO_x Results

Vehicle / Test	Camaro	Matador	New Yorker	Vega	Volkswagen	T_r
LA-4 Prep	7.27 7.71 7.89	9.19 8.69 9.29	8.13 9.61 7.63	5.61 6.10 5.89	8.02 6.26 6.71	114.00
HFET Prep	7.84 7.89 7.46	10.3 10.9 10.6	8.86 7.53 7.86	5.84 6.19 5.75	6.20 6.61 6.28	116.11
Tc	46.06	58.97	49.62	35.38	40.08	T= 230.11

No. of columns, c = 5
No. of rows, r = 2

No. of replicates, n = 3
Total No. of tests, N = 30

$T^2/N = 1765.02$

$\Sigma x^2 = 1830.06$

$\Sigma Tc^2 = 10919$

$\Sigma Tr^2 = 26477$

$\Sigma Tcr^2 = 5472.86$

$SS_c = \Sigma Tc^2/n \cdot r - T^2/N = 54.81$

$SS_r = \Sigma Tr^2/n \cdot c - T^2/N = 0.148$

$SS_{cr} = \Sigma T_{cr}^2/n - T^2/N - SS_c - SS_r = 4.309$

$SS_t = \Sigma X^2 - T^2/N = 65.090$

$SS_{res} = SS_t - SS_c - SS_r - SS_{cr} = 5.823$

Source of Variation	SS	DF	M S, (SS/DF)	MSR, (MS/MS res)	< >	F (α = 0.10)
Vehicles	54.81	5-1 = 4	13.70	47.06	>	2.25
Test Type	0.148	2-1 = 1	0.148	0.509	<	2.97
Vehicle-Test Interaction	4.309	(4) (1) = 4	1.077	3.702	>	2.25
Residual	5.823	29 - 9 = 20	0.291			
Total	65.090	30 - 1 = 29				

Hoa: Rejected α 90% C.L.
Hob: Accepted
Hoc: Accepted

Analysis of Variance for Composite HC Results

Vehicle / Test	Camaro	Matador	New Yorker	Vega	Volkswagen	T_r
LA-4 Prep	.528 .524 .507	.284 .283 .703	.210 .372 .462	.765 .675 .679	.892 .832 .941	8.657
HFET Prep	.514 .524 .431	.297 .302 .296	.419 .489 .388	.630 .748 .745	.891 .930 .860	8.464
T_c	3.028	2.165	2.340	4.242	5.346	T=17.121

No. of columns, c = 5
No. of rows, r = 2

No. of replicates, n = 3
Total No. of tests, N = 30

T^2/N = 9.771

Σx^2 = 11.203

ΣTc^2 = 65.906

ΣTr^2 = 146.583

ΣTcr^2 = 33.059

$SS_c = \Sigma Tc^2/n \cdot r - T^2/N$ = 1.213

$SS_r = \Sigma Tr^2/n \cdot c - T^2/N$ = .00124

$SS_{cr} = \Sigma T_{cr}^2/n - T^2/N - SS_c - SS_r$ = .03443

$SS_t = \Sigma X^2 - T^2/N$ = 1.4320

$SS_{res} = SS_t - SS_c - SS_r - SS_{cr}$ = .1833

Source of Variation	SS	DF	M S, (SS/DF)	MSR, (MS/MS res)	< >	F (α = 0.1)
Vehicles	1.213	5-1 = 4	0.303	33.06	>	2.25
Test Type	1.24×10^{-3}	2-1 = 1	1.24×10^{-3}	.135	<	2.97
Vehicle-Test Interaction	3.443×10^{-2}	(4) (1) = 4	8.608×10^{-3}	.939	<	2.25
Residual	.1833	29 - 9 = 20	9.17×10^{-3}			
Total	1.4320	30 - 1 = 29				

Hoa: Rejected α 90% C.L.
Hob: Accepted
Hoc: Accepted

Analysis of Variance for Composite CO Results

Vehicle / Test	Camaro	Matador	New Yorker	Vega	Volkswagen	T_r
LA-4 Prep	9.32 11.1 9.91	3.06 3.01 7.29	10.4 14.5 21.6	11.5 10.6 13.3	4.27 4.39 4.31	138.56
HFET Prep	9.23 13.4 10.5	3.51 3.48 3.55	15.8 20.2 14.8	11.7 11.9 12.9	4.73 4.50 4.78	144.98
T_c	63.46	23.90	97.30	71.90	26.98	T= 283.54

No. of columns, c = 5
No. of rows, r = 2

No. of replicates, n = 3
Total No. of tests, N = 30

T^2/N = 2679.8

Σx^2 = 3441.5

ΣTc^2 = 19963

ΣTr^2 = 40218

ΣTcr^2 = 9999.9

$SS_c = \Sigma Tc^2/n \cdot r - T^2/N$ = 647.4

$SS_r = \Sigma Tr^2/n \cdot c - T^2/N$ = 1.374

$SS_{cr} = \Sigma T_{cr}^2/n - T^2/N - SS_c - SS_r$ = 4.726

$SS_t = \Sigma X^2 - T^2/N$ = 761.8

$SS_{res} = SS_t - SS_c - SS_r - SS_{cr}$ = 108.3

Source of Variation	SS	DF	M S, (SS/DF)	MSR, (MS/MS res)	< >	F (α = 0.1)
Vehicles	647.4	5-1 = 4	161.8	29.9	>	2.25
Test Type	1.374	2-1 = 1	1.374	.254	<	2.97
Vehicle-Test Interaction	4.726	(4) (1) = 4	1.182	.218	<	2.25
Residuel	108.3	29 - 9 = 20	5.415			
Total	761.8	30 - 1 = 29				

Hoa: Rejected α 90% C.L.
Hob: Accepted
Hoc: Accepted

Analysis of Variance for Composite CO_2 Results

Vehicle / Test	Camaro	Matador	New Yorker	Vega	Volkswagen	T_r
LA-4 Prep	647 643 645	649 637 671	818 879 858	358 353 348	361 368 358	8593
HFET Prep	649 640 657	657 667 661	853 867 868	358 362 359	360 365 361	8684
T_c	3881	3942	5143	2138	2173	T=17277

No. of columns, c = 5
No. of rows, r = 2

No. of replicates, n = 3
Total No. of tests, N = 30

$T^2/N = 9.9498 \times 10^6$

$\Sigma x^2 = 1.106 \times 10^7$

$\Sigma Tc^2 = 6.6345 \times 10^7$

$\Sigma Tr^2 = 1.4925 \times 10^8$

$\Sigma Tcr^2 = 3.3174 \times 10^7$

$SS_c = \Sigma Tc^2/n \cdot r - T^2/N = 1.1077 \times 10^6$

$SS_r = \Sigma Tr^2/n \cdot c - T^2/N = 276.03$

$SS_{cr} = \Sigma T_{cr}^2/n - T^2/N - SS_c - SS_r = 90.00$

$SS_t = \Sigma X^2 - T^2/N = 1.1102 \times 10^6$

$SS_{res} = SS_t - SS_c - SS_r - SS_{cr} = 2.1340 \times 10^3$

Source of Variation	SS	DF	M S, (SS/DF)	MSR, (MS/MS res)	< >	F ($\alpha = 0.10$)
Vehicles	1.1077×10^6	5-1 = 4	2.769×10^5	2595	>>	2.25
Test Type	276.03	2-1 = 1	276.03	2.59	<	2.97
Vehicle-Test Interaction	90.00	(4) (1) = 4	22.50	.2 x 109	<	2.25
Residual	2134	29 - 9 = 20	106.7			
Total	1.1102×10^6	30 - 1 = 29				

Hoa: Rejected α 90% C.L.
Hob: Accepted
Hoc: Accepted

Analysis of Variance for Composite NO_x Results

Vehicle / Test	Camaro	Matador	New Yorker	Vega	Volkswagen	T_r
LA-4 Prep	1.24 1.38 1.21	2.27 1.99 2.28	1.72 2.46 1.88	1.46 1.60 1.46	1.79 1.37 1.42	25.53
HFET Prep	1.31 1.23 1.37	2.70 2.60 2.54	2.37 1.89 1.89	1.48 1.54 1.52	1.34 1.45 1.40	26.63
T_c	7.74	14.38	12.21	9.06	8.77	T= 52.16

No. of columns, c = 5
No. of rows, r = 2

No. of replicates, n = 3
Total No. of tests, N = 30

$T^2/N = \underline{90.69}$

$\Sigma x^2 = \underline{96.78}$

$\Sigma Tc^2 = \underline{574.77}$

$\Sigma Tr^2 = \underline{1360.94}$

$\Sigma Tcr^2 = \underline{288.31}$

$SS_c = \Sigma Tc^2/n\cdot r - T^2/N = \underline{5.11}$

$SS_r = \Sigma Tr^2/n\cdot c - T^2/N = \underline{0.0403}$

$SS_{cr} = \Sigma T_{cr}^2/n - T^2/N - SS_c - SS_r = \underline{0.2658}$

$SS_t = \Sigma X^2 - T^2/N = \underline{6.09}$

$SS_{res} = SS_t - SS_c - SS_r - SS_{cr} = \underline{0.6739}$

Source of Variation	SS	DF	M S, (SS/DF)	MSR, (MS/MS res)	< >	F (α = 0.10)
Vehicles	5.11	5-1 = 4	1.28	38.0	>	2.25
Test Type	0.0403	2-1 = 1	0.0403	1.20	<	2.97
Vehicle-Test Interaction	0.2658	(4) (1) = 4	0.0665	1.97	<	2.25
Residual	0.6739	29 - 9 = 20	0.0337			
Total	6.09	30 - 1 = 29				

Hoa: Rejected α 90% C.L.
Hob: Accepted
Hoc: Accepted