Technical Report

Evaluation of Restorative Maintenance Retesting of Passenger Cars in Detroit

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by

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ABSTRACT

This report describes the results of an exhaust emission testing program in which twenty-seven vehicles received prescribed sequences of testing, corrective maintenance, and retesting at different time intervals. The purpose of this program was to study the effects of age and mileage on emission levels, control system durability and ultimate restorability. The vehicles involved were twenty-one 1976 and six 1977 model year vehicles manufactured by Chrysler, Ford and General Motors. Fourteen vehicles received one retesting sequence approximately one year after the original test sequence. Thirteen vehicles received two retesting sequences at time intervals of approximately twelve months and eighteen months after the original tests. Each test point in the sequences consisted of a 1975 FTP, Highway Fuel Economy Test and three short cycle tests (Federal Three-Mode, Two-Speed Idle and Federal Short Cycle). Representatives of the three automobile manufacturers assisted in the inspection and maintenance activities.

The results show a deterioration in the average emission levels of the retested vehicles in their "as-received" condition. These levels were reduced to close to the original lowest levels achieved through restorative maintenance. As the mileage increased on these vehicles, the average emission levels of the "tuned-up" vehicles was slightly greater for HC and CO, and slightly lower for NOx.

Background

During the period of September 1976 to August 1977, a prescribed sequence of emission and fuel economy tests and corrective maintenance were performed on one-hundred 1975 and 1976 and thirty 1977 model year passenger cars in Detroit (Reference 1). The purpose of these two programs was to investigate the effects of various types of emission control malperformance on exhaust emissions and fuel economy. This type of effort is known as "Restorative Maintenance Evaluation". Twenty-one of the 1976 model year vehicles were procured and retested after approximately one year of in-use service. The testing sequence used in the original program was again employed. This retesting allowed the collection of data on vehicles with thorough inspection histories. After approximately six more months of in-use service, thirteen of these twenty-one 1976 model year vehicles again underwent retesting using the testing sequence from the original program. During this same period, six 1977 model year vehicles were retested for the first time after approximately one year of in-use service. There were three basic purposes behind these retesting efforts:

1. To determine the extent and nature of modifications which occurred to the vehicles since they were inspected and tested in the previous program(s).

2. To examine the effects of vehicle deterioration on exhaust emissions and fuel economy.

3. To evaluate vehicle restorability in terms of the baseline emission data established in the previous testing.

Vehicle Acquisition

Of the one hundred 1975 and 1976 model year vehicles tested in the original program, 73 were available for testing. The remainder were lost due to the following reasons:

1. Owner could not be found (3 vehicles)
2. Car sold, wrecked or repossessed (14 vehicles)
3. Owner declined to participate (6 vehicles)
4. Owner was not sure at the time (4 vehicles)

Of the 73 willing owners, six Chryslers were disqualified because they had undergone major powertrain work or had received extensive damage. From the remaining 67, seven cars of each manufacturer were selected and tested. These vehicles averaged 28,600 miles, an average of 18,000 miles greater than when they were tested originally. More procurement problems were encountered in obtaining 15 of these 21 1976 vehicles for the second retest approximately 6 months later. Although 5 Fords and 5 Chryslers were obtained, only 3 1976 GM cars could be reprocured. Of the previous seven, two were disqualified for mechanical reasons. One

of the owners could not be contacted and another did not wish to have his car tested. Thus, a total of only 13 1976 vehicles underwent the second retest.

Of the 30 1977 model year vehicles originally tested, 9 were rejected as candidates for retesting for the following reasons:

1. Vehicle had undergone major mechanical work which could possibly affect emissions (6 vehicles)

2. Vehicle was sold (2 vehicles)

3. Owner was not sure at the time (1 vehicle)

From the remaining 21 vehicles, 6 were selected to undergo retests. This total was comprised of 2 vehicles from each of the three manufacturers. Although those with the highest mileage were favored, the subsample was generally chosen to represent the original fleet in terms of average emission levels, make, model, engine size and state of tune.

Testing Procedures

All vehicles involved in the retesting underwent the first test sequence in their "as-received" condition. The test sequence consisted of a 1975 FTP, a Highway Fuel Economy Test and three short cycles (Federal Three-Mode, Federal Short Cycle, and Two-Speed idle). The vehicles were then examined for any maladjustments, disablements, or emission component failures. The criteria for those determinations were the same as those used in the original program. If a vehicle passed the Federal Standards in its "as-received" condition and no maladjustments or disablements were found, it was returned to the owner. If any maladjustments or disablements were found, they were corrected and the vehicle received a second test. For 1977 model year vehicles, all maladjustments, including idle parameter adjustments were corrected in preparation for the second test. The 1976 model year vehicles received correction of all maladjustments except idle parameter adjustments which were not corrected until before the third test. If a 1977 model year vehicle failed the second test, it received a major tune-up plus the replacement of any defective emission components and was then tested a third and final time. If a 1976 model year vehicle failed the second test and had idle parameter maladjustments, it received correction of these and was then tested a third time. If it failed the second test and had no idle maladjustments, or failed the third test, it received a major tune-up plus the replacement of any defective emission components before undergoing the fourth and final test. A flow chart which graphically demonstrates this procedure is attached as Figure 1.

Inspection Results

Three of the twenty-one 1976 model year vehicles involved in the first retest were not able to pass Federal standards as a result of all mainte-

nance steps of the original test sequence. Each of these again failed when returned for the second retest. Of the remaining eighteen vehicles, half failed their "as received" test in the first retest. Of these nine vehicles, eight had received emission-related maintenance, primarily performed by the vehicle owner, and all eight exhibited some form of maladjustment or disablement action. Of the nine vehicles which passed the initial retest, only two were found with maladjustments or disablements. In both cases, the ignition timing had been retarded beyond our 2 degree tolerance. Although six of the vehicles which passed had received emission-related maintenance, only one had maintenance performed by the owner. The inspections performed at the first retest revealed a high level of defective parts. The temperature sensor for the heated air inlet door on four Chrysler vehicles was the most prevalent defect although two choke timer switches were also replaced. The choke pull-off was inoperative on two Fords and a Pontiac vehicle was found to have a broken EGR exhaust gas backpressure transducer.

Of the thirteen 1976 model year vehicles which were retested a second time, four had received maladjustments since the first retest. Of these four vehicles, two had only timing maladjusted, one had timing and idle mixture maladjustments, and one had a choke maladjustment. According to the owner questionnaire of these four vehicles, two claimed no maintenance was performed since the first test and two had "tune-ups", one performed by the owner and one performed by an independent garage. Two of these four vehicles had received maladjustments between the original test and the first retest. The emission component inspection revealed one Ford vehicle with a defective choke pull-off which had been replaced in the first retest, one defective choke timer on a Chrysler vehicle which was operating properly in the first retest, one inoperative backpressure transducer on a Ford, and one GM vehicle with a leaky vacuum break diaphragm.

Only two of the six 1977 model year vehicles exhibited maladjustments; one idle mixture maladjustment and one choke maladjustment. According to the owners questionnaire, neither vehicle had received maintenance since the original testing. Two of the vehicles had defective heated air door sensors and one had a leaky EGR valve diaphragm.

Test Results

Table 1 displays the average emission results of the entire one hundred 1975/1976 model year fleet and the thirty 1977 model year fleet in the original test. Attached as Figure 2 are the average emission levels of the twenty-one retested vehicles for both the original test and the retest. Although most of these vehicles had passed the halfway point in their "useful life", these results indicate that original ultimate emission levels were approached by only a correction of maladjustments and disablements. When comparing the retest results with those of the original test, there has clearly been a great deal of degradation, even to the point of being worse than when first tested. Moreover, one of

the vehicles had such high HC values before tuneup that the results without this vehicle have been indicated in the HC bar charts. The unusually high results presented in the CO charts are due to a vehicle that was included in the sample because of its high mileage since the original test. It is not truly representative of that manufacturer's portion of the fleet since it was his only vehicle at the Detroit site in the original testing that was ultimately unable to pass. Although this vehicle never met its CO standard, the CO emissions were reduced from 47 gm/mile to 27 gm/mile when a special test was conducted with a new carburetor. The bar charts graphically demonstrate the improvement in the average emission levels of these twenty-one vehicles following corrective actions and a major tune-up. The average HC of all twenty-one vehicles increased 272% between the original test and the retest. The average CO increased 166% and the average NOx increased 17%. Approximately six months after these vehicles were retested, thirteen of the twenty-one were procured to undergo a second retest. Their emission history from the original test through the second retest is shown in Figure 3. Again, the unusual results in the HC chart are due to the same vehicle which was retested earlier and cleaned up dramatically with a tuneup. There seems to be a sparkplug fouling problem with this vehicle. A possible cause may be a bent distributor shaft as suggested by variance which was found in the air gap between the armature and the magnetic pickup in the distributor. Unfortunately, the owner wanted his car back before it could be examined further. Another problem was found with a vehicle which never met NOx standards even though it has been in three Restorative Maintenance programs. In an attempt to determine the cause of this problem, the EGR valve was removed and released to the manufacturer who performed flow checks on it. These tests showed that its flow characteristics were within specifications. The timing advance mechanisms were also within specifications. The NOx emission level was never reduced enough to meet standards which made this the only 1976 model Ford vehicle to ultimately fail its Standards. The bar charts in Figure 3 demonstrate the "sawtooth effect" of the average emissions of the thirteen vehicles which have now been in three Restorative Maintenance programs. Between the first and second retest, the average HC and CO emissions increased 285% and 121%, respectively. The NOx emissions showed a decrease of 10%.

Figure 4 shows the average emission levels of each pollutant in the original and the retest sequences for the retested 1977 model year vehicles. These vehicles fared slightly better than the 1976 models with increases of 113% and 151% for HC and CO respectively. The NOx emission showed a decrease of 13%. Although average HC and CO both increased, only CO was above Federal Standards when the vehicles were tested in "as-received" condition. Only two of the 1977 model year vehicles exhibited maladjustments or disablements and this could account for the difference in comparison with the 1976 model year vehicles.

Attached as Figure 5 are charts showing the percentage of each fleet that met Federal Standards after each test sequence in both the original test and the retests. The "sawtooth" effect is again evident in these charts. Of special consideration are the low percentages of passing vehicles in the "as received" condition in the retests since these low percentages are from groups of vehicles which were showing much higher passing percentages approximately 6-12 months prior to retesting. Average emissions of vehicles from both model years were reduced with correction of maladjustments, disablements, and a major tune-up. As a general observation, there was little, if any, change in average fuel economy on the vehicles in the "final test" condition. Test results on individual vehicles are attached as an appendix.

Conclusions

Relative to the useful life of a vehicle and the time between scheduled maintenance actions, these vehicles show a relatively rapid deterioration in exhaust emission levels. Most of this deterioration seems to be caused by the following reasons, ranked in order of descending significance:

1. Maladjustments and/or disablements which have occurred to the subject vehicles in relatively short time intervals. The maladjustment having the most impact is overly rich idle mixture. Timing and choke maladjustments can also produce significant increases in emissions. The most common disablement which has been found to cause the greatest increase in emission levels is plugged or rerouted vacuum lines, particularly those in the EGR or air injection systems.

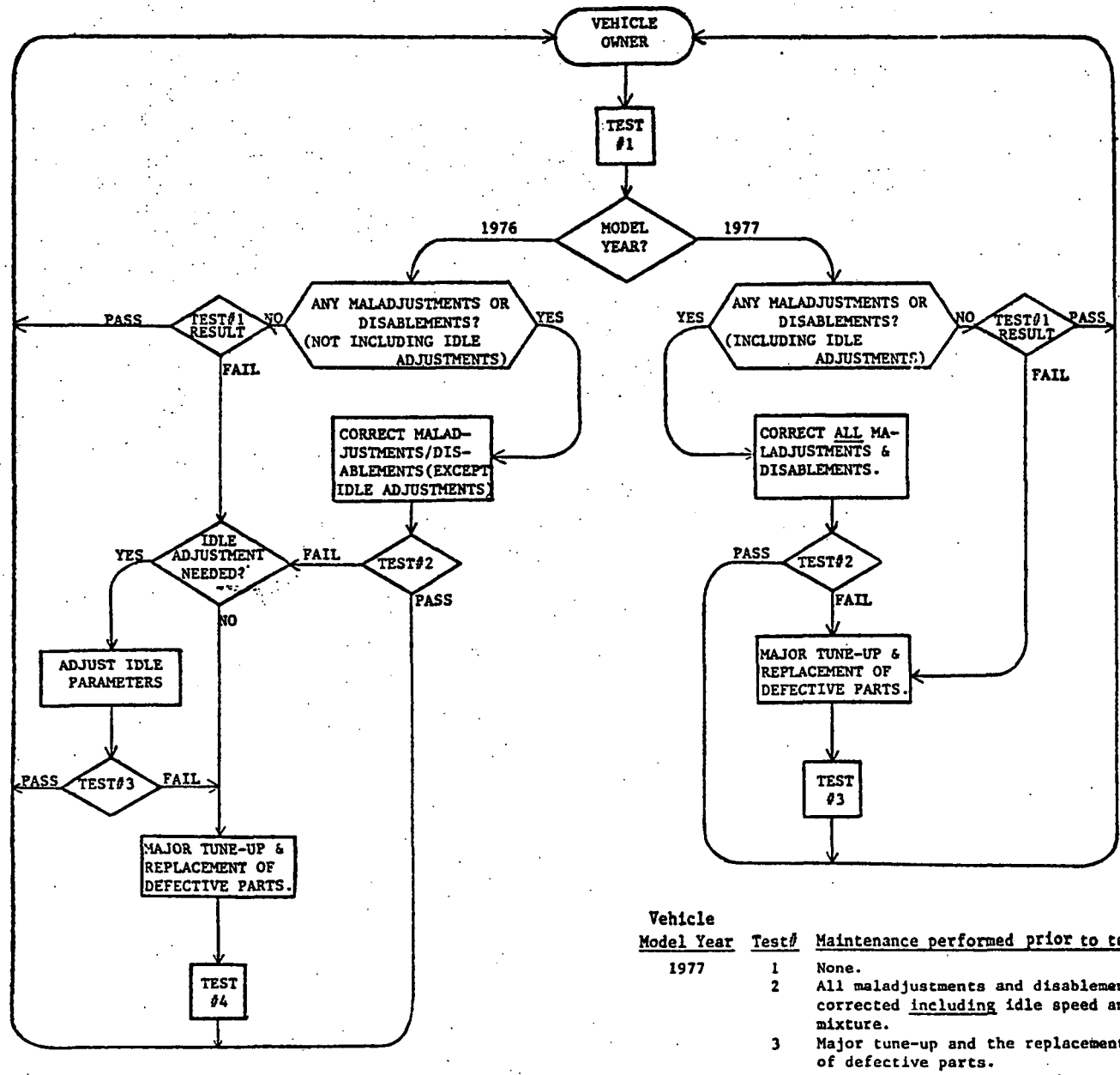
2. Inadequate or improper maintenance. This area gains importance as the mileage of the vehicle increases. Many of the defective parts found were neither expensive nor difficult to replace, yet the defective items remained within the emission control systems of the vehicle. This is probably because neither driveability nor performance were noticeably affected.

3. Actual general deterioration of the engine and the emission control systems through accumulated mileage and time. This is shown by the ultimate HC and CO levels in each of the test series. Although the average values were brought down to acceptable levels, they were never reduced to the final test averages of the preceding test program(s).

References

1. J.T. White, "An Evaluation of Restorative Maintenance on Exhaust Emissions from In-Use Automobiles", SAE Paper 780082, March, 1978.

Restorative Maintenance Retesting
Figure 1
Flow Diagram



Vehicle Model Year	Test#	Maintenance performed prior to test
1976	1	None.
	2	Maladjustments and disablements corrected except for idle speed and idle mixture.
	3	Idle speed and mixture adjusted to manufacturer's specifications.
	4	Major tune-up and the replacement of defective parts.

Vehicle Model Year	Test#	Maintenance performed prior to test
1977	1	None.
	2	All maladjustments and disablements corrected including idle speed and mixture.
	3	Major tune-up and the replacement of defective parts.

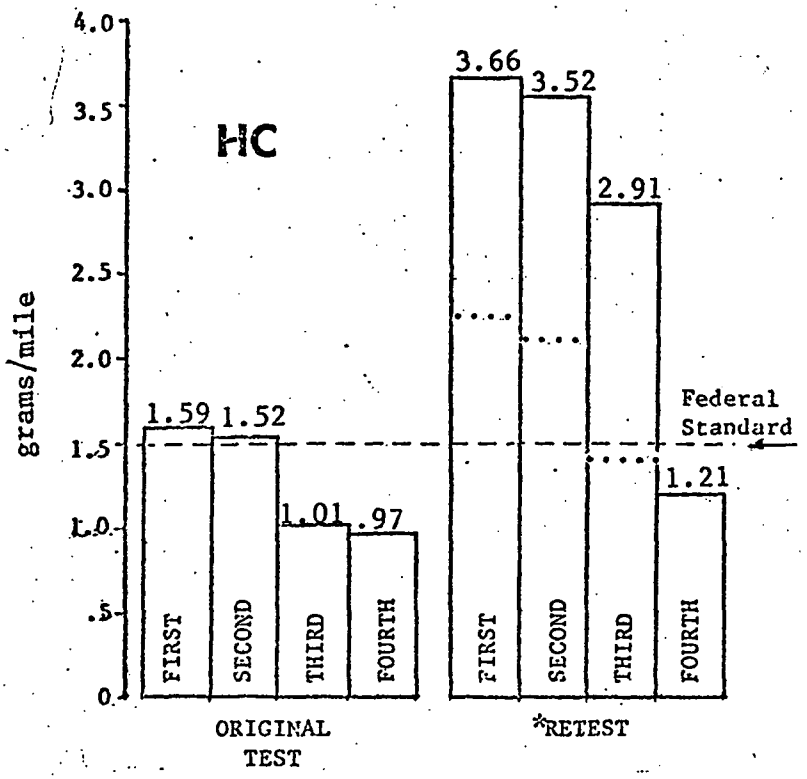
Restorative Maintenance Retesting
Table 1
Fleet Average Emissions of the
Entire Original Test Fleets

	100 1975 & 1976 Model Year Vehicles Tested in Detroit From Sept. 1976 to May 1977		30 1977 Model Year Vehicles Tested in Detroit From May 1977 to Aug. 1977	
Average Odometer	8,676 miles		2,400 miles	
	Initial	Final	Initial	Final
Average HC (gm/mi)	1.32	.85	1.29	.71
Average CO (gm/mi)	19.14	6.62	20.30	9.90
Average NO_x (gm/mi)	2.54	2.36	1.59	1.56
Average MPG on FTP	14.0	14.4	13.5	13.7
Average MPG on HFET	20.1	20.2	18.9	19.0
Percent Meeting Standards	50%	87%	44%	80%

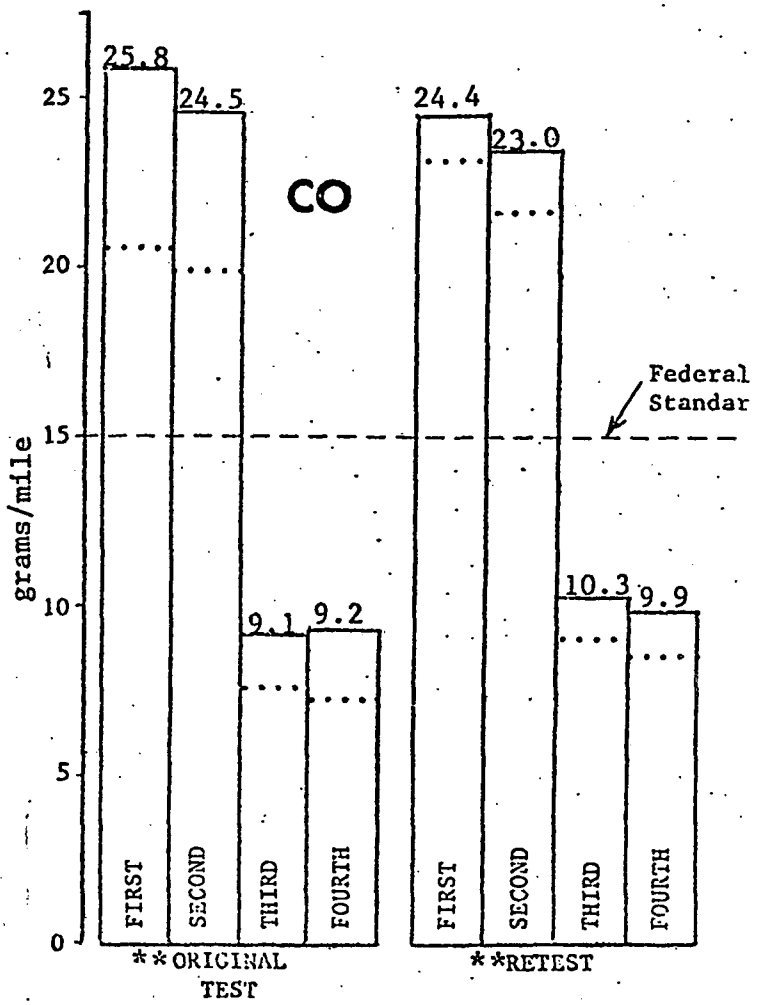
Federal Standards:		HC	CO	NO_x	
	1975/76	1.5	15	3.1	all values are in grams/mile
	1977	1.5	15	2.0	

NOTE: These averages are from the entire original test fleets. It is from these fleets that the subject vehicles were chosen for retesting.

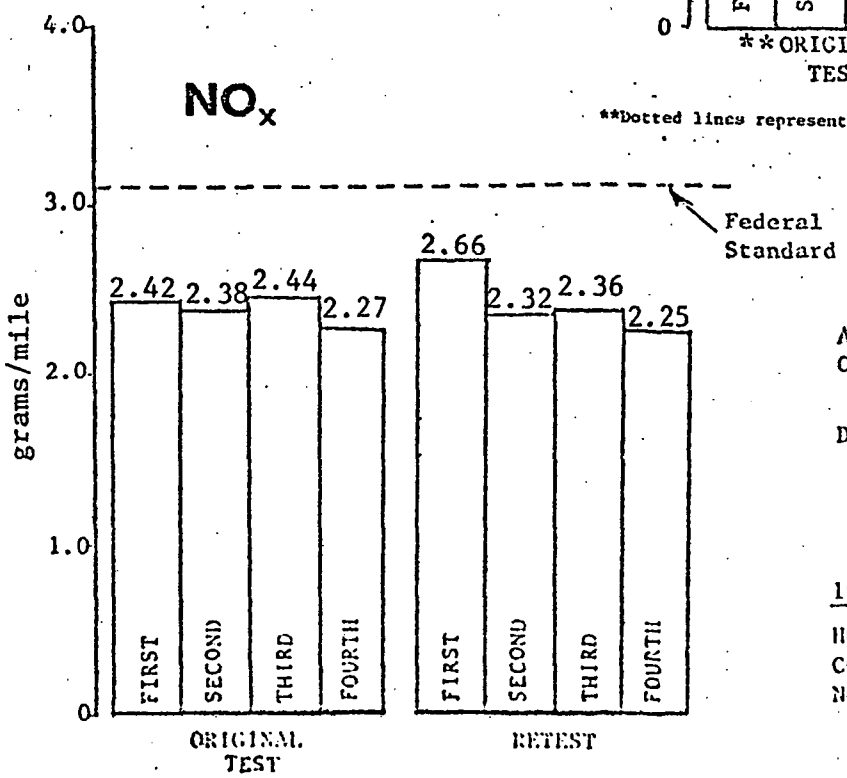
Restorative Maintenance Retesting
Figure 2
Fleet Average Emission Levels of
21 1976 Model Year Vehicles in Detroit



*Dotted lines represent average emission levels without Vehicle #5325



**Dotted lines represent average CO emission levels without Vehicle #6284

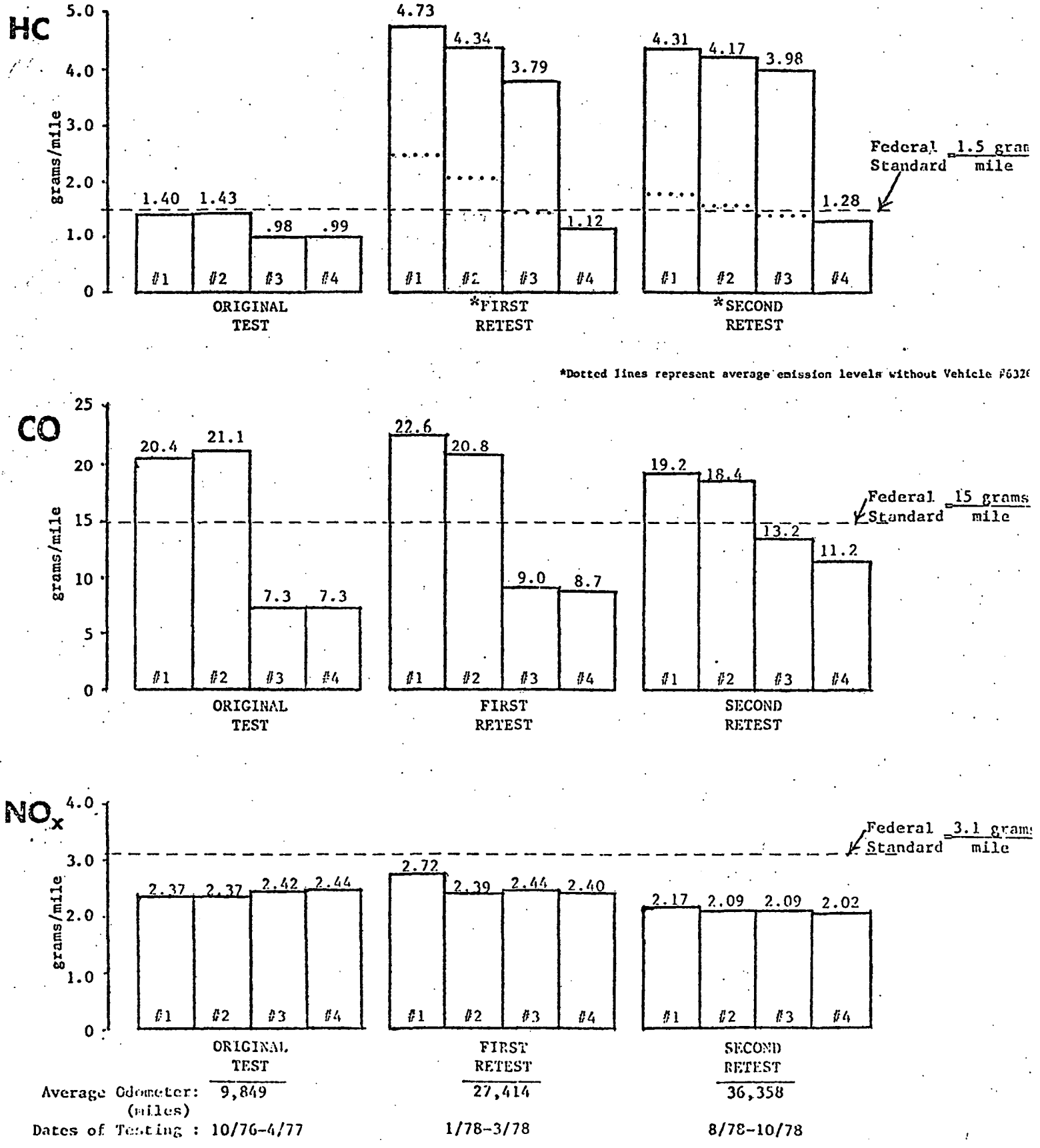


	ORIGINAL TEST	RETEST
Average Odometer: (miles)	10,537	28,644
Dates of Testing:	9/76-5/77	1/78-3/78

1976 Federal Standards

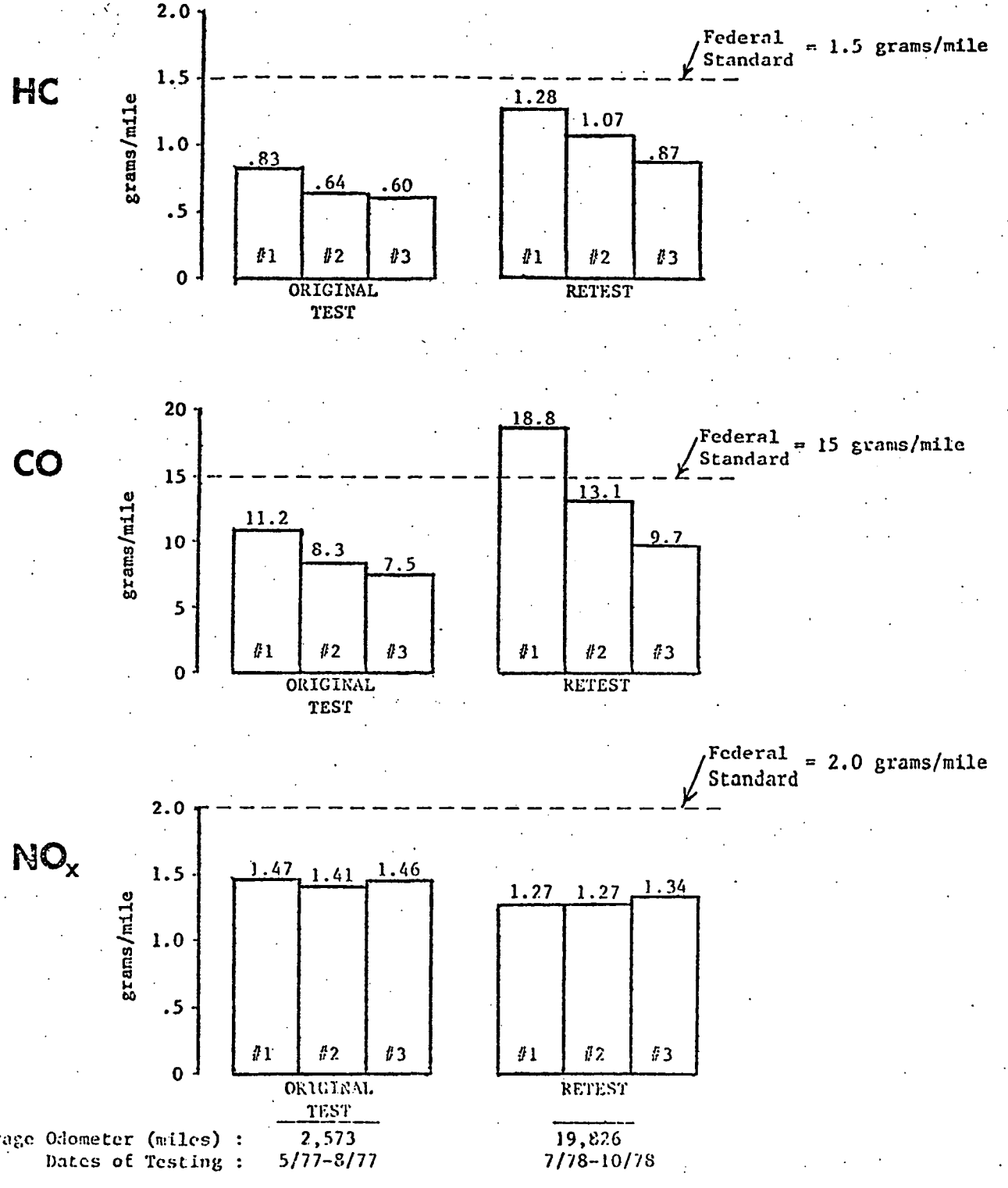
HC = 1.5 grams/mile
CO = 15 grams/mile
NO_x = 3.1 grams/mile

Restorative Maintenance Retesting
Figure 3
Fleet Average Emission Levels of
13 1976 Model Year Vehicles in Detroit



	ORIGINAL TEST	FIRST RETEST	SECOND RETEST
Average Odometer: (miles)	9,849	27,414	36,358
Dates of Testing :	10/76-4/77	1/78-3/78	8/78-10/78

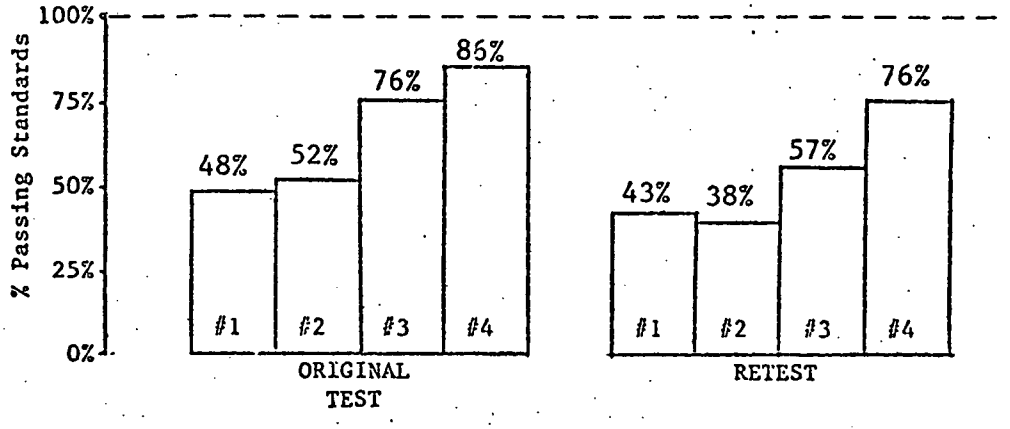
Restorative Maintenance Retesting
Figure 4
Fleet Average Emission Levels of
6 1977 Model Year Vehicles in Detroit



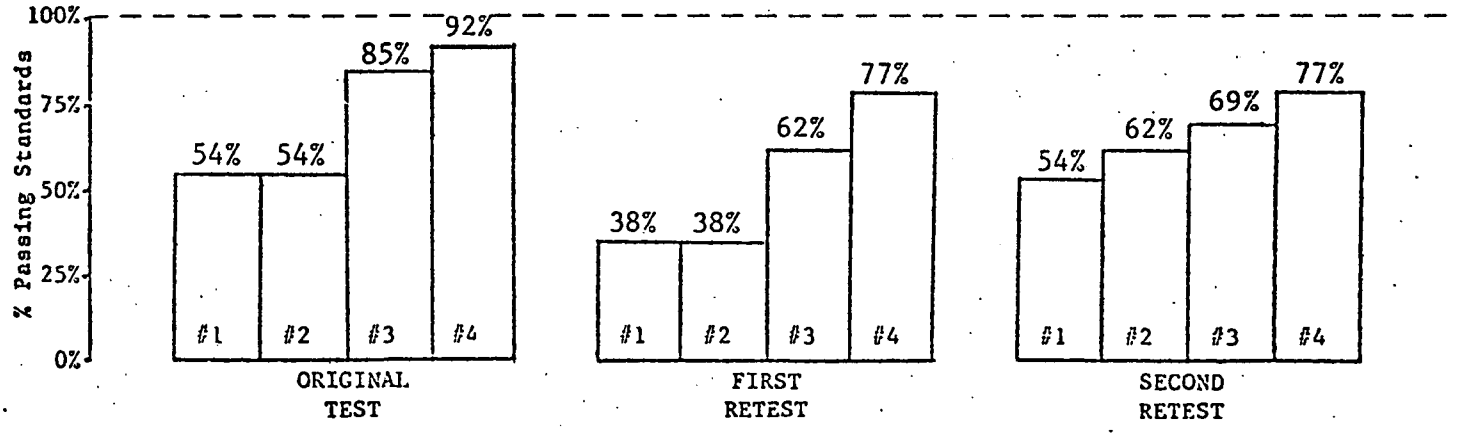
	ORIGINAL TEST	RETEST
Average Odometer (miles) :	2,573	19,826
Dates of Testing :	5/77-8/77	7/78-10/78

Restorative Maintenance Retesting
Figure 5
Percentage of Vehicles
Passing Federal Standards

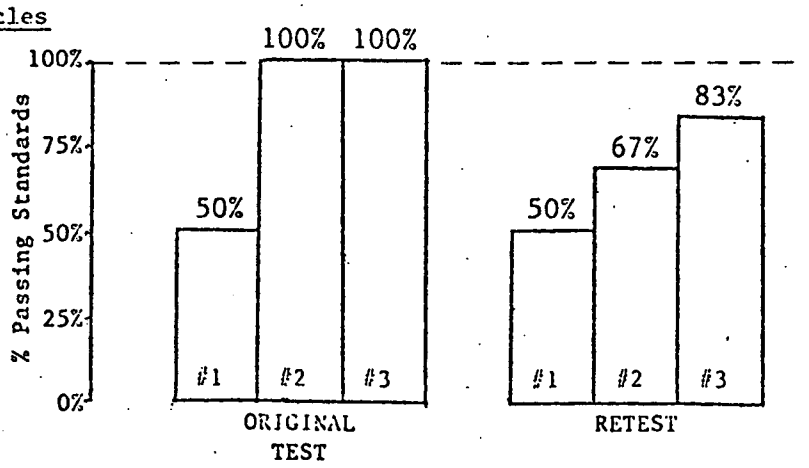
21 1976 Model Year Vehicles



13 1976 Model Year Vehicles



6 1977 Model Year Vehicles



Appendix

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 6304 Site 07 Vin NL45C6B193156 Odometer 32824/23,33?/7293

Make Dodge Model Aspen CID 225 Trans A Carb 1v Inertia Wt. 4000

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	11/28/76	1.26	6.95	3.34	18.09	23.46	90	.40	CAPS OK
3	11/30/76	.92	4.15	3.06	18.67	23.90	400	.12	ADJ IDLE MIXTURE
1	2/1/78	1.03	5.72	3.05	17.03	22.13	25	.01	CAPS OK
1	9-19-78	1.15	7.34	2.52	17.24	23.10	35	.04	CAPS OK

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF . T RESULTS

Vehicle No. 6305 Site 07 Vin NH29C6B166233 Odometer 39412/32615/12131

Make DODGE Model Aspen CID 225 Trans A Carb 1V Inertia Wt. 4000

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	11/17/76	2.57	35.42	1.79	16.90	22.43	250	5.0	CAPS MSSNG TIMING -5
2	11/19/76	2.74	40.16	2.44	17.63	22.82	499	6.1	TIMING ADJUSTED
3	11/20/76	1.09	8.29	2.53	18.02	23.24	117	1.35	IDLE MIXTURE ADJ.
1	2/7/78	2.18	26.45	2.09	17.29	21.47	300	3.5	CAPS MSSNG H.A.D. SENSOR DEFECTIVE
3	2/8/78	1.16	7.46	2.22	17.79	22.76	25	.01	ADJ. IDLE MIXTURE
1	8-28-78	2.30	14.58	1.67	16.82	22.15	35	.02	CAPS MSSNG choke switch on tooLong
4	9-5-78	1.41	9.4	1.43	21.62	27.82	135	.45	Major tune up Replaced choke switch

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 6310 Site 07 Vin X522K6R309002 Odometer 40083/29225/7896

Make Dodge Model Charger CID 360 Trans A Carb 2V Inertia Wt. 4500

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1		2.47	71.35	2.28	11.99	18.34	280	5.2	CAPS BROKEN VAC. KICK OUT OF SPECS
2		2.91	77.35	2.23	11.69	18.71	250	5.7	ADJ VAC KICK
3	11/15/76	.39	3.81	2.48	12.41	19.01	15	.01	ADJ. IDLE MIXTURE
1	1/31/78	5.83	84.12	4.26	12.08	18.42	800	5.8	CAPS BROKEN, FULL VACUUM ADV. TO DIST. LINE TO OSAC DISCONNECTED, CANISTER PURGE LINE DISCONNECTED
2	2/10	3.60	69.98	2.26	11.83	18.59	220	5.0	VACUUM LINES CONNECTED PROPERLY
3	2/11	.56	5.44	2.30	12.55	18.62	20	.01	ADJ. IDLE MIXTURE
1	9-1978	4.54	90.76	2.11	11.89	18.59	340	5.0	TIMING +6
2	9/21	3.17	78.4	1.62	11.56	18.41	68	1.26	ADJ. TIMING
3	9/22	0.56	8.1	1.64	13.91	21.11	30	.02	ADJ. IDLE MIXTURE

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 6211 Site 07 Vin X522G6R270003 Odometer 28,853/9810

Make Dodge Model Charger CID 318 Trans A Carb 2v Inertia Wt. 4500

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	12/5/76	4.22	51.3	2.01	11.84	19.91	395	3.4	Caps mssng, Vacuum advance diaphragm leaky.
3	12/7/76	2.46	14.1	2.55	14.07	20.28	430	.20	Adj. Idle mixture
4	12/9/76	1.95	7.8	2.81	14.03	19.40	700	.18	Major Tune-up, replaced vacuum advance diaphragm.
1	2/8/78	4.36	52.4	6.00	14.32	21.08	620	5.4	CAPS MSSNG, H.A.D. Line disconnected, HAD sensor defective, EGR Line plugged.
2	2/9	4.59	50.2	2.55	13.77	20.06	600	5.2	Connected H.A.D. vacuum line, connected EGR (removed plug)
3	2/10	3.28	8.1	2.57	14.62	20.28	450	.01	Adj. Idle mixture
4	2/11	3.12	6.4	2.44	14.61	20.02	80	.01	Major Tune-up, H.A.D. sensor replaced. (Compression test showed low compression in one cylinder)

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 6216 Site 07 Vin 1L29C6G162525 Odometer 32912 / 11,626

Make Plym Model Duster CID 225 Trans A Carb 1v Inertia Wt. 3500

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	11/2/76	1.24	12.5	1.80	20.69	27.35	160	.5	Caps o.k.
1	1/30/78	6.66	68.9	2.86	17.29	25.51	780	7.3	Caps Broken, timing +9°, Air filter element missing H.A.D. temp sensor defective.
2	2/3	5.48	66.3	2.01	17.14	25.52	700	7.3	Adjusted timing, installed air filter.
3	2/6	1.95	10.3	2.74	19.06	24.77	65	.01	Adj. Idle mixture
4	2/7	1.42	8.0	2.33	16.79	25.56	85	.01	Major tune-up, replaced HAD sensor.

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 6321 Site 07 Vin HH29G6B274817 Odometer 37430 [30,101] [1,028]

Make Plymouth Model Volare' CID 318 Trans A Carb 2v Inertia Wt. 4000

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1.	10-30-76	2.64	37.97	1.72	14.46	20.25	330	2.8	CAPS OK, AIR HORN WARPED CHOKE TIMER ON TOO LONG
3	11-1-76	1.70	7.6	1.65	15.51	20.35	450	.60	ADJ. IDLE MIXTURE AND SPEED
4	11-2-76	1.42	6.4	1.83	15.57	20.25	180	.20	Major Tune up Replaced choke timer
1.	1-28-78	4.38	40.6	1.75	13.92	19.54	420	.42	CAPS MSSNG, HAD SENSOR DEFECTIVE ELECTRIC CHOKE SWITCH REMAINS ON BEYOND SPECS
3	2-2-78	2.09	9.5	1.47	14.35	19.28	190	.01	ADJ IDLE MIXTURE AND SPEED
4	2-3-78	2.04	5.4	1.48	13.91	19.22	125	.03	Major Tune up, Replaced H.A.D. Temperature Sensor Replaced Electric Choke Switch.
1.	8-16-78	2.32	9.5	1.61	14.44	18.32	110	.11	CAPS MSSG CHOKE VACUUM BREAK OUT OF SPEC
2	8-22-78	2.11	9.1	1.71	14.51	18.97	75	.09	CHOKE Adj.
3	8-29-78	2.24	11.97	1.63	14.75	18.57	75	.1	Adj Idle mixture
4	9-5-78	1.76	5.92	1.39	15.22	20.40	350	.12	Major Tune up

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF OT RESULTS

Vehicle No. 6326 Site 07 Vin PH4/NGD172151 Odometer 33961/25,047/6248

Make PLY Model GRAN FURY CID 400 Trans A Carb 4v Inertia Wt. 5000

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	10/14/76	1.77	38.71	1.84	10.96	17.77	140	.30	CAPS MSSNG choke Htr. wire terminal broken at t.ming element
2	10/16	1.75	37.79	1.69	11.08	18.13	150	1.85	Replaced choke heater timer and reconnected
3	10/17	1.14	12.95	1.66	11.20	18.14	120	.40	ADJ. IDLE MIXT.
1	2-14-78	31.84	21.7	2.44	10.34	15.80	1625	.38	TIMING -3 CAPS MSSNG
2	2-15-78	32.37	11.9	2.48	10.16	16.04	1625	.08	ADJ. TIMING
4	2-17-78	1.115	11.78	1.95	9.71	16.84	20	.11	Major Tune-Up
1	8-29-78	35.78	34.6	2.35	10.19	14.95	2000+	1.4	CAPS MSSNG
4	9-16-78	2.16	15.18	1.79	10.10	17.90	118	.55	Major Tune-Up

Federal Standards

	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 6239 Site 07 Vin 6L082L199336 Odometer 40,629/11,542

Make Ford Model Granada CID 250 Trans A Carb 1v Inertia Wt. 4000

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	1/23/78	.67	1.1	1.97	15.90	21.51	20	.01	Caps OK
1	1/24/78	1.00	3.8	1.72	15.43	21.41	30	.01	Caps missing EGR valve Diaphragm leaky

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 6246 Site 07 Vin 6B63H175563 Odometer 21,886/11,613

Make Ford Model LTD CID 351 Trans A Carb 2v Inertia Wt. 5000

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1		2.58	51.4	4.84	12.96	18.42	280	2.7	Caps mssng, vacuum line to air pump bypass disconnected EGR Back pressure transducer broken
2		1.67	29.4	5.66	13.41	18.64	170	2.2	Vacuum line connected
3		.52	3.2	6.20	13.09	18.70	50	.01	Adj. Idle mixture
4	2-17-77	.44	3.96	1.72	14.18	19.18	28	.01	Major Tune-up, replaced back pressure transducer
1	1-9-78	1.20	8.7	1.93	12.17	17.00	600	.01	Caps mssNG

Federal Standards

	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 6349 Site 07 Vin 6G21H255737 Odometer 32872/24,280/7854

Make FORD Model ELITE CID 351 Trans A Carb 2v Inertia Wt. 4500

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	2-18-77	1.58	25.2	3.74	12.78	18.71	7	.01	Caps Missing Timing +4
2	2-20-77	1.46	24.4	3.21	13.66	20.14	15	.08	Timing adjusted
3	2-21-77	1.58	7.98	3.97	13.45	19.04	90	.02	ADS IDLE MIXTURE AND SPEED
4	2-23-77	1.52	8.69	4.04	13.05	18.98	45	.01	Major Tune up
1	1-20-78	1.77	5.3	4.29	13.55	19.14	140	.02	Caps Missing
4	1-28-78	1.497	11.2	4.07	13.49	18.99	95	.95	Major Tune up
1	8-18-78	1.54	13.3	4.02	13.31	18.01	60	1.2	Timing -12°
2	8-23-78	1.47	13.5	3.63	1590	19.69	60	1.0	Adj Timing
4	8-30-78	1.39	17.8	3.76	13.33	18.64	150	1.0	Major Tune-Up

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 6350 Site 07 Vin 6H25H189147 Odometer 38906 / 29650 / 13760

Make FORD Model TORINO CID 351 Trans A Carb 2v Inertia Wt. 4500

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	2-14-77	1.45	7.52	2.89	13.44	19.91	35	.09	CAPS OK
1	1-23-78	1.55	22.59	2.36	12.99	19.00	340	5.90	LIMITER CAPS MSSNG
3	1-25-78	1.91	14.85	2.49	13.25	19.11	35	.18	ADJ. IDLE MIXTURE AND SPEED
4	1-26-78	1.75	20.14	2.43	12.96	18.99	20	.07	major Tune up Replaced bent idle needle screw
1,	8-8-78	1.39	10.2	2.50	13.56	18.65	50	.5	Caps missing

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 6352 Site 07 Vin 6G21S248440 Odometer 31085/21739/6983

Make FORD Model ELITE CID 400 Trans A Carb 2v Inertia Wt. 5000

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	2-22-77	.87	2.2	2.49	11.7	15.7	50	.01	CAPS O.K.
1.	1-6-78	.80	4.96	1.48	11.79	15.4	1000	5%	CAPS OK TIM - 8°
2	1-11-78	1.11	4.8	2.09	12.27	16.1	2000+	5.6	ADJ. TIMING
1	8-2-78	1.61	6.1	2.14	11.60	15.03	100	.01	CAPS MSSNG TIM +4°
→ 2	8-9-78	1.38	8.3	1.85	11.26	14.85	90	.01	ADS TIMING

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 6354 Site 07 Vin 6B66H254365 Odometer 43002/34702/11595

Make FORD Model LTD CID 351 Trans A Carb 2 Inertia Wt. 5000

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	2-15-77	.77	4.15	2.61	12.46	19.24	25	.01	CAPS OK
1	1-18-78	3.49	20.1	1.94	11.74	18.7	1000	3.0	CAPS MSSNG, VACUUM LEAK IN EMERGENCY BRAKE PULLOFF, LEAKY DIAPHRAGM IN CHOKE PULL-OFF. MAP. SENSOR LEAKING.
3	1-20-78	4.38	18.6	2.19	13.77	19.59	450	0	ADJ. IDLE MIXTURE & SPEED
4	1-24-78	1.46	8.5	2.47	13.39	18.51	350	0	M.J.U., REPLACED CHOKE PULL OFF, REPLACED MAP. SENSOR PLUGGED VACUUM LINE TO EMERGENCY BRAKE
1 →	8-1-78	1.22	15.2	1.96	12.45	17.89	380	4.2	CAPS MSSNG CHOKE PULLOFF DIAPHRAGM LEAKING Back Pressure Transducer broken at braze joint idle rich
2									NO M.ER D.
*A	8-3-78	1.71	16.8	2.35	13.00	18.1	185	.01	Adj. Idle mixture
*B	8-4-78	1.82	20.8	1.85	12.47	16.95	200	.01	Major Tune up, replaced back pressure transducer replaced choke pull off

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

* THESE TESTS WERE FOR SUPPLEMENTARY DATA ONLY AND WERE NOT USED IN THE AVERAGES.

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 6357 Site 07 Vin 6Y87A130426 Odometer 40816/31,852/14,790

Make FORD Model T-BIRD CID 460 Trans A Carb 4v Inertia Wt. 5500

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	HC (ppm)	CO (%)	Comments
1	3-4-77	.72	8.2	1.99	10.54	16.12	65	.01	CAPS OK
1	1-17-78	.88	10.2	2.59	10.61	16.03	15	0.0	CAPS OK, choke pulloff diaphragm leaking.
1	8-8-78	1.58	14.1	1.75	8.07	14.72	15	.011	CAPS OK, choke pull off diaphragm leaking

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 6370 Site 07 Vin 4P57J6H551969 Odometer 40227/28,961/13584

Make BUICK Model LeSabre CID 350 Trans A Carb 4v Inertia Wt. 5000

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	3/18/77	.48	5.9	2.29	12.50	12.64	15	0	CAPS OK
1	2/14/78	.46	4.38	2.19	12.51	12.35	7	0	CAPS OK
1	10/14/78	.50	5.99	2.18	11.99	17.09	25	.02	CAPS MISSING

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 6272 Site 07 Vin 6D4956Q233991 Odometer 18,581/8757

Make Cadillac Model Sedan DeVille CID 500 Trans A Carb 4v Inertia Wt. 5500

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	3/14/77	1.23	11.1	1.72	11.30	15.79	25	.01	Caps OK
1	2/21/78	1.71	16.5	2.07	11.11	15.46	100	.35	Caps OK
3.	2/25	1.34	11.6	1.93	10.88	15.35	210	.01	Adj idle mixture

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 6284 Site 07 Vin 1H57V6144053 3 Odometer 29,912 / 14328

Make Chev Model Monte Carlo CID 350 Trans A Carb 2v Inertia Wt. 4500

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1		4.07	138.9	1.43	11.85	17.94	370	5.0	Caps mssng Timing +4°
2		3.14	117.9	1.35	11.39	17.69	110	3.1	Timing adj.
3		1.63	49.6	1.07	13.18	18.31	13	0	Adj Idle mixture
4		1.83	55.0	1.19	12.64	17.15	4	0	Major Tune up
1	2/15/78	2.32	57.3	1.54	13.71	18.78	25	.01	CAPS MSSNG
3	2/16	1.87	47.6	1.25	13.84	18.33	20	.01	Adj Idle mixture
4	2/17	1.88	47.1	1.52	13.45	18.48	15	.01	Major Tune-up

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 6386 Site 07 Vin 1L69V6121881 7 Odometer 29891 / 21,509 / 11584

Make Chev. Model Impala CID 350 Trans A Carb 2V Inertia Wt. 5000

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	4/24/77	.58	11.7	1.67	13.07	17.44	35	0.0	CAPS OK
1	2/24/78	.73	13.35	1.94	12.82	16.83	5	.1	CAPS OK
1	10/3/78	.87	14.6	1.64	13.26	17.93	45.	.02	CAPS OK Leaking vacuum break

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 6394 Site 07 Vin 3X37T6M364900 Odometer 32143/23374/13292

Make OLDS Model REGENCY CID 455 Trans A Carb 4bl Inertia Wt. 5000

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	4-23-77	.99	10.3	2.22	12.10	17.53	25	.01	CAPS OK
1	2-22-78	3.54	34.7	4.99	13.01	17.79	500	4.5	CAPS BROKEN EGR LINE PLUGGED
2	2-24-78	2.92	35.1	2.07	13.11	18.42	440	4.3	REMOVED PLUG FROM EGR LINE
3	2-25-78	.83	4.9	2.36	13.20	18.22	7	.01	Adj idle mixture
1	10/11/78	1.33	13.53	1.81	14.37	18.09	25	.03	CAPS MISSING

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 6296 Site 07 Vin 2C15B6U530015 Odometer 35215/12,274

Make Pontiac Model Astre CID 140 Trans A Carb 2v Inertia Wt. 3000

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MFG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1		.84	17.8	2.08	20.30	28.31	65	1.00	Caps missng
3		.45	6.2	1.96	20.94	28.94	8	.01	Adj idle mixture
1	2/16/78	.46	5.6	2.06	19.80	27.02	15	.01	Caps Mssng

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 6297 Site 07 Vin 2Y69F6W137726 Odometer 37153/13,377

Make Pontiac Model Venture CID 260 Trans A Carb 2v Inertia Wt. 4000

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	4/14/77	.34	1.8	4.06	17.32	23.19	25	.01	CAPS OK EGR LINE DISCONNECTED
2	4/11/77	.42	1.3	2.73	17.07	22.30	33	0	EGR LINE CONNECTED
1	2/22/78	.76D	5.4	2.33	17.76	23.56	16	0	CAPS BROKEN BACK-PRESSURE TRANSDUCER BROKEN AT BRAZE JOINT TIMING -6°
2	2/23	.62	3.5	3.73	18.87	24.25	20	0	Adj timing
3	2/27	.69	3.4	3.78	17.25	23.59	10	0	Adj Idle mixture
4	3/1	.72	2.9	2.98	16.97	23.82	28	0	Major Tune-up, Replaced Back pressure Transducer

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 7455 Site 07 Vin RL41G7A216005 Odometer 23515 / 2760

Make Plymouth Model Fury CID 318 Trans A Carb 2v Inertia Wt. 4500

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	5-26-77	.47	4.58	2.00	13.17	18.89	20	0.0	CAPS OK
1	9-19-78	.58	7.28	1.41	12.99	18.32	16	.01	CAPS OK Leaky HAD Sensor

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 7461 Site 07 Vin 5S22N7R270529 Odometer 24886/1742

Make Chrysler Model Cordoba CID 400 Trans A Carb 4v Inertia Wt. 4500

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	5/25/77	.297	2.31	1.37	10.49	17.20	40	.55	CAPS OK
1	9/22/78	.67	5.04	1.79	11.88	18.25	37	.03	CAPS OK

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 7463 Site 07 Vin 7X11Y188269 Odometer 21471 (13402)

Make FORD Model PINTO CID 140 (2.3L.) Trans A Carb 2 Inertia Wt. 2750

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	6/16/77	.91	17.0	1.67	20.6	28.8	10	0.0	Lim. CAPS O.K., Idle speed + 80, Idle rich.
2	6/18	.77	17.2	.96	21.1	28.8	48	.02	ADJ. Idle mixture & speed
2"A"	6/21	.54	12.6	1.25	20.8	28.5	33	.01	Readjusted idle mixture & speed.
1 →	7/11/78	.95	12.5	1.36	22.0	27.7	9	.01	Leaky HAD Sensor

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 7470 Site 07 Vin 7H94H539747 Odometer 13,795 / (1421)

Make MERCURY Model COUGAR CID 351"W" Trans A Carb 2 Inertia Wt. 4500

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	6/10/77	.97	16.3	1.46	13.1	17.8	23	.16	LIM CAPS MSSNG, IDLE RICH
2	6/15/77	.59	8.1	1.88	13.5	18.2	12	.01	ADJ. IDLE MIXTURE
1	7/18/78	2.84	52.2	1.44	13.4	18.95	340	4.6	LIM CAPS MSSNG, IDLE RICH, EGR DIAPHRAGM LEAKS
2	7/21/78	1.66	20.8	1.46	13.6	18.60	110	0.57	ADJ. IDLE MIXTURE
R 3	7/26/78	1.16	17.7	1.52	13.32	18.57	7	.01	REPLACED EGR VALVE MAJOR TUNE UP

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF [illegible] RESULTS

Vehicle No. 7473 Site 07 Vin 4X69K7H5822 44 Odometer 13560 / 2300

Make BUICK Model ELECTRA CID 403 Trans A Carb 4v Inertia Wt. 4500

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	8/4/77	1.04	9.2	1.22	13.06	17.81	40	.85	CAPS OK
1	10/18/78	1.29	20.1	.72	12.37	16.85	9	1.75	CAPS OK
3	10/20	.62	2.7	1.04	12.54	17.69	27	.01	Major tune up

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0

RESTORATIVE MAINTENANCE EVALUATION
SUMMARY OF TEST RESULTS

Vehicle No. 7479 Site 07 Vin 3H35R7D166462 Odometer 21,726 / 3810

Make OLDS Model Vista Cruiser CID 350 Trans A Carb 4v Inertia Wt. 5000

Test #	Date	FTP (gm/mi) HC	CO	NOxc	MPG FTP	HFET	IHC (ppm)	ICO (%)	Comments
1	6/18/77	1.26	17.8	1.09	12.95	18.22	220	.34	CAPS OK
2	6/21/77	.68	8.2	1.02	13.18	18.54	28	.01	Replaced Evap Canister w/slave canister
1	11/6/78	1.35	15.6	0.92	13.49	19.81	150	.65	CAPS OK Primary vacuum break .04" rich.
2	10/13	1.24	12.7	0.90	12.55	16.26	10	.03	Choke Adj.

Federal Standards	HC	CO	NOxc
1975/76	1.5	15	3.1
1977/78	1.5	15	2.0