EPA-AA-TSS-I/M-86-06

Technical Report

Inspection and Maintenance of New Technology Vehicles in Maryland

By

Larry C. Landman

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NOTICE

Technical Support Staff
Emission Control Technology Division
Office of Mobile Sources
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Table of Contents

List of Tables

List of Tables (Cont.)

List of Illustrations

Inspection and Maintenance of New Technology Vehicles in Maryland

1. Introduction

In 1978 and 1979, EPA conducted an emissions test program in Portland, Oregon. The Portland Study provided data which have been useful in the development of mobile source models and public policy regarding inspection and maintenance (I/M) programs. Among these data is information about the emissions behavior of a fleet influenced by I/M, the costs and effectiveness of emission-related repairs, and how well I/M short term tests can identify excess emissions. Since the completion of the Portland Study, many changes have occurred in the emission control technology of cars. The new technology has the potential for altering the way cars perform on the short tests of I/M programs, respond to repair, and behave in a fleet. Since the changes have included the addition of complex electronic controls, questions have arisen about whether most mechanics can conduct effective repairs on these vehicles. To obtain information about those new technology cars, EPA conducted a program during the spring and summer of 1984 in Washington, D.C.* That program was limited to the 1980 and 1981 model year cars.

This report summarizes a second effort to study these new technology cars. In this program, the goal was to recruit and test approximately 100 late-model year cars which failed the Maryland I/M program. (The actual test results along with a description of the associated repairs can be found in the appendices of this report.) This contract had several objectives, but the primary one was to determine the nature of in-use emissions problems on 1981 and later vehicles which fail I/M short tests and the types of repairs needed to reduce their emission levels to near or below the new car standards. EPA hopes to use this information to better focus mechanic training efforts, to formulate cost-effective policy towards repair cost waivers in I/M programs, and to support development of emission reduction estimates for I/M programs.

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* J. Adler, "Inspection and Maintenance of New Technology Vehicles in Washington, D.C.," U.S. EPA, Emission Control Technology Division, Technical Support Staff, Paper Number EPA-AA-TSS-85-07, July 1985.

2. Test Fleet Selection

The contractor, EG&G Automotive Research, Inc. (EG&G), recruited 1981 and later model year passenger cars that failed the Maryland I/M test at Stations #7 and #8, both of which are located in Prince George's County. These stations were selected because of their proximity to the EG&G testing laboratory in Virginia. The I/M station personnel gave the drivers of all such cars a letter stating the purpose of this program and inviting them to call the lab if they wished to participate. At the same time, the Maryland Division of Motor Vehicles forwarded lists of I/M failures at stations #7 and #8 to EG&G. In order to assure that the selection of cars for this program was a representative cross-section, EG&G rearranged the full list including the volunteers by using a random number generator in a Hewlett-Packard 9825A computer.

All incoming vehicles were initially road-tested in the vicinity of the laboratory for approximately ten (10) minutes to check for transmission or brake defects which would make testing on the dynamometer unsafe. The vehicles were then immediately given an I/M short test similar to that used in Maryland. Vehicles that failed the Maryland I/M test cut-points of 220 ppm for HC or 1.2 percent for CO at the Maryland lanes, but passed based on the lab readings (using an EPA-75 Sun machine on the fully warmed-up car) were returned to the owner unless the vehicle had a significant emission control problem (e.g., a computer trouble code). A margin was given to the I/M cutpoints so that any marginal failures would not be rejected solely due to moderate test variability. The margin was 0.5% CO and 100 ppm HC. Thus, the cutpoints used at the lab were 0.7% CO and 120 ppm HC.

2.1 Representativeness of Recruited Vehicles:

Of a total of 178 cars which were recruited for this program, 107 were tested over the FTP driving cycle at least once, and 100 of those completed the program. The contractor was asked to give priority in recruiting to fuel injected vehicles with the exception of the 1983-84 model year Chrysler 135 CID (2.2 liter) fuel injected cars equipped with automatic transmissions (on which EPA had already accumulated repair data). After 27 Chevettes/T-1000s had been recruited, EPA told the contractor to stop recruiting any more of those cars.

In order to examine whether the recruited cars formed a representative sample, we found in the Emission Factor data bases (as of March 14, 1986) a typical sample of 1,689 1981 and later cars. To determine which of those 1,689 cars would fail a test similar to the Maryland I/M test, we found the vehicles which had either idle HC emissions more than 220 ppm or had idle CO emissions more than 1.2 percent as measured on the second idle of the 4-Mode Test (63 of the 1,689 cars) or on the idle mode of the Restart Test (51 of the 1,689 cars). For these populations and for the Maryland data, we calculated the average FTP emissions for the open-loop carbureted cars, for

the closed-loop carbureted cars, and for the closed-loop fuel injected cars. The results of those calculations appear below:

Table 2.1

Comparison of the Cars Tested in This Program (MD) With 1981+ Cars in the Emission Factor (EF) Program

	--- Population ---					------ Ave FTP -------		
Program	Fuel Mtr.	Cntrl Conf.	Fail* Idle	No.	Odom Mile	HC	CO	NOx
MD (100 cars)	Carb	Op-Lp	--	32	49,719	1.726	31.643	0.974
	Carb	Cl-Lp	--	49	51,128	1.919	35.357	1.112
	F.I.	Cl-Lp	--	19	41,471	2.121	41.579	0.930
MD (all 107 cars)	Carb	Op-Lp	--	33	51,412	1.692	30.927	0.979
	Carb	Cl-Lp	--	54	53,951	2.141	36.153	1.142
	F.I.	Cl-Lp	--	20	41,115	2.140	39.944	0.896
EF	Carb	Op-Lp	4	17	57,169	2.525	39.321	0.879
	Carb	Cl-Lp	4	30	58,001	3.043	48.667	1.023
	F.I.	Cl-Lp	4	16	41,166	0.485	8.720	0.934
EF	Carb	Op-Lp	R	15	58,322	2.761	42.068	0.999
	Carb	Cl-Lp	R	22	58,176	3.706	54.464	0.980
	F.I.	Cl-Lp	R	14	37,981	0.550	8.240	1.158
EF	Carb	Op-Lp	B	14	56,591	2.850	43.768	0.834
	Carb	Cl-Lp	B	17	59,970	4.102	66.339	1.016
	F.I.	Cl-Lp	B	9	41,383	0.411	9.077	0.934
EF	Carb	Op-Lp	E	18	58,579	2.468	38.152	1.013
	Carb	Cl-Lp	E	35	57,154	2.946	47.750	0.999
	F.I.	Cl-Lp	E	21	38,950	0.560	8.247	1.083

* "Fail Idle" refers to the Idle Test criterion used to determine which Emission Factor cars were included in the analyses:

"4" Means the cars failed to pass the 220/1.2 cut-point on the second idle of the 4-Mode Test.

"R" Means the cars failed to pass the 220/1.2 cut-point on the idle mode of the Restart Test.

"B" Means the cars failed to pass the 220/1.2 cut-point on the second idle of the 4-Mode Test and then either failed or did not take the Restart Test.

"E" Means the cars failed to pass the 220/1.2 cut-point on either the second idle of the 4-Mode Test or on the Restart Test.

From those results, we observe that the carbureted cars in this study appear to be slightly cleaner than the average. (However, the variations of the FTP HC, CO, and NOx were so great that we can not make that statement with any degree of statistical confidence.) The fuel injected cars in this study were substantially dirtier on average than those corresponding fuel injected cars from the Emission Factor data base. Most of this discrepancy between the two populations of fuel injected cars can be accounted for by five (5) cars in the Maryland sample. Those five cars each required a new oxygen sensor, and together they accounted for 66 percent of the fuel injected fleet HC and 83 percent of the fuel injected fleet CO emissions.

2.2 Description of Test Fleet:

The distribution of the 100 cars which completed the program is given in Table 2.2. All of the 81 carbureted cars, described in Table 2.2, and almost one-half of the fuel injected cars (i.e., 9 out of 19) were equipped with a supplementary air injection system.

Table 2.2

Distribution of the Cars
Which Completed the Program

Model Year	-- Carbureted -- Open-Loop	Closed-Loop	Fuel Injected Closed-Loop
1981	8	28*	2
1982	12	14	3
1983	6	2	10
1984	6	5	4
Totals:	32	49	19

* A twenty-ninth closed-loop, carbureted car (a 1981 Chevrolet Caprice) was also tested, repaired, and retested in this program. Even though sufficient time was not available to complete the repairs so that the car could pass the Maryland I/M test, the data from that car are used in the analyses (in Section 6.5) to determine the effect of repairs on FTP emissions.

3. Vehicle Testing

The testing and maintenance for this contract was performed at the Virginia Test Laboratory (VTL) operated by EG&G Automotive Research, Inc. For this task, EG&G was required to perform the following nine (9) steps:

1. Recruit late-model year (i.e., 1981 and newer) passenger cars which failed the Maryland I/M program (which has cut-points of 220 ppm HC and 1.2 percent CO),

2. Screen those cars (to remove cars which either passed the screening cut-points, or which have already received some repairs, or which were identified as requiring extensive engine or transmission repairs),

3. Test those cars for evidence of the use of leaded gasoline by using Plumbtesmo brand lead-sensitive paper in the exhaust pipe and by using a wet chemistry lead detection kit to measure to level of lead in the car's gasoline.

4. Test those cars for emissions (the FTP cycle, the 4-Mode Idle Test, and the Restart Idle Test),

5. Examine those cars for malfunctions,

6. Repair those malfunctions which appeared responsible for the I/M failure and which could reasonably be expected to be part of a competent I/M field repair,

7. Return those cars to one of the Maryland I/M lanes for a passing retest,

8. Retest those cars for emissions (FTP & short tests), and

9. Identify those cars which still had high FTP emissions (i.e., twice the applicable standard) as candidates for additional restorative maintenance followed by a third set of emission tests.

This project was spread out over two individual tasks. EG&G recruited the first car for the first task on February 21, 1985, and testing (i.e., preconditioning for the FTP) began that same day. The testing continued through September 21, 1985, by which time FTPs had been performed on 97 cars. Of these 97 cars, 90 completed the program. For the second task, testing began on November 12, 1985 and continued through December 21, 1985. Ten (10) cars were tested in this portion, all of which completed the program. Of the seven cars which did not complete the program:

- Two cars did not complete the program because the time available under the first task for testing ran out. One of those cars (a 1981 Chevrolet Caprice, IM5/052) had some maintenance performed, and a second FTP was performed, even though the car did not yet pass the Maryland I/M cut-points.

- One car was rejected prior to the repair step because it had been so highly modified as to make access to the engine and ECM extremely difficult.

- Four other cars were rejected after the first FTP because they required extensive, non-emission related repairs. One car had high HC levels due to oil leaking into the exhaust from the turbocharger. Each of the remaining three cars required a valve job and/or new rings. (Those four cars are examined in detail in Section 5.)

4. Initial Repairs

The repairs were preceded by a thorough, non-altering inspection of the vehicle's emission control components. For the 101 cars which were repaired in this program, each inspection reportedly averaged four hours and 26 minutes (4:26) (ranging from 2:15 to 21:00).

All repairs were performed by the Contractor except for warranty repairs on three cars. EG&G elected to send the following three cars to the respective dealers because the EG&G mechanic was having difficulty in determining the appropriate repairs.

- The warranty repairs on a 1981 Cadillac deVille (IM5/018) involved replacing the O_2 sensor, the upstream check valve, and the throttle spring for the throttle position sensor (TPS).

- The warranty repairs on a 1981 Ford Escort Wagon (IM6/043) consisted of replacing a defective exhaust system (excluding the catalyst).

- The warranty repairs on a 1984 Chrysler Laser XE (IM8/123) consisted of replacing the O_2 sensor.

After completion of the first test sequence and the vehicle inspection, the Contractor attempted to repair the test vehicle to allow it to pass the I/M test cutpoints used in the Maryland program for that vehicle. The Contractor mechanic decided which repairs and adjustments in his judgment would result in significant reductions in idle exhaust emissions, and he then performed those repairs in a systematic fashion until the vehicle's idle emissions passed the I/M test cutpoints with a cushion to allow for test variability. Generally, disconnected hoses and wires were the first item to be repaired; beyond this, attention was given to the manufacturer's recommended procedures. The mechanic attempted to avoid any unnecessary repairs and adjustments or actions which were not likely to affect idle exhaust emissions of hydrocarbons (HC) or carbon monoxide (CO).

5. Types of Repairs

A large portion (44%) of the 100 cars which completed this program required only minor repairs in order to be able to pass the Maryland I/M test. Ten (10) of the cars required only a very simple carburetor adjustment (i.e., resetting idle speed to specifications and/or cleaning the choke area) to pass I/M. In addition, 20 other carbureted cars required only adjusting the idle mixture (possibly in addition to resetting the idle speed); of those 20 cars, 12 cars required only minor work since the mixture plugs had already been removed. Combining those minor carburetor adjustments with:

- setting the idle timing to specification increased that number by 3 cars, or
- replacing the air filter increased that number by 2, or
- cleaning the choke area increased that number by 1.

Thus, a carburetor adjustment alone or in conjunction with one of the preceding three minor repairs was sufficient to permit 36 of the 81 carbureted cars to pass the I/M test. In order to determine whether those 36 cars which required only minor repairs were "marginal" I/M failures (i.e., were those cars so variable on an I/M test that the variability rather than those minor repairs were the reason for passing I/M after the repairs), we compared the performance of those cars on the four idle modes that EG&G initially performed to that of all 107 cars which were tested. The results of that analysis appears in Table 5.1.

Table 5.1

Comparison of Cars Requiring Only Minor Carburetor Adjustment to the Entire Sample of 107 Tested Cars

Cars in the "As Received" Condition That Passed* at EG&G:	Requiring Only Carb Adjustment	All 107 Cars
At least one idle test	52.8%	53.3%
At least two idle tests	50.0%	41.1%
At least three idle tests	44.4%	37.4%
All four idle tests	27.8%	21.4%

* A car "passed" an idle test if the HC $\leq$ 220 ppm and the CO $\leq$ 1.20%.

That analysis indicates that the variability in the idle test pass/fail results on those cars was not substantially different from the results on the rest of the cars in the sample. (See Section 9 for a discussion of the variability of the I/M test results.)

In addition to those 36 cars, three (3) fuel injected cars also required only the setting of the idle speed and/or the idle CO (only when the mixture plugs had already been removed) to manufacturers' specifications. In addition, five (5) other cars required either the cleaning or replacing of the distributor cap, rotor, or coil; or the replacing of either spark plugs or plug wires. Thus, a total of 44 of the 100 cars (44%) needed only the minor repairs associated with what many would consider a typical tune-up.

Of the 68 closed-loop cars, 31 (45.6%) of them required the following (possibly overlapping) repairs to the closed-loop electronic systems in order to pass the Maryland test:

- 24 required a replacement O_2 sensor.
- 9 required a replacement ECM.
- 3 required a replacement PROM which plugged into the ECM (for each of those cars, as the mechanic continued to work through the "trouble trees," he was eventually led to also replacing the entire ECM).
- 5 required a replacement throttle position sensor.

The frequency of each type of maintenance which was required for the 100 cars to pass the Maryland I/M test is summarized in Table 5.2 (page 10). From those data, the most frequently performed maintenance on the 81 carbureted cars was a carburetor adjustment to idle speed or A/F mixture (performed on 62 cars, or 76.5%), followed by repairs to the supplementary air system (performed on 20 cars, or 24.7%), and followed by repairs to the closed-loop system (performed on 18 of the 49 closed-loop cars, or 36.7%). The most frequently performed maintenance on the 19 fuel injected cars was the replacement of one of the electronic sensors (performed on 13 cars, or 68.4%). Thus, 31 of the 68 closed-loop cars (45.6%) required repairs to their closed-loop systems (most frequently the O_2 sensor).

Of the 100 cars which were repaired to pass the Maryland I/M test, 41 of them (39 carbureted and 2 fuel injected) required resetting the idle mixture. However most of those 41 (22 carbureted and 2 fuel injected) were either missing or had broken idle mixture limiting devices. (The topic of missing/broken limiter devices is discussed later in this report.) Also, of the 29 cars which completed this program and had missing/broken limiter devices, 24 (82.8 per cent) required the resetting of their idle mixture. Thus, a typical car in

Table 5.2

Frequency (%) of Repairs by Control System

System Repaired	Open-Loop Carb	-- Closed-Loop -- Carb	FI
Induction System:			
Air Filter	9.4	10.2	5.3
TAC	3.1	4.1	-
Fresh Air Tube	3.1	2.0	-
TOTAL:	15.6	16.3	5.3
Carb. Replacement	3.1	2.0	NA
Fuel Metering System:			
Set Idle CO	46.9	51.0	10.5
Set Curb Idle	62.5	28.6	10.5
Mix. Solenoid	-	6.1	-
Clean/Rpl Choke	-	8.2	NA
TOTAL:	90.6	67.3	15.8
Ignition System:			
Distributor	6.2	6.1	-
Plug/Wires	6.2	6.1	10.5
Timing Module	3.1	-	-
TOTAL:	12.5	12.2	10.5
Reset Timing:			
Advance(A)	3.1	8.2	-
Retard(R)	12.5	6.1	-
TOTAL:	15.6	14.3	-
EGR	-	6.2	8.2
Supplementary AIR	25.0	24.5	10.5
PCV System:			
PCV Valve	-	4.1	-
PCV Hoses	-	4.1	-
TOTAL:	-	6.1	-
3-Way Electronics:			
ECM	NA	18.4	-
PROM	NA	6.1	-
O_2 Sensor	NA	24.5	63.2
Misc (TPS)	NA	8.2	5.3
TOTAL:	NA	36.7	68.4
Cat. Replacement	-	6.1	-
Sample Size:	32	49	19

(A) The repair was to advance the timing to spec.

(R) The repair was to retard the timing to spec.

this study which had its idle mixture limiting device missing or broken was almost $3^1/_2$ times as likely to require resetting as was a typical car in this study which did not have its idle mixture limiting device missing or broken.

An examination of the frequency of repairs for the closed-loop systems (Table 5.3), indicates that:

- Regardless of model year, about 40 percent of the closed-loop cars required replacement of a sensor (usually O_2).

- Replacement of the ECM and/or PROM was required for about 19 percent of 1981 and 1982 closed-loop cars, but for none of the 1983 and 1984 models. This could indicate either:

    o an improvement in ECM/PROM manufacture after the 1982 model year,

    o a durability problem which appears after three years of use, or

    o an improvement in the service literature used to identify problems (i.e., the decision or trouble trees) allowing the EG&G mechanic to identify the real problem as something other than the ECM/PROM. (However, the PROM replacements on 1981 and 1982 cars were generally accompanied by sizable emission reductions, suggesting that most were necessary. See Sections 6.5. and 7.0.)

Table 5.3

Frequency (%) of Repairs by Model Year to Closed-Loop Systems

	Model Year			
Replace	1981	1982	1983	1984
ECM or PROM	20%	18%	0%	0%
Sensor (O_2 or TPS)	40%	35%	42%	44%
Sample Size:	30	17	12	9

Of the 100 cars which completed this program, three of them (3%) required a catalyst replacement in order to pass the Maryland I/M test. (The new catalysts were installed only after all the repairs performed by the EG&G mechanic proved insufficient to permit the cars to pass the Maryland I/M test. Prior to the catalyst replacement, the cars were retested in order to separate the effects on emissions of the two types of repairs.) Those cars were a 1981 Pontiac Bonneville, a 1982 Oldsmobile Cutlass, and a 1982 Chevrolet Caprice (vehicles numbered IM5/029, IM7/101, and IM7/203, respectively). The 1982 Cutlass exhibited evidence of misfueling (see Section 8). The catalysts from those three cars were shipped to EPA for future testing.

Of the 178 cars which were recruited, five of them (2.8%) were not repaired and retested (even though they exhibited high idle and FTP emissions) because they required extensive repairs. Those five vehicles are described below in Table 5.4.

Table 5.4

Vehicles Rejected Due to Extensive Non-Emission Repairs

Vehicle Number	Model	--- FTP --- HC	CO	Needed Repairs
IM6/017	81 Datsun 310	0.60	8.02	Valves & Rings
IM6/042	81 Dodge Omni	1.83	6.75	Rings
IM7/112	83 Chev Cavalier	Not Tested		Major engine work needed to correct oil leak.
IM7/167	82 Buick Park Avenue	6.17	30.59	Valve Job
IM8/191	84 Mits Colt	2.50	8.89	Turbocharger needs seals.
	Average Emissions:	2.78	13.56	

We can see that the average FTP HC emissions of those four rejected cars, which were tested, substantially exceeds the average fleet HC emissions (see Table 6.1). Those four vehicles represented 5.18% of the total HC (or 5.53% of the excess HC) emitted by all 107 cars that were FTP tested. Thus, the overall effectiveness of an I/M program may depend to this degree on whether these types of repairs (e.g., valve jobs, ring jobs, repairing seals on turbochargers) are required and accomplished properly.

6. Effects of Maintenance on FTP Emissions

6.1 Effects of Maintenance Required to Pass I/M:

The effects of the maintenance, which was in the opinion of EG&G's mechanic, required for the cars to pass the Maryland I/M test on FTP emissions are summarized below in Table 6.1:

Table 6.1

Average FTP Results
(Cars Which Completed the Program)

Strata	N		HC (g/mi)	CO (g/mi)	NOx (g/mi)	Fuel* Economy (mpg)
All Cars	100	Initial	1.896	35.351	1.034	21.119
		Passed I/M	0.827	11.891	0.968	21.826
		Percent Chg	-56%	-66%	- 6%	+ 3%
Cars with RM after passing I/M	9	Initial	2.197	46.730	0.957	18.452
		Passed I/M	1.462	26.153	0.872	18.722
		Percent Chg	-33%	-44%	- 9%	+ 1%
		Final	1.218	17.689	0.966	19.292
		Net Change	-45%	-62%	+ 1%	+ 4%
Carb Cars	81	Initial	1.843	33.890	1.058	21.301
		Passed I/M	0.874	13.156	0.917	21.822
		Percent Chg	-53%	-61%	-13%	+ 2%
F.I. Cars	19	Initial	2.121	41.579	0.930	20.377
		Passed I/M	0.628	6.495	1.190	21.844
		Percent Chg	-70%	-84%	+26%	+ 7%
Closed-Loop Cars	68	Initial	1.976	37.095	1.062	20.675
		Passed I/M	0.812	10.622	1.014	21.661
		Percent Chg	-59%	-71%	- 5%	+ 5%
Open-Loop Cars	32	Initial	1.726	31.643	0.974	22.129
		Passed I/M	0.861	14.587	0.873	22.184
		Percent Chg	-50%	-54%	-10%	< 1%
Carb, Closed-Loop	49	Initial	1.919	35.357	1.112	20.793
		Passed I/M	0.883	12.222	0.945	21.661
		Percent Chg	-54%	-65%	-15%	+ 4%

* The "Fuel Economy" averages are all harmonic averages.

Briefly, the average FTP HC emissions were reduced by 56 percent (from 1.896 g/mi to 0.827), and the average CO emissions by 66 percent (from 35.351 g/mi to 11.891). The FTP NO_x emissions appear to be unaffected with the exceptions of NO_x from the 19 fuel injected cars which increased by 26 percent (from 0.930 g/mi to 1.190). The distribution of the emissions is illustrated in the histograms in Figures 6.1 and 6.2.

Of the 107 cars which were tested over the FTP driving cycle in this program, six (6) of them exhibited, prior to any repairs, both FTP HC and CO emissions below the applicable standards; although, two (2) of those six had NO_x emissions in excess of the applicable standard. The FTP results for those six cars are given in Table 6.2. As was expected, the repairs to those six cars resulted in changes in both FTP emissions and fuel economy which were significantly smaller than the corresponding changes in the remaining 94 cars which completed the program. It should be noted that these six cars did pass the I/M test consistently after the repairs.

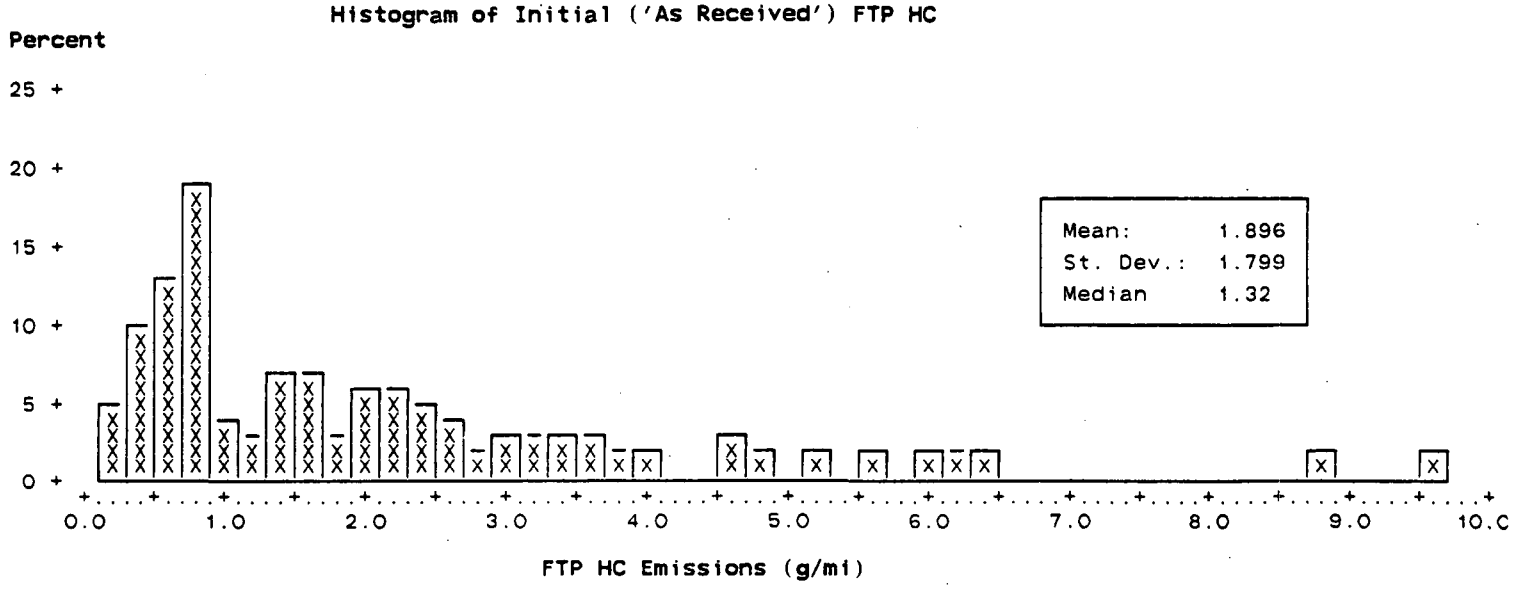
Table 6.2

The Effects of Repairs on Error of Commission Cars

Vehicle Number	Test Sequence	--FTP Emissions--- HC	CO	NOx	Fuel Econ (mpg)	Repairs Performed
IM6/014	As Recvd	0.40	3.37	2.34*	17.84	Reconnected
	Pass I/M	0.51	3.76	1.77	17.38	EGR
IM5/027	As Recvd	0.39	6.16	1.00	27.91	Replaced O_2
	Pass I/M	0.37	5.02	0.90	27.76	sensor
IM5/040	As Recvd	0.25	5.23	0.56	26.28	Cleaned dist,
	Pass I/M	0.30	5.35	0.58	27.75	vacuum hose, set idl spd
IM7/107	As Recvd	0.27	2.05	0.63	29.03	Set idle spd,
	Pass I/M	0.22	1.49	0.69	28.99	rpl air fltr
IM7/131	As Recvd	0.38	5.26	1.46*	20.86	Replace ECM,
	Pass I/M	0.32	3.55	1.44	20.62	set timing
IM8/138	As Recvd	0.22	2.95	0.57	38.04	Set idle spd
	Pass I/M	0.17	2.37	0.62	37.80	

* Failed the FTP NO_x standard.

Figure 6.1


Histogram of Initial ('As Received') FTP HC
Percent
25 +
20 +
15 +
10 +
5 +
0 +
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Mean: 1.896
St. Dev.: 1.799
Median 1.32
FTP HC Emissions (g/mi)

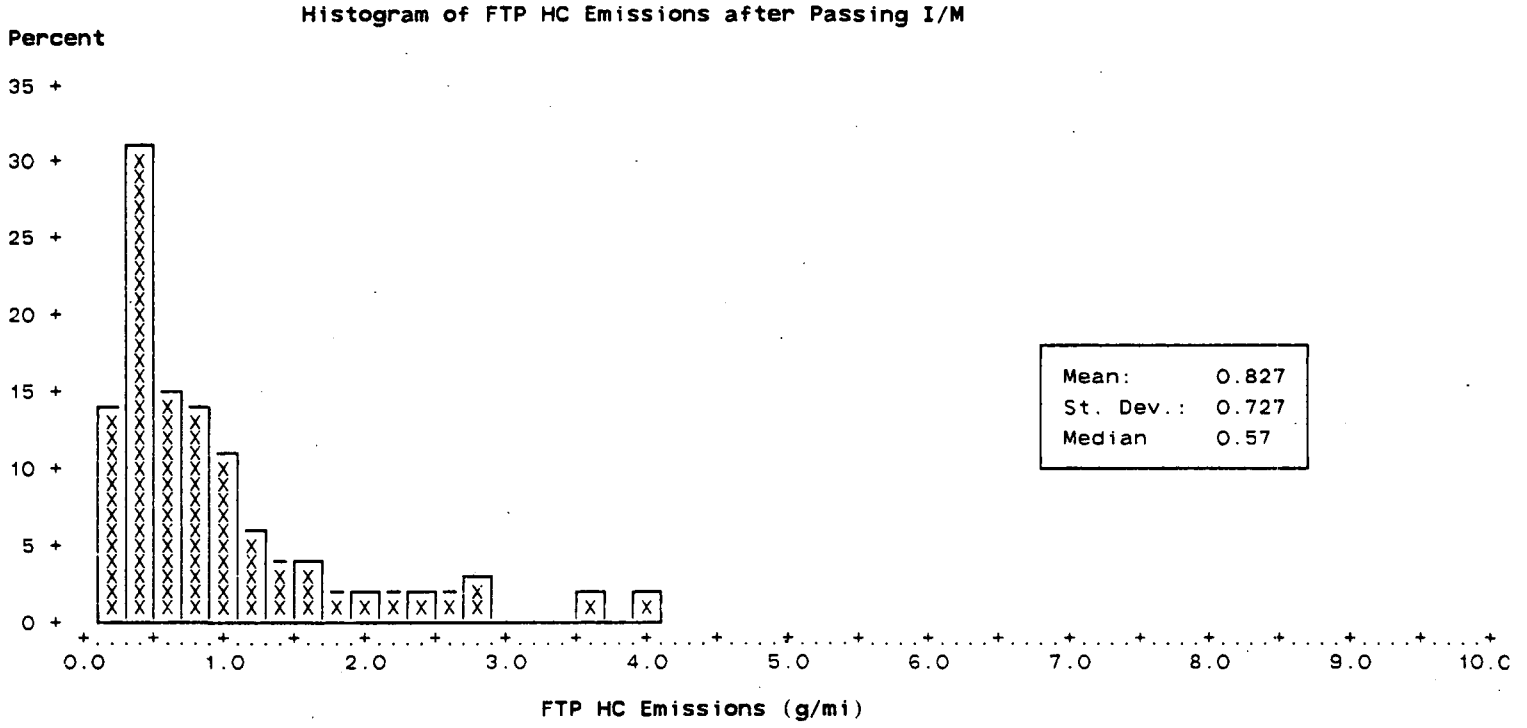
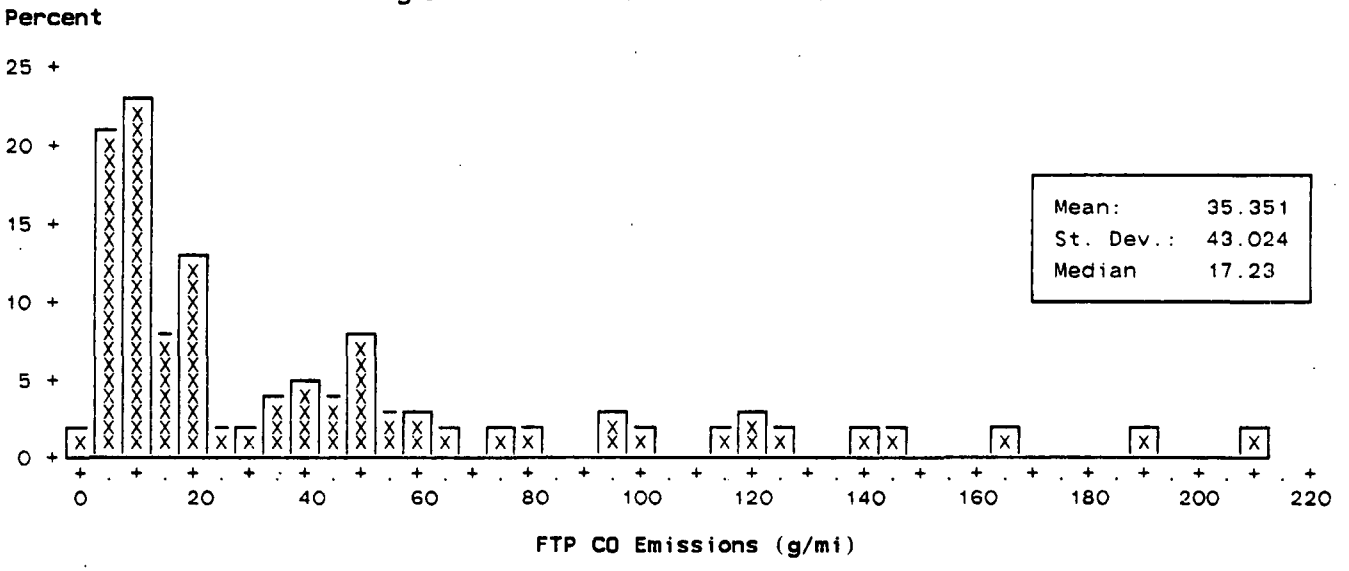
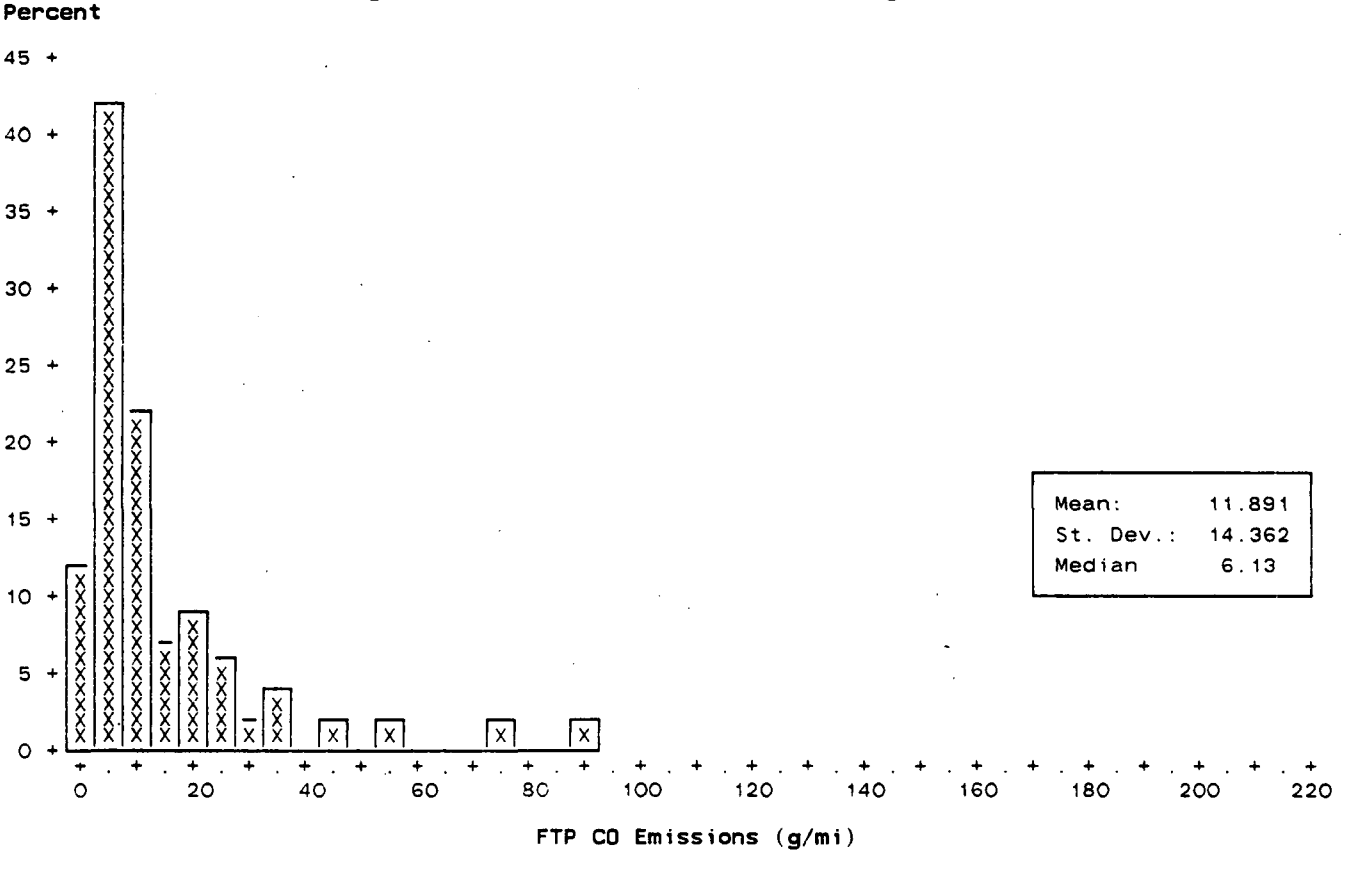

Histogram of FTP HC Emissions after Passing I/M
Percent
35 +
30 +
25 +
20 +
15 +
10 +
5 +
0 +
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Mean: 0.827
St. Dev.: 0.727
Median 0.57
FTP HC Emissions (g/mi)

Figure 6.2

Histogram of Initial ('As Received') FTP CO



Histogram of FTP CO Emissions after Passing I/M



6.2 Outliers:

The repairs performed on the 100 cars which completed this program resulted in either increased FTP HC emissions for eight (8) cars or in increased FTP CO emissions for 13 cars. (Six of those cars exhibited increases in both HC and CO.) Of the eight cars for which the HC increased:

- The increase was no more than 0.21 g/mi for six of the eight cars.
- The increase was more than 1.00 g/mi for the remaining two cars.

Of the 13 cars for which the CO increased:

- The increase was no more than 1.01 g/mi for eight of the 13 cars.
- The increase ranged from 1.09 g/mi to 5.25 g/mi for three of the 13 cars; however, each of those three exhibited a decrease in HC.
- The increase was more than 45.00 g/mi for the remaining two cars.

The two cars which experienced these substantial increases in HC emissions were the same two cars that experienced substantial increases in CO emissions. If we examine the plots of the reduction in emissions (i.e., "as received" minus "after passing I/M") versus the "as received" emissions for each of the FTP HC (Figure 6.3) and CO (Figure 6.4) (pages 18 and 19) for the 100 cars which completed this program, we can easily identify those two outliers (especially in Figure 6.4). Each of those two data points represents a 1981 model year, open-loop, carbureted car (a Datsun 310 and a Mercury Lynx, vehicles numbered IM6/056 and IM6/057, respectively) which were each repaired in the final week of the first task, and each car exhibited substantial increases in FTP HC and CO emissions as well as in fuel consumption.

The results of the repairs on those two cars are given in Table 6.3 (on page 20).

Figure 6.3

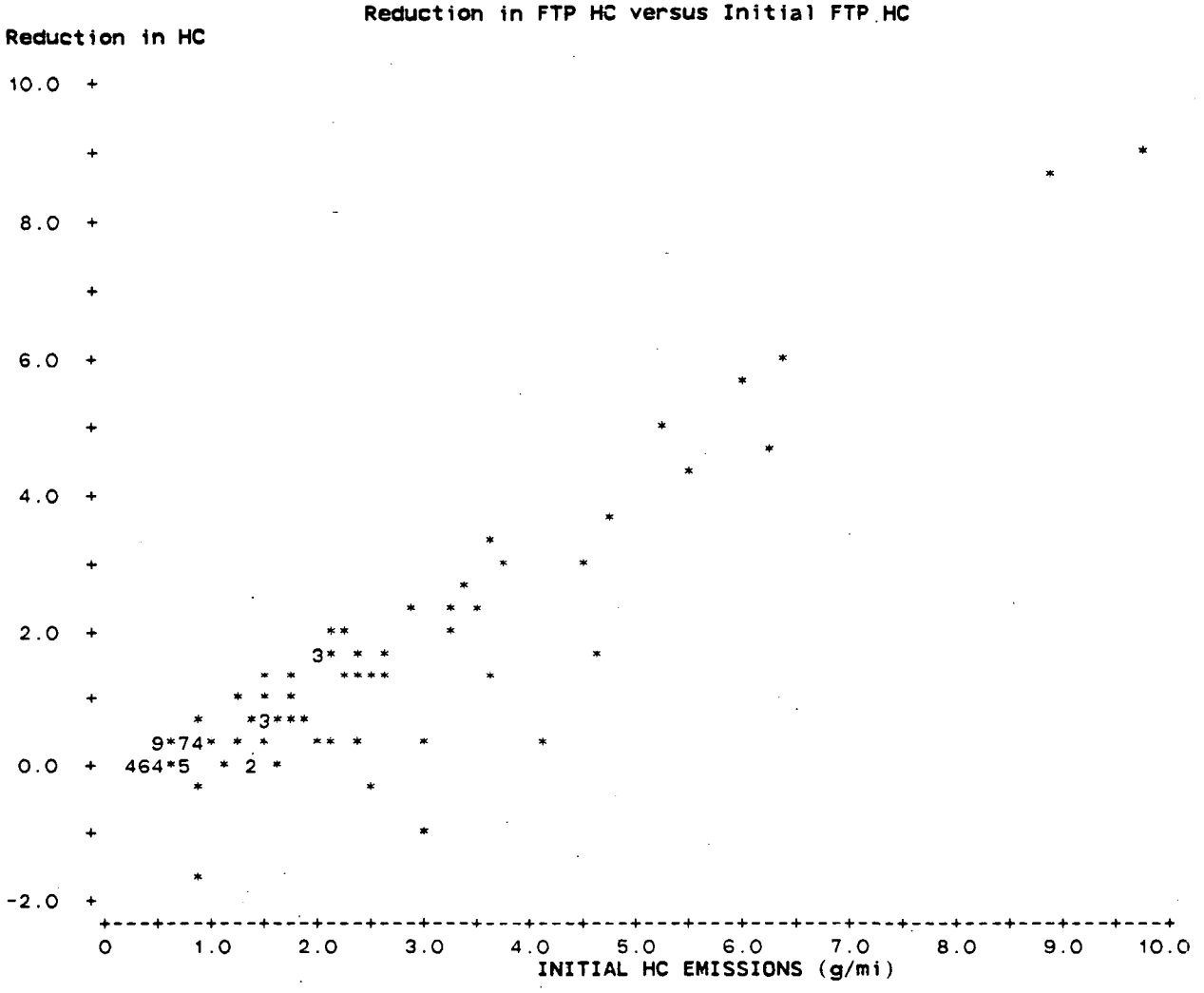

Reduction in FTP HC versus Initial FTP HC
Reduction in HC
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
INITIAL HC EMISSIONS (g/mi)

Figure 6.4

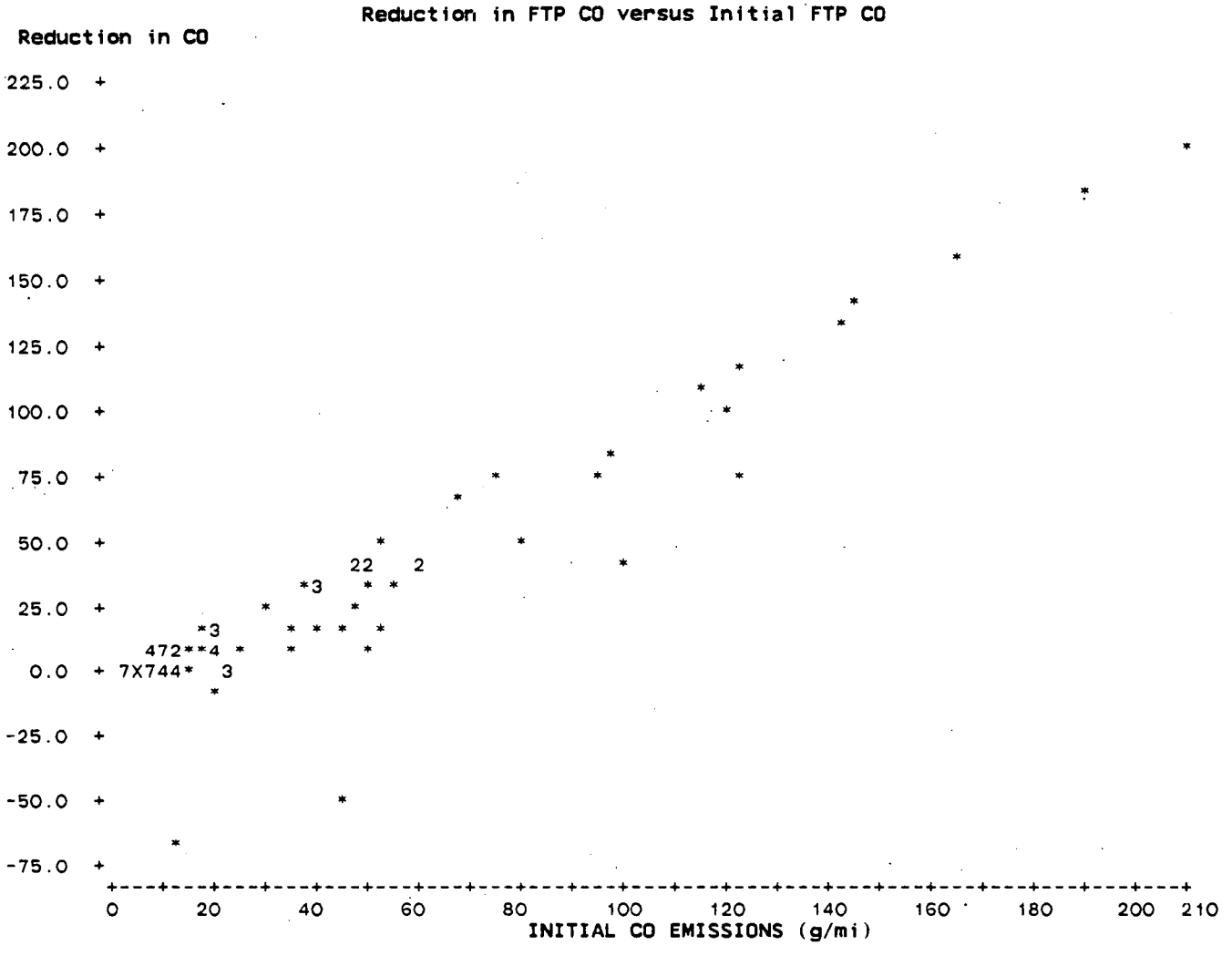

Reduction in FTP CO versus Initial FTP CO
Reduction in CO
225.0
200.0
175.0
150.0
125.0
100.0
75.0
50.0
25.0
0.0
-25.0
-50.0
-75.0
0
20
40
60
80
100
120
140
160
180
200
210
INITIAL CO EMISSIONS (g/mi)

Table 6.3

The Effects of Repairs on Two Outliers

Vehicle	Test Seq.	HC (g/mi)	CO (g/mi)	NO_x (g/mi)	Fuel Econ. (mpg)
IM6/056	As Received	0.86	12.50	0.58	24.81
	After Repairs	2.46	76.77	1.28	19.88
	Percent increase:	186%	514%	120%	-24.8%
IM6/057	As Received	3.04	44.69	1.34	23.43
	After Repairs	4.09	91.18	0.52	21.80
	Percent increase:	34.5%	104%	-61.2%	-7.5%

Deleting these two cars from the 100 cars which completed the program, from the 81 carbureted cars which completed the program, and from the 32 open-loop cars which completed the program, we can then revise Table 6.1 as follows:

Table 6.4

Average FTP Results
(After Deleting the Two Outliers)

Strata	N		HC (g/mi)	CO (g/mi)	NOx (g/mi)	Fuel* Economy (mpg)
All Cars	98	Initial	1.895	35.489	1.036	21.066
		Passed I/M	0.777	10.420	0.969	21.848
		Percent Chg	-59%	-71%	- 6%	+ 4%
Carb Cars	79	Initial	1.840	34.024	1.060	21.239
		Passed I/M	0.813	13.363	0.917	21.849
		Percent Chg	-56%	-67%	-13%	+ 3%
Open-Loop Cars	30	Initial	1.711	31.846	0.975	22.009
		Passed I/M	0.700	9.961	0.871	22.283
		Percent Chg	-59%	-69%	-11%	+ 1%

* The "Fuel Economy" averages are all harmonic averages.

The repairs on the Mercury Lynx (IM6/057) consisted of repairing a vacuum leak which was leaning out the mixture and causing a lean misfire and of resetting the curb idle from 850 rpm to the specified speed of 750 rpm. The EG&G mechanic believes that the repair, which resulted in enriching the air/fuel mixture, might have re-established a very rich air/fuel ratio (itself presumably a factory defect since no external cause for it was evident) and thus could have accounted for the observed changes.

It is not clear why such large increases in FTP HC and CO emissions from the Datsun 310 (IM6/056) resulted from the following four repairs:

- replacing a dirty pulse AIR filter,
- resetting (i.e., advancing) the timing which had been retarded off-scale,
- resetting a rich idle mixture to specifications, and
- resetting the idle speed of 850 rpm to the specified 750 rpm.

One possible explanation for this increase in the Datsun's emissions and fuel consumption is that the choke was sticking intermittently. The car's owner had stated that the car had been repaired to correct an intermittent choke problem. An examination of the car's FTP emissions (bag-by-bag) also suggests that a faulty choke could have been responsible for the high emissions.

6.3 Effects of Maintenance Performed after Passing I/M:

Of those 100 cars which were repaired to pass the Maryland I/M test, nine (9) were selected to have additional maintenance performed after passing I/M. Each of those nine cars had either FTP HC or CO emissions in excess of twice the applicable standard. The additional maintenance was an attempt to further reduce FTP emissions and to identify the reasons for the continued high FTP emissions after passing I/M. The additional items replaced had not all necessarily been determined to be defective; rather, the repairs were somewhat exploratory. As shown in Table 6.5 (page 22), three of the nine displayed substantial FTP reductions (HC reduced by an additional 34 to 50%, and CO reduced by an additional 53 to 60%). One car experienced a substantial reduction in CO (49%) but only slight HC reductions (5%). Repairs on the other five cars produced little if any additional reductions in FTP emissions. The average incremental benefit to FTP emissions of the maintenance performed after those nine cars met the Maryland I/M standards was 12 percent for HC and 18 percent for CO. For those nine cars, the average FTP emissions are also given in Table 6.1. Complete descriptions of the repairs performed on each of those nine cars appear in Appendix E.

Table 6.5

Cars Repaired after Passing I/M

Vehicle Number	Test Sequence	-- FTP Emissions --- HC	CO	NOx	Fuel Econ (mpg)
IM5/013	As Received	1.66	51.89	0.36	22.10
	Passing I/M	1.07	33.27	0.23	23.81
	Add. Repairs	0.24	5.57	0.40	24.41
IM5/018	As Received	3.32	121.15	0.77	11.41
	Passing I/M	0.77	24.57	0.87	11.73
	Add. Repairs	0.87	27.71	0.97	12.07
IM5/022	As Received	2.45	21.55	1.99	18.33
	Passing I/M	2.66	20.26	1.59	18.16
	Add. Repairs	2.70	22.17	1.56	18.29
IM6/036	As Received	1.92	41.02	0.26	17.82
	Passing I/M	1.23	23.29	0.28	17.49
	Add. Repairs	1.01	20.48	0.32	19.30
IM8/122	As Received	1.96	49.06	0.86	22.96
	Passing I/M	1.73	37.29	0.38	24.33
	Add. Repairs	1.05	11.10	0.61	24.82
IM8/145	As Received	3.22	49.88	0.56	22.87
	Passing I/M	1.35	19.40	0.55	22.75
	Add. Repairs	1.28	9.99	0.71	24.46
IM8/151	As Received	1.50	45.07	0.49	18.63
	Passing I/M	1.00	30.46	0.54	19.33
	Add. Repairs	0.90	28.22	0.57	19.28
IM7/153	As Received	2.42	18.95	2.26	18.09
	Passing I/M	2.06	24.20	2.40	18.29
	Add. Repairs	2.14	24.60	2.41	18.32
IM7/172	As Received	1.32	22.00	1.06	20.83
	Passing I/M	1.29	22.64	1.01	20.08
	Add. Repairs	0.77	9.36	1.14	20.57

6.4 Emissions before Repairs versus after Repairs:

A visual inspection of the plots of the reduction in emissions versus the "as received" emissions for each of the FTP HC and CO (Figures 6.3 and 6.4, respectively) indicates a strong linear correlation between the reduction in emissions and the initial emissions.

By performing a linear regression analysis on each of the HC and the CO emissions, we obtained the following equations:

Reduction in HC = -0.597 + (0.878) * (Initial HC),
with: R^2 = 0.839.

Reduction in CO = -9.577 + (0.934) * (Initial CO),
with: R^2 = 0.891.

If the two outliers (which were discussed in Section 6.2) are deleted and then the regression analyses of emission reductions versus the initial emissions are repeated for the remaining 98 cars, the following new equations are obtained:

Reduction in HC = -0.558 + (0.883) * (Initial HC),
with: R^2 = 0.878.

Reduction in CO = -7.942 + (0.930) * (Initial CO),
with: R^2 = 0.947.

Using those two equations, it can be inferred that there was virtually no reduction in emissions for cars with initial FTP HC up to 0.632 and CO up to 8.540 g/mi. Above those levels, the reduction in FTP HC increases, approaching 80 percent for cars with initial FTP HC near 6 g/mi, and the reduction in FTP CO emissions increases, approaching 85 percent for cars with initial FTP CO near 100 g/mi.

6.5 Effects of Individual Repairs:

A total of 101 cars were repaired and tested in this program. Of those 101 cars, nine (9) received a second set of repairs after passing I/M followed by a third FTP and three (3) other cars received a third FTP after replacing their catalysts, thus, producing 113 pairs of FTP results before and after repairs. A (mean zero) linear regression was performed to determine what changes in FTP emissions and fuel economy were associated (i.e., not necessarily a "cause and effect" relationship) with each type of repair. Prior to performing the regression analyses, the population of 113 pairs of tests were stratified into the following four distinct vehicle populations:

1. tests of open-loop, carbureted cars with AIR (34 tests),
2. tests of closed-loop, carbureted cars with AIR (58 tests),
3. tests of closed-loop, fuel injected cars with AIR (10 tests), and
4. tests of closed-loop, fuel injected cars with no AIR (11 tests).

The results of those multi-variable, linear, mean zero (i.e., the constant term is set equal to zero) regression analyses for HC, CO, and fuel economy are given in Tables 6.6, 6.7, and 6.8, respectively.

Table 6.6

The Increase in FTP HC Emissions (g/mi)
Associated with Types of Repairs
(based on linear regressions)

System Repaired	Open-Loop Carb with AIR	Closed-Loop Carb with AIR	Closed-Loop FI with AIR	Closed-Loop FI with No AIR
Induction	-0.374	0.170	-----	0.322
Carburetor Replaced/ Rebuilt	-5.890	0.907	-----	-----
Fuel Meter.	-0.278	-0.336	0.100	-0.283
Ignition:				
Distrib	0.193	0.908	-----	-----
Plug/Wire	-0.155	-0.474	-0.920	-0.470
Timing	-0.775	-0.284	-----	-----
EGR	0.380	-1.433	-----	-----
AIR	-0.601	-0.023	0.285	-----
PCV	-----	-1.547	-----	-----
3-Way Elect:				
ECM/PROM	-----	-1.099	-----	-----
Sensors	-----	-1.224	-3.341	-0.462
Cat. Replac	-----	-2.203	-----	-----

Table 6.7

The Increase in FTP CO Emissions (g/mi)
Associated with Types of Repairs
(based on linear regressions)

System Repaired	Open-Loop Carb with AIR	Closed-Loop Carb with AIR	Closed-Loop FI with AIR	Closed-Loop FI with No AIR
Induction	-6.417	9.424	-----	9.735
Carburetor Replaced/ Rebuilt	-135.90	28.646	-----	-----
Fuel Meter.	-3.248	-5.620	3.140	-7.393
Ignition:				
Distrib	5.984	25.481	-----	-----
Plug/Wire	-7.016	-21.222	-0.540	-0.370
Timing	-8.848	-11.040	-----	-----
EGR	4.606	-47.314	-----	-----
AIR	-15.607	3.289	-10.295	-----
PCV	-----	-36.476	-----	-----
3-Way Elect:				
ECM/PROM	-----	-30.796	-----	-----
Sensors	-----	-36.555	-78.539	-13.265
Cat. Replac	-----	-11.513	-----	-----

Table 6.8

The Increase in FTP Fuel Economy (mpg)
Associated with Types of Repairs
(based on linear regressions)

System Repaired	Open-Loop Carb with AIR	Closed-Loop Carb with AIR	Closed-Loop FI with AIR	Closed-Loop FI with No AIR
Induction	0.218	-0.623	-----	-0.203
Carburetor Replaced/ Rebuilt	5.630	-0.616	-----	-----
Fuel Meter.	0.438	0.520	0.340	0.250
Ignition:				
Distrib	-2.014	0.246	-----	-----
Plug/Wire	2.990	-0.029	0.250	0.010
Timing	-2.775	-0.389	-----	-----
EGR	0.328	1.230	-----	-----
AIR	-0.185	-0.697	-1.490	-----
PCV	-----	0.389	-----	-----
3-Way Elect:				
ECM/PROM	-----	1.248	-----	-----
Sensors	-----	1.166	3.260	-0.163
Cat. Replac	-----	0.530	-----	-----

Given the variety of vehicle designs even within each of these four populations, the fact that even the best mechanic may perform some unnecessary repairs, and the relatively small sample sizes, it is not surprising that the analyses reported in Tables 6.6 through 6.8 produced some inconsistent results. However, there are some consistent results:

1. Replacing defective catalysts (on three cars) reduces both FTP HC and CO emissions. Since the three new catalysts were not aged, the long term size of the reductions is no doubt overstated in the tables.

2. Replacing the spark plugs and/or wires (on eight cars) was associated with lower FTP HC emissions.

3. Replacing faulty ECMs and/or PROMs (on 11 closed-loop cars) was associated with increased fuel economy and lower FTP HC and CO emissions.

4. Replacing faulty electronic sensors (O_2 or TPS) for the closed-loop system (on 30 cars) was also associated with increased fuel economy and lower FTP HC and CO emissions.

5. The stratum of closed-loop, fuel injected cars without a supplementary AIR system (10 test pairs on 9 cars) was the only stratum in which both the FTP HC and CO emissions always decreased after repairs.

Using regression analyses (as above), has the disadvantage of permitting the effects of multiple repairs to skew the results. That problem can be avoided by identifying the cars which had only a single type of repair performed. The results of that analysis are given in Table 6.9 (page 28). The obvious disadvantage with this approach is that some of the repair types are represented by only a small number of vehicles (e.g., the effects of replacing an air filter is based on a single car).

Tables 6.6 through 6.9 generally indicate that the EG&G mechanic, for the most part, replaced and repaired components only when they were in fact defective.

Table 6.9

Changes in Mean FTP Emissions
Associated with a Single Type of Repair

System	Number	HC Before	HC After	CO Before	CO After
Induction (Air Filter)	1	1.20	0.70	20.32	12.70
Replace Carb.	1	6.34	0.45	141.54	5.64
Fuel Metering:					
Reset idle speed	10	0.980	0.618	11.410	7.956
Reset idle mixture	15	1.278	0.842	22.805	12.404
Reset both idle speed and idle mixture	7	1.017	0.569	18.129	7.013
Reset idle speed and/or idle mixture	32	1.128	0.713	18.221	9.839
Ignition System:					
Only spark plugs and/or wires	2	1.945	1.250	4.465	4.010
Both distributor and spark plugs and/or wires	1	0.720	0.500	10.60	5.66
Either distributor or spark plugs and/or wires	3	1.537	1.000	6.510	4.560
EGR	2	0.415	0.500	6.020	6.720
AIR	6	1.298	0.865	22.307	11.183
PCV	1	1.56	0.38	21.00	5.89
3-Way Electronics:					
Sensors	14	2.311	0.584	47.420	6.569
PROM/ECM	3	2.650	1.860	46.680	21.367
Replace Catalyst	3	2.633	0.430	17.247	5.733

7. Cost of Maintenance

The average (i.e., arithmetic mean) number of hours required to repair the 100 cars which completed this program is given in Table 7.1. (For these analyses we assumed that the repair costs for the two cars which received warranty repairs were two hours labor and $100 in parts for the deVille and one hour labor and $30 in parts for the Laser XE.) The repair time includes only the time actually spent on repair work; it does not include either the inspection or diagnostic work which was quite extensive. (However, the inspection and diagnostic procedure was deliberately thorough to ensure that all possible malperformances were found; on many, if not most, of the cars the malperformances which were eventually repaired might have been found in less time.) Table 7.1 also includes the average cost of the replacement parts those cars required. By assuming a cost of labor of $30 per hour, we can calculate an estimated total cost for repairing each of those cars, and the average of that estimate also is included in the following table:

Table 7.1

Average Repair Costs to Pass I/M

Population	Size	Repair Time	Cost of Parts	Estimated Total
All Cars	100	1:21	$ 69.47	$109.95
Carb. Cars	81	1:29	$ 75.53	$119.82
F.I. Cars	19	0:48	$ 43.63	$ 67.84
Closed-Loop	68	1:30	$ 90.82	$135.90
Open-Loop	32	1:01	$ 24.09	$ 54.80
Carb, Closed-Loop	49	1:46	$109.12	$162.29
FI, Closed-Loop	Identical to 'F.I. Cars'			
Carb, Open-Loop	Identical to 'Open-Loop Cars'			

The mean values which appear in the preceding table can be misleading since they can be skewed by a few disproportionately high values. The distribution of each of those three values (i.e., repair time, cost of parts, and estimated total cost), for each population, is given in Tables 7.2 through 7.4. Using the estimated total cost calculations, two-thirds of the 100 cars in this study were repaired for not more than $65.

Table 7.2

Distribution of Repair Parts (in dollars)

		Percentile															
	No.	5%	10%	20%	25%	30%	1/3	40%	50%	60%	2/3	70%	75%	80%	90%	95%	99.9%
All Cars	100	0	0	0	0	0	0	0	10	30	35	40	70	100	260	390	600
Carb. Cars	81	0	0	0	0	0	0	0	0	12	35	37	80	130	275	410	600
FI Cars	19	0	0	0	0	10	30	30	35	35	40	44	45	100	125	150	150
Closed-Loop	68	0	0	0	0	0	0	0	30	35	50	80	100	150	330	420	600
Open-Loop	32	0	0	0	0	0	0	0	0	8	10	10	10	15	95	140	250
Closed-Loop, Carb.	49	0	0	0	0	0	0	0	12	37	80	90	150	265	410	450	600

Table 7.3

Distribution of Repair Time (in hours:minutes)

		Percentile															
	No.	5%	10%	20%	25%	30%	1/3	40%	50%	60%	2/3	70%	75%	80%	90%	95%	99.9%
All Cars	100	0:20	0:30	0:30	0:30	0:30	0:30	1:00	1:00	1:00	1:15	1:30	1:30	2:00	2:00	3:00	15:00
Carb. Cars	81	0:20	0:30	0:30	0:30	0:30	0:30	1:00	1:00	1:15	1:30	1:30	2:00	2:00	2:30	3:00	15:00
FI Cars	19	0:20	0:30	0:30	0:30	0:30	0:30	0:30	0:30	1:00	1:00	1:00	1:00	1:00	2:00	2:00	2:00
Closed-Loop	68	0:30	0:30	0:30	0:30	0:30	0:30	1:00	1:00	1:00	1:15	1:30	2:00	2:00	3:00	4:00	15:00
Open-Loop	32	0:10	0:15	0:30	0:30	0:30	0:30	0:30	1:00	1:00	1:30	1:30	1:30	1:30	2:00	2:00	2:00
Closed-Loop, Carb.	49	0:30	0:30	0:30	0:30	0:30	1:00	1:00	1:00	1:30	1:30	2:00	2:00	2:00	3:00	6:00	15:00

Table 7.4

Distribution of Total (estimated) Repair Cost (in dollars)

		Percentile															
	No.	5%	10%	20%	25%	30%	1/3	40%	50%	60%	2/3	70%	75%	80%	90%	95%	99.9%
All Cars	100	15	15	15	15	29	30	30	43	57	65	74	120	160	305	465	900
Carb. Cars	81	15	15	15	15	29	30	30	38	55	70	90	130	190	365	495	900
FI Cars	19	15	15	15	25	30	45	50	60	60	60	70	74	135	165	185	185
Closed-Loop	68	15	15	15	25	30	30	38	50	65	110	130	160	210	420	590	900
Open-Loop	32	5	8	15	15	15	15	30	30	45	55	55	57	60	140	195	280
Closed-Loop, Carb.	49	15	15	15	29	30	30	30	42	90	130	185	210	325	495	610	900

To determine what the loss in the FTP emission reductions (from the levels attained in Table 6.1) would have been if the cars with estimated repair costs greater than a predetermined value were waived without any repairs being performed (and hence no emission reduction for the waived cars), we generated Tables 7.5 and 7.6. (The reductions which appear in these tables are the percentages of the corresponding emission reductions given in Table 6.1.) In general, over one-half the HC and CO reductions were obtained from the cars which were repaired for not more than $90. The reductions vary greatly with the type of control system. For the fuel injected (closed-loop) cars, 89% of the total HC reduction attained by the EG&G mechanic and 84% of the total attained CO reduction was obtained from the cars which were repaired for a cost of not more than $90. However, for the carbureted closed-loop cars, only 29% of the total attained HC reduction and only 24% of the attained CO reduction was obtained from the cars which were repaired for not more than $200.

These analyses do not provide any insight on the emission reductions from an I/M program in which at least partial repairs are required up to a predetermined dollar value.

To understand why the repairs on the closed-loop carbureted cars were much less cost effective than the repairs either on the open-loop carbureted cars or on the fuel injected cars, we sorted the cars within that stratum by emission reduction. Of the 49 closed-loop carbureted cars which completed this study, the six (6) cars with the largest HC reductions (at least 2.5 g/mi HC) were also the six cars with the largest CO reductions (at least 65 g/mi CO). Each of those six cars required at least $275 to repair. Five of those six cars received new ECMs as well as possibly other repairs. (The fact the such large emission reductions resulted from these repairs suggests that the ECMs actually needed to be replaced.) The sixth car (IM5/029, the car with the largest reductions of HC and of CO of any of the 100 cars) required a replacement catalyst in addition to other extensive repairs (see Appendix E).

Of the 19 closed-loop carbureted cars which exhibited CO reductions of more than 10.00 g/mi, eight (8) required new ECMs and one (1) required a new catalyst. Also, of the 15 closed-loop carbureted cars which exhibited HC reductions of more than 1.00 g/mi, six (6) required new ECMs and three (3) required a new catalyst. These cars, which received a new catalyst or a new ECM, all had repair costs ranging from $275 to $900. If repair costs are limited to $250 or less (as is the case in Tables 7.5 and 7.6), then the emission reductions obtained must be much less than the largest attainable reductions.

Table 7.5

Percent of Attained Reduction in FTP HC Emissions
by Strata and by Estimated Repair Costs

		Total Repair Cost Limited To								
	No.	$50	$70	$90	$110	$130	$150	$175	$200	$250
All Cars	100	31.1	55.2	55.2	55.6	58.0	58.6	61.1	60.9	62.7
Carb. Cars	81	34.1	43.4	43.0	43.6	46.9	47.2	47.2	46.9	49.1
FI Cars	19	23.0	87.9	88.9	88.9	88.9	90.2	99.7	100.0	100.0
Closed-Loop	68	24.3	47.5	47.5	48.2	49.7	50.3	53.7	54.7	57.0
Open-Loop	32	50.7	76.8	76.8	76.8	81.6	82.4	82.4	78.6	78.6
Closed-Loop, Carb.	49	25.0	25.0	24.4	25.4	28.0	28.0	28.0	29.3	33.1
Open-Loop, Minus Outliers*	30	46.3	75.4	75.4	75.4	79.8	80.5	80.5	80.6	80.6
All 1983+ Cars	33	41.1	98.9	99.8	99.8	99.8	99.8	99.8	100.0	100.0

Table 7.6

Percent of Attained Reduction in FTP CO Emissions
by Strata and by Estimated Repair Costs

		Total Repair Cost Limited To								
	No.	$50	$70	$90	$110	$130	$150	$175	$200	$250
All Cars	100	26.5	50.3	50.6	50.6	53.9	54.4	58.6	57.4	59.6
Carb. Cars	81	29.1	37.1	37.2	37.4	42.0	42.3	42.2	40.5	43.6
FI Cars	19	19.7	83.6	84.1	84.1	84.1	84.8	99.8	100.0	100.0
Closed-Loop	68	19.3	43.1	43.4	43.6	45.2	45.4	51.0	52.1	54.9
Open-Loop	32	49.9	74.2	74.2	74.2	82.7	83.7	83.7	75.1	75.1
Closed-Loop, Carb.	49	19.3	19.3	19.4	19.6	22.3	22.3	22.3	23.9	28.6
Open-Loop, Minus Outliers*	30	41.4	71.5	71.5	71.5	78.5	79.3	79.3	79.3	79.3
All 1983+ Cars	33	40.4	99.4	99.9	99.9	99.9	99.9	99.9	100.0	100.0

*The two outliers are described in Section 6.2.

Since catalyst replacements and ECM replacements were limited to the 1981 and 1982 model years in this sample (see Table 5.3), we repeated the analyses using only the 33 cars from the 1983 and 1984 model years (see the "All 1983+ Cars" entry in Tables 7.5 and 7.6). These analyses demonstrate that virtually all of the emission reduction can be obtained from the cars which were repaired for not more than $70. However, care should be taken when examining those 33 cars since newer cars are expected to require few if any major repairs. (These 33 1983-1984 cars had an average odometer mileage of 33,084 as compared to 56,604 miles for the 67 1981-1982 cars.)

In reviewing the data in Tables 7.5 and 7.6, we note that there is an apparent decrease in effectiveness occurring at $200 for the overall sample, for the carbureted cars, and for the open-loop cars. This anomaly is due to the two outliers which were discussed in Section 6.2. If we delete those two cars and repeat the analysis, the drop in effectiveness vanishes.

It should be noted that, in all of the cost calculations in this section, we not only included estimates for the cost of repairs performed under warranty (for the deVille and Laser XE discussed on page 29), but we also did not attempt to determine whether any of the other repairs should have been performed under the manufacturer's emission control warranty (sections 207(a) or 207(b) of The Clean Air Act as Amended 1977). If we exclude the cost of repairs performed under warranty, then this program becomes more cost effective.

8. Tampering and/or Malmaintenance among the Test Cars

Of the 107 cars that were tested over the FTP driving cycle, 106 of them were inspected, and 43 of those 106 cars (40.6%) exhibited signs of possible tampering. The most common type of tampering or malmaintenance involved the idle mixture limiting device; there was a total of 30 cars in which the limiting device was either missing or broken. Those cars are described in Table 8.2 (page 36). (The EG&G mechanic determined whether the carburetor was set rich, lean, or to specification by observing the engine speed when the mixture was enriched by covering the carburetor or by injecting propane and when the mixture was leaned by disconnecting a vacuum line. This method cannot be considered completely reliable, especially for closed-loop vehicles.)

Ten (10) cars (two of which also appeared in Table 8.2), showed signs of possible misfueling (i.e., seven exhibited a positive Plumbtesmo test result indicating the use of leaded gasoline, two had lead levels in the car's fuel tank measured at more than 0.050 grams of lead per gallon of gasoline, and one had a damaged fuel inlet restrictor). One of those ten (a 1982 Oldsmobile Cutlass, number IM7/101) required a new catalyst to pass the Maryland I/M test. Those ten cars are described in Table 8.1. Of the nine with FTP tests, four appear, from their HC levels, to have been significantly damaged by misfueling.

Table 8.1

Vehicles with Possible Misfueling

	---- Vehicle Description ----			--Sign of Misfueling--			--Best FTP-- Without a New Catalyst	
Veh No.	Year	Make/Model	CID/ bbl.	Lead in Fuel (g/gal)	Plumb-tesmo	Fuel Inlet	HC	CO
IM5/012	1981	Chev. Chevette	98/ 2	0.027	Pos	OK	0.42	8.11
IM6/039	1981	Plym. Reliant	135/ 2	0.000	Pos	OK	0.54	8.89
IM7/101	1982	Olds. Cutlass	231/ 2	0.025	Pos	OK	1.63	5.94
IM8/110	1982	Dodge Challanger	156/ 2	0.059	Neg	OK	0.50	5.66
IM7/114	1983	Chev. Chevette	98/ 2	N.A.	Neg	Bad	----	----
IM7/117	1983	Chev. Camaro	151/FI	0.059	Neg	OK	1.64	4.84
IM7/143	1983	Chev. Cavalier	122/FI	0.006	Pos	OK	1.07	10.23
IM8/154	1983	Chry. New Yorker	156/ 2	0.006	Pos	OK	0.33	3.38
IM7/164	1983	Chev. Chevette	98/ 2	0.000	Pos	OK	0.45	3.55
IM8/202	1984	Dodge Daytona	135/FI	0.010	Pos	OK	1.11	3.73

Table 8.2

Vehicles with Tampered Idle Limiter Device

Veh No.	Year	Make/Model	CID/ bbl.	Limiter Device -- Status	Mechanic's Assessment
IM6/001	1981	Datsun 210	91/ 2	Missing	Too Rich
IM5/012	1981	Chev. Chevette	98/ 2	Missing	To Spec
IM6/014	1981	Ford Fairmont	255/ 2	Missing	To Spec
IM5/015	1981	Olds Cutlass	231/ 2	Missing	Too Rich
IM5/023	1981	Pont. Grand Prix	231/ 2	Missing	Too Rich
IM5/029	1981	Pont. Bonneville	231/ 2	Missing	Too Rich
IM5/030	1981	Chev. Caprice	305/ 4	Missing	Too Rich
IM5/033	1981	Buick Skylark	173/ 2	Broken	Too Rich
IM6/036	1981	Mercury Capri	140/ 2	Broken	Too Rich
IM5/041	1981	Pont. Le Mans	231/ 2	Missing	Too Rich
IM5/044	1981	Chev. Chevette	98/ 2	Missing	Too Rich
IM5/052*	1981	Chev. Monte Carlo	267/ 2	Missing	Too Rich
IM6/053	1981	Mercury Zephyr	200/ 1	Missing	Too Rich
IM6/054	1981	Ford Mustang	200/ 1	Missing	Too Rich
IM8/103	1983	Dodge Omni	135/ 2	Missing	Too Rich
IM8/125	1982	Ford Mustang	140/ 2	Broken	Too Lean
IM8/141	1983	Chrysler E-Class	156/ 2	Missing	Too Rich
IM8/145	1982	Ford EXP	98/ 2	Missing	Too Rich
IM7/148	1982	Olds Cutlass	231/ 2	Missing	Too Rich
IM8/151	1983	Datsun Maxima	146/FI	Missing	Too Rich
IM7/153	1982	Chev. Malibu	229/ 2	Missing	Too Lean
IM8/154	1983	Chry. New Yorker	156/ 2	Missing	Too Rich
IM7/167+	1982	Buick Park Ave	307/ 4	Broken	Too Rich
IM7/172	1982	Chev. Malibu	229/ 2	Missing	To Spec
IM8/181	1982	Subaru Hatchback	97/ 2	Missing	Too Rich
IM8/186	1984	Ford EXP	98/ 2	Missing	Too Rich
IM8/190	1982	VW Rabbit	105/FI	Missing	Too Rich
IM7/201+	1982	Chev. Monte Carlo	229/ 2	Broken	Too Rich
IM7/203	1982	Chev. Caprice	229/ 2	Missing	Too Lean
IM8/221	1984	Ford Escort	98/ 2	Missing	Too Rich

* Repairs were not completed on this car when the task ended.

+ These two cars were inspected but not repaired.

In addition to the 38 vehicles described in Tables 8.1 and 8.2, there were the following:

- One car (a 1983 Cadillac deVille, number IM7/115) had its AIR management line blocked with BBs.

- Two cars (a 1982 Ford Mustang and a 1982 Oldsmobile Cutlass, numbers IM8/125 and IM7/148, respectively) were each missing the fan belt to the air pump in addition to missing or broken limiter devices.

- Two cars (a 1981 Ford Fairmont and a 1984 Ford Escort, numbers IM6/014 and IM8/119, respectively) had their EGR hoses either plugged or disconnected. As indicated in Table 8.2, the former also was missing its limiter devices.

- One car (a 1983 Chevrolet Chevette, number IM7/164) had the vacuum hoses to the choke and to the hot air door disconnected in addition to exhibiting a positive Plumbtesmo test result.

- One car (a 1981 Datsun 280ZX, number IM6/008) was missing its air filter.

- One car (a 1981 Toyota Corolla, number IM6/045) had its oxygen sensor disconnected.

- One car (a 1981 Chevrolet Malibu, number IM5/005) had the bulb in its diagnostic warning light removed.

9. Variability of I/M Test Results

Of the 178 cars obtained by EG&G, fully 33 percent (59/178) were not kept for testing because each had:

- No apparent mechanical or electrical problem which could account for the high idle emissions exhibited on the Maryland I/M test,
- HC emissions less than 120 ppm (as measured by EG&G during the idle mode of the Restart Idle Test), and
- CO emissions less than 0.7 percent (as measured by EG&G during the idle mode of the Restart Idle Test).

Had the screening cut-points been 1.2% CO and 220 ppm HC, 55.6 percent (99/178) would not have been kept for testing. Of those 59 cars which were not tested, 50 are known to have been returned to the Maryland lane (by the owners) without any repairs being performed, and 47 (94%) of them then passed the I/M test. Information on the remaining nine rejected cars was not available. If we extrapolate from those results, we can estimate that over 30 percent of the cars that initially failed the Maryland I/M test could have passed a retest at the Maryland I/M lane without any repairs being performed. The rejection rate, by model year is given in Table 9.1. This study provided no information on model years prior to 1981.

Table 9.1

Rejection Rate by Model Year
(based on EG&G screening test)

	Model Year					
	'81	'82	'83	'84	'85	Over-All
Total Recruited	57	47	39	34	1	178
Number Meeting 0.7/120	12	14	16	16	1	59
Percentage	21%	30%	41%	47%	100%	33%
Number Meeting 1.2/220	27	25	26	20	1	99
Percentage	47%	53%	67%	59%	100%	56%

The rejection rate is further broken down by manufacturer and by control system in Tables 9.2 and 9.3, respectively.

Table 9.2

Distributions of Vehicles Recruited and of Vehicles Rejected (for low idle emissions)

	Model Year					
Manufacturer	81	82	83	84	85	Total
General Motors						
Recruited:	33	18	15	8	0	74
Rejected:	6	5	5	6	0	22
Ford						
Recruited:	13	10	9	15	1	48
Rejected:	4	3	5	6	1	19
Nissan						
Recruited:	4	8	6	2	0	20
Rejected:	0	3	4	2	0	9
Chrysler						
Recruited:	5	3	3	4	0	15
Rejected:	1	1	0	1	0	3
Honda						
Recruited:	0	1	3	1	0	5
Rejected:	0	0	1	1	0	2
Toyota						
Recruited:	2	1	2	0	0	5
Rejected:	1	1	1	0	0	3
Mitsubishi						
Recruited:	0	1	1	2	0	4
Rejected:	0	0	0	1	0	1
Fuji						
Recruited:	0	2	0	1	0	3
Rejected:	0	0	0	0	0	0
AMC						
Recruited:	1	0	0	1	0	2
Rejected:	0	0	0	0	0	0
VW						
Recruited:	0	1	0	0	0	1
Rejected:	0	0	0	0	0	0
Toyo Kogyo						
Recruited:	0	1	0	0	0	1
Rejected:	0	0	0	0	0	0
TOTALS:						
Recruited:	57	46	38	36	1	178
Rejected:	12	13	15	18	1	59

Table 9.3

Distributions of Vehicles Recruited and of Vehicles Rejected (for low idle emissions)

	Model Year					
Technology	81	82	83	84	85	Total
Carbureted Cars						
Recruited:	54	42	19	24	1	140
Rejected:	11	12	8	11	1	43
F.I. Cars						
Recruited:	3	4	19	12	0	38
Rejected:	1	1	7	7	0	16
Open-Loop Cars						
Recruited:	12	21	12	8	1	54
Rejected:	2	7	5	1	1	16
Closed-Loop Cars						
Recruited:	45	25	26	28	0	124
Rejected:	10	6	10	17	0	43
Open-Loop Carb.						
Recruited:	12	21	12	8	1	54
Rejected:	2	7	5	1	1	16
Closed-Loop Carb.						
Recruited:	42	21	7	16	0	86
Rejected:	9	5	3	10	0	27
Closed-Loop F.I.						
Recruited:	3	4	19	12	0	38
Rejected:	1	1	7	7	0	16
TOTALS:						
Recruited:	57	46	38	36	1	178
Rejected:	12	13	15	18	1	59

In addition to those 59 rejected cars, four (4) others were accepted into the program because they had obvious mechanical problems (e.g., an O_2 sensor warning light), even though their emissions failed to exceed either of the two preceding emission criteria. Those four cars are listed in Table 9.4.

Table 9.4

Cars NOT Rejected
But with Screening Emissions of:
HC ≤ 120 ppm and CO ≤ 0.7%:

Vehicle Number	-- FTP Emissions -- HC	CO	NOx	The Reason the Car Was NOT Rejected
IM6/008	0.49	5.96	1.10	O_2 sensor light on
IM7/105	0.26	7.76	0.34	O_2 sensor code
IM7/109	0.71	8.72	0.79	O_2 sensor code
IM7/150	0.50	8.33	0.26	TPS sensor code
Means:	0.49	7.69	0.62	

Two of those four cars (in Table 9.4) plus 21 other vehicles (all 23 of which appear in Table 9.5, on page 42) exhibited idle emissions below the 220/1.2 cut-point on each of the following four idle modes:

- the screening test,
- the first and second idle modes of the 4-Mode Test (performed after the initial FTP), and
- the idle mode of the Restart Test (performed after the 4-Mode Test which followed the first FTP).

Among those 23 cars, were two-thirds (four of six) of all the errors of commission cars (i.e., cars which passed the applicable FTP standards but failed the I/M idle test).

Table 9.5

Cars with ALL Idle Emissions of:
HC ≤ 220 ppm and CO ≤ 1.2%:

Vehicle Number	-- FTP Emissions -- HC	CO	NOx
IM5/002	1.05	12.54	0.38
IM6/008*	0.49	5.96	1.10
IM5/009	0.32	3.60	3.34
IM6/014+	0.40	3.37	2.34
IM5/015	0.61	12.24	0.71
IM6/017	0.60	8.02	1.13
IM5/037	0.76	10.68	0.45
IM6/039	0.77	10.20	1.14
IM5/040+	0.25	5.23	0.56
IM5/041	1.53	20.53	0.64
IM8/103	0.91	10.97	0.70
IM7/105*	0.26	7.76	0.34
IM8/113	1.78	3.72	2.39
IM7/117	2.11	5.21	1.95
IM7/124	0.88	7.60	0.68
IM7/131+	0.38	5.26	1.46
IM7/135	0.43	8.67	2.41
IM8/138+	0.22	2.95	0.57
IM8/139	1.67	21.96	1.43
IM8/147	0.35	5.97	0.89
IM8/178	1.08	6.50	1.41
IM8/186	0.73	6.35	0.76
IM8/216	0.81	16.16	1.44
Means:	0.80	8.76	1.23

* Duplicate entry from Table 9.4.

+ "Error of Commission" car. (See Table 6.2.)

Comparing the average emissions of these cars with the averages appearing in Table 6.1, we can see that the cars appearing in either Tables 9.4 or 9.5 are cleaner than the typical cars in this study. However, they are clearly not a random sample of in-use vehicles; they are higher emitters than the average car on the street. About one-half of the cars listed in Table 9.5 (11 of 23) have FTP emissions above 1.0 g/mi HC or 10.00 g/mi CO.

While we have not yet discovered why so many cars fail the 220/1.2 cut-point at the Maryland I/M lane and then pass that same cut-point at VTL, we are preparing a new program to study why this difference in idle emissions occurs. One significant difference between the idle tests conducted at the Maryland I/M lanes and those conducted by EG&G was the way in which the cars were preconditioned. While no special or consistent type of preconditioning was given to the cars in the Maryland lanes beyond a brief period of "half throttle" operation, a loaded preconditioning driving cycle was given to each car at EG&G immediately prior to the idle tests. (i.e., the screening test was preceded by a 10-minute road test, and the Restart Test was preceded by a 4-Mode Test which was preceded by an FTP.) Differences in the preconditioning cycle could result in different idle emissions for several reasons:

- An extended period of idle prior to the test may permit the car's catalyst to cool down, thus reducing its conversion efficiency.

- An extended period of idle prior to the test might result in a closed-loop car's oxygen sensor cooling down, thus either slowing the response time of the car's computer control to changing air/fuel ratios or causing the car to function in its default (i.e., open-loop) mode.

- Different types of preconditioning cycles will trigger different emission control strategies affecting such things as shut-offs of some components or changes in air/fuel ratios. (e.g., Some vehicles require an engine shut-off prior to the short test to prevent diversion of supplementary air.)

10. On-Board Diagnostics

It has been suggested that an I/M program based on examining the vehicle's on-board diagnostics would be more effective in identifying FTP failures of late-model cars than a program which measures tailpipe emissions. To study some aspects of that hypothesis, we analyzed data from the 73 closed-loop cars in this program which were examined by the EG&G mechanic.

The EG&G mechanic consistently used the vehicles' on-board diagnostic systems only for the GM cars. Of those 73 closed-loop cars, 46 were GMs, of which 13 displayed trouble codes. The average "As Received" FTP emissions of those GM cars are given below in Table 10.1. Those 13 cars are 28% of the GM cars, and account for 40% and 53% of the HC and CO emissions, respectively. The repairs performed on eight of those 13 GM cars were exactly the ones specified by the trouble codes. The remaining five GM cars (which appear in Table 10.2) required repairs in addition to those specified by the trouble codes. The corresponding emission reductions of the 43 GM cars which completed the program (three of the 46 did not finish the program) are given in Table 10.3 on the next page.

Table 10.1

Average Initial FTP Emissions (g/mi) of GM Cars

	Count	HC	CO	NOx
All GMs	46	2.09	34.01	1.08
GMs without Trouble Codes	33	1.76	22.16	1.23
GMs with Trouble Codes	13	2.94	64.09	0.70
GMs for which Trouble Codes Identified All Items Repaired	8	1.84	44.24	0.60
GMs for which Trouble Codes Identified Some of the Items Repaired	5	4.69	95.85	0.87

Table 10.2

Non-Trouble Code Repairs for the 5 GM Cars Which Had Both Types of Repairs Performed

Vehicle Number	Non-Trouble Code Repairs Performed
IM5/005	Reset ISC to specification. Replaced: PCV hose, #2 spark plug wire, & mixture solenoid.
IM5/006	Reset idle mixture dwell. Replaced: ECM & oxygen sensor.
IM5/029	Reset timing. Replaced catalyst; EGR; idle air bleed; mixture solenoid; upstream pipe, check valve, and tubing for AIR system; and oxygen sensor.
IM7/101	Replaced: catalyst, check valve, & upstream air pipe.
IM7/148	Corrected hoses to EFE and TAC. Replaced fan belt to air pump.

Table 10.3

Average Reduction of FTP Emissions (g/mi) of GM Cars

	Count	HC	CO	NOx
All GMs	43	0.99	21.70	0.14
GMs without Trouble Codes	30	0.41	6.66	0.26
GMs with Trouble Codes	13	2.33	56.38	-0.13
GMs for which Trouble Codes Identified All Items Repaired	8	1.35	36.46	-0.12
GMs for which Trouble Codes Identified Some of the Items Repaired	5	3.89	88.24	-0.15

We can determine (using a Student's t-Test at the 0.01 level) that the HC and CO emissions of the GM cars which both displayed computer trouble codes and which were in this program (i.e., failed the Maryland I/M test) were significantly greater than the emissions of the GM cars which were in this program but did not display computer trouble codes.

Of the six error of commission cars (described on page 14), four of them are GM cars. Three of the four had no computer trouble codes; the fourth did have codes present which identified all of the repairs performed. That three-to-one ratio of error of commission cars approximates the ratio of all GM cars in this study without codes to those with trouble codes.

From the data in Table 10.3, we can calculate that 71% of the HC and 78% of the CO reductions from all 43 GM cars came from the 13 cars which had trouble codes. About 60% of the 13-car reductions were obtained from the five cars which had both the repairs indicated by the trouble codes as well as other repairs. These results cannot be used to determine what emission reductions to associate with the trouble code repairs for each of the five cars which had other repairs performed. Consequently, the uncertainty of the contribution of the two repair types to the 5-car reduction is important to any conclusion on what percent of the 43-car reduction would have been obtained if only trouble code identified repairs had been performed. The CO emission reductions from the eight cars which received only the repairs indicated by the trouble codes exceeded the total CO reductions from the 30 GM cars that had no computer trouble codes, and the HC emission reductions from the eight cars which received only the repairs indicated by the trouble codes equalled 88% of the total CO reductions from the 30 GM cars that had no computer trouble codes.

This testing program did not provide any information on the FTP emissions of GM cars which pass the Maryland I/M test but have trouble codes in their computers.

10. Conclusions

This study showed that the average FTP HC and CO emissions, from new technology cars that failed the Maryland I/M program during 1985, were reduced substantially by repairs which were targeted at reducing Idle Test emissions.

The most effective repairs (i.e., the repairs associated with the largest emission reductions) to the closed-loop cars were repairs to the electronics of the closed-loop system (i.e., replacing defective sensors and/or, for the 1981-1982 cars, replacing the ECM).

The repair which was most effective in reducing HC or CO emissions from the carbureted, closed-loop cars (i.e., replacing the ECM) was also the repair which was one of the most costly. The 1983-1984, carbureted, closed-loop cars in this study were able to pass I/M without the need of a new ECM, possibly because those cars were newer or because the newer ECMs were more durable.

The most frequently performed repair on the carbureted cars (both open- and closed-loop) was a carburetor adjustment to idle speed or to A/F mixture. The most frequently performed repair to the fuel injected cars was the replacement of one of the electronic sensors (either a TPS or an O_2 sensor).

Approximately 40 percent of the cars inspected in this study showed signs of either tampering or malmaintenance.

The data suggest that the preconditioning which a vehicle receives just prior to an I/M test can significantly affect the results of the I/M test. EPA is planning new test programs to study this idle test variability and sensitivity to preconditioning.

APPENDIX A

Description of the 107 Vehicles Tested

Description of the Cars Tested in This Program

Vehicle Number	Yr	Make	Model	Engine CID	Engine Fuel Mtr	Engine Family	Tran	Supp. AIR	Catalyst	Control Config	CO Stan	MD I/M Failure
IM6/001	81	Datsun	210	91	2	BNS1.5V2AB6	M-5	Pulse	Oxid	Open	3.40	HC & CO
IM5/002	81	Chevrolet	Chevette	98	2	11W2TNQZ	A-3	Pulse	3-Way	Closed	7.00	HC & CO
IM6/004	81	Plymouth	Horizon	135	2	BCR2.2V2HA5	A-3	Pump	3-Way + Oxid	Closed	7.00	HC & CO
IM5/005	81	Chevrolet	Malibu	229	2	11E2AC	L-3	Pump	3-Way + Oxid	Closed	7.00	HC & CO
IM5/006	81	Chevrolet	Chevette	98	2	11W2TNQZ	M-4	Pulse	3-Way	Closed	7.00	HC & CO
IM6/007	81	Ford	Fairmont	140	2	2.3AX	A-3	Pump	3-Way + Oxid	Closed	3.40	CO Only
IM6/008	81	Datsun	280ZX	168	PFI	BNS2.8V5FB3	M-5	None	3-Way	Closed	3.40	CO Only
IM5/009	81	Oldsmobile	Omega	151	2	12X2NN	A-3	Pump	3-Way + Oxid	Closed	3.40	CO Only
IM5/012	81	Chevrolet	Chevette	98	2	11W2TNQZ	A-3	Pulse	3-Way	Closed	7.00	HC Only
IM5/013	81	Chevrolet	Chevette	98	2	11W2TNQZ	A-3	Pulse	3-Way	Closed	7.00	CO Only
IM6/014	81	Ford	Fairmont	255	2	4.2/5.0MAF	L-4	Pump	3-Way + Oxid	Open	3.40	HC & CO
IM5/015	81	Oldsmobile	Cutlass Supr	231	2	14E2TM	L-3	Pump	3-Way	Closed	7.00	HC Only
IM6/017	81	Datsun	310	91	2	BNS1.5V2AB6	M-4	Pulse	Oxid	Open	3.40	HC Only
IM5/018	81	Cadillac	De Ville	368	PFI	16T5ARB	A-3	Pump	3-Way + Oxid	Closed	7.00	CO Only
IM5/019	81	Chevrolet	Malibu	229	2	11E2AC	L-3	Pump	3-Way + Oxid	Closed	7.00	HC & CO
IM5/022	81	Chevrolet	Malibu	229	2	11E2AC	L-3	Pump	3-Way + Oxid	Closed	7.00	HC & CO
IM5/023	81	Pontiac	Grand Prix	231	2	14E2TM	L-3	Pump	3-Way	Closed	7.00	CO Only
IM5/027	81	Chevrolet	Chevette	98	2	11W2TNQZ	A-3	Pulse	3-Way	Closed	7.00	CO Only
IM5/028	81	Chevrolet	Chevette	98	2	11W2TNQZ	A-3	Pulse	3-Way	Closed	7.00	HC & CO
IM5/029	81	Pontiac	Bonneville	231	2	14E2TM	L-3	Pump	3-Way	Closed	7.00	HC & CO
IM5/030	81	Chevrolet	Caprice	305	4	11L4AC	L-4	Pump	3-Way + Oxid	Closed	7.00	HC Only
IM5/033	81	Buick	Skylark	173	2	11C2NDM	A-3	Pump	3-Way + Oxid	Closed	7.00	HC & CO
IM6/036	81	Mercury	Capri	140	2	2.3AX	M-5	Pump	3-Way + Oxid	Closed	3.40	HC & CO
IM5/037	81	Chevrolet	Chevette	98	2	11W2TNQZ	A-3	Pulse	3-Way	Closed	7.00	HC & CO
IM5/038	81	Chevrolet	Chevette	98	2	11W2TNQZ	A-3	Pulse	3-Way	Closed	7.00	HC & CO
IM6/039	81	Plymouth	Reliant	135	2	BCR2.2V2HA5	A-3	Pump	3-Way + Oxid	Closed	7.00	HC Only
IM5/040	81	Chevrolet	Chevette	98	2	11W2TNQZ	A-3	Pulse	3-Way	Closed	7.00	CO Only
IM5/041	81	Pontiac	Le Mans Wgn	231	2	14E2TM	L-3	Pump	3-Way	Closed	7.00	CO Only
IM6/042	81	Dodge	Omni	105	2	BCR1.7V2HJ1	M-4	Pump	3-Way + Oxid	Closed	7.00	HC Only
IM6/043	81	Ford	Escort Wgn	98	2	1.6AP	M-4	Pump	3-Way + Oxid	Open	7.00	HC & CO
IM5/044	81	Chevrolet	Chevette	98	2	11W2TNQZ	A-3	Pulse	3-Way	Closed	7.00	CO Only
IM6/045	81	Toyota	Corolla	108	2	BTY1.8V2HF3	A-3	Pump	3-Way	Closed	3.40	HC Only

Description of the Cars Tested in This Program (Continued)

Vehicle Number	Yr	Make	Model	Engine CID	Engine Fuel Mtr	Engine Family	Tran	Supp. AIR	Catalyst	Control Config	CO Stan	MD I/M Failure
IM6/046	81	Ford	LTD Wgn	302	2	4.2/5.OGCF	L-4	Pump	3-Way + Oxid	Closed	3.40	HC & CO
IM5/048	81	Chevrolet	Impala	267	2	11D2AC	L-3	Pump	3-Way + Oxid	Closed	7.00	HC & CO
IM5/049	81	Chevrolet	Camaro	229	2	11E2AC	L-3	Pump	3-Way + Oxid	Closed	7.00	HC Only
IM6/051	81	Ford	Mustang	255	2	4.2/5.OMAF	A-3	Pump	3-Way	Open	3.40	HC & CO
IM5/052	81	Chevrolet	Monte Carlo	267	2	11D2AC	L-3	Pump	3-Way + Oxid	Closed	7.00	HC & CO
IM6/053	81	Mercury	Zephyr	200	1	3.3GQ	A-3	Pump	3-Way + Oxid	Open	3.40	HC & CO
IM6/054	81	Ford	Mustang	200	1	3.3GQ	A-3	Pump	3-Way + Oxid	Open	3.40	HC & CO
IM6/056	81	Datsun	310	91	2	BNS1.5V2AB6	M-4	Pulse	Oxid	Open	3.40	CO Only
IM6/057	81	Mercury	Lynx	98	2	1.6AP	A-3	Pump	3-Way + Oxid	Open	7.00	HC Only
IM7/101	82	Oldsmobile	Cutlass Supr	231	2	C4G3.8V2TMA5	L-3	Pump	3-Way	Closed	7.00	HC Only
IM7/102	82	Oldsmobile	Cutlass Supr	231	2	C4G3.8V2TMA5	L-3	Pump	3-Way	Closed	7.00	HC Only
IM8/103	83	Dodge	Omni	135	2	DCR2.2V2HAC3	M-5	Pump	3-Way + Oxid	Closed	3.40	CO Only
IM7/105	83	Chevrolet	Cavalier	121	TBI	D1G2.OV5XAJ4	L-3	Pulse	3-Way	Closed	3.40	CO Only
IM7/107	84	Chevrolet	Chevette	98	2	E1G1.6V2NEA1	L-3	Pump	3-Way + Oxid	Closed	3.40	CO Only
IM7/108	84	Pontiac	T1000	98	2	E1G1.6V2NEA1	L-3	Pump	3-Way + Oxid	Closed	3.40	CO Only
IM7/109	82	Buick	Skyhawk	110	TBI	C2G1.8V5TDG9	L-3	None	3-Way	Closed	7.00	HC & CO
IM8/110	82	Dodge	Challenger	156	2	CMT2.6V2BFD8	M-5	Pulse	Oxid	Open	3.40	CO Only
IM8/113	83	Ford	Escort	98	PFI	DFM1.6V5HMF3	M-5	Pulse	3-Way	Closed	3.40	HC Only
IM7/114	83	Chevrolet	Chevette Sct	98	2	D1G1.6V2NEAO	L-3	Pump	3-Way + Oxid	Closed	3.40	HC & CO
IM7/115	83	Cadillac	De Ville	249	TBI	D6G4.1V5AGA4	L-4	Pump	3-Way + Oxid	Closed	3.40	HC Only
IM7/117	83	Chevrolet	Camaro	151	TBI	D2G2.5V5TPG6	M-4	None	3-Way	Closed	3.40	HC Only
IM8/119	84	Ford	Escort	98	2	EFM1.6V2GDK7	A-3	Pulse	3-Way + Oxid	Closed	3.40	CO Only
IM8/122	82	Ford	EXP	98	2	CFM1.6V2GKC2	M-4	Pump	3-Way	Open	7.00	CO Only
IM8/123	84	Chrysler	Laser XE	135	PFI	ECR2.2V5HCF1	M-5	Pulse	3-Way + Oxid	Closed	3.40	HC & CO
IM7/124	83	Pontiac	J-2000	110	PFI	D2G1.8V5TDGX	L-3	None	3-Way	Closed	3.40	CO Only
IM8/125	82	Ford	Mustang GL	140	2	CFM2.3V2GBB2	M-5	Pump	3-Way + Oxid	Open	7.00	HC Only
IM7/131	82	Chevrolet	Cavalier	112	2	C1G1.8V2NNAO	L-3	Pump	3-Way	Closed	7.00	HC Only
IM8/134	84	Ford	EXP	98	2	EFM1.6V2GDK7	M-5	Pump	3-Way	Open	3.40	HC & CO
IM7/135	82	Chevrolet	Chevette	98	2	C1G1.6V2TNR1	L-3	Pulse	3-Way	Closed	7.00	HC & CO
IM8/136	83	Honda	Civic DX	91	3	DHN1.5V3ACF6	M-5	Pulse	Oxid	Open	3.40	HC Only
IM7/137	82	Pontiac	Grand Prix	231	2	C4G3.8V2TMA5	L-3	Pump	3-Way	Closed	7.00	HC & CO
IM8/138	83	Toyota	Starlet	79	PFI	DTY1.3V5FBBX	M-4	None	3-Way	Closed	3.40	HC Only
IM8/139	82	Plymouth	Horizon	105	2	CCR1.7V2HBF7	M-4	Pump	3-Way + Oxid	Closed	7.00	CO Only

Description of the Cars Tested in This Program (Continued)

Vehicle Number	Yr	Make	Model	Engine CID	Engine Fuel Mtr	Engine Family	Tran	Supp. AIR	Catalyst	Control Config	CO Stan	MD I/M Failure
IM8/140	82	Datsun	280ZX	168	PFI	CNS2.8V5FAF4	M-5	None	3-Way	Closed	3.40	HC & CO
IM8/141	83	Chrysler	New Yorker	156	2	DCR2.6V2BAP2	A-3	Pulse	Oxid	Open	3.40	CO Only
IM7/143	83	Chevrolet	Cavalier	121	PFI	D1G2.0V5XAJ4	L-3	Pulse	3-Way	Closed	3.40	CO Only
IM8/144	82	Ford	Escort	98	2	CFM1.6V2GKC2	M-4	Pump	3-Way + Oxid	Open	7.00	HC & CO
IM8/145	82	Ford	EXP	98	2	CFM1.6V2GKC2	M-4	Pump	3-Way + Oxid	Open	7.00	HC & CO
IM8/147	83	Plymouth	Sapporo	156	2	DMT2.6V2BFD9	M-5	Pulse	Oxid	Open	3.40	CO Only
IM7/148	82	Oldsmobile	Cutlass Supr	231	2	C4G3.8V2TMA5	L-3	Pump	3-Way	Closed	7.00	HC & CO
IM7/150	83	Chevrolet	Cavalier	121	PFI	D1G2.0V5XAJ4	L-3	Pulse	3-Way	Closed	3.40	HC Only
IM8/151	83	Datsun	810/Maxima	146	PFI	DNS2.8V5FAA0	L-4	None	3-Way	Closed	3.40	CO Only
IM7/153	82	Chevrolet	Malibu	229	2	C1G3.8V2TMA8	L-3	Pump	3-Way + Oxid	Closed	7.00	HC Only
IM8/154	83	Chrysler	New Yorker	156	2	DCR2.6V2BAP2	A-3	Pulse	Oxid	Open	3.40	CO Only
IM8/159	82	Datsun	Stanza	120	2	CNS2.0V2AAF6	A-3	Pulse	Oxid	Open	3.40	CO Only
IM7/164	83	Chevrolet	Chevette	98	2	D1G1.6V2NEA0	L-3	Pump	3-Way + Oxid	Closed	3.40	HC & CO
IM8/166	83	Honda	Civic	91	3	DHN1.5V3ACF6	M-5	Pulse	Oxid	Open	3.40	HC & CO
IM7/167	82	Buick	Park Avenue	307	4	C3G5.0V4ARA8	L-4	Pump	3-Way + Oxid	Closed	7.00	HC Only
IM8/168	84	Mercury	Lynx	98	2	EFM1.6V2GDK7	A-3	Pump	3-Way + Oxid	Open	3.40	CO Only
IM7/169	82	Chevrolet	Chevette Sct	98	2	C1G1.6V2NEAX	M-4	Pump	3-Way + Oxid	Closed	7.00	HC & CO
IM8/170	82	Datsun	210	91	2	CNS1.5V2AAF6	M-5	Pulse	Oxid	Open	3.40	HC & CO
IM8/171	82	Mercury	Lynx	98	2	CFM1.6V2GAF3	A-3	Pump	3-Way + Oxid	Open	7.00	CO Only
IM7/172	82	Chevrolet	Malibu	229	2	C1G3.8V2TMA8	L-3	Pump	3-Way + Oxid	Closed	7.00	HC & CO
IM8/178	83	Datsun	280ZX	168	PFI	DNS2.8V5FBF7	M-5	None	3-Way	Closed	3.40	HC & CO
IM8/181	82	Subaru	Hatchback	97	2	CFJ1.6V2FAA1	M-4	Pulse	3-Way	Closed	7.00	HC Only
IM8/183	84	Ford	Escort	98	2	EFM1.6V2GDK7	M-5	Pump	3-Way + Oxid	Open	3.40	CO Only
IM8/184	83	Ford	Escort	98	2	DFM1.6V2GDK6	A-3	Pump	3-Way + Oxid	Open	3.40	CO Only
IM8/186	84	Ford	EXP	98	2	EFM1.6V2GDK7	M-5	Pump	3-Way + Oxid	Open	3.40	HC & CO
IM8/190	82	VW	Rabbit	105	PFI	CVW1.7V6FAF8	M-4	None	3-Way	Closed	3.40	CO Only
IM8/191	84	Dodge	Colt (Turbo)	98	PFI	EMT1.6V5FFD4	D-4	Pulse	3-Way	Closed	3.40	HC Only
IM8/195	82	Ford	Escort	98	2	CFM1.6V2GKC2	A-3	Pump	3-Way + Oxid	Open	7.00	CO Only
IM8/196	84	Dodge	Daytona	135	PFI	ECR2.2V5HCF1	M-5	Pulse	3-Way + Oxid	Closed	3.40	HC & CO
IM8/200	82	Ford	Escort	98	2	CFM1.6V2GKC2	M-4	Pump	3-Way + Oxid	Open	7.00	CO Only
IM7/201	82	Chevrolet	Monte Carlo	229	2	C1G3.8V2ACA0	L-3	Pump	3-Way + Oxid	Closed	7.00	HC & CO
IM8/202	84	Dodge	Daytona	135	PFI	ECR2.2V5HCF1	A-3	Pulse	3-Way + Oxid	Closed	3.40	HC & CO

Description of the Cars Tested in This Program (Continued)

Vehicle Number	Yr	Make	Model	Engine CID	Engine Fuel Mtr	Engine Family	Tran	Supp. AIR	Catalyst	Control Config	CO Stan	MD I/M Failure
IM7/203	82	Chevrolet	Caprice	229	2	C1G3.8V2TMA8	L-3	Pump	3-Way	Closed	7.00	HC Only
IM8/209	84	AMC/Renault	Alliance	85	PFI	EAM1.4V5FFA1	A-3	None	3-Way	Closed	3.40	HC & CO
IM8/210	84	Ford	LTD	231	2	EFM3.8V2GXF1	L-3	Pump	3-Way + Oxid	Open	3.40	HC & CO
IM8/212	84	Ford	Tempo GL	140	1	EFM2.3V1HRFX	A-3	Pump	3-Way + Oxid	Closed	3.40	HC Only
IM8/214	82	Datsun	Stanza	120	2	CNS2.0V2AAF6	M-5	Pulse	Oxid	Open	3.40	CO Only
IM8/215	82	Subaru	Wagon GL	109	2	CFJ1.8V2FAA2	M-5	Pulse	3-Way	Closed	3.40	CO Only
IM8/216	84	Mercury	Topaz GS	140	1	EFM2.3V1HFK0	M-5	Pump	3-Way + Oxid	Closed	3.40	CO Only
IM8/219	82	Dodge	Omni	105	2	CCR1.7V2HBF7	A-3	Pump	3-Way + Oxid	Closed	7.00	CO Only
IM8/220	82	Honda	Prelude	107	3	CHN1.8V3AFE6	M-5	Pulse	Oxid	Open	3.40	CO Only
IM8/221	84	Ford	Escort	98	2	EFM1.6V2GDK7	A-3	Pump	3-Way + Oxid	Open	3.40	HC & CO

APPENDIX B

Description of the:

71 Vehicles Rejected from the Program
and
7 Vehicles Which Were Tested but Did Not Finish

Veh No.	Model Year	Make	Model	Disp/ #bbl	Contrl Config	Tran	MD I/M Failure	Comments
IM6/003	1981	AMC	EAGLE	258/2	Open	M-4	HC Only	Truck !!
IM5/010	1981	CHEV	CHEVETTE	98/2	Closed	?	CO Only	Idle Criteria
IM6/011	1981	PLYM	RELIANT	135/2	Closed	?	CO Only	Idle Criteria
IM5/016	1981	CHEV	CHEVETTE	98/2	Closed	?	CO Only	Idle Criteria
IM6/017	1981	DATSUN	310	91/2	Open	M-4	HC Only	Major Repair
IM5/020	1981	PONT	T-1000	98/2	Closed	M-4	HC & CO	Driveability
IM5/021	1981	PONT	GrandPrix	231/2	Closed	?	HC Only	Idle Criteria
IM6/024	1981	MERC	COUGAR	255/2	Open	A-3	HC & CO	Idle Criteria
IM5/025	1981	CHEV	CITATION	173/2	Closed	?	HC Only	Driveability
IM5/026	1981	CHEV	CHEVETTE	98/2	Closed	?	CO Only	Idle Criteria
IM6/031	1981	FORD	LTD(CrnVc)	V8/2	Closed	L-4	HC & CO	Idle Criteria
IM5/032	1981	PONT	LEMANS	231/2	Closed	?	HC & CO	Idle Criteria
IM5/034	1981	CHEV	CHEVETTE	98/2	Closed	A-3	HC & CO	Bad Brakes
IM6/035	1981	LINC	CONTINENT	302/FI	Closed	L-4	HC & CO	Idle Criteria
IM6/042	1981	DODGE	OMNI	105/2	Closed	M-4	HC Only	Valve Job
IM6/047	1981	TOYOTA	TERCEL	89/2	Open	?	HC Only	Idle Criteria
IM5/050	1981	PONT	GrandPrix	231/2	Closed	L-3	CO Only	Idle Criteria
IM5/052	1981	CHEV	MontCarlo	267/2	Closed	L-3	HC & CO	Ran out of time
IM6/055	1981	MERC	MARQUIS	V8/2	Closed	L-4	HC & CO	Idle Criteria
IM8/104	1982	DATSUN	210	L4/2	Open	?	HC Only	Unsafe on Dyno
IM7/106	1983	CHEV	CAVALIER	121/FI	Closed	?	CO Only	Idle Criteria
IM8/111	1982	DATSUN	STANZA	120/2	Open	?	CO Only	Idle Criteria
IM7/112	1983	CHEV	CAVALIER	121/FI	Closed	L-?	HC & CO	Major Repair
IM7/114	1983	CHEV	CHEVETTE	98/2	Closed	L-3	HC & CO	Too Modified

Veh No.	Model Year	Make	Model	Disp/ #bbl	Contrl Config	Tran	MD I/M Failure	Comments
IM8/116	1983	DATSUN	MAXIMA	168/FI	Closed	?	HC Only	Idle Criteria
IM8/118	1983	FORD	ESCORT	98/FI	Closed	A-3	CO Only	Unsafe on Dyno
IM7/120	1983	CHEV	CAVALIER	121/FI	Closed	?	HC Only	Idle Criteria
IM8/121	1983	MERCUR	COUGAR	231/2	Open	A?L	CO Only	Idle Criteria
IM7/126	1983	CHEV	CHEVETTE	98/2	Closed	?	CO Only	Trans. problems
IM8/127	1984	FORD	T-BIRD	140/FI	Closed	?	CO Only	Idle Criteria
IM7/128	1983	OLDS	CUTLASS	231/2	Closed	?	HC Only	Idle Criteria
IM8/129	1983	MERC	LYNX	98/2	Open	?	CO Only	Idle Criteria
IM8/130	1984	DATSUN	PULSAR	98/FI	Closed	?	CO Only	Idle Criteria
IM8/132	1982	CHRY	LeBARON	156/2	Open	A-3	CO Only	Idle Criteria
IM8/133	1984	MITS	TREDIA	122/2	Closed	L-3	HC & CO	Idle Criteria
IM8/142	1983	TOYOTA	TERCEL	89/2	Closed	M	HC Only	Idle Criteria
IM7/146	1982	CHEV	MALIBU Wg	305/4	Closed	L-3	HC Only	Idle Criteria
IM7/149	1982	PONT	T-1000	98/2	Closed	?	HC Only	Idle Criteria
IM8/152	1983	FORD	ESCORT	98/FI	Closed	?	CO Only	Idle Criteria
IM8/155	1983	HONDA	CIVIC	91/3	Open	?	HC Only	Idle Criteria
IM8/156	1983	FORD	ESCORT Wg	98/2	Open	A-3	HC & CO	Trans. problems
IM8/157	1984	FORD	ESCORT	98/FI	Closed	?	HC Only	Idle Criteria
IM8/158	1982	DATSUN	STANZA	120/2	Open	?	CO Only	Idle Criteria
IM8/160	1983	FORD	T-BIRD	140/FI	Closed	M-5	CO Only	Idle Criteria
IM8/161	1983	FORD	EXP	98/2	Open	?	CO Only	Idle Criteria
IM8/162	1982	PONT	T-1000	98/2	Closed	?	CO Only	Idle Criteria
IM8/163	1984	HONDA	PRELUDE	112/2	Closed	?	CO Only	Idle Criteria
IM7/165	1984	CHEV	CELEBRITY	173/2	Closed	?	CO Only	Idle Criteria

Veh No.	Model Year	Make	Model	Disp/ #bbl	Contrl Config	Tran	MD I/M Failure	Comments
IM7/167	1982	BUICK	PARK AVE	307/4	Closed	L-4	CO Only	Needs Valve Job
IM7/173	1982	CHEV	CHEVETTE	98/2	Closed	?	CO Only	Idle Criteria
IM7/174	1984	CHEV	CAVALIER	121/FI	Closed	?	HC Only	Idle Criteria
IM7/175	1984	CHEV	CHEVETTE	98/2	Closed	?	HC & CO	Some RM done
IM7/176	1984	CHEV	CHEVETTE	98/2	Closed	?	HC & CO	Idle Criteria
IM7/177	1983	BUICK	REGAL	231/2	Closed	?	HC Only	Idle Criteria
IM8/179	1983	DATSUN	PULSAR	91/FI	Closed	?	CO Only	Idle Criteria
IM8/180	1982	TOYOTA	CELICA	144/2	Open	?	HC & CO	Idle Criteria
IM8/182	1982	FORD	EXP	98/2	Open	?	CO Only	Idle Criteria
IM7/185	1984	OLDS	CUTLASS	231/2	Closed	L-3	HC Only	Idle Criteria
IM8/187	1982	FORD	ESCORT	98/2	Open	?	CO Only	Idle Criteria
IM8/188	1984	DATSUN	SENTRA	98/2	Closed	?	HC & CO	Idle Criteria
IM8/189	1984	FORD	EXP	98/2	Open	?	HC & CO	Idle Criteria
IM8/191	1984	MITS	COLT(TRB)	110/FI	Closed	M-5	CO Only	Turbocharger needs $1600 in repairs.
IM8/192	1984	SUBARU	Wgn 4WD	109/2	Open	?	CO Only	Truck !!
IM8/193	1982	DATSUN	310	91/2	Open	?	HC Only	Idle Criteria
IM8/194	1983	DATSUN	MAXIMA	168/FI	Closed	?	HC & CO	Idle Criteria
IM8/197	1983	DATSUN	SENTRA	98/2	Open	?	HC & CO	Idle Criteria
IM7/198	1984	CHEV	CAVALIER	121/FI	Closed	?	CO Only	Idle Criteria
IM8/199	1984	MERC	MARQUIS	231/FI	Closed	L-?	HC Only	Idle Criteria
IM7/201	1982	CHEV	MontCarlo	229/2	Closed	L-3	HC & CO	Ran out of time on Contract
IM8/204	1984	FORD	EXP	98/FI	Closed	M-5	CO Only	Idle Criteria
IM8/205	1984	PLYM	Grand Fury	318/2	Closed	A-3	HC & CO	Idle Criteria

Veh No.	Model Year	Make	Model	Disp/ #bbl	Contrl Config	Tran	MD I/M Failure	Comments
IM8/206	1982	MAZDA	626	120/2	Open	A-3	HC Only	Unsafe on Dyno
IM7/207	1983	BUICK	REGAL	231/2	Closed	L-3	CO Only	Idle Criteria
IM8/208	1982	MERC	MARQUIS	302/2	Closed	L-4	CO Only	Idle Criteria
IM8/211	1985	FORD	MUSTANG	302/4	Open	M-5	CO Only	Idle Criteria
IM7/213	1982	CHEV	CORVETTE	350/FI	Closed	L-4	CO Only	Idle Criteria
IM8/217	1984	FORD	TEMPO	140/1	Closed	A-3	CO Only	Idle Criteria
IM7/218	1984	OLDS	CIERA	231/2	Closed	L-3	CO Only	Idle Criteria

APPENDIX C

FTP Results for the 107 Cars tested

Vehicle Number	Test Sequence	Odometer (mile)	-- Emissions (g/mi) -- HC	CO	NOx	Fuel Econ (mpg)
IM6/001	As Received:	57,300	0.78	12.50	0.65	27.79
	Passing I/M:	57,366	0.37	4.22	0.86	28.66
IM5/002	As Received:	41,337	1.05	12.54	0.38	24.55
	Passing I/M:	41,403	0.85	11.87	0.37	24.13
IM6/004	As Received:	67,765	2.24	48.31	1.19	24.37
	Passing I/M:	67,825	0.76	8.31	1.21	23.80
IM5/005	As Received:	115,833	6.27	165.64	0.43	15.10
	Passing I/M:	115,923	1.46	10.98	1.74	19.07
IM5/006	As Received:	62,280	3.68	74.50	0.56	23.04
	Passing I/M:	62,350	0.42	3.16	1.78	26.77
IM6/007	As Received:	68,781	3.23	95.58	0.73	18.96
	Passing I/M:	68,842	0.74	17.33	0.53	18.95
IM6/008	As Received:	45,968	0.49	5.96	1.10	18.58
	Passing I/M:	46,029	0.35	2.43	1.47	18.54
IM5/009	As Received:	57,472	0.32	3.60	3.34	22.38
	Passing I/M:	57,529	0.26	2.11	3.19	22.04
IM5/012	As Received:	87,515	0.84	9.02	0.97	27.64
	Passing I/M:	87,578	0.42	8.11	0.49	26.32
IM5/013	As Received:	54,981	1.66	51.89	0.36	22.10
	Passing I/M:	55,057	1.07	33.27	0.23	23.81
	Add. Repairs:	55,080	0.24	5.57	0.40	24.41
IM6/014	As Received:	51,033	0.40	3.37	2.34	17.84
	Passing I/M:	51,093	0.51	3.76	1.77	17.38
IM5/015	As Received:	66,645	0.61	12.24	0.71	19.10
	Passing I/M:	66,703	0.50	10.59	0.81	18.98
IM6/017	As Received:	105,583	0.60	8.02	1.13	30.39
	Rejected after first FTP					

Vehicle Number	Test Sequence	Odometer (mile)	-- Emissions (g/mi) -- HC	CO	NOx	Fuel Econ (mpg)
IM5/018	As Received:	44,374	3.32	121.15	0.77	11.41
	Passing I/M:	44,483	0.77	24.57	0.87	11.73
	Add. Repairs:	44,515	0.87	27.71	0.97	12.07
IM5/019	As Received:	69,096	5.23	144.92	0.20	15.33
	Passing I/M:	69,159	0.32	5.14	0.60	19.95
IM5/022	As Received:	62,529	2.45	21.55	1.99	18.33
	Passing I/M:	62,589	2.66	20.26	1.59	18.16
	Add. Repairs:	62,614	2.70	22.17	1.56	18.29
IM5/023	As Received:	55,702	3.06	34.68	2.41	18.39
	Passing I/M:	55,763	2.74	26.91	2.16	18.94
IM5/027	As Received:	58,287	0.39	6.16	1.00	27.91
	Passing I/M:	58,347	0.37	5.02	0.90	27.76
IM5/028	As Received:	40,117	1.56	21.00	0.29	24.41
	Passing I/M:	40,174	0.38	5.89	0.32	24.97
IM5/029	As Received:	71,004	9.69	209.78	0.78	13.15
	FAILING I/M:	71,120	4.35	29.27	2.56	17.47
	Passing I/M:	71,146	0.76	10.93	0.09	17.91
IM5/030	As Received:	58,861	0.55	12.42	0.52	15.88
	Passing I/M:	58,922	0.27	7.32	0.70	15.81
IM5/033	As Received:	54,758	0.54	10.21	0.65	20.29
	Passing I/M:	54,820	0.35	4.54	0.65	21.05
IM6/036	As Received:	67,748	1.92	41.02	0.26	17.82
	Passing I/M:	67,807	1.23	23.29	0.28	17.49
	Add. Repairs:	67,832	1.01	20.48	0.32	19.30
IM5/037	As Received:	44,978	0.76	10.68	0.45	26.80
	Passing I/M:	45,037	0.62	11.42	0.33	26.54
IM5/038	As Received:	27,353	1.44	33.77	0.98	24.24
	Passing I/M:	27,444	0.84	14.56	1.09	24.23

Vehicle Number	Test Sequence	Odometer (mile)	-- Emissions (g/mi) -- HC	CO	NOx	Fuel Econ (mpg)
IM6/039	As Received:	35,566	0.77	10.20	1.14	22.31
	Passing I/M:	35,635	0.54	8.89	1.06	22.07
IM5/040	As Received:	44,024	0.25	5.23	0.56	26.28
	Passing I/M:	44,085	0.30	5.35	0.58	27.75
IM5/041	As Received:	41,085	1.53	20.53	0.64	17.17
	Passing I/M:	41,157	0.83	14.67	0.67	17.72
IM6/042	As Received:	123,847	1.83	6.75	1.41	25.66
	Rejected after first FTP					
IM6/043	As Received:	48,482	6.34	141.54	0.60	18.64
	Passing I/M:	48,591	0.45	5.64	0.66	24.27
IM5/044	As Received:	40,043	0.62	9.80	0.83	24.17
	Passing I/M:	40,115	0.32	5.41	0.71	23.77
IM6/045	As Received:	47,399	2.15	49.27	0.91	24.94
	Passing I/M:	47,605	0.30	5.01	0.57	25.71
IM6/046	As Received:	55,359	4.53	121.62	0.62	12.25
	Passing I/M:	55,513	1.58	47.19	0.33	12.51
IM5/048	As Received:	38,767	1.69	40.51	1.08	18.30
	Passing I/M:	38,826	0.43	9.24	0.29	17.58
IM5/049	As Received:	48,505	1.20	20.32	0.42	18.54
	Passing I/M:	48,584	0.70	12.60	0.48	18.67
IM6/051	As Received:	52,045	3.72	37.18	1.85	18.92
	Passing I/M:	52,135	0.60	2.12	2.85	18.64
IM5/052	As Received:	99,119	5.88	57.17	0.90	16.37
	FAILING I/M:	99,219	4.74	31.30	1.13	16.44
IM6/053	As Received:	57,660	1.32	10.50	2.46	20.04
	Passing I/M:	57,762	0.57	3.53	2.81	20.14

Vehicle Number	Test Sequence	Odometer (mile)	-- Emissions (g/mi) -- HC	CO	NOx	Fuel Econ (mpg)
IM6/054	As Received:	76,442	2.67	54.05	0.84	16.89
	Passing I/M:	76,569	1.25	21.78	0.76	16.97
IM6/056	As Received:	85,130	0.86	12.50	0.58	24.81
	Passing I/M:	85,209	2.46	76.77	1.28	19.88
IM6/057	As Received:	70,616	3.04	44.69	1.34	23.43
	Passing I/M:	70,677	4.09	91.18	0.52	21.80
IM7/101	As Received:	89,018	2.02	8.20	1.27	18.11
	FAILING I/M:	89,086	1.63	5.94	1.35	18.39
	Passing I/M:	89,146	0.29	2.39	0.50	19.39
IM7/102	As Received:	56,927	0.70	8.13	4.04	18.44
	Passing I/M:	57,085	0.79	8.50	0.99	20.37
IM8/103	As Received:	15,327	0.91	10.97	0.70	23.27
	Passing I/M:	15,827	0.74	6.13	0.74	25.32
IM7/105	As Received:	49,038	0.26	7.76	0.34	23.98
	Passing I/M:	49,097	0.22	5.74	0.66	23.93
IM7/107	As Received:	17,023	0.27	2.05	0.63	29.03
	Passing I/M:	17,082	0.22	1.49	0.69	28.99
IM7/108	As Received:	11,797	0.77	5.75	0.58	27.14
	Passing I/M:	11,856	0.43	2.86	0.59	26.55
IM7/109	As Received:	40,194	0.71	8.72	0.79	26.87
	Passing I/M:	40,255	0.40	3.75	0.92	26.47
IM8/110	As Received:	71,746	0.72	10.60	1.04	19.32
	Passing I/M:	71,858	0.50	5.66	1.15	19.07
IM8/113	As Received:	40,596	1.78	3.72	2.39	26.57
	Passing I/M:	40,656	0.86	3.18	2.58	26.82
IM7/114	As Received:	36,876	2.15	42.37	0.43	24.67
	Rejected after first FTP					

Vehicle Number	Test Sequence	Odometer (mile)	-- Emissions (g/mi) -- HC	CO	NOx	Fuel Econ (mpg)
IM7/115	As Received:	35,628	0.50	4.55	0.46	17.93
	Passing I/M:	35,690	0.28	2.00	0.81	17.89
IM7/117	As Received:	60,621	2.11	5.21	1.95	21.14
	Passing I/M:	60,686	1.64	4.84	1.76	21.15
IM8/119	As Received:	9,084	2.28	40.41	1.23	25.31
	Passing I/M:	9,145	0.42	3.51	0.48	25.45
IM8/122	As Received:	56,174	1.96	49.06	0.86	22.96
	Passing I/M:	56,279	1.73	37.29	0.38	24.33
	Add. Repairs:	56,312	1.05	11.10	0.61	24.82
IM8/123	As Received:	6,523	8.89	189.11	0.19	14.64
	Passing I/M:	6,584	0.17	2.15	0.91	21.85
IM7/124	As Received:	54,264	0.88	7.60	0.68	25.93
	Passing I/M:	54,355	0.60	4.20	0.66	25.51
IM8/125	As Received:	62,591	5.50	96.84	1.08	19.33
	Passing I/M:	62,675	1.03	11.37	0.82	16.55
IM7/131	As Received:	62,714	0.38	5.26	1.46	20.86
	Passing I/M:	62,795	0.32	3.55	1.44	20.62
IM8/134	As Received:	23,613	0.72	5.55	0.38	22.59
	Passing I/M:	23,673	0.67	4.38	0.40	21.54
IM7/135	As Received:	38,938	0.43	8.67	2.41	25.01
	Passing I/M:	39,005	0.49	9.68	0.61	24.21
IM8/136	As Received:	37,073	0.54	2.66	1.25	31.74
	Passing I/M:	37,139	0.52	2.86	1.14	32.78
IM7/137	As Received:	42,743	4.08	24.14	1.19	18.60
	Passing I/M:	42,814	3.66	11.65	1.44	18.67
IM8/138	As Received:	29,809	0.22	2.95	0.57	38.04
	Passing I/M:	29,869	0.17	2.37	0.62	37.80

Vehicle Number	Test Sequence	Odometer (mile)	-- Emissions (g/mi) -- HC	CO	NOx	Fuel Econ (mpg)
IM8/139	As Received:	56,395	1.67	21.96	1.43	28.05
	Passing I/M:	56,461	1.59	19.76	1.75	29.08
IM8/140	As Received:	47,471	1.45	9.81	1.16	20.30
	Passing I/M:	47,451	1.08	5.55	1.55	20.42
IM8/141	As Received:	33,846	0.74	30.68	0.82	19.26
	Passing I/M:	33,907	0.40	8.72	0.74	19.93
IM7/143	As Received:	35,289	3.46	50.14	0.30	20.40
	Passing I/M:	35,356	1.07	10.23	0.38	22.58
IM8/144	As Received:	52,931	2.32	40.78	0.92	27.63
	Passing I/M:	52,992	0.63	6.04	0.84	28.09
IM8/145	As Received:	54,283	3.22	49.88	0.56	22.87
	Passing I/M:	54,356	1.35	19.40	0.55	22.75
	Add. Repairs:	54,386	1.28	9.99	0.71	24.46
IM8/147	As Received:	24,009	0.35	5.97	0.89	20.36
	Passing I/M:	24,070	0.34	5.14	0.82	20.51
IM7/148	As Received:	73,064	1.79	21.15	1.31	18.07
	Passing I/M:	73,215	1.05	10.59	1.01	18.55
IM7/150	As Received:	30,746	0.50	8.33	0.26	21.94
	Passing I/M:	30,804	0.22	5.04	0.24	23.88
IM8/151	As Received:	28,497	1.50	45.07	0.49	18.63
	Passing I/M:	28,577	1.00	30.46	0.54	19.33
	Add. Repairs:	28,602	0.90	28.22	0.57	19.28
IM7/153	As Received:	51,272	2.42	18.95	2.26	18.09
	Passing I/M:	51,423	2.06	24.20	2.40	18.29
	Add. Repairs:	51,449	2.14	24.60	2.41	18.32
IM8/154	As Received:	41,532	0.56	19.82	0.86	17.56
	Passing I/M:	41,593	0.33	3.38	0.81	18.68

Vehicle Number	Test Sequence	Odometer (mile)	-- Emissions (g/mi) -- HC	CO	NOx	Fuel Econ (mpg)
IM8/159	As Received:	70,347	0.52	19.65	0.46	23.13
	Passing I/M:	70,405	0.34	15.00	0.43	22.02
IM7/164	As Received:	24,590	0.80	8.28	0.66	28.23
	Passing I/M:	24,652	0.45	3.55	0.50	25.66
IM8/166	As Received:	46,483	0.53	3.43	0.87	30.51
	Passing I/M:	46,586	0.33	1.92	0.87	30.38
IM7/167	As Received:	69,735	6.17	30.59	3.44	15.45
	Rejected after first FTP					
IM8/168	As Received:	17,931	2.13	52.76	0.29	22.16
	Passing I/M:	17,996	0.42	5.09	0.59	25.04
IM7/169	As Received:	41,566	4.65	99.47	0.59	22.33
	Passing I/M:	41,648	2.85	56.40	0.84	25.97
IM8/170	As Received:	40,935	1.29	20.00	0.46	26.00
	Passing I/M:	41,027	0.34	3.06	0.48	27.88
IM8/171	As Received:	52,310	2.85	48.26	0.64	23.90
	Passing I/M:	52,372	0.67	8.33	0.50	23.16
IM7/172	As Received:	46,370	1.32	22.00	1.06	20.83
	Passing I/M:	46,460	1.29	22.64	1.01	20.08
	Add. Repairs:	46,484	0.77	9.36	1.14	20.57
IM8/178	As Received:	52,420	1.08	6.50	1.41	20.61
	Passing I/M:	52,488	1.00	5.34	1.17	20.33
IM8/181	As Received:	48,373	0.53	4.61	1.35	30.51
	Passing I/M:	48,454	0.26	3.65	1.08	31.18
IM8/183	As Received:	17,513	1.34	4.37	0.52	22.02
	Passing I/M:	17,578	1.27	4.89	0.72	21.53
IM8/184	As Received:	58,890	0.56	8.94	0.52	24.40
	Passing I/M:	58,951	0.55	8.89	0.51	24.22

Vehicle Number	Test Sequence	Odometer (mile)	-- Emissions (g/mi) -- HC	CO	NOx	Fuel Econ (mpg)
IM8/186	As Received:	29,769	0.73	6.35	0.76	24.25
	Passing I/M:	29,845	0.72	7.44	0.73	24.66
IM8/190	As Received:	56,762	0.49	7.40	2.95	28.46
	Passing I/M:	56,835	0.19	0.41	1.91	28.75
IM8/191	As Received:	34,351	2.50	8.89	0.24	28.04
	Rejected after first FTP					
IM8/195	As Received:	91,873	2.34	79.90	0.80	24.32
	Passing I/M:	91,933	1.02	33.55	0.28	21.42
IM8/196	As Received:	31,427	5.96	115.54	0.70	17.38
	Passing I/M:	31,503	0.43	3.95	1.60	22.55
IM8/200	As Received:	56,651	0.83	13.36	0.52	23.25
	Passing I/M:	56,725	1.04	12.62	0.60	23.77
IM7/201	As Received:	78,522	5.52	82.91	1.01	15.86
	Rejected after first FTP					
IM8/202	As Received:	33,578	4.70	123.45	0.71	17.12
	Passing I/M:	33,635	1.11	3.73	3.04	21.68
IM7/203	As Received:	59,595	1.97	17.23	1.87	17.89
	FAILING I/M:	59,695	1.92	16.53	1.78	17.84
	Passing I/M:	59,818	.24	3.88	.23	17.99
IM8/209	As Received:	64,749	2.00	67.03	.46	24.33
	Passing I/M:	64,810	.37	3.47	.91	26.34
IM8/210	As Received:	19,810	2.57	47.00	1.00	16.61
	Passing I/M:	19,895	1.03	19.26	.93	17.22
IM8/212	As Received:	48,745	3.63	59.61	1.52	20.94
	Passing I/M:	48,805	2.24	17.50	2.20	23.54
IM8/214	As Received:	60,386	.46	12.02	3.53	24.44
	Passing I/M:	60,479	.44	11.96	.76	24.95

Vehicle Number	Test Sequence	Odometer (mile)	-- Emissions (g/mi) -- HC	CO	NOx	Fuel Econ (mpg)
IM8/215	As Received:	55,898	1.49	17.96	1.06	24.24
	Passing I/M:	55,595	.64	11.64	.85	23.77
IM8/216	As Received:	25,697	.81	16.16	1.44	21.51
	Passing I/M:	25,763	.76	18.34	1.61	21.93
IM8/219	As Received:	46,341	.89	14.54	2.04	22.82
	Passing I/M:	46,414	.44	7.60	1.61	27.31
IM8/220	As Received:	35,734	.82	9.38	.92	25.21
	Passing I/M:	35,820	.26	1.50	.88	26.92
IM8/221	As Received:	35,863	2.50	58.98	.57	24.47
	Passing I/M:	35,928	1.33	20.04	.49	26.28

APPENDIX D

Short-Test Results for the 107 Cars tested

Vehicle Number	Test Sequence	4-Mode Test: 1st Idle HC (ppm)	1st Idle CO (%)	2500 rpm HC (ppm)	2500 rpm CO (%)	2nd Idle HC (ppm)	2nd Idle CO (%)	Idle-in-Driv HC (ppm)	Idle-in-Driv CO (%)	Restart Test: 2500 rpm HC (ppm)	2500 rpm CO (%)	Idle-in-Neut HC (ppm)	Idle-in-Neut CO (%)
IM6/001	As Received:	450	5.70	40	.04	700	6.20	---	----	40	.04	650	6.75
	Passing I/M:	25	.04	25	.04	30	.02	---	----	30	.04	30	.04
IM5/002	As Received:	110	.15	20	.07	55	.09	160	.08	15	.03	35	.05
	Passing I/M:	30	.04	15	.15	20	.04	50	.06	10	.02	10	.02
IM6/004	As Received:	150	3.40	30	.20	150	3.40	200	3.40	150	.05	150	3.40
	Passing I/M:	20	.05	10	.04	40	.04	50	.10	10	.04	20	.06
IM5/005	As Received:	145	2.05	60	2.20	140	2.00	165	2.45	15	.38	138	1.95
	Passing I/M:	50	.10	23	.12	25	.05	100	.20	20	.10	50	.10
IM5/006	As Received:	300	8.20	170	5.00	285	7.95	---	----	150	4.00	280	7.60
	Passing I/M:	70	.10	10	.02	10	.02	---	----	12	.02	10	.02
IM6/007	As Received:	215	4.30	175	6.00	210	4.40	285	3.90	185	6.10	220	3.80
	Passing I/M:	21	.08	30	.20	20	.08	25	.07	30	.16	25	.06
IM6/008	As Received:	10	.04	10	.06	8	.04	---	----	10	.06	12	.03
	Passing I/M:	15	.02	5	.04	15	.03	---	----	10	.05	20	.03
IM5/009	As Received:	45	.02	10	.02	10	.02	12	.03	10	.21	20	.05
	Passing I/M:	20	.02	15	.03	10	.02	15	.02	10	.04	11	.02
IM5/012	As Received:	250	.12	12	.10	300	.08	115	.06	45	.10	265	.08
	Passing I/M:	10	.03	12	.20	8	.04	12	.05	15	.10	8	.04
IM5/013	As Received:	130	1.60	140	4.20	130	1.60	175	1.85	130	2.60	140	1.25
	Passing I/M:	5	.04	45	1.10	5	.04	5	.04	10	.03	5	.04
	Add. Repairs:	5	.02	5	.03	5	.02	5	.02	9	.02	9	.02
IM6/014	As Received:	10	.03	3	.03	5	.03	15	.03	5	.03	5	.03
	Passing I/M:	15	.02	8	.02	8	.02	18	.02	8	.02	8	.02
IM5/015	As Received:	10	.65	20	.25	70	.65	85	.70	20	.25	10	.75
	Passing I/M:	40	.55	20	.25	35	.60	10	.25	70	.04	70	.60
IM6/017	As Received:	30	.03	35	.02	40	.02	---	----	45	.03	50	.03
	Rejected after first FTP												

Vehicle Number	Test Sequence	4-Mode Test: --1st Idle-- HC (ppm)	--1st Idle-- CO (%)	--2500 rpm-- HC (ppm)	--2500 rpm-- CO (%)	--2nd Idle-- HC (ppm)	--2nd Idle-- CO (%)	Idle-in-Driv HC (ppm)	Idle-in-Driv CO (%)	Restart Test: --2500 rpm-- HC (ppm)	--2500 rpm-- CO (%)	Idle-in-Neut HC (ppm)	Idle-in-Neut CO (%)
IM5/018	As Received:	170	2.50	60	1.70	100	2.50	160	4.00	60	2.20	70	2.50
	Passing I/M:	20	.04	19	.03	11	.04	10	.04	20	.03	12	.04
	Add. Repairs:	20	.02	20	.02	18	.02	10	.02	15	.02	12	.02
IM5/019	As Received:	500	7.25	40	.18	440	7.60	430	8.10	35	.05	440	6.90
	Passing I/M:	20	.05	10	.14	10	.05	10	.10	5	.02	7	.05
IM5/022	As Received:	460	.50	75	.25	250	.80	180	.80	150	1.20	330	.50
	Passing I/M:	190	.18	40	.30	50	.05	50	.08	65	.60	60	.05
	Add. Repairs:	350	.31	60	.30	220	.40	110	.09	70	.30	190	.20
IM5/023	As Received:	430	1.75	125	1.05	480	1.70	255	.75	80	.80	380	1.70
	Passing I/M:	300	.55	80	.70	325	.70	250	.50	85	.80	380	.80
IM5/027	As Received:	10	.03	20	.15	50	.10	50	.07	20	.10	20	.08
	Passing I/M:	20	.04	10	.06	5	.02	70	.06	10	.02	5	.03
IM5/028	As Received:	240	.19	100	1.40	220	.20	300	.15	130	2.30	185	.40
	Passing I/M:	5	.03	10	.12	5	.03	5	.03	5	.04	5	.03
IM5/029	As Received:	510	8.60	185	8.80	450	8.40	490	8.10	200	8.30	495	8.60
	FAILING I/M:	750	1.50	120	.70	600	1.40	480	1.30	100	.70	500	1.40
	Passing I/M:	50	.09	15	.30	50	.15	60	.23	10	.28	28	.12
IM5/030	As Received:	100	.40	15	.08	30	.48	75	.45	5	.03	50	1.10
	Passing I/M:	10	.03	10	.04	5	.03	5	.03	8	.04	5	.03
IM5/033	As Received:	170	4.80	25	.05	30	.65	150	4.60	95	.80	45	.75
	Passing I/M:	25	.03	10	.06	15	.03	12	.04	12	.04	11	.03
IM6/036	As Received:	365	6.40	55	.02	390	5.80	---	----	75	.05	370	6.00
	Passing I/M:	30	.07	28	.04	110	1.60	---	----	35	.04	135	1.70
	Add. Repairs:	20	.03	20	.04	15	.03	---	----	28	.04	20	.03
IM5/037	As Received:	210	.10	40	.25	200	.20	80	.08	35	.04	90	.07
	Passing I/M:	20	.05	30	.45	10	.04	35	.05	60	1.00	5	.03
IM5/038	As Received:	340	5.20	170	5.60	300	3.00	375	5.60	80	.70	260	4.60
	Passing I/M:	35	.04	40	1.00	35	.05	32	.04	50	1.00	90	1.10

Vehicle Number	Test Sequence	4-Mode Test: --1st Idle-- HC (ppm)	--1st Idle-- CO (%)	--2500 rpm-- HC (ppm)	--2500 rpm-- CO (%)	--2nd Idle-- HC (ppm)	--2nd Idle-- CO (%)	Idle-in-Driv HC (ppm)	Idle-in-Driv CO (%)	Restart Test: --2500 rpm-- HC (ppm)	--2500 rpm-- CO (%)	Idle-in-Neut HC (ppm)	Idle-in-Neut CO (%)
IM6/039	As Received:	60	.04	15	.03	50	.04	80	.24	25	.04	50	.04
	Passing I/M:	35	.03	18	.03	35	.03	30	.03	12	.04	10	.02
IM5/040	As Received:	5	.03	5	.06	5	.03	8	.05	10	.30	8	.04
	Passing I/M:	30	.04	22	.08	20	.04	20	.06	20	.30	18	.02
IM5/041	As Received:	110	1.20	23	.19	50	.60	185	1.20	40	.04	60	1.00
	Passing I/M:	100	.70	10	.10	20	.28	20	.10	28	.04	10	.20
IM6/042	As Received:	490	.03	100	.04	400	.03	---	----	100	.05	450	.02
	Rejected after first FTP												
IM6/043	As Received:	335	6.40	280	5.40	330	6.30	---	----	375	6.50	910	7.30
	Passing I/M:	30	.02	35	.02	15	.02	---	----	22	.02	10	.02
IM5/044	As Received:	255	3.30	25	.04	250	3.30	345	2.90	30	.04	235	3.30
	Passing I/M:	5	.04	5	.04	8	.04	5	.04	10	.04	15	.04
IM6/045	As Received:	220	1.70	230	4.20	210	1.80	250	1.40	250	4.40	220	1.70
	Passing I/M:	5	.03	15	.08	5	.03	5	.03	22	.07	10	.04
IM6/046	As Received:	255	5.30	180	4.10	1090	4.90	400	4.90	190	4.00	275	5.00
	Passing I/M:	25	.04	12	.04	15	.06	12	.12	5	.02	10	.02
IM5/048	As Received:	240	2.60	85	4.50	245	2.90	295	2.80	30	.05	40	.55
	Passing I/M:	70	.27	20	.22	15	.10	60	.10	10	.02	30	.20
IM5/049	As Received:	40	.08	18	.25	35	.08	35	.18	25	.25	225	.60
	Passing I/M:	130	.15	30	.10	155	.15	20	.02	50	.20	200	.50
IM6/051	As Received:	580	2.50	95	.02	570	2.50	600	3.70	50	.02	580	2.20
	Passing I/M:	25	.01	15	.01	20	.01	25	.01	15	.01	27	.01
IM5/052	As Received:	920	2.20	100	1.00	910	2.20	1000	2.40	100	2.10	250	2.10
	FAILING I/M:	1400	2.45	190	1.20	1300	2.30	1350	2.30	180	.30	1370	2.40
IM6/053	As Received:	600	1.80	80	.04	700	1.70	300	1.90	90	.05	750	1.70
	Passing I/M:	150	.04	50	.04	100	.04	85	.04	110	.04	105	.04

Vehicle Number	Test Sequence	4-Mode Test: 1st Idle HC (ppm)	1st Idle CO (%)	2500 rpm HC (ppm)	2500 rpm CO (%)	2nd Idle HC (ppm)	2nd Idle CO (%)	Idle-in-Driv HC (ppm)	Idle-in-Driv CO (%)	Restart Test: 2500 rpm HC (ppm)	2500 rpm CO (%)	Idle-in-Neut HC (ppm)	Idle-in-Neut CO (%)
IM6/054	As Received:	210	2.00	65	.04	200	2.30	300	1.20	70	.04	230	1.80
	Passing I/M:	85	.05	30	.04	80	.04	110	.04	30	.03	80	.03
IM6/056	As Received:	68	.30	40	.20	80	.35	---	----	45	.25	90	.42
	Passing I/M:	125	.18	80	.25	120	.18	---	----	60	.32	130	.19
IM6/057	As Received:	65	.08	130	2.60	70	.09	120	.15	140	2.60	170	.10
	Passing I/M:	90	.06	120	2.26	80	.06	120	.05	140	2.20	100	.06
IM7/101	As Received:	65	.15	130	.20	270	.20	175	.20	150	.20	250	.20
	FAILING I/M:	40	.08	75	.10	130	.04	130	.10	110	.08	140	.04
	Passing I/M:	10	.05	10	.04	15	.05	20	.07	10	.03	10	.07
IM7/102	As Received:	10	.05	15	.04	600	.50	10	.05	10	.04	600	.50
	Passing I/M:	10	.03	45	.12	10	.05	10	.03	50	.20	10	.03
IM8/103	As Received:	50	.03	25	.05	70	.03	---	----	30	.06	80	.03
	Passing I/M:	30	.03	30	.07	15	.03	---	----	30	.07	28	.03
IM7/105	As Received:	15	.04	10	.03	10	.03	5	.03	10	.05	10	.03
	Passing I/M:	10	.03	10	.03	8	.03	8	.03	15	.03	10	.03
IM7/107	As Received:	5	.03	10	.03	5	.03	5	.02	10	.03	8	.03
	Passing I/M:	20	.05	10	.04	10	.04	10	.04	25	.04	10	.04
IM7/108	As Received:	315	2.45	50	.04	280	2.63	400	2.90	35	.04	250	2.25
	Passing I/M:	25	.03	25	.03	15	.03	25	.03	40	.03	15	.03
IM7/109	As Received:	360	8.80	80	.28	320	6.20	380	9.00	90	.20	250	8.00
	Passing I/M:	10	.05	12	.05	8	.04	8	.04	20	.05	15	.05
IM8/110	As Received:	45	1.00	130	.05	35	.80	---	----	250	.06	35	1.40
	Passing I/M:	30	.04	25	.04	45	.03	---	----	30	.04	40	.04
IM8/113	As Received:	60	.08	40	.35	80	.40	---	----	60	.18	100	.42
	Passing I/M:	40	.04	35	.19	55	.23	---	----	30	.14	70	.42
IM7/114	As Received:	25	.05	30	.04	20	.04	50	.03	30	.05	10	.04
	Rejected after first FTP												

Vehicle Number	Test Sequence	4-Mode Test: --1st Idle-- HC (ppm)	--1st Idle-- CO (%)	--2500 rpm-- HC (ppm)	--2500 rpm-- CO (%)	--2nd Idle-- HC (ppm)	--2nd Idle-- CO (%)	Idle-in-Driv HC (ppm)	Idle-in-Driv CO (%)	Restart Test: --2500 rpm-- HC (ppm)	--2500 rpm-- CO (%)	Idle-in-Neut HC (ppm)	Idle-in-Neut CO (%)
IM7/115	As Received:	330	.12	5	.03	75	.10	160	.09	5	.03	120	.09
	Passing I/M:	30	.02	12	.02	28	.02	20	.02	12	.02	28	.03
IM7/117	As Received:	200	.21	20	.13	150	.19	---	----	20	.10	220	.15
	Passing I/M:	165	.21	10	.05	150	.19	---	----	12	.10	190	.10
IM8/119	As Received:	250	2.50	190	2.10	240	2.50	290	3.00	150	1.20	250	2.40
	Passing I/M:	35	.03	12	.02	40	.03	40	.03	20	.03	38	.02
IM8/122	As Received:	110	2.80	76	2.50	105	2.60	---	----	85	2.40	110	2.60
	Passing I/M:	70	.04	90	2.25	60	.04	---	----	110	3.40	95	.60
	Add. Repairs:	30	.03	45	.40	30	.04	---	----	50	.50	40	.04
IM8/123	As Received:	380	7.60	600	10.00	100	2.80	---	----	235	7.40	860	7.50
	Passing I/M:	10	.02	10	.02	8	.02	---	----	10	.03	5	.02
IM7/124	As Received:	165	.50	65	.10	75	.60	200	.70	150	.12	180	.80
	Passing I/M:	25	.12	65	.12	40	.23	70	.13	70	.08	30	.31
IM8/125	As Received:	870	1.00	255	7.70	1080	2.45	---	----	280	8.00	1130	2.15
	Passing I/M:	10	.04	10	.06	10	.03	---	----	10	.04	10	.03
IM7/131	As Received:	15	.03	10	.03	5	.03	15	.02	10	.03	8	.02
	Passing I/M:	5	.02	5	.02	0	.01	5	.01	45	.02	3	.02
IM8/134	As Received:	20	.04	20	.04	15	.03	---	----	40	.04	20	.04
	Passing I/M:	20	.03	18	.02	10	.02	---	----	21	.02	10	.02
IM7/135	As Received:	75	.50	10	.05	50	.28	170	.10	10	.20	50	.10
	Passing I/M:	110	.20	18	.08	20	.10	150	.08	18	.08	30	.40
IM8/136	As Received:	265	.31	25	.08	330	.34	---	----	80	.50	375	.30
	Passing I/M:	25	.03	60	.70	35	.04	---	----	100	1.25	60	.05
IM7/137	As Received:	660	.70	300	1.00	620	.85	760	1.10	220	.80	650	.75
	Passing I/M:	605	.28	200	1.00	570	.23	500	.20	250	.68	570	.28
IM8/138	As Received:	220	.18	15	.03	150	.10	---	----	20	.03	150	.12
	Passing I/M:	100	.12	10	.03	20	.07	---	----	12	.03	25	.08

Vehicle Number	Test Sequence	4-Mode Test: 1st Idle HC (ppm)	1st Idle CO (%)	2500 rpm HC (ppm)	2500 rpm CO (%)	2nd Idle HC (ppm)	2nd Idle CO (%)	Idle-in-Driv HC (ppm)	Idle-in-Driv CO (%)	Restart Test: 2500 rpm HC (ppm)	2500 rpm CO (%)	Idle-in-Neut HC (ppm)	Idle-in-Neut CO (%)
IM8/139	As Received:	80	.60	30	.20	90	.95	---	----	50	.40	125	.78
	Passing I/M:	185	.32	30	.30	130	.30	---	----	60	.20	120	.40
IM8/140	As Received:	40	.08	28	.23	25	.09	---	----	40	.18	30	.07
	Passing I/M:	28	.04	30	.08	20	.03	---	----	35	.08	22	.04
IM8/141	As Received:	138	5.70	40	.05	130	5.60	75	3.90	15	.06	110	6.10
	Passing I/M:	15	.02	20	.02	15	.02	10	.02	20	.02	20	.02
IM7/143	As Received:	440	9.60	45	.12	20	.07	220	5.00	80	1.70	20	.05
	Passing I/M:	10	.04	15	.04	10	.04	5	.04	30	.04	20	.04
IM8/144	As Received:	275	5.60	185	3.00	275	5.00	---	----	160	2.60	265	4.80
	Passing I/M:	40	.03	30	.02	20	.02	---	----	20	.02	20	.02
IM8/145	As Received:	520	9.20	175	4.60	430	8.70	---	----	180	4.70	440	8.60
	Passing I/M:	55	.08	30	.05	28	.05	---	----	120	2.30	50	.09
	Add. Repairs:	45	.03	55	.09	45	.03	---	----	45	.08	45	.05
IM8/147	As Received:	15	.04	10	.04	8	.04	---	----	15	.05	10	.04
	Passing I/M:	10	.03	20	.05	10	.03	---	----	12	.05	5	.03
IM7/148	As Received:	125	1.63	400	.60	680	.65	190	1.60	450	.30	720	.49
	Passing I/M:	60	.45	25	.14	320	.25	190	.30	60	.35	230	.20
IM7/150	As Received:	150	.20	15	.03	120	.25	90	.15	130	6.40	180	6.00
	Passing I/M:	15	.02	20	.02	10	.02	10	.02	20	.02	15	.02
IM8/151	As Received:	215	4.60	45	.09	180	4.70	35	.08	75	2.40	175	4.60
	Passing I/M:	10	.03	8	.05	6	.03	10	.04	50	2.35	10	.03
	Add. Repairs:	10	.04	10	.06	10	.05	10	.04	15	.06	8	.04
IM7/153	As Received:	700	.18	60	.70	600	.17	285	.10	80	.17	500	.18
	Passing I/M:	170	.39	45	.75	175	.30	170	.30	40	.15	250	.25
	Add. Repairs:	220	.32	50	.60	280	.40	160	.18	30	.40	200	.20
IM8/154	As Received:	75	4.30	50	.06	50	3.40	60	5.60	60	.35	70	4.40
	Passing I/M:	15	.04	20	.03	20	.03	10	.55	25	.03	15	.04

Vehicle Number	Test Sequence	4-Mode Test: --1st Idle-- HC (ppm)	--1st Idle-- CO (%)	--2500 rpm-- HC (ppm)	--2500 rpm-- CO (%)	--2nd Idle-- HC (ppm)	--2nd Idle-- CO (%)	Idle-in-Driv HC (ppm)	Idle-in-Driv CO (%)	Restart Test: --2500 rpm-- HC (ppm)	--2500 rpm-- CO (%)	Idle-in-Neut HC (ppm)	Idle-in-Neut CO (%)
IM8/159	As Received:	28	.04	15	.05	25	.04	90	1.50	15	.06	25	.04
	Passing I/M:	55	.60	12	.04	65	1.25	15	.03	12	.03	90	.75
IM7/164	As Received:	325	3.60	50	.10	290	3.40	325	3.80	110	.05	265	3.20
	Passing I/M:	25	.02	25	.02	20	.02	15	.02	20	.04	20	.03
IM8/166	As Received:	305	.16	110	.80	300	.30	---	----	130	.90	320	.70
	Passing I/M:	180	.08	60	.45	235	.08	---	----	95	.40	230	.07
IM7/167	As Received:	700	.90	220	.58	700	.80	485	.48	155	.40	450	.21
	Rejected after first FTP												
IM8/168	As Received:	180	3.20	165	2.60	180	3.00	230	3.60	185	2.60	180	3.10
	Passing I/M:	18	.03	8	.02	18	.03	15	.03	8	.03	20	.03
IM7/169	As Received:	190	3.60	460	7.50	41	3.10	---	----	420	7.60	220	4.00
	Passing I/M:	40	.06	210	3.10	30	.05	---	----	210	3.40	30	.05
IM8/170	As Received:	580	9.50	60	.05	610	9.60	---	----	65	.05	690	9.70
	Passing I/M:	32	.05	45	.05	30	.05	---	----	40	.05	22	.04
IM8/171	As Received:	290	2.95	190	3.45	280	3.30	340	3.00	190	3.10	260	3.00
	Passing I/M:	40	.03	50	.04	40	.03	50	.03	50	.05	45	.02
IM7/172	As Received:	285	2.60	50	.18	285	2.80	305	2.75	40	.03	330	1.60
	Passing I/M:	270	2.10	30	.20	255	2.20	255	1.85	25	.01	230	1.40
	Add. Repairs:	150	.10	30	.20	50	.10	60	.10	20	.04	30	.04
IM8/178	As Received:	22	.07	10	.04	12	.04	---	----	15	.04	18	.04
	Passing I/M:	20	.04	12	.03	30	.08	---	----	15	.03	20	.03
IM8/181	As Received:	200	.10	20	.10	270	.20	---	----	40	.10	350	.20
	Passing I/M:	170	.30	15	.10	250	.15	---	----	20	.18	220	.10
IM8/183	As Received:	30	.08	45	.08	25	.04	---	----	35	.10	30	.18
	Passing I/M:	20	.03	28	.08	10	.03	---	----	5	.10	10	.03
IM8/184	As Received:	35	.05	55	.04	50	.04	30	.07	40	.03	50	.04
	Passing I/M:	30	.04	40	.04	45	.03	50	.03	60	.06	50	.03

Vehicle Number	Test Sequence	4-Mode Test: --1st Idle-- HC (ppm)	--1st Idle-- CO (%)	--2500 rpm-- HC (ppm)	--2500 rpm-- CO (%)	--2nd Idle-- HC (ppm)	--2nd Idle-- CO (%)	Idle-in-Driv HC (ppm)	Idle-in-Driv CO (%)	Restart Test: --2500 rpm-- HC (ppm)	--2500 rpm-- CO (%)	Idle-in-Neut HC (ppm)	Idle-in-Neut CO (%)
IM8/186	As Received:	47	.03	35	.03	40	.02	---	----	28	.02	40	.01
	Passing I/M:	35	.02	20	.02	25	.01	---	----	25	.02	30	.01
IM8/190	As Received:	160	4.20	20	.03	160	4.20	---	----	70	.60	170	3.90
	Passing I/M:	60	.02	60	.02	55	.02	---	----	50	.02	50	.02
IM8/191	As Received:	1330	.65	170	.30	1500	.85	---	----	270	.20	1330	.80
	Rejected after first FTP												
IM8/195	As Received:	255	5.50	270	6.10	280	5.15	275	5.90	250	5.90	270	4.90
	Passing I/M:	32	1.20	65	.45	65	1.30	40	1.60	82	.45	70	1.30
IM8/196	As Received:	290	6.40	260	9.00	520	7.40	---	----	430	10.00	580	7.30
	Passing I/M:	20	.03	20	.04	20	.02	---	----	50	.05	20	.03
IM8/200	As Received:	85	.15	80	.23	95	1.30	---	----	65	.80	90	1.35
	Passing I/M:	42	.01	40	.20	38	.01	---	----	58	.50	40	.02
IM7/201	As Received:	1500	10.00	430	5.80	1630	9.60	950	9.80	240	.10	880	9.30
	Rejected after first FTP												
IM8/202	As Received:	820	7.90	320	7.10	340	3.20	490	8.20	320	6.30	860	7.40
	Passing I/M:	90	.03	40	.10	55	.03	45	.03	35	.13	60	.03
IM7/203	As Received:	500	.75	150	.75	500	.75	280	.60	200	.25	430	.75
	FAILING I/M:	440	.80	100	.70	400	.70	350	.60	200	.15	440	.12
	Passing I/M:	20	.05	20	.08	20	.04	20	.05	20	.04	20	.04
IM8/209	As Received:	370	4.20	150	1.80	340	3.70	340	4.00	200	3.20	360	3.20
	Passing I/M:	25	.05	20	.05	30	.04	30	.04	20	.04	30	.04
IM8/210	As Received:	1540	10.00	270	.05	1450	10.00	800	10.00	150	.05	1380	10.00
	Passing I/M:	1500	10.00	170	.04	1000	10.00	630	10.00	150	.04	80	.04
IM8/212	As Received:	400	.10	90	.40	220	.08	180	.08	80	.25	70	.07
	Passing I/M:	460	.09	90	.60	370	.08	260	.05	80	.60	360	.05
IM8/214	As Received:	120	1.00	30	.05	100	.90	---	----	30	.04	160	2.60
	Passing I/M:	40	.30	25	.05	100	1.60	---	----	30	.04	100	.80

Vehicle Number	Test Sequence	4-Mode Test: --1st Idle-- HC (ppm)	--1st Idle-- CO (%)	--2500 rpm-- HC (ppm)	--2500 rpm-- CO (%)	--2nd Idle-- HC (ppm)	--2nd Idle-- CO (%)	Idle-in-Driv HC (ppm)	Idle-in-Driv CO (%)	Restart Test: --2500 rpm-- HC (ppm)	--2500 rpm-- CO (%)	Idle-in-Neut HC (ppm)	Idle-in-Neut CO (%)
IM8/215	As Received:	300	4.00	60	.04	270	4.20	---	----	80	.20	300	3.90
	Passing I/M:	20	.10	20	.12	25	.20	---	----	18	.10	20	.08
IM8/216	As Received:	20	.10	30	.50	20	.20	---	----	30	.70	20	.08
	Passing I/M:	35	.02	50	.40	30	.02	---	----	30	.70	20	.01
IM8/219	As Received:	100	1.30	40	.15	120	1.20	110	2.70	35	.12	120	1.10
	Passing I/M:	20	.04	25	.04	20	.04	20	.03	30	.04	25	.03
IM8/220	As Received:	480	4.00	220	4.00	500	4.50	---	----	240	3.50	530	4.20
	Passing I/M:	28	.04	25	.04	28	.04	---	----	20	.04	22	.04
IM8/221	As Received:	480	8.50	320	6.00	500	9.00	450	8.00	320	5.50	480	8.00
	Passing I/M:	30	.04	180	2.20	30	.04	100	.08	180	2.00	40	.04

APPENDIX E

Description of the Repairs Performed on the 101 Cars Repaired in This Program

Vehicle Number	Repaired To:	Repair Time H:M	Parts ($)	MD I/M Failure	Type of Repairs
IM6/001	Pass I/M	0:30	0	HC & CO	Reset idle mixture & curb idle.
IM5/002	Pass I/M	1:15	0	HC & CO	Reset idle mixture dwell (after removing plug).
IM6/004	Pass I/M	2:00	150	HC & CO	New air pump & belt. Cleaned choke area.
IM5/005	Pass I/M	2:30	420	HC & CO	Set ISC to spec. Replaced: ECM, PCV hose, #2 spark plug wire, mixture solenoid, & TPS sensor.
IM5/006	Pass I/M	2:00	550	HC & CO	Reset idle mixture dwell (after removing plug). Replaced: ECM, O_2 sensor, & TPS sensor.
IM6/007	Pass I/M	0:30	260	CO	Replaced ECM.
IM6/008	Pass I/M	0:30	150	CO	Replaced O_2 sensor & missing air filter.
IM5/009	Pass I/M	2:00	50	CO	Replaced upstream check valve & pipe assembly.
IM5/012	Pass I/M	1:00	80	HC	Set: fast & curb idles, timing, & idle mixture dwell. Replaced PAIR shut-off solenoid & reconnect PAIR hose to air cleaner.
IM5/013	Pass I/M	15:00	450	CO	Replaced ECM, PROM, & mixture solenoid. Mixture plug removed & reset idle mixture.
	AFTER	1:00	50		Replaced O_2 sensor.

Vehicle Number	Repaired To:	Repair Time H:M	Parts ($)	MD I/M Failure	Type of Repairs
IM6/014	Pass I/M	0:30	0	HC & CO	Reconnected EGR.
IM5/015	Pass I/M	0:30	0	HC	Reset mixture solenoid dwell.
IM5/018	Pass I/M	0:00*	0	CO	Replaced O_2 sensor, upstream check valve, & throttle spring (for TPS).
		(Repairs were covered by Warranty and were estimated to be 2:00 hours and $100)			
	AFTER	1:00	0		Reset ISC motor.
IM5/019	Pass I/M	2:30	390	HC & CO	Replaced ECM, PROM, & TPS.
IM5/022	Pass I/M	2:00	30	HC & CO	Replaced O_2 sensor. Reset idle mixture dwell.
	AFTER	1:30	310		Replaced ECM.
IM5/023	Pass I/M	1:30	0	CO	Reset idle mixture.
IM5/027	Pass I/M	1:00	35	CO	Replaced O_2 sensor.
IM5/028	Pass I/M	0:30	0	HC & CO	Replace PCV valve & hose. Reset idle mixture dwell.
IM5/029	ALMOST	4:00	350	HC & CO	Reset timing. Replace: mixture solenoid, idle air bleed, AIR (check valve, tube, & upstream pipe), O_2 sensor, TPS, & EGR.
	Pass I/M	2:00	250		Replace catalyst.
IM5/030	Pass I/M	0:30	0	HC	Reset idle mixture (using air bleed screw).
IM5/033	Pass I/M	0:30	0	HC & CO	Reset idle mixture dwell.

Vehicle Number	Repaired To:	Repair Time H:M	Parts ($)	MD I/M Failure	Type of Repairs
IM6/036	Pass I/M	1:00	140	HC & CO	Replaced O_2 sensor & all spark plug wires. Reset idle mixture & curb idle. Repaired fresh air tube.
	AFTER	0:30	0		Repaired leak in diverter valve. Reset curb idle (again).
IM5/037	Pass I/M	1:00	0	HC & CO	Cleaned corroded distributor cap. Reset idle speed & timing.
IM5/038	Pass I/M	1:00	0	HC & CO	Cleaned idle air bleed. Removed mixture plug & reset dwell.
IM6/039	Pass I/M	0:30	0	HC	Reset idle speed & timing.
IM5/040	Pass I/M	0:30	0	CO	Cleaned distributor cap. Reset idle speed. Replaced vacuum hose to vacuum break.
IM5/041	Pass I/M	1:00	0	CO	Reset idle mixture (using air bleed screw).
IM6/043	PRIOR	0:00*	0	HC & CO	Replaced defective (leaky) exhaust system prior to FTP.
		(Warranty repairs were performed by dealer and estimated to be 1:00 hours and $120)			
	Pass I/M	1:00	250		Replaced carburetor.
IM5/044	Pass I/M	0:30	0	CO	Reset idle mixture & speed.

Vehicle Number	Repaired To:	Repair Time H:M	Parts ($)	MD I/M Failure	Type of Repairs
IM6/045	PRIOR	1:30	110	HC	Repair leaky exhaust system prior to FTP.
	Pass I/M	1:00	0		Reconnected O_2 sensor. Reset: idle mixture, timing, and idle speed.
IM6/046	Pass I/M	2:00	265	HC & CO	Replaced: ECM, O_2 sensor, PCV valve & filter, AIR bypass solenoid, & AIR management valve.
IM5/048	Pass I/M	2:00	70	HC & CO	Replaced: air pump check valve, air filter, PCV filter, & O_2 sensor.
IM5/049	Pass I/M	1:00	12	HC	Replaced air filter & canister filter.
IM6/051	Pass I/M	0:10	0	HC & CO	Reset idle speed.
IM5/052	ALMOST	6:00	800	HC & CO	Replaced: carb, O_2 sensor, PCV valve & filter, 8 spark plugs & 2 wires, oil & oil filter, air filter, canister filter, & check valve. (Ran out of time on contract.)
IM6/053	Pass I/M	1:00	0	HC & CO	Reset idle mixture.
IM6/054	PRIOR	1:00	50	HC & CO	Replaced defective ignition module prior to FTP.
	Pass I/M	0:15	1		Reset idle mixture. Repaired leaky vacuum lines in AIR system.

Vehicle Number	Repaired To:	Repair Time H:M	Parts ($)	MD I/M Failure	Type of Repairs
IM6/056	Pass I/M	1:30	12	CO	Replaced pulse AIR filters. Reset: idle timing, idle mixture (after removing plug), & idle speed.
IM6/057	Pass I/M	2:00	130	HC	Repaired power brake booster (vacuum leak). Reset idle speed.
IM7/101	ALMOST	1:30	41	HC	Replaced: O_2 sensor, check valve for upstream air, & upstream air pipe.
	Pass I/M	1:30	250		New catalyst (Plumb-tesmo positive).
IM7/102	Pass I/M	1:30	37	HC	Reset ISC motor. Secured distributor cap. Replaced EGR.
IM8/103	Pass I/M	1:15	0	CO	Reset idle mixture & curb idle. Cleaned choke area.
IM7/105	Pass I/M	0:20	35	CO	Replaced O_2 sensor.
IM7/107	Pass I/M	0:20	19	CO	Reset curb idle. Replaced dirty air filter.
IM7/108	Pass I/M	0:30	0	CO	Reset curb idle.
IM7/109	Pass I/M	0:30	45	HC & CO	Replaced O_2 sensor.
IM8/110	Pass I/M	1:30	95	CO	Replaced: spark plug wire,distributor cap, rotor, coil, & coil wire. Reset idle mixture (after removing plug).
IM8/113	Pass I/M	0:30	10	HC	Replaced broken #3 plug wire.

Vehicle Number	Repaired To:	Repair Time H:M	Parts ($)	MD I/M Failure	Type of Repairs
IM7/115	Pass I/M	0:30	0	HC	Removed BBs from AIR management line.
IM7/117	Pass I/M	0:30	0	HC	Reinstalled plug wire & repaired boot.
IM8/119	Pass I/M	0:30	0	CO	EGR hose reconnected, repaired vacuum line to dump valve.
IM8/122	Pass I/M	1:30	10	CO	Reset curb idle. Repaired vacuum hoses to: EGR, AIR, canister purge, & vacuum advance.
	AFTER	0:30	0		Repaired small leak at TVS.
IM8/123	Pass I/M	1:00	0*	HC & CO	Replaced O_2 sensor. (Repairs were covered by Warranty and were estimated to be $30.)
IM7/124	Pass I/M	1:00	40	CO	Replaced O_2 sensor & radiator cap.
IM8/125	Pass I/M	1:30	10	HC	Reset timing & idle parameters. Replaced air pump belt. Tightened check valve connection.
IM7/131	Pass I/M	1:30	260	HC	Replaced ECM. Reset timing.
IM8/134	Pass I/M	0:30	0	HC & CO	Reset curb idle.
IM7/135	Pass I/M	0:30	0	HC & CO	Reconnected ported signal hose.
IM8/136	Pass I/M	0:30	0	HC	Reset curb idle.
IM7/137	Pass I/M	4:00	90	HC & CO	Rebuilt carb. Replaced: vacuum break & O_2 sensor.
IM8/138	Pass I/M	0:30	0	HC	Reset idle speed.

Vehicle Number	Repaired To:	Repair Time H:M	Parts ($)	MD I/M Failure	Type of Repairs
IM8/139	Pass I/M	1:00	0	CO	Reset timing & mixture (after removing plug).
IM8/140	PRIOR	2:00	100	HC & CO	Repair leaky exhaust system prior to FTP.
	Pass I/M	0:30	120		Replaced O_2 sensor.
IM8/141	Pass I/M	0:30	0	CO	Reset idle mixture.
IM7/143	PRIOR	1:00	80	CO	Repair leaky exhaust system prior to FTP.
	Pass I/M	0:30	35		Replace O_2 sensor.
IM8/144	Pass I/M	1:30	10	HC & CO	Reset idle mixture. Replaced TVS for AIR.
IM8/145	Pass I/M	1:00	0	HC & CO	Reconnected hoses to VOTM (in carb) & to TAC. Reset idle speed & idle mixture.
	AFTER	1:30	35		Replaced TVS switch.
IM8/147	Pass I/M	0:10	0	CO	Reset idle speed.
IM7/148	Pass I/M	3:00	330	HC & CO	Corrected hoses to EFE & TAC. Replaced: ECM, PROM, & air pump belt.
IM7/150	Pass I/M	1:00	44	HC	Replace TPS.
IM8/151	Pass I/M	0:30	0	CO	Reset idle mixture.
	AFTER	0:30	110		Replace O_2 sensor.
IM7/153	Pass I/M	1:00	0	HC	Reset carb. mixture screws & dwell.
	AFTER	1:00	275		Replaced ECM.
IM8/154	Pass I/M	0:30	0	CO	Reset idle mixture. Reconnect bowl vent hose.

Vehicle Number	Repaired To:	Repair Time H:M	Parts ($)	MD I/M Failure	Type of Repairs
IM8/159	Pass I/M	1:00	15	CO	Replaced filter air and PAIR filter. Reset idle speed after replacing filters.
IM7/164	Pass I/M	0:30	0	HC & CO	Reconnected hoses to vacuum break & to hot air door. Removed plug & reset mixture dwell.
IM8/166	Pass I/M	0:30	20	HC & CO	Reset idle speed. Replaced dirty air filter & cracked distributor cap.
IM8/168	Pass I/M	2:00	0	CO	Reset idle mixture (after removing plug).
IM7/169	Pass I/M	3:00	275	HC & CO	Replaced: air filter, ECM, & O_2 sensor.
IM8/170	Pass I/M	2:00	10	HC & CO	Replaced all spark plugs. Reset: idle speed, idle mixture, & idle timing.
IM8/171	Pass I/M	1:00	0	CO	Repaired vacuum lines. Reset idle speed & timing.
IM7/172	Pass I/M	2:00	88	HC & CO	Replaced check valves & tubes for AIR.
	AFTER	3:20	0		Reset: idle speed, idle mixture, & curb idle.
IM8/178	Pass I/M	2:00	125	HC & CO	Replaced O_2 sensor.
IM8/181	Pass I/M	1:00	0	HC	Reset idle speed & idle mixture.
IM8/183	Pass I/M	0:30	0	CO	Reset idle speed.

Vehicle Number	Repaired To:	Repair Time H:M	Parts ($)	MD I/M Failure	Type of Repairs
IM8/184	PRIOR	2:00	125	HC & CO	Repair leaky exhaust system prior to FTP.
	Pass I/M	0:10	0		Reset idle speed.
IM8/186	Pass I/M	1:10	8	HC & CO	Replaced air filter. Reset idle speed & idle mixture.
IM8/190	Pass I/M	1:00	0	CO	Reset idle speed & idle mixture.
IM8/195	Pass I/M	2:00	60	CO	Reset idle timing & idle speed. Replaced AIR management valve.
IM8/196	Pass I/M	1:00	30	HC & CO	Replaced O_2 sensor.
IM7/200	Pass I/M	2:00	0	CO	Removed idle mixture adjustment limiter plug & reset idle mixture.
IM8/202	Pass I/M	1:00	30	HC & CO	Replaced O_2 sensor.
IM7/203	ALMOST	4:00	110	HC Only	Replaced: spark plug wires, O_2 sensor, and check valve & tubes. Reset idle mixture. Canister hoses reconnected.
	Pass I/M	2:00	300		Replaced catalyst.
IM8/209	Pass I/M	0:30	35	CO Only	Replaced O_2 sensor.
IM8/210	Pass I/M	0:30	0	HC & CO	Reconnected dump valve in AIR system.
IM8/212	Pass I/M	0:30	35	HC Only	Replaced electric choke.
IM8/214	PRIOR	1:00	125	CO Only	Repair leaky exhaust system prior to FTP.
	Pass I/M	1:50	140		Replaced electronic timing module. Reset curb idle speed.

Vehicle Number	Repaired To:	Repair Time H:M	Parts ($)	MD I/M Failure	Type of Repairs
IM8/215	Pass I/M	1:00	10	CO Only	Replaced air filter. Freed up the choke. Reset idle mixture (after removing plug) and idle speed.
IM8/216	Pass I/M	0:30	0	CO Only	Reset idle speed.
IM8/219	Pass I/M	1:00	0	CO Only	Reset idle mixture (after removing plug).
IM8/220	Pass I/M	1:00	0	HC & CO	Reset idle speed. Reconnected hose to air bleed check valve. Unpinched hose to accel pump.
IM8/221	Pass I/M	1:00	0	HC & CO	Reset idle mixture and idle speed.

APPENDIX F

EG&G Mechanic's Narrative Comments

Vehicle Number	Test Sequence	Mechanic's Comments
IM6/001	As Received:	Idle mixture limiting device is missing. Idle mixture is too rich. Idle speed is 200 rpm above the spec.
	Passing I/M:	Idle CO adjusted to 1.5%. Curb idle set to 800 rpm. Reinspection results: HC=124 ppm CO=0.18%.
IM5/002	As Received:	Idle CO is OK, but mixture dwell is at upper limits, about 50 (54 is max). Initial lane results: HC=260 ppm CO=2.49%.
	Passing I/M:	Idle mixture plug removed & dwell set to spec of 30. Reinspection results: HC=19 CO=0.07; not a good candidate for third sequence testing.
IM6/004	As Received:	Air pump is frozen & belt is broken. Upstream air hose clamp is missing. Carburetor is exceptionally dirty. Initial lane results: HC=267 CO=5.97.
	Passing I/M:	Choke area cleaned. New air pump & belt installed. Upstream air hose clamped tightly. Reinspection results: HC=30 CO=0.02.
IM5/005	As Received:	PCV hose kinked shut. Both canister purge hose and EFE hose are off at temp switch, also incorrect switch has been installed (2 port switch should be a 4 port switch). Number 2 plug wire is cut. Mixture solenoid inoperative. 6 deg fixed dwell. ECM is bad. Diagnostic bulb had been removed. Throttle position sensor is inoperative. Idle CO is rich. EGR valve is stuck open/closed. Canister is coated with fuel. Load sensor has high resistance. Idle speed control is bad. Air/fuel control stepper motor is stuck. Inspection results: HC=315, CO=4.88.
	Passing I/M:	PCV hose replaced (kinked shut). New EFE/canister purge temp switch installed and all hoses connected. #2 plug wire replaced. New ECM & mixture solenoid installed. New check bulb installed. Idle CO is OK (<0.5). Build date is not available. Replaced TPS sensor. The ISC was set to spec. EGR valve is stuck open/closed. Canister is saturated with fuel. Reinspection results: HC=106 ppm, CO=0.01%.

Vehicle Number	Test Sequence	Mechanic's Comments
IM5/006	As Received:	The TPS sensor is bad & the ECM computer is not operative. Code 21 is present (TPS). Mixture dwell remains at 6 at all times. EGR valve is stuck open/closed. Build date is not available. Inspection lane results: HC=729 ppm, CO=10.01%.
	Passing I/M:	New ECM & TPS sensor installed. Idle CO is now .04. Dwell is no longer fixed at 6 degrees. Build date is not available. Installed new O2 sensor since old one had very "slow" reaction time. Removed mixture plug & "centered" dwell. Reinspection results: HC=78 ppm, CO=0.09%.
IM6/007	As Received:	The computer timer system is bad, sending signal to solenoid switch to dump air continuously. ECM will not go into test mode. Engine oil is excessively dirty. Initial lane results: HC=159ppm, CO=1.53%.
	Passing I/M:	New ECM unit installed, does not dump air continuously, CO is now .01. Engine has excessive external oil leakage. Reinspection results: HC=21 ppm, CO=0.01%.
IM6/008	As Received:	Idle tailpipe readings are too high and O2 sensor light is on. Idle CO is rich. No air filter element present. Excessive external oil leakage. Valve lash over spec. Vehicle passed our idle screening but was kept because the O2 sensor light was on. Initial inspection lane results: HC=169 ppm, CO=2.59%.
	Passing I/M:	New air filter & new O2 sensor installed; idle CO is .08. Reinspection results: HC=2 ppm, CO=0.01%.
IM5/009	As Received:	Upstream air pipe rusted; leaks air to O2 sensor. Fresh air duct is damaged. Initial inspection lane results: HC=117 ppm, CO=1.81%.
	Passing I/M:	Replaced upstream check valve & pipe assembly. Reinspection results: HC=92 ppm, CO=0.30%.

Vehicle Number	Test Sequence	Mechanic's Comments
IM5/012	As Received:	Carburetor very dirty, may have been on fire. Timing advanced too much. EGR valve not working. Idle speed is high. Pulse air shut-off solenoid rusted open allowing air into exhaust upstream of O2 sensor. Initial inspection results: HC=300 ppm, CO=0.05%. Idle mixture limiting device is broken off.
	Passing I/M:	Set fast idle & curb idle. Set timing. EGR valve is broken. Replaced pulse air shut-off solenoid. Set idle mixture dwell. Reinspection results: HC=39 ppm, CO=0.03%. Reconnected pulse air hose to air cleaner.
IM5/013	As Received:	ECM may be bad, dwell 6 deg always. Packet delayed for completion of maintenance. Initial inspection lane results: HC=144 ppm, CO=2.77%.
	Passing I/M:	New ECM installed, trouble codes 23, 41, 51, 54 present. New PROM installed. New mixture solenoid installed, mixture plug removed & set. Reinspection results: HC=7 ppm, CO=0.03%.
	Add. Repairs:	O2 sensor replaced, very heavily corroded.
IM6/014	As Received:	Engine is very dirty & leaks oil. EGR hose is plugged. Carburetor or catalyst may have been loaded up during idle test; choke stuck, etc. Initial inspection lane results: HC=239 ppm, CO=5.37%.
	Passing I/M:	EGR reconnected. Reinspection results: HC=0 ppm, CO=0.02%.
IM5/015	As Received:	Idle air bleed screw is misadjusted. Mixture dwell on high end of scale. Initial inspection lane results: HC=350 ppm, CO=0.6%.
	Passing I/M:	Set mixture solenoid dwell to center of band 30 deg. Reinspection results: HC=20 ppm, CO=0.75%.

Vehicle Number	Test Sequence	Mechanic's Comments
IM6/017	As Received:	Blue smoke pours out of tailpipe. Probably needs valve job & rings. Valves very noisy. Initial inspection results HC=317, CO=0.78. Vehicle was rejected due to need for major engine work (valves & rings).
IM5/018	As Received:	O2 sensor is bad. Upstream check valve burned out. Throttle switch code present. Check engine light stays on. Initial inspection lane results: HC=66 ppm, CO=2.83%. Packet delayed for maintenance.
	Passing I/M:	O2 sensor replaced. Upstream check valve replaced. Throttle spring replaced; weak causing false TPS signal. Engine decarboned from rich condition. Reinspection results: HC=18 ppm, CO=0.03%. Repair costs covered by warranty.
	Add. Repairs:	Reset ISC motor with cruise control. Linkage disconnected. Idle speed was hanging up causing car to run richer than needed. FTP trace is out of spec on last hill due to brake failure.
IM5/019	As Received:	Idle CO & HC extremely high. Several codes present in computer. Initial inspection lane results: HC=427 ppm, CO=6.68%. Codes present: 25, 31, 32, 34, 44, 45, 51, 52, 54.
	Passing I/M:	New ECM & PROM installed which led to replacement of TPS (because codes 21 & 35 appeared). Tailpipe is clean now. Reinspection results: HC=6 ppm, CO=0.02%.
IM5/022	As Received:	Car stays in open loop. Vehicle has no emission label. Catalyst may be damaged. Canister filter is dirty. Oxygen sensor malfunction-rich. Initial inspection lane results: HC=451 ppm, CO=6.10%.
	Passing I/M:	O2 sensor replaced. Car now goes into closed loop. Idle bleed cover removed & dwell set. Catalyst still may be marginal. Vehicle has no emission label. Catalyst may be loaded up. Canister filter is dirty. Reinspection result: HC=67 ppm, CO=0.00%.
	Add. Repairs:	Car takes too long to go into closed loop. VSS code 24 now present. Replaced ECM. Car smokes blue smoke very bad. Maybe coating O2 sensor & affecting operation & temp. Vehicle has no emission label. Canister filter is dirty. Catalyst may bad.

Vehicle Number	Test Sequence	Mechanic's Comments
IM5/023	As Received:	All 5 mixture plugs are missing. Carburetor is way out of adjustment. Build date is not available. Initial inspection lane results: HC=173 ppm, CO=1.70%.
	Passing I/M:	Carburetor is out of spec-set parameters. Catalyst may have been damaged. No third sequence. Problem cannot be pinpointed. May be catalyst or carburetor. Build date is not available. Reinspection results: HC=157 ppm, CO=0.61%.
IM5/027	As Received:	Car appears OK, heavy deposits on O2 sensor. Initial inspection lane results: HC=169 ppm, CO=2.95%.
	Passing I/M:	Deposits on O2 sensor, replaced. Reinspection results: HC=18 ppm, CO=0.01%.
IM5/028	As Received:	Dwell fixed at 54 deg. PCV body is cracked & hose collapsed. "Emissions" flag is covering most of odometer. Initial inspection lane results: HC=247 ppm, CO=1.46%.
	Passing I/M:	Installed new PCV & hose. Set mixture dwell. Emissions flag is still covering odometer. Reinspection results: HC=9 ppm, CO=0.01%.
IM5/029	As Received:	Upstream air tube rusted in half. EGR valve inoperative, stuck open. TPS plunger stuck down (full rich). O2 sensor completely shot. Mixture solenoid spring broken. Idle air bleed needle is bent. Timing is retarded 7 deg from spec. Packet delayed for completion of maintenance. Ambient CO was out of spec during FTP due to rusted out upstream air tube on the car's engine. Initial inspection lane results: HC=380 ppm, CO=9.22%.
	FAILING I/M:	New check valve & tube installed. New EGR valve installed. New TPS installed. New O2 sensor installed. New mixture solenoid installed. New idle air bleed installed. Timing set to spec. Car will not pass MD I/M inspection without a new catalyst. Packet was delayed for corrections. 50 highway miles were accumulated on car before this test sequence. Initial inspection lane results: HC=597 ppm, CO=1.41%.
	Passing I/M:	New catalyst installed. Second reinspection: HC=9 ppm, CO=0.04%.

Vehicle Number	Test Sequence	Mechanic's Comments
IM5/030	As Received:	Air bleed cover missing. Idle mixture too rich. Carburetor bolts are loose. Idle speed too high. Initial inspection lane results: HC=305 ppm, CO=0.56%.
	Passing I/M:	Set idle mixture using air bleed screw. Reinspection results: HC=18 ppm, CO=0.01%.
IM5/033	As Received:	Idle mixture is too rich, mixture dwell is 54 deg. Initial inspection lane results: HC=259 ppm, CO=6.77%.
	Passing I/M:	Mixture is too rich. Set dwell to 35 deg using mixture screw. Reinspection results: HC=19 ppm, CO=0.01%.
IM6/036	As Received:	Replaced oxygen sensor, reading rich. Repaired fresh air tube. Idle mixture plug was broken out. Mixture reading 6.2% at idle. Plug wires shorting to ground through the plug boots. Initial inspection lane results: HC=237, CO=4.10%.
	Passing I/M:	Replaced oxygen sensor. Repaired fresh air tube. Adjusted idle mixture. Replaced all plug wires. Set curb idle to 850 rpm. Inspection lane results: HC=28, CO=0.09.
	Add. Repairs:	Curb idle was too high, set to spec. Small leak in divertor valve hose, (repaired) causing to dump prematurely.
IM5/037	As Received:	Initial timing 20 deg btdc, set to 16 deg btdc. Distributor cap corroded, cleaned. Engine rpm at 800, set to 700. Initial inspection lane results: HC=263 ppm, CO=1.37%.
	Passing I/M:	Reinspection results: HC=19 ppm, CO=0.01%.

Vehicle Number	Test Sequence	Mechanic's Comments
IM5/038	As Received:	Carburetor is very dirty. Idle CO is high. Valve cover is leaking. Initial inspection lane results: HC=286 ppm, CO=8.04%.
	Passing I/M:	Cleaned idle air bleed with carburetor cleaner. Valve cover is leaking. Car failed reinspection, mixture plug removed & dwell set to lower end of spec, tailpipe is now 60 HC + .08 CO. Inspection lane results: HC=57, CO=0.04.
IM6/039	As Received:	Idle speed out of spec 750, should be 900 rpm. Timing out of spec 13 deg btdc, should be 10 deg btdc. Initial inspection lane results HC=328 ppm, CO=0.98%.
	Passing I/M:	Set idle speed to 900 rpm. Set timing to 10 deg btdc. Reinspection results: HC=21 ppm, CO=0.01%.
IM5/040	As Received:	As received idle speed 850 rpm, set to 700 rpm. EGR valve inoperable. The hose to the vacuum break has a hole in it. Cleaned the distributor cap. Initial inspection results: HC=114 ppm, CO=4.05%.
	Passing I/M:	Replaced the vacuum hose going to the vacuum break. Set idle speed to 700 rpm. Cleaned the distributor cap. EGR valve defective, but not replaced since the car now passes MD I/M. Reinspection results: HC=37 ppm, CO=0.00%.
IM5/041	As Received:	Air bleed screw is misadjusted. Engine is covered with oil. Inspection lane results: HC=205, CO=4.93.
	Passing I/M:	Set idle air bleed adjustment. Inspection lane results: HC=36, CO=0.23.
IM6/042	As Received:	Compression is too low. Needs rings. Initial inspection results: HC=222, CO=0.08. Vehicle was rejected due to the need of major engine work. (ring job).

Vehicle Number	Test Sequence	Mechanic's Comments
IM6/043	As Received:	Exhaust system checked OK. Car sent to dealer for high CO and HC. Dealer replaced complete exhaust system, did not help problem. Bad carburetor. Build date not on door. Inspection lane results: 236 ppm HC, 7.39% CO.
	Passing I/M:	Carburetor replaced. Reinspection results: 8 ppm HC, 0.05% CO.
IM5/044	As Received:	Idle mixture is too rich. Inspection lane results: HC=196, CO=4.05.
	Passing I/M:	Set idle mixture & idle speed.
IM6/045	As Received:	Muffler and extension pipe rusted. Replaced before first FTP. Oxygen sensor disconnected. Initial inspection lane results: 662 ppm HC, 0.07% CO.
	Passing I/M:	Adjust timing. Adjust carburetor. Reconnected oxygen sensor wire. Reinspection results: 7 ppm HC, 0.02% CO.
IM6/046	As Received:	Electronic control unit bad. PCV valve and filter dirty. Oxygen sensor bad. Initial inspection lane results: 730 ppm HC, 10.01% CO. Air pump bypass solenoid and air management valve bad.
	Passing I/M:	Replaced electronic control unit. Replaced PCV valve and filter. Replaced air pump bypass solenoid and oxygen sensor. No third sequence. Replaced air management valve, both diaphragms were leaking. CO=.04, HC=25 ppm. Reinspection results: 13 ppm HC, 0.01% CO.
IM5/048	As Received:	Defective oxygen sensor. Dirty air filter and PCV filter. Defective air pump check valve. Initial inspection lane results: 245 ppm HC, 3.05% CO.
	Passing I/M:	Replaced air filter, air pump check valve, PCV filter and oxygen sensor. Reinspection results: 92 ppm HC, 0.11% CO.

Vehicle Number	Test Sequence	Mechanic's Comments
IM5/049	As Received:	Air filter is very dirty. Canister filter is missing. Initial inspection lane results: 347 ppm HC, 0.28% CO.
	Passing I/M:	Replaced air and canister filters. Reinspection results: 8 ppm HC, 0.04% CO.
IM6/051	As Received:	Idle speed: 900 rpm, spec: 650 rpm. Idle CO: 1.6%, idle HC: 440 ppm. Initial inspection lane results: 372 ppm HC, 3.02% CO.
	Passing I/M:	Adjusted idle speed to spec: 650 rpm. Final inspection lane results: 133 ppm HC, 0.00% CO.
IM5/052	As Received:	Carburetor apparently defective, idle mixture limiting device damaged, idle CO rich. Idle speed maladjusted, plugs fouled, check valve dirty. PCV not seated, PCV filter dirty, evap canister saturated w/fuel, vacuum line plugged, O2 sensor malfunctioned. Inspection lane results: 956 ppm HC, 2.25% CO.
	FAILING I/M:	Replaced: check valve, air cleaner, PCV filter, 8 plugs, carburetor, O2 sensor, canister filter, PCV valve, oil, 2 spark plug wires, and oil filter. Inspection lane results: HC 0741 ppm hexane, CO .04%. Ran out of time on contract to complete repair in order to pass I/M.
IM6/053	As Received:	Idle mixture limiter missing. Idle HC & CO high: 0.70% CO, 700 ppm HC. Initial inspection lane results: 813 ppm HC, 7.60% CO.
	Passing I/M:	Adjusted idle mixture to manufacturer's specifications. Reinspection lane results: 50 ppm HC, 0.01% CO.

Vehicle Number	Test Sequence	Mechanic's Comments
IM6/054	As Received:	Idle mixture limiting device missing. Vacuum hose nipple broken at TVS switch causing air pump to dump continuously to atmosphere. Idle mixture rich. Repair cost of $50 (and 1 hour) is for the replacement of a bad ignition module prior to FTP to correct stalling problem. Inspection lane results: 294 ppm HC, 2.80% CO.
	Passing I/M:	Repaired vacuum hose that caused air pump to dump to atomosphere. Set idle mixture to spec. Reinspection results: 9ppm HC, 0.02% CO.
IM6/056	As Received:	Pulse air filters are very dirty. Timing retarded off-scale and is unreadable. Idle mixture rich (2.40% CO). Idle speed 100 rpm high. Inspection lane results: 140 ppm HC, 2.14% CO.
	Passing I/M:	Replaced pulse air filters. Adjust timing to spec. Adjust idle mixture to spec. Adjust idle speed to spec. Reinspection results: HC 91 ppm, CO .39%.
IM6/057	As Received:	Curb idle 100 rpm above spec. Uneven cylinder compression: cyl #1 & 2=130 psi, cyl #3 & 4=160 psi. Power brake booster diaphragm leaking, causing vacuum leak and apparent lean misfire. Initial inspection lane results: HC=1252 ppm, CO=0.06%
	Passing I/M:	Set idle speed to spec. Replaced brake booster. Reinspection results: 85 ppm HC, 0.01% CO.
IM7/101	As Received:	Check valve & pipe rusted out for upstream air of air injection system. O2 sensor fouled. Diagnostic system has code 13 for oxygen sensor circuit. I/M lane results: HC=256 ppm, CO=0.02%.
	FAILING I/M:	Check valve replaced for upstream air. Upstream air pipe replaced. O2 sensor replaced. Reinspection results: HC=319 ppm CO=0.01% (failed HC).
	Passing I/M:	New catalyst installed. Final reinspection results: HC=98 ppm CO=0.01%. Two reinspection attempts were made.

Vehicle Number	Test Sequence	Mechanic's Comments
IM7/102	As Received:	Distributor cap is loose. EGR valve inoperative (if stuck open can increase HC). Initial lane results: HC=841 CO=0.06.
	Passing I/M:	Distributor cap secured. EGR valve replaced. The base idle screw found to be in too far, causing the electrical advance not to release. This condition takes place only on decel in neutral. Otherwise the ISC overrides this condition upon placing gear selector in drive, which reduces the rpm. Centered ISC motor to middle of spec, allowing adv to reset. Reinsp #1: HC=960 ppm CO=0.06%. Reinsp #2: HC=1019 ppm CO=0.14%. Waiver obtained after 2nd reinsp; final repairs above were performed after the waiver. Third reinspection: HC=190 ppm, CO=0.02%.
IM8/103	As Received:	Carburetor choke area very dirty. Idle mixture slightly rich. Curb idle extremely low causing engine to lug. Idle mixture limiting device is missing. Initial lane results: HC=35 ppm CO=1.32%.
	Passing I/M:	Cleaned choke area of carb. Set idle mixture. Set curb idle to 800. Reinspection results: HC=62 CO=0.00.
IM7/105	As Received:	Engine appears OK, but has 02 sensor code present in computer. Idle speed is set at factory and is not adjustable. Initial inspection results: HC=175 ppm, CO=5.74%.
	Passing I/M:	New 02 sensor installed. Engine idle speed is not adjustable; there is no spec. Reinspection results: HC=8 ppm, CO=0.01%.
IM7/107	As Received:	Curb idle is slightly low. Air filter element is very dirty. Initial inspection results: HC=177 ppm CO=2.34%.
	Passing I/M:	Curb idle adjusted & new air filter installed. Reinspection results: HC=0 ppm, CO=0.02%.

Vehicle Number	Test Sequence	Mechanic's Comments
IM7/108	As Received:	Curb idle is too low, causing engine to lug & CO to stay high. Inspection lane results: HC=168 ppm CO=3.58%.
	Passing I/M:	Curb idle was too low, causing engine to lug and CO to creep up at idle. May be due to air pump turning too slowly. Curb idle set to spec, CO remains steady at .02. Reinspection results: HC=25 ppm CO=0.01%.
IM7/109	As Received:	Car appears OK, but has O2 sensor code. No build date available. Inspection lane results: HC=278 ppm, CO=5.31%. Vehicle passed our idle screening test but was kept because the diagnostic system indicated the car has a problem.
	Passing I/M:	New O2 sensor installed because code 44 present. Car is OK otherwise. Reinspection results: HC=1 ppm, CO=0.00%.
IM8/110	As Received:	Coil wire arcing at coil castle causing engine to miss & idle to fluctuate. Initial inspection results: HC=23 ppm, CO=2.10%.
	Passing I/M:	New coil & coil wire installed. Engine was breaking down due to coil arcing. Distributor cap, rotor & spark plug wires repl. Since coil arcing can cause minute cracking and/or fatigue in these parts. Idle mixt plug removed & CO set to help catalyst recover from previous engine miss from bad coil/coil wire connection. Two reinsps were required. 1st reinsp results: HC=53 ppm, CO=2.66%. After this, the mixture plug was removed and CO was set. 2nd reinsp results: HC=49 ppm, CO=0.01%.
IM8/113	As Received:	#3 spark plug wire broken causing partial miss. Idle speed is computer controlled and not adjustable. No spec is given. Initial inspection lane results: HC=234 ppm, CO=0.49%.
	Passing I/M:	Replaced broken #3 plug wire. Idle speed is computer controlled and not adjustable. No spec is given. Reinspection results: HC=196 ppm, CO=0.19%.

Vehicle Number	Test Sequence	Mechanic's Comments
IM7/114	As Received:	Initial inspection results: HC=298 ppm, CO=7.02%. Vehicle was rejected because non-OEM a/c made access to ECM virtually impossible. (The Chevette Scooter does not come with a/c.)
IM7/115	As Received:	Hose to air management valve has 2 bb's in it. Causing no downstream air. Engine idle speed is computer controlled. No spec is given. Initial inspection lane results: HC=190 ppm, CO=0.08%.
	Passing I/M:	Removed bb's from air management line allowing air to flow downstream. HC is 65 ppm. Engine idle speed is computer controlled. No spec is given. Reinspection results: HC=36 ppm, CO=0.01%.
IM7/117	As Received:	#1 spark plug wire is arcing to ground causing engine miss. Initial inspection results: HC=233 ppm, CO=0.03%.
	Passing I/M:	Repaired boot & reinstalled plug wire. Car should clean up since engine no longer misses. Build date is not available. Reinspection results: HC=128 ppm, CO=0.12%. Idle speed is not available.
IM8/119	As Received:	The hose to the dump valve has a cut in it from rubbing against the battery tray. EGR hose is disconnected, but not plugged. Initial inspection results: HC=208 ppm, CO=3.79%.
	Passing I/M:	EGR hose reconnected. Vacuum line to dump valve repaired, allowing air to both up stream & down stream. CO is .3, HC is 100. Reinspection results: HC=17 ppm, CO=0.01%.

Vehicle Number	Test Sequence	Mechanic's Comments
IM8/122	As Received:	Hose to vacuum advance sloppy fit. Hoses that control EGR/air management valve & canister purge valve have all been broken at TVS switches & repaired very poorly. They all leak or are not connected properly. Air management valve is getting no signal at all. Curb idle set very high (1600 rpm). No fuel sample was taken by testing, thus no lead analysis is available. Initial inspection results: HC=104 ppm, CO=2.43%.
	Passing I/M:	Repaired vacuum signal hoses to EGR system, air management system, canister purge system & vacuum advance. Set curb idle to spec. Reinspection results: HC=28 ppm, CO=0.00%.
	Add. Repairs:	Small leak at TVS under intake manifold. Dump valve was not receiving full signal. Signal weak and bleeding down too early. Repaired leak. Lead content of vehicle fuel is not available due to technician error.
IM8/123	As Received:	O2 sensor is bad (Code 51). Initial inspection lane results: HC=321 ppm, CO=7.77%.
	Passing I/M:	New O2 sensor installed. Reinspection results: HC=8 ppm, CO=0.01%. No cost for repair parts- repaired under warranty.
IM7/124	As Received:	Car appears to be OK, but there is a code 13 in computer which is O2 sensor circuit. Radiator cap leaks, allowing water to spurt out during testing. Initial inspection results: HC=199 ppm, CO=1.53%. No spec for engine idle speed is available.
	Passing I/M:	New O2 sensor installed (code 13 was present in computer before). Replaced radiator cap. Packet delayed for corrections. Reinspection results: HC=66 ppm, CO=0.07%.

Vehicle Number	Test Sequence	Mechanic's Comments
IM8/125	As Received:	Carburetor is set too lean. Air pump belt is missing. Timing is off 6 deg. Air injection check valve connection is very loose. Fresh air hose is falling apart. Idle mixture limiting device is broken. Fast idle speed is too high. Crankcase vent hose is broken. Initial inspection lane results: HC=546 ppm, CO=0.36%.
	Passing I/M:	Set timing, set idle parameters. Installed air pump belt. Tightened check valve connection. Reinspection results: HC=9 ppm, CO=0.01%. Fresh air hose is falling apart. PCV fresh air hose is broken.
IM7/131	As Received:	Timing is retarded 8 deg from spec. Car does not idle. No measured speed. O2 sensor output is 0. Does not go to closed loop more than a moment at a time. No idle speed spec. ECM has got to be bad. About 30 codes present in computer. Inspection results: HC=283 ppm, CO=0.02%.
	Passing I/M:	New ECM installed may have had bad connection in wiring harness to computer. Reinspection results: HC=8 ppm, CO=0.01%. Unknown idle rpm spec. Set timing to spec. Reinspection results: HC=8 ppm, CO=0.01%.
IM8/134	As Received:	Car appears to be OK, but curb idle is so low engine lugs & almost stalls. Packet delayed for corrections. Initial inspection results: HC=315 ppm, CO=4.89%.
	Passing I/M:	Set curb idle, engine runs 100% better. CO is .02, HC is 30 ppm. Reinspection results: HC=17 ppm, CO=0.01%.
IM7/135	As Received:	Vacuum hose disconnected at 3-way tee, affects EGR, purge valve, & distributor. Initial inspection lane results: HC=258 ppm, CO=2.22%.
	Passing I/M:	Reconnected ported signal hose at 3way tee. Car now has EGR, ported vacuum advance & canister purge. Reinspection results: HC=34 ppm, CO=0.04%.

Vehicle Number	Test Sequence	Mechanic's Comments
IM8/136	As Received:	Curb idle speed is 1100, probably affecting air system operation & idle. Circuit operation of CVCC system valves are out of adjustment. Inspection lane results: HC=251 ppm, CO=0.26%.
	Passing I/M:	Set curb idle to spec CO is .03. HC is 95 ppm. Valves are out of adjustment. Reinspection results: HC=44 ppm, CO=0.00%.
IM7/137	As Received:	Needs carburetor overhaul. Packet delayed for maintenance. Build date is not available. Idle CO is too rich. Choke is not working. Catalyst may be loaded up. Oxygen sensor may be damaged. I/M lane results: HC=560 ppm, CO=2.77%.
	Passing I/M:	Overhauled carb. Replaced vacuum break. Replaced O2 sensor. Catalyst may be loaded up. Build date is not available. No third sequence. The vehicles exact problem cannot be found, but is probably a bad catalyst and/or a vacuum leak. Reinspection results: HC=121 ppm, CO=0.13%.
IM8/138	As Received:	Curb idle is just a little bit too low, but HC numbers are very susceptable to idle speed. No other problems found. Initial inspection lane results: HC=240 ppm, CO=0.01%.
	Passing I/M:	Idle speed set to spec. HC is 110. Reinspection results: HC=71 ppm, CO=0.00%.
IM8/139	As Received:	The carburetor is too lean at idle with some dripping off idle. Timing is way off. Initial inspection lane results: HC=90 ppm, CO=1.25%.
	Passing I/M:	Set timing to spec. Removed mixture plug & set mixture. Still has some carburetor dripping off of idle. No third sequence. Reinspection results: HC=123 ppm, CO=0.44%.
IM8/140	As Received:	O2 sensor bad. Muffler replaced before first test due to an exhaust leak.
	Passing I/M:	New O2 sensor installed. Canister filter is dirty. Reinspection results: HC=10 ppm, CO=0.01%.

Vehicle Number	Test Sequence	Mechanic's Comments
IM8/141	As Received:	Idle mixture plug is missing. Idle CO is too high. Initial inspection lane results: HC=161 ppm, CO=7.74%.
	Passing I/M:	Set idle mixture. CO is now .03. Reinspection results: HC=8 ppm, CO=0.03%.
IM7/143	As Received:	Car has bad O2 sensor. Diagnostic Codes 42 & 44 are present. Initial inspection lane results: HC=205 ppm, CO=4.16%.
	Passing I/M:	New O2 sensor installed, idle readings came down to 130 HC & 0.4 CO. No third sequence since no obvious problem, clean at idle. Reinspection results: HC=22 ppm, CO=0.01%.
IM8/144	As Received:	Nipple broken at TVS for air system. Carburetor is rich. Initial inspection lane results: HC=226 ppm, CO=3.67%.
	Passing I/M:	Replaced TVS for air system. Removed mixture plug & set mixture. Reinspection results: HC=110 ppm, CO=0.01%.
IM8/145	As Received:	Idle speed is too low. Idle mixture is too rich. VOTM signal & air cleaner temp sensor lines reversed. Idle mixture limiting device is missing. Initial inspection lane results: HC=469 ppm, CO=9.26%.
	Passing I/M:	Set idle speed & mixture. Reconnected hoses to VOTM and air cleaner temp sensor. Reinspection results: HC=86 ppm, CO=0.01%.
	Add. Repairs:	Air switching TVS had broken nipple on inside of hose connector, replaced TVS switch.
IM8/147	As Received:	Pulse air system very sensitive to misadjusted idle speed. Idle speed is too high. PCV filter is dirty. Initial inspection lane results: HC=41 ppm, CO=1.68%.
	Passing I/M:	Set idle speed to spec. PCV filter is very dirty (but not replaced). Reinspection results: HC=17 ppm, CO=0.00%.

Vehicle Number	Test Sequence	Mechanic's Comments
IM7/148	As Received:	Computer not working properly (dwell in fixed mode). Almost all diagnostic codes (42, 44, 51 - 55) are present. Air pump belt is missing. Lines to hot air door & EFE are reversed. Build date is not available. Dwell is locked at 30 degrees. Idle mixture limiting device is missing. Initial inspection lane results: HC=471 ppm, CO=1.84%.
	Passing I/M:	Corrected hoses to EFE & hot air door. Installed belt on air pump. Replaced ECM & PROM dwell was in fixed mode. Build date is not available. Three reinspections required to pass. Packet delayed for possible third sequence inspection. First reinspection: HC=809 ppm, CO=0.05%. Second reinspection: HC=362 ppm, CO=1.13%. Third reinspection: HC=218 ppm, CO=0.03%.
IM7/150	As Received:	TPS sensor bad, code 21. Idle speed is high. Initial inspection lane results: HC=237 ppm, CO=0.18%.
	Passing I/M:	New TPS sensor installed. Reinspection results: HC=25 ppm, CO=0.01%.
IM8/151	As Received:	Idle plug missing, set too rich. Idle speed is high. Initial inspection lane results: HC=104 ppm, CO=2.98%.
	Passing I/M:	Set idle mixture, CO is .06 HC is 70 ppm. Reinspection results: HC=4 ppm, CO=0.01%.
	Add. Repairs:	Replaced O2 sensor since idle readings are low but FTP numbers are still high.

Vehicle Number	Test Sequence	Mechanic's Comments
IM7/153	As Received:	Carburetor mixture screws are in too far causing lean miss, dwell is 6 deg. Catalyst may be bad. Carburetor loose on manifold. Idle mixture limiter is missing. Initial inspection lane results: HC=617 ppm, CO=0.17%.
	Passing I/M:	Set carburetor mixture screws and dwell. Catalyst may be loaded from lean miss. Failed first reinspection. Added 1 can gm top engine cleaner to decarbonize motor. CO is now 0.5%, HC is 140 ppm. Carburetor is loose on manifold. Two reinspections required. First results: HC=288 ppm, CO=0.78%. Second results: HC=220 ppm, CO=0.25%.
	Add. Repairs:	Code 41 is present, baro/map sensor. Diagnostics lead to bad ECM which was replaced. Idle readings are still high. Catalyst may be bad. Carburetor is loose on manifold.
IM8/154	As Received:	Idle mixture is too rich. Mixture plugs are missing. Bowl vent hose is off. Valves are out of adjustment. Inspection lane results: HC=36 ppm, CO=3.25%.
	Passing I/M:	Set idle mixture. Reconnected bowl vent hose. Valves out of adjustment. Reinspection results: HC=32 ppm, CO=0.01%.
IM8/159	As Received:	Both air filter & pulse filter are extremely dirty. Initial inspection lane results: HC=185 ppm, CO=4.86%.
	Passing I/M:	New air filter & pulse air filter installed, this system is marginal to start with. Adjusted idle speed after new filters installed. Reinspection results: HC=34 ppm, CO=0.06%. No third sequence for this car because no obvious problem could be found.

Vehicle Number	Test Sequence	Mechanic's Comments
IM7/164	As Received:	Vacuum break hose off (leak). Hot air door hose off (leak). Dwell fixed at 54 deg. Initial inspection lane results: HC=492 ppm, CO=8.05%.
	Passing I/M:	Reconnected hose to vacuum break. Reconnected hose to hot air door. Removed plug & set mixture dwell. Inspection lane results: HC=10, CO=0.03.
IM8/166	As Received:	Air filter extremely dirty. This caused the CO to be high. Distributor cap was cracked causing the high HC readings. Idle speed too high (1025). Inspection lane results: HC=300, CO=2.04.
	Passing I/M:	Replaced air filter, replaced distributor cap, adjusted idle speed to 700 rpm. Inspection lane results: HC=115, CO=0.02.
IM7/167	As Received:	Vehicle has bad valve guides. #3 cylinder has 120 pounds of compression. Removed valve cover and #3 intake valve guide is bad. Initial inspection results HC=591, CO=0.64. Vehicle was rejected due to the need for major engine work (valve job).
IM8/168	As Received:	Idle CO rich. Inspection lane results: HC=181, CO=4.68.
	Passing I/M:	Adjusted idle mixture to spec. Inspection lane: HC=6, CO=0.01.
IM7/169	As Received:	Dwell fixed at 6 deg. ECM bad. O2 sensor very fouled. Inspection lane results: HC=455, CO=9.91.
	Passing I/M:	New ECM installed. New air filter installed. New O2 sensor installed. No third sequence. Needs new carburetor. Inspection lane: HC=10, CO=0.01.

Vehicle Number	Test Sequence	Mechanic's Comments
IM8/170	As Received:	CO high, HC high, spark plugs bad. Inspection lane results: HC=754, CO=10.01.
	Passing I/M:	Reset timing. Set idle CO. Set carburetor idle. Install spark plugs. Inspection results: HC=6, CO=0.02.
IM8/171	As Received:	No vacuum to air pump, vacuum gun shows blockage. Each hose checked for blockage. Hose to cold weather modulator stuck with glue. Fresh air duct missing. Timing out of spec. Idle speed out of spec. Inspection lane results: HC=158, CO=1.86.
	Passing I/M:	Hoses checked and repaired. Timing set. Idle speed set. Inspection lane: HC=180, CO=0.07.
IM7/172	As Received:	Check valve rusted. Manifold tubes rusted. Idle mixture plugs missing. CO in spec. Inspection lane results: 239 ppm HC, 1.68% CO.
	Passing I/M:	Check valve and tubes replaced. Idle mixture plugs missing. CO was in spec. Reinspection results: 169 ppm HC, 0.01% CO.
	Add. Repairs:	Set carburetor parameters to spec using mixture screws & idle air bleed.
IM8/178	As Received:	Oxygen sensor bad. Initial inspection lane results: 540 ppm HC, 8.29% CO.
	Passing I/M:	Replaced oxygen sensor. Reinspection results: 113 ppm HC, 0.31% CO.

Vehicle Number	Test Sequence	Mechanic's Comments
IM8/181	As Received:	Idle mixture set too rich. Initial inspection lane results: 306 ppm HC, 0.34% CO.
	Passing I/M:	Set idle mixture & idle speed. Reinspection results: 140 ppm HC, 0.17% CO.
IM8/183	As Received:	Idle speed is slightly off. Car appears to be clean. Initial inspection lane results: 156 ppm HC, 2.62% CO.
	Passing I/M:	Set idle speed to manufacturer's specifications. Reinspection results: 1 ppm HC, 0.01% CO.
IM8/184	As Received:	Exhaust system rusted out. Replaced exhaust pipe, muffler, and tailpipe prior to first FTP. Initial inspection lane results: 81 ppm HC, 2.30% CO. Idle speed high-950 rpm, spec:750 rpm.
	Passing I/M:	Adjusted idle speed to spec. No third sequence. Reinspection results: 20 ppm HC, 0.01% CO.
IM8/186	As Received:	Air filter element is very dirty. Idle mixture rich- 280 ppm HC, 1.50% CO. Idle speed 700 rpm, spec: 800 rpm. Initial inspection results: 457 ppm HC, 3.31% CO.
	Passing I/M:	Replaced air filter element. Set idle mixture to manufacturer's specifications. Set idle speed to manufacturer's specifications. Final inspection results: 63 ppm HC, 0.01% CO.
IM8/190	As Received:	Idle mixture set too rich. 4.0% CO, 170 ppm HC. Initial inspection lane results: 166 ppm HC, 5.41% CO.
	Passing I/M:	Set idle mixture & idle speed to manufacturer's specifications. Reinspection lane results: 79 ppm HC, .25% CO.

Vehicle Number	Test Sequence	Mechanic's Comments
IM8/191	As Received:	Turbocharger seals worn - allowing lubricating oil past seals and into turbo cavity. Est repair cost (per dealer)=$1600. Reject 9/10/85. Initial inspection lane results: 442 ppm HC, 0.23% CO. Vehicle was rejected due to need for major engine work (turbocharger seals).
IM8/195	As Received:	Air system dumps continuosly, diaphragm is leaking. Idle is too high, 1000 rpm (spec=750 rpm); idle CO rich. Timing is advanced 17 deg above spec (27 deg BTDC instead of spec of 10 deg BTDC), causing lean miss. Car leaks oil, air diverter valve is stuck open. Inspection lane results: 118 ppm HC, 5.29% CO.
	Passing I/M:	Replaced air management valve. Set timing to spec. Set idle speed to spec. Reinspection results: HC 60 ppm, CO .52%.
IM8/196	As Received:	O2 sensor is bad. Malfunctions rich. Inspection lane results: 644 ppm HC, 9.24% CO.
	Passing I/M:	Replaced O2 sensor. Reinspection results: 10 ppm HC, 0.00% CO.
IM8/200	As Received:	Carburetor is too rich at idle. Noisy lifter. Reinspection results: HC 65 ppm, CO 1.27%.
	Passing I/M:	Removed idle mixture adjustment limiter plug and set idle mixture to spec. Reinspection lane results: 87 ppm HC, 0.05% CO.
IM7/201	As Received:	Idle CO rich. Idle speed high. Idle mixture limiting device altered. Inspection results: 965 ppm HC, 8.68% CO. Vehicle rejected after first sequence due to lack of time remaining on contract.
IM8/202	As Received:	O2 sensor is bad - malfunction rich. Inspection lane results: 843 ppm HC, 8.54% CO.
	Passing I/M:	O2 sensor replaced. Reinspection results: HC 66 ppm, CO .01%.

Vehicle Number	Test Sequence	Mechanic's Comments
IM7/203	As Received:	Check valve & tubes rusted out on driver side. O2 sensor fouled up. Carb completely maladjusted, screws in too far. Spark plug wires cut & worn. Canister signal & purge hoses off at carb. Cat may be damaged. Initial inspection lane results: HC=299 ppm, co o=.65%.
	FAILING I/M:	New check valve & tubes installed. New O2 sensor installed. New plug wires installed. Carb completely readjusted. Hoses reconnected at carb for canister purge & signal. Cat still probably damaged. Not much change in HC & CO readings. Probably due to bad cat & reconnection of hoses (two vacuum leaks repaired). Second MD inspection results: HC=476 ppm, CO=.72%. Note: Car was driven approximately 50 miles at highway and city speeds to see if any ECM codes would appear; none did.
	Passing I/M:	New cat installed, big change in HC & CO readings HC is 185 & CO is .03. Third MD inspection results: HC=12 ppm, CO=0.01%.
IM8/209	As Received:	O2 sensor is fouled, no change in HC & CO when disconnected. MD inspection results: HC=170 ppm, CO=3.02%.
	Passing I/M:	Replaced O2 sensor. CO is 0.15, HC is=150. MD reinspection results: HC=47 ppm, CO=.01%.
IM8/210	As Received:	Delay valve in dump system has been removed. Car dumps immediately upon returning to idle speed. MD inspection results: 952 ppm HC, 9.53% CO.
	Passing I/M:	Delay valve re-installed in hose to dump valve. MD reinspection results: 28 ppm HC, .22% CO. Third sequence declined. Mechanic believes that with time (and driving) catalyst will become more efficient.
IM8/212	As Received:	Electric choke not operating (does not open at all). MD inspection results: HC 271 ppm, CO .01%.
	Passing I/M:	New electric choke assembly installed operates OK. No way of knowing catalyst condition. MD reinspection results: 205 ppm HC, .02% CO. Third sequence declined; catalyst replaced. Muffler & tailpipe

Vehicle Number	Test Sequence	Mechanic's Comments
IM8/214	As Received:	rusted, replaced. Valves are a little noisy. Electronic timing module defective, no spark from #2 coil to exhaust spark plugs. Curb idle is too high. MD inspection results: 138 ppm HC, 1.68% CO.
	Passing I/M:	New timing module installed. Curb idle set to 650. Valves are still a little noisy. MD reinspection results: 47 ppm HC, .13% CO. Third sequence declined. Catalyst replaced. Mechanic believes the catalyst condition will improve with time.
IM8/215	As Received:	Air filter is very dirty. Some back flow thru air suction valve. Choke stuck in 1/2 position. Carb is too rich. MD inspection results: 191 ppm HC, 2.91% CO.
	Passing I/M:	New air filter installed. Choke freed up, now operating OK. Carb mixture plug removed & mixture adjusted, curb idle adjusted. Air suction valve is a little slow in shutting off back flow. MD reinspection results: 26 ppm HC, .11% CO.
IM8/216	As Received:	Curb idle is way too high, possibly preventing electronics to "clear". (timing may not return to base, air switching may be delayed due to throttle plate position, etc.). MD inspection results: 151 ppm HC, 2.56% CO.
	Passing I/M:	Set curb idle to spec. HC is 65 ppm, CO is 0.02. MD reinspection results: HC 41 ppm, CO .01%. Mechanic believes that with time and driving condition of catalyst will improve. Third sequence declined; however, catalyst was replaced.

Vehicle Number	Test Sequence	Mechanic's Comments
IM8/219	As Received:	Mixture plug is intact, but carb has gone very rich. MD inspection results: 139 ppm HC, 4.27% CO.
	Passing I/M:	Mixture plug removed & carb mixture adjusted. MD reinspection results: 16 ppm HC, .01% CO.
IM8/220	As Received:	Hose pinched under air cleaner to accel pump / servo. Hose off to air bleed check valve assembly. Curb idle is way too high (1100 rpm). MD inspection results: 220 ppm HC, 3.0% CO.
	Passing I/M:	Corrected pinched hose to accel pump servo. Reconnected hose to air bleed check valve. Reset curb idle. MD reinspection results: 8 ppm HC, .01% CO.
IM8/221	As Received:	Mixture screw back out too far. Idle speed too high. MD inspection results: 368 ppm HC, 8.35% CO.
	Passing I/M:	Set curb idle & idle mixture. MD reinspection results: 13 ppm HC, .01% CO.