EPA 460/3-82-013

A STUDY OF EMISSIONS FROM LIGHT DUTY VEHICLES IN LOS ANGELES: IN-USE FEASIBILITY PROGRAM

AESi
AUTOMOTIVE ENVIRONMENTAL SYSTEMS
A division of Clayton Manufacturing Company

EPA 460/3-82-013

A STUDY OF EMISSIONS FROM LIGHT DUTY VEHICLES IN LOS ANGELES: IN-USE FEASIBILITY PROGRAM

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ABSTRACT

This report presents the procedures used in a feasibility study to test properly maintained vehicles which had accumulated between 40,000 and 50,000 miles. The test fleet consisted of California certified 1979 automobiles obtained through random selection from private owners in Los Angeles and Orange County areas. The testing was conducted between May and October of 1982.

All eligible vehicles were randomized to provide a list of random candidate vehicles with assigned order. Proceeding in order, each candidate vehicle was screened until an acceptable one was located which became a test vehicle.

Each test vehicle received an incoming inspection and repair of minor disablements prior to testing. The test consisted of a diurnal heat build, less emissions, followed by the 1978 Federal Test Procedure. Vehicles failing the 1979 California standards received a tune-up, maintenance, and repair of malfunctions prior to a retest.

The project screened 3194 candidate vehicles which resulted in 60 original sample vehicles and 38 expanded sample vehicles for a total of 98 test vehicles. 74 of the 98 vehicles failed the emission standards and received a tune-up and second test.

ACKNOWLEDGEMENTS

Automotive Environmental Systems, a Division of Clayton Manufacturing Company, wishes to extend its appreciation and special thanks to Mr. John Shelton, Project Officer, for providing counsel, technical guidance, and understanding throughout the program.

We also wish to recognize the assistance of the manufacturers of the automobiles which were tested in this project.

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SECTION 1

INTRODUCTION

This report discusses the program that was implemented with modifications Five (5) and Six (6) to contract 68-03-3023. The program was a feasibility study on securing and emission testing properly maintained vehicles which had accumulated between 40,000 and 50,000 miles. The test fleet consisted of 1979 model year automobiles obtained through random selection from private owners in Los Angeles and Orange County.

The sequence of events, as shown in Exhibit 1, started with the procurement effort to locate acceptable vehicles, this included an on-site inspection of the candidate vehicles. Once accepted as a test vehicle, a functional check of the emission systems was completed and disablements were remedied. Next, the vehicle received a 1978 Federal Test Procedure (FTP), exhaust emissions only, preceded by a preconditioning diurnal heat build. If the vehicle failed the 1979 California exhaust emission standards it received maintenance and repair of malfunctions followed by a second test.

This report will address major aspects of the program including vehicle procurement, inspection and maintenance, laboratory test equipment, laboratory test procedures and quality assurance.

PROGRAM FLOW CHART

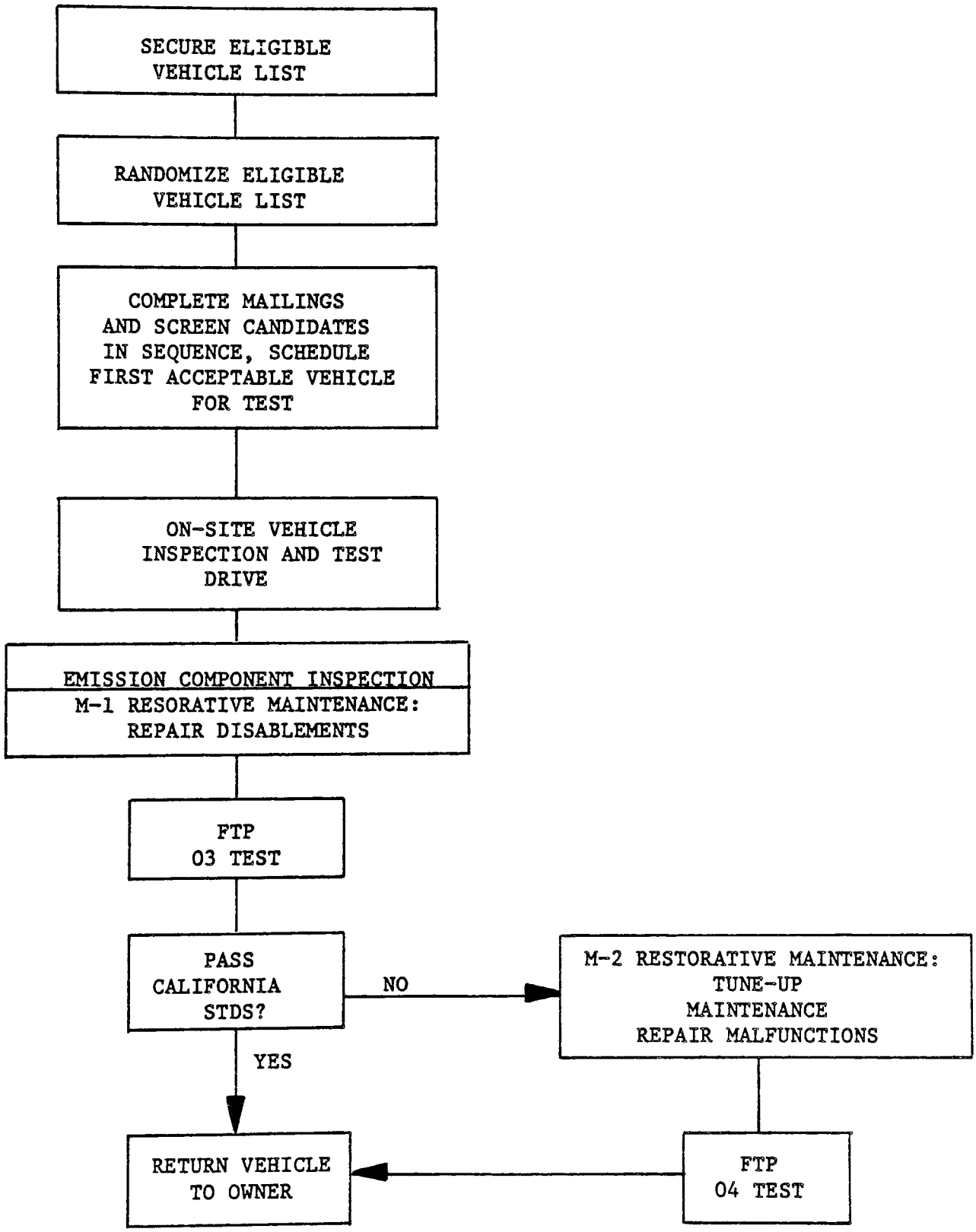

EXHIBIT 1

2028A

SECTION 2

VEHICLE PROCUREMENT

2.1 Eligible Vehicle List

The eligible vehicle list consisted of a registration list which was purchased from an outside marketing company. The project specified a test vehicle matrix designating the model year, manufacturer, engine size and vehicle model. Additionally, all vehicles were to be presently owned by the original owner. In general, all registrations were screened according to this criteria prior to delivery from the marketing company. The project matrix is included as Exhibit 2.

The scope of the project was to complete this matrix of 60 vehicles with a secondary goal of duplicating the matrix as contract funds allowed. The second matrix was filled with 38 vehicles which were a cross section of vehicle types. The contract also specified that no additional procurement mailings be completed to fill the second matrix. Therefore, some of the vehicles in the second matrix technically failed one of the screening criteria. Typically, these failures were minor mechanical failures which had not been repaired according to program guidelines e.g., (meater core not dealer replaced).

Please note that the cell designation on Exhibit 2 defines a randomized group of identical candidates as supplied by the vendor, and the number of eligible registrations purchased was a function of the number of test vehicles required. Furthermore, cell 107 combines two matrix selections because the marketing company was unable to distinguish between a 260 and 305 V-8 engine in their coding system.

2.2 Eligible Vehicle Randomization

Within each matrix cell the listing of eligible vehicles were assigned identification numbers which were randomized according to Appendix 10 of the contract Scope of Work. An AESi computer routine randomized the list and then printed out a sequential list of the eligible vehicles. This randomized and sequence identified list became the Candidate Vehicle List. This randomizing process from Appendix 10 is printed below.

VEHICLE MATRIX

In-Use Feasibility Study
Test Fleet Breakdown
1979 Model Year

CYl	CID	Cell #	Number of Eligible Vehicles	Numbers Assigned	#/Vehicle Model
GM					
4	98	101	615	20206 thru 20820	4-Chevette
4	151	102	205	20821 21025	1-Monza/Starfire/Sunbird
8	305	103	410	21026 21435	3-Camaro/Firebird
8	305	104	205	21436 21640	2-Impala/Capri
8	305	105	152	21641 21792	1-Nova/Phoenix
8	305	106	205	21793 21997	2-Malibu/Lemans
8	305	107	2050	21998 24047	7-Monte Carlo/two-door Century/Regal/Grand Prix/Cutlass
8	260				5-Cutlass/Monte Carlo/two-door Century/Regal/ Grand Prix
6	231	108	615	24048 24662	4-Regal/Cutlass, Monte Carlo/two-door Century/Grand Prix
6	231	109	541	24663 25203	4-Malibu/Lemans
6	231	110	205	25204 25408	2-Monza/Starfire/ Sunbird/Skyhawk
Ford					
4	140	201	410	25409 thru 25818	2-Mustang
4	140	202	205	25819 26023	1-Fairmont/Zephyr
4	140	203	205	26024 26228	2-Capri
4	140	204	410	26229 26638	3-Bobcat/Pinto
6	171	205	205	26639 26843	1-Mustang
6	200	206	205	20001 20205	2-Fairmont/Zephyr
6	250	207	205	26844 27048	1-Monarch/ Granada/Versailles
8	302	208	205	27049 27253	2-Mustang
8	302	209	205	27254 27458	1-Fairmont/Zephyr
8	302	210	205	27459 27663	1-Granada/Monarch
4	98	211	205	27664 27868	1-Fiesta
Chrysler					
4	98	301	410	27869 28278	3-Colt/Champ
4	105	302	205	28279 28483	2-Omni/Horizon
8	318	303	205	28484 28688	1-Aspen
8	318	304	39	28689 28727	1-St. Regis/ Newport/New Yorker
8	318	305	205	28728 28932	1-LeBaron/Diplomat/ Volare
			8,932		60

EXHIBIT 2

"The "List of Eligible Vehicles" shall be numbered 1 thru N consecutively, where N is the total number of vehicles contained in the "List of Eligible Vehicles." A random number q is selected with the same number of digits as N. If q is less than or equal to N the vehicle is placed first on the "List of Candidate Vehicles." If q is greater than N, the number is skipped and the next random number is selected until a candidate is chosen. If one random number appears more than once, it is ignored after it is used the first time. The procedure continues until a sufficient number of candidates are seleted for a particular test vehicle group. To illustrate this procedure; suppose there are 8,592 eligible vehicles. Assume the first four digit random numbers generated are 8268, 5011, 9857, 2532, 0455, 6976, ... For the first random number, 8268, car number 8268 on the "List of Eligible Vehicles" is placed first on the "List of Candidate Vehicles." The next random number is 5011 is placed second the the "List of Candidate Vehicles." The next random number is 9857. Since 9857 is greater than 8592, it is ignored. The next random number is 2532, so car number 2532 becomes the third member of the "List of Candidate Vehicles," and so forth."

2.3 Candidate Vehicle Screening

The overall screening process applied to each candidate vehicle included a rigorous attempt to contact each candidate through a certified mailing, a first class mailing and "up to ten" telephone calls. After contacting, the acceptability of each vehicle was carefully explored with a telephone questionnaire provided by EPA . Exhibit 3 provides a flow chart of the process.

All of the actions involving this contacting and screening process were compiled in a Log Book which consisted of a Control Sheet, Exhibit 4, for each Candidate Vehicle. The control sheet is a record of dates and activities for the mailings and phone attempts with a summary of the questionnaire if it was completed.

AESi coded all telephone attempts as to type, these could be a solicitation to test the vehicle, a call to complete the questionnaire, or a call to schedule the vehicle for test. Additionally, a subjective estimate of the participant's reaction to being contacted was recorded. The response category indicates the inclination of the candidate to participate in the program at the time of contact.

The coding for these three categories is listed below.

TYPES: SOLICITATION
QUESTIONNAIRE
SCHEDULE

PARTICIPANT REACTION:

1. Extremely helpful and friendly
2. Moderately helpful
3. Responds with no bias
4. Shows annoyance at call
5. Very angry

RESPONSE: + Positive, willing to participate
- Negative, not willing to participate
? Undecided

2.3.1 Certified Mailing

The initial contacts with the candidate vehicle list were made with a certified first class letter. The process was to multiply the number of required vehicles by 75 to obtain the quantity of the first mailing since 75 was found to produce one acceptable test vehicle. If these 75X did not produce the required number of vehicles, additional sequence numbers were prepared for mailing. This continued until an acceptable vehicle was located or until the Candidate List was depleted. Only in cell #304 was the Candidate List depleted before locating a test vehicle. EPA authorized substituting a vehicle from Cell #305 in its place.

2.3.2 First Class Mailing

If a period of 7-10 days elapsed with no response following the certified mailing the candidate address was verified and a first class letter was mailed.

2.3.3 Telephone Contact

For each candidate, regardless of response to the initial mailing, an attempt to contact them by telephone was completed.

Usually, it was easy to contact those individuals who indicated a positive response, that is, a desire to have their vehicle tested, as these people provided phone numbers. The negative response candidates often posed difficulties in locating the individuals since they were reluctant to provide information, and if contacted were sometimes annoyed. In both cases, if contact was made, AESi attempted to complete the telephone questionnaire on the vehicle.

If contact was not able to be made, and no new address or phone number was determined, a minimum of 10 phone calls were placed before eliminating the candidate. These calls were spaced throughout the day and evening and on weekends.

PROCUREMENT FLOW CHART

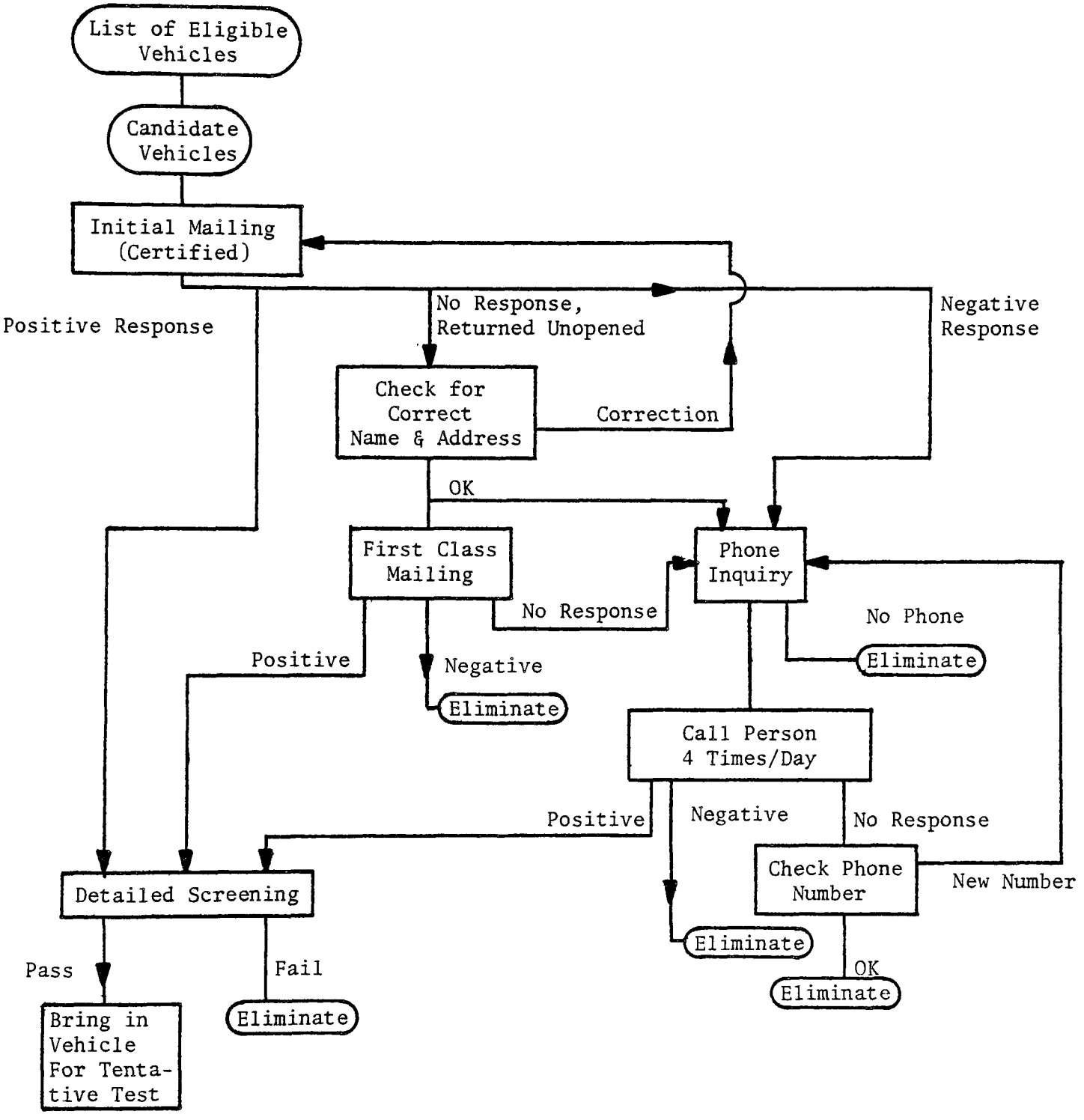

EXHIBIT 3

OMB NO. 2000-0027

CONTROL SHEET

GM FORD CHRYSLER PHONE: HOME ( ) _____

SEQUENCE NO. _____ WORK ( ) _____

BEST TIME _____

BEST TIME _____

CERTIFIED MAILING

DATE MAILED _____

DATE REPLY CARD RECEIVED _____

RESPONSE _____

COMMENTS: _____

_____

1. WAS A CERTIFIED MAILING SENT?	Y	N
2. WAS A REPLY CARD RETURNED?	Y	N
3. WAS A POSITIVE RESPONSE INDICATED?	Y	N
4. WAS A NEGATIVE RESPONSE INDICATED?	Y	N
5. WAS PARTICIPANT UNDECIDED?	Y	N
6. LETTER RETURNED UNOPENED.	Y	N

FIRST CLASS MAILING

DATE MAILED _____

DATE REPLY CARD RECEIVED _____

RESPONSE _____

COMMENTS: _____

_____

7. WAS A FIRST CLASS MAILING SENT?	Y	N
8. WAS A REPLY CARD RETURNED?	Y	N
9. WAS A POSITIVE RESPONSE INDICATED?	Y	N
10. WAS A NEGATIVE RESPONSE INDICATED?	Y	N
11. WAS THE PARTICIPANT UNDECIDED?	Y	N
12. LETTER RETURNED UNOPENED.	Y	N

TELEPHONE

DATE CALLED	TIME	TYPE	PARTICIPANT REACTION	RESPONSE	COMMENTS	INITIA

13. HOW MANY CALLS WERE COMPLETED SOLICITATIONS?		_____
14. WAS A POSITIVE RESPONSE INDICATED?	Y	N
15. WAS A NEGATIVE RESPONSE INDICATED?	Y	N
16. WAS THE PARTICIPANT UNDECIDED?	Y	N

SUMMARY OF PHONE QUESTIONNAIRE

17. WAS A QUESTIONNAIRE COMPLETED?	Y	N
18. DID THE VEHICLE MEET THE QUALIFICATION CRITERIA?	Y	N
IF NO, WHAT WAS THE REASON FOR REJECTION? A - M		_____
19. WAS THE VEHICLE DELIVERED TO AESi FOR TEST?	Y	N
20. WAS THE VEHICLE ACCEPTED FOR TEST ONCE AT AESi?	Y	N
IF NO, WHAT WAS THE REASON FOR REJECTION? N - Q		_____
21. WAS THE VEHICLE TESTED?	Y	N

)ATE \LLED	TIME	TYPE	PARTICIPANT REACTION	RESPONSE	COMMENTS	INITIALS

2.3.4. Questionnaire

The EPA questionnaire is included as Appendix A of this report. In summary, the questionnaire explores the following areas of vehicle condition and history.

		Reference Questionnaire
A.	Model Year 1979	Matrix
	Make/Model/Engine Size	Matrix
	Original Purchaser	1,2,3
B.	Favorable Mail or Phone Response	
C.	Correct Mileage (40,000-50,000)	5
D.	Not used in unusual manner.	6,7,8,9,20,22,23
E.	Not used leaded gas.	15
F.	No overheating problems.	18
G.	Not involved in accident.	19
H.	No add-on AC	22
I.	No vehicle modifications	23
J.	Properly maintained	26,27,28,29,30
K.	Dealer maintained	33
L.	No misadjustments, disablements	34

It should be noted that this screening process generated three classes of candidate vehicles which are described below:

1. Vehicles failed the questionnaire and were rejected for testing.

2. Vehicle passed the questionnaire and were brought in for test. The owners had evidence of proper maintenance.

3. Vehicles passed the questionnaire and were brought in for test. The owners thought that the vehicles were properly maintained, but had no evidence of proper maintenance; this was not cause for rejection.

2.4 Vehicle Check-In Procedures

In all cases, test vehicles were delivered to AESi by the participant. Several additional screening tasks were completed at this time. First, the questionnaire was reviewed with the participant to verify all responses and the participant was asked to sign the cover page. Further screening consisted of checking the lead content of a fuel sample and a short test drive. Lead content over 0.05 g/gal caused a vehicle to be rejected while obvious transmission, engine or braking problems on the test drive disqualified a vehicle. Further visual inspection was made for evidence of improper maintenance or tampering. With the questionnaire, test drive and lead test indicating an acceptable vehicle, AESi tentatively accepted the vehicle for test subject to one more inspection which was to be carried out by the Inspection and Maintenance (I&M) group.

Usually within a few hours of securing the test vehicle, I&M would perform a more detailed inspection of the underhood emission components for evidence of major disablements which would disqualify the vehicle from test.

Prior to this final inspection, Procurement had completed a Test Agreement, Vehicle Exchange Agreement, and Saving Bond Application.

2.4.1 Incentives for Participation

The owners of a suitable test vehicle were provided the following incentives for their participation:

A $100 U.S. Saving Bond. Bonds were mailed to participants within two weeks following the test on their vehicle.
The use of a late-model, fully insured loaner automobile during the time their vehicle was undergoing testing.

Tune-up as required.

The owner's automobile was returned with a full tank of fuel.

2.5 Elimination Criteria and Summary

Vehicles from the Candidate Vehicle List were eliminated sequentially until an acceptable test vehicle was located. In summary, the candidates were eliminated for the following reasons.

1) Unable to contact the candidate by certified mail, first class mail or telephone.

2) Two statements by the candidate that they did not want to participate. Usually this was a negative indicator on the reply card and a follow-up telephone call.

3) Met a rejection criteria in the Telephone Questionnaire.

4) Failed the lead test.

5) Failed the underhood tampering inspection.

6) Failed the road test.

7) Unable to supply the vehicle within 10 days of AESi's request to test the vehicle.

The following tables, Exhibits 5 and 6, summarize the project in terms of procurement activity and reasons for rejection.

Summary of the In-Use Feasibility Program
Procurement Activities

		GM	FORD	CHRY
MAIL SOLICITATIONS Certified # Sent		1401	1169	624
MAIL SOLICITATIONS First Class # Sent		724	682	314
TELEPHONE SOLICITATIONS # of Telephone Calls Completed To:	Positive -	571	379	251
	Negative	90	133	35
	Undecided -	13	15	13
# OF RESPONSES RECEIVED	Certified -	687	577	325
	First Class -	174	156	58
# OF POSITIVE RESPONSES	Certified -	451	426	238
	First Class -	72	69	23
	Undecided -	32	20	17
# OF NEGATIVE RESPONSES	Certified -	208	144	76
	First Class -	98	74	29
# OF VEHICLES MEETING QUALIFICATION CRITERIA		82	66	28
# OF VEHICLES REJECTED BY QUALIFICATION CRITERIA		592	461	271
# OF VEHICLES PROCURED		57	44	12
# OF VEHICLES REJECTED After being Procured		6	8	1
# OF VEHICLES TESTED		51	36	11

As of (date): 10/29/82

Summary

of

Reasons for Rejection

of

Eligible Candidate Vehicles

Reasons for Rejection*

STAGE 1 - INITIAL SCREENING	REFERENCE	GM	FORD	CHRY.
ELIGIBLE - BUT NOT INTERESTED		11	4	1
A. No longer owns vehicle.	Reply Card	43	89	17
B. Is not 1979 model year Make/Model/Engine Size Desired.	Sample Matrix Reply Card	64	29	10
C. Not original purchaser.	*Q1,2,3	22	25	7
D. Incorrect mileage (not between 40,000-50,000).	Q5	443	433	225
E. Used in unusual manner.	Q6,7,8,9,10,11,12	1	3	1
F. Used leaded gas.	Q15	Ø	Ø	Ø
Catalytic Converter Replaced	Q16	Ø	7	Ø
G. Had (has) overheating problems.	Q18	13	1	1
H. Was involved in accident	Q19	2	2	Ø
I. Equipped with add-on AC.	Q22	Ø	Ø	Ø
J. Has vehicle modifications.	Q23	Ø	Ø	2
K. Not properly maintained .	Q26,27,28,29,30	27	5	6
L. Not Dealer maintained.	Q33	31	12	17
M. Misadjustments, or disablements.	Q34	1	Ø	Ø

* - The first reason for rejection shall be recorded
*Q - Questionnaire Question Number

EXHIBIT 6

STAGE II - DELIVER VEHICLE TO ASEi	REFERENCE	GM	FORD	CHRY
N. Unfavorable verification of all information relayed on the questionnaire.	Appendix 10	Ø	4	1
STAGE III - PREPARE FOR TESTING				
O. Unsatisfactory Test Drive.	Appendix 10	Ø	2	Ø
P. Unsatisfactory Component Inspection (Disablement)	Appendix 10 Q34	2	1	Ø
Q. Failed Lead Tests.	Appendix 10	4	1	Ø

EXHIBIT 6 CONTINUED

SECTION 3

INSPECTION AND MAINTENANCE

3.1 Emission Component Inspection

As shown in Exhibit 1, the Emission Component Inspection occured prior to any testing or alteration of the vehicle. The results of this inspection were recorded on appropriate forms with written descriptions of all disablements or maladjustments.

Major disablements (e.g. system removed) caused rejection of the vehicle. Minor disablements such as misrouted or plugged vacuum lines were noted and recorded under the heading "As Received".

This inspection determined the operational status of each component in the emission control system which included the following broad topics: induction system, fuel system (carburetor and choke), ignition system, EGR system, air injection system, PCV system, exhaust system, evaporative system, engine assembly, and three-way catalyst system. The tolerances and methods of inspection were obtained from manufacturer's shop manuals and engine compartment emission data stickers. Verbal instructions from manufacturer representatives were utilized only when supported by published information.

3.2 M-1 Restorative Maintenance

Based upon the findings of the emission component inspection, specific actions were taken to restore malperforming systems prior to any CVS testing. The actions taken may be considered in terms of three types of malperformance which are disablements, maladjustments, and malfunctions. The following items received repairs as required.

Disablements (incorrect component or system disconnected):

- reroute misrouted vacuum lines.
- replace non-OEM equivalent spark plugs
- unplug blocked vacuum lines
- replace non-OEM PCV valve, EGR valve

Maladjustments:

- adjust idle mixture if adjustment plugs have been removed, or, if equipped with limiter caps, adjust within the range of the controls.

- set idle RPM, timing, dwell, and choke rod adjustment if outside of EPA tolerance range.

Malfunctions:

- repair exhaust system leaks

- replace spark plugs and secondary wiring as required to obtain proper firing voltage.

Any changes made to the vehicle from its "As Received" condition was noted as "Repairs completed prior to Test 03".

3.3 M-2 Restorative Maintenance

Following the first CVS test, extensive maintenance and repair was performed on any vehicle which exceeded the 1979 California exhaust emission standards. These tasks are listed below under three categories.

30,000 Mile Maintenance

The following items were changed or serviced as required according to manufacturers specifications:

- carburetor choke and hoses

- EFE System

- carburetor bolt torque

- vacuum advance and hoses

- fuel filter replaced

- PCV valve replaced, service hoses

- oxygen sensor changed

- idle stop solenoid serviced

- air cleaner element replacement

- carburetor vacuum break check

- ECS system, filter replacement

- fuel line check

- engine valve clearance

Tune-Up:

- change oil and filter

- change spark plugs

- set timing, dwell, idle RPM, and choke adjustments to specification.

- set idle mixture to specification.

Malfunctions:

- all emission system malfunctions were remedied except those which required the following actions:

    1) carburetor replacement
    2) internal engine component replacement
    3) catalyst replacement

SECTION 4

FACILITIES AND EQUIPMENT

4.1 Test Location

All tests were performed at AESi's test facility at 7300 Bolsa Avenue in Westminster, California. The facility is located approximately 25 miles south of downtown Los Angeles at an elevation of 45 feet above sea level.

The test facility environment, including test and vehicle soak areas, was maintained at the required ambient temperature for all phases of testing. The vehicle soak area is located inside the same building as the test area and both are free from precipitation.

4.2 Constant Volume Sampler

A positive displacement pump type constant volume sampler (CVS) built by AESi was used in this program. This CVS meets or exceeds all specifications defined in the Code of Federal Regulations Title 40, Part 86, Subparts A and B (40 CFR Part 86). The system contains six bags switched by computer in sample/background pairs for all dilute exhaust sample testing.

All plumbing in the sampling, analytical and calibration systems is either stainless steel or teflon. This includes all sample, calibration and zero gas lines and the valves and regulators for NO gases. Leak-tight stainless steel convoluted tubing is used between the CVS and the vehicle tail pipe for exhaust gas sampling. An appropriate leak-tight boot was used to connect the tail pipe to the convoluted tubing. A stainless steel heat exchanger with a temperature controlled cold water inlet was used to provide essentially a constant exhaust gas temperature through the entire test.

4.3 Emission Analysis Console

An AESi exhaust gas analytical system meeting or exceeding the specifications of 40 CFR Part 86, was used for dilute gas measurements. Similar laboratory type instrumentation, with additional ranges, was available for analysis of raw NO, CO2, HC, and CO gas. The consoles contain the following instrument types and ranges:

Analyzer	Ranges
Bendix Model 8501-5C NDIR (Lo CO - Dilute Exhaust)	0-100, 0-500 ppm (11 1/4" Cell Length)
Beckman 315B NDIR (Hi CO - Dilute Exhaust)	0-.3% (5 1/4" Cell Length) 0-3% (1.8" Cell Length)
Beckman 315B NDIR (CO_2 - Dilute Exhaust)	0-2.5%, 0-4% (1/8" Cell Length)
Beckman 315B NDIR (CO_2 - Raw Exhaust)	0-15% (1/8" Cell Length)
Beckman 400 FID (Lo HC - Dilute Exhaust)	0-50, 0-100, 0-300 ppm Carbon
Beckman 400 FID (Hi HC - Dilute Exhaust)	0-1,000, 0-3,000 ppm Carbon
Teco 10AR Chemiluminescent (NOx - Dilute Exhaust)	0-100, 0-250, 0-1,000, 0-2,500 ppm
Teco 10AR Chemiluminescent (NO - Raw Exhaust)	0-100, 0-1,000, 0-2,500, 0-4,000 ppm
Chrysler Model III Garage (HC - Raw Exhaust)	0-300, 0-2,000 ppm Hexane Equivalent
(CO - Raw Exhaust)	0.5%, 0-10%

4.3.1 Laboratory Standard Calibration & Working Gases

Laboratory standard calibration gases, previously approved by EPA, were used for defining instrument calibration curves and assigning concentration values for the working gases. Each cylinder of standard gas and each working gas cylinder was equipped with its own pressure regulator. All gases were plumbed to a quick-disconnect panel for ease in selecting the gas desired during calibration and testing.

Calibration gases for each range of the HC and NOx analyzers were chosen such that three points were used across the curve (zero and approximately 45% and 90% of full scale concentration). CO and CO_2 calibration points were at zero and approximately 15, 30, 45, 60, 75 and 90 percent of full scale. All span gases were 80-100 percent of full scale.

The diluents used in the calibration and working gases are:

HC, ppmC	Propane in HC free air
NOx, ppm	In zero grade nitrogen
CO, mole %	In zero grade nitrogen
CO_2, mole %	In zero grade nitrogen

4.4 Sealed Housing for Evaporative Determinations (SHED)

Evaporative emissions tests were performed using an AESi SHED and its associated operator console. The SHED meets all requirements in "Evaporative Emission Regulations for Light-Duty Vehicles and Trucks" as described in Federal Register 164, dated Monday, August 23, 1976. The console includes a Beckman 400 FID analyzer with ranges of 0-100, 0-300, 0-1000 and 0-3000 ppmC; a Linear Instruments chart recorder for analyzer output; a Leeds and Northrup SPEEDOMAX multipoint temperature recorder; and a variable voltage source and heating element (blanket) for applying heat to the vehicle gas tank for the diurnal heat build. A cooling package was installed to ensure operation of the SHED within the temperature range of 68°F to 86°F.

4.5 Chassis Dynamometer

The chassis dynamometer was equipped to simulate vehicle inertia and road load horsepower as required in 40 CFR Part 86.

The dynamometer used was a Clayton ECE-50 with RLPC, remote controlled lift, 17 1/4 inch roll center spacing, 89 inch overall roll length and 4000 lb axle weight capacity. Direct drive variable inertia loading weights were employed, with 125 pound increments from 1000 through 8875 lbs.

A speed meter which indicates mi/hr was used to monitor the speed of the dynamometer roll. The rear dynamometer roll was equipped with a tachometer generator which provides the speed signal during testing. The meter response was linear with speed and the accuracy was within $\pm$2.0 km/hr ($\pm$1.2 mph) over the range of 0-95 km/hr (0-59 mph). The dynamometer was equipped to measure actual distance traveled for each segment of the FTP testing sequence.

The power absorption unit was monitored by a power meter accurate and readable to $\pm$0.25 hp (.187 kw) over the range of intended use.

4.6 Data Acquisition System

Data was obtained from the analyzers, CVS and dynamometer via an AESi Data Acquisition Control Computer (DACC). The Data General NOVA computer was also used for generation of driver traces for the various driving schedules, for sample bag management and for calculation and presentation of the emission test results. The data was printed by a Data General Dasher printer immediately following sample analysis.

The output from the analyzers was also wired to the inputs of two Hewlett-Packard Model 7130A two-pen recorders. One recorder was used for dilute HC and NOx and one for dilute CO and CO_2.

4.7 Driver's Aid

An AESi-designed two-pen Hewlett-Packard Model 7130A Driver's Aid (speed vs time recorder) and Clayton speed/power meters were employed to permanently record the driver's performance during the test. The Hewlett-Packard Recorder was mounted in the Driver's Aid box. The box itself was situated on a 4-piece moveable boom so that it could be easily moved when testing vehicles with front wheel drive. The driving trace was generated by the NOVA computer on this recorder in agreement with the specifications of 40 CFR Part 86.

4.8 Miscellaneous Equipment

Miscellaneous equipment used in conjunction with the major items of equipment included the following:

Two Teco Model 100 NOx Generators. The generator in the raw gas analysis bench was not used since only NO is reported.

One Rustrak Chart Recording Psychrometer, Model 2133B with continuous recording of wet/dry bulb temperatures.

One Rustrak Chart Recorder, Model AD 101-462-2A for continuous recording of CVS temperature.

One Weathermeasure M701 continuous recording temperature recorder for soak area temperature.

One Princo mercurial Barometer.
One Meriam 50 MC2-4SF Laminar Flow Element for CVS calibration.

One Sartorius Model 2257 Balance used for weighing the propane cylinders for propane recovery tests.

One Strobotach for dynamometer speed calibration.

Horiba GSM and MEXA 300A garage analyzers were used for inspection by the mechanic.

SECTION 5

EQUIPMENT QUALIFICATION, CALIBRATION AND CROSSCHECK

This section describes the qualification, calibration, and crosscheck procedures utilized by AESi and verified by EPA technical personnel to ensure that valid test data were generated throughout the test program. Initial qualification included complete demonstration of individual instrument calibration, stability, response time, zero air and nitrogen purity, CVS calibration, dynamometer calibration, and inspection of all daily, weekly and monthly logs.

5.1 Constant Volume Sampler

The CVS was calibrated with a laminar flow element (Meriam Model 50-MC 2-45F) using the basic procedures specified in the Federal Register. CVS air flow, measured using the laminar flow element on the inlet side of the mass pump (CVS blower), was controlled by throttling. Air flow rates were measured at five incremental changes in pump differential pressure on each side of the normal operating point. Flow rates at a total of at least ten points were measured. The nominal air flow of the CVS is 345 cfm. Auxiliary devices employed in the calibration included a mercury barometer to measure absolute ambient pressure, a close tolerance mercury thermometer to measure pump inlet air temperature, a U-tube water manometer to measure the pressure drop across the pump and the pump inlet pressure, and a close tolerance inclined water manometer to measure the pressure drop across the laminar flow element. Once this calibration was completed, data from these devices were computer processed and the mid-range blower operating point was determined. Propane recovery tests using instrument grade propane were made after the calibration to confirm its accuracy. A copy of the calibration data was provided to the EPA Project Officer as a part of the qualification data package.

Calibration of the laminar flow element (LFE) was traceable to the National Bureau of Standards, and a certified copy of the LFE calibration curve was furnished to the Project Officer at the time of Laboratory Qualification.

Daily propane recovery tests were made to confirm continued calibration of the CVS system. The measured propane mass recovered by the CVS had to be within ± 2.0 percent of the injected mass of up to 20 grams of instrument grade propane as determined gravimetrically. The recovered amount of propane was measured on the 0-300 ppmC FID range. A Rustrak chart recorder was used to continuously record CVS temperature during these tests.

5.2 Dilute Exhaust Analysis Console

Complete calibrations of the mass emission analysis console instruments were performed initially and checked each week thereafter until testing was completed. Calibration curves for the mass emission analysis console CO, CO_2, HC and NOx instruments were established using the gases previously identified. The CO and CO_2 instruments were calibrated at seven somewhat evenly spaced points (zero and six upscale points) across each operating range. Calibration of the HC and NOx instruments was performed at three somewhat evenly spaced points (zero and two upscale points) across each operating range. Calibration of these instruments was established and maintained within one percent of full scale for each range, respectively, or five percent of the measured value, whichever was smaller. A computer program provided by the EPA was used in the generation of the calibration curves.

In connection with each test, the CVS sample bags were purged with nitrogen, evacuated and leak-checked. These operations were performed in a bag evacuate, N_2 purge, evacuate and leak-check sequence by means of a manual push-button selection of solenoids located within the CVS. A leak in the system was indicated by a non-zero flow in the flow meters on the operator's console.

Other activities included setting zero and span points immediately prior to exhaust sample analysis and zero and span point verifications immediately following exhaust sample analysis. Strip chart recorders were operated throughout the zero and span set-point calibration, sample analysis and zero and span verification sequence. Verification tolerances were maintained within ± 1 deflection from the set-point for the range in use. Converter efficiency of the NOx converter was maintained above 90 percent. The noise level of analyzer outputs as indicated on the strip chart was maintained within ± 0.5 percent of full scale for the range used during both calibration and analysis.

5.2.1 Daily Qualification Checks

Daily qualification checks included:

Leak-check of each instrument as well as the system.

Recording of zero, gain and tune, as applicable, for each instrument.

Hang-up and leak-checks for background and sample bags and sample line.

NOx analyzer vacuum and converter efficiency checks.

Propane recovery tests to ensure proper FID operation as well as verification of the CVS calibration.

Recording of FID fuel and air pressure.

Recording of cylinder number, concentration, deflection, cylinder pressure for each working gas.

In addition to the above daily checks, weekly calibration curve checks were mad for each range of each instrument.

Appropriate calibrations, leak-checks, etc., were also made whenever maintenance was performed which could change instrument or system operation.

5.3 SHED

The volume of the SHED used was determined by physical measurement. Calibration of thermocouples used in the SHED was verified by an ASTM thermometer as was the temperature recording instrument. Calibration curves were generated for each range of the Beckman 400 FID used in the analytical console. These curves were verified weekly.

For initial calibration, the FID was zeroed on zero grade prepurified air and calibrated at two upscale points (i.e. 45% and 90% of full scale) on each of the ranges used. The same hydrocarbon gas standards previously described were employed for this calibration. Curve fit tolerances and verification frequency were the same as those applied to the dilute emission analysis console instruments.

The SHED was subjected to a background hydrocarbon check, a calibration check and a retention check prior to testing the first vehicle.

The background emissions check was performed by sealing the enclosure and allowing it to remain sealed for a period of four hours. Initial and final hydrocarbon readings were taken. The background emission rate was acceptable when it was less than the maximum increase of 0.4 grams for the four hours, as defined in 41 Federal Register 164, dated Monday, August 23, 1976.

The SHED was calibrated by first purging with fresh air and then sealing the enclosure. Approximately 4 grams of instrument grade propane was injected into the enclosure after the enclosure was sealed. The mixing fans were operating during this injection. After five minutes of mixing, the stabilized hydrocarbon level of the enclosure was measured and the mass calculated. The quantity of the calculated recovery was within $\pm$2% of the injected amount.

The propane retention (leak) check was performed following the calibration. In this check the SHED was allowed to remain sealed for a minimum of four hours with the mixing blowers operating. At the end of this period the hydrocarbon level of the enclosure was measured and the mass calculated. For this check, the hydrocarbon level was within ±4% of the initial reading as calculated. The SHED calibration and retention tests were performed monthly thereafter.

5.4 ECE-50 Chassis Dynamometer

Dynamometer speed was verified initially and bi-weekly with a Strobotach. Road load force was determined using calibrated weights. Coastdowns were performed initially and bi-weekly thereafter to verify the road load force versus inertia weight relationships as given in 40 CFR Part 86.

5.5 Data Acquisition System

The data acquisition system was verified by performing manual checks of equipment performance and hand calculations from strip chart data and comparing these with the data provided by the DACC. This activity is verified by a Quality Assurance inspection for each test. A reasonableness check was performed for each critical data element. Any suspect data was verified by strip chart or calculation. Any data found to be in error was independently recalculated wherever possible or the test was rejected.

5.6 Miscellaneous Equipment

All miscellaneous equipment was calibrated or verified according to manufacturer's recommended practices. The CVS laminar flow element and barometers were calibrated by Meriam Instruments Company.

SECTION 6

TEST PROCEDURES

6.1 Vehicle Preparation

With reference again to Exhibit 1, the vehicle received an emission component inspection followed by repairs made prior to CVS testing. Before testing, the levels of engine oil, transmission fluid, and coolant were checked and the vehicle's fuel tank was drained and refueled with appropriate test fuel to 40% of tank capacity. All vehicles were prepared for the conditioning duirnal heat build by fitting the gas tank with a type J thermocouple by soldering it to the side of the tank at the approximate mid-point of the 40% fuel volume.

As preconditioning to purge the fuel system and warm up the vehicle prior to cold soak, all vehicles were driven for 7.5 miles on the AESi city street preconditioning route.

After the preconditioning run, the vehicle was driven into the soak area for the required 12 to 36 hour soak at temperatures between 68°F and 86°F.

6.1. 1. Driveability Evaluation

An evaluation of the driveability of each vehicle was performed prior to and during each FTP. The evaluation is essentially the same as that performed on previous EPA light duty vehicle projects.

6.2 Equipment Preparation

Prior to the first test of the day and following any shut-down, equipment which had been idle or in a stand-by condition was activated to begin warm-up. This included the CVS water heater and mass pump and each of the analytical instruments. Following the warm-up of the respective instruments, efficiency of the NOx instrument thermal converter was checked and the propane recovery test involving the CVS sample system and the FID hydrocarbon instrument was conducted. Subsequent to these checks, analyzer outputs as indicated by the strip chart recorders and the DACC computer and printer, were checked for correlation by calibrating at zero and five volts. Prior to the first exhaust emissions test of the day or following any two hour shut-down, the dynamometer was warmed-up. The prescribed 15 minutes of 30 mile per hour operation of the dynamometer was the warm-up

procedure followed. Following warm-up, the speed calibration of the dynamometer, driver's aid recorder and associated indicating devices were also checked and calibrated as necessary.

Prior to each test, all charts were properly stamped to show the vehicle number, run number, date and persons involved in the test.

6.3 Federal Test Procedure

The Federal Test Procedure as described in 40 CFR Part 86 was performed on all vehicles in both the first and second tests. Although no emission levels were measured, each vehicle received a diurnal heat build as preconditioning to the FTP exhaust test. The exhaust emission portion of the Federal Test Procedure is comprised of cold transient, cold stabilized and hot transient phases. The cold transient portion is 505 seconds long, covering a distance of 3.59 miles with an average speed of 25.6 mph. The cold stabilized portion is 869 seconds in length, 3.91 miles in distance and a 16.2 mph average speed. The hot transient portion is identical to the cold transient portion except that it is preceded by a 10 minute soak. The evaporative emissions testing consisted of the SHED technique as described in 41 Federal Register 164, dated Monday, August 23, 1976 less emissions and hot soak.

The cold soak period used for the test vehicles was 12 to 36 hours. The starting procedures and shift points used for the test vehicles were as recommended by each manufacturer in owner's manuals.

SECTION 7

QUALITY ASSURANCE AND DATA HANDLING

AESi has established a comprehensive review system of all data to guarantee the accuracy of the results. This quality assurance program extends through laboratory qualification, establishing test parameters, emission test data and I&M data. This section presents the procedures as they were applied to the project and then discusses the data handling required for the project.

7.1 Quality Assurance Responsibilities

1. Ensure that daily calibrations have been performed prior to the first test of the day. Plot PRT results and report unusual trends. Report errors in daily checks to Lab Supervisor.

2. Inspect all test packet materials for proper test conditions, procedures and results reporting and ensure that the data are complete.

3. Work with the Project Engineer in the resolution of all rejected tests and make the Project Engineer aware of the quantity and reasons for all aborted tests.

4. Work with the Project Engineer in establishment of test data requirements and any special forms needed.

5. Maintain logs of all tests received by Q.A. and the disposition of these tests.

6. Prepare all data processing inputs and oversee the data processing operations necessary to satisfy contract requirements.

7. Ensure that data are submitted to the customer in a timely manner.

8. Act as interface with major contract principals in providing weekly status reports when necessary.

9. Ensure that all contract required calibrations are accomplished and provide any necessary forms at least 24 hours in advance of the required calibration.

10. Perform a weekly equivalency check on the Testing Laboratory.

11. Maintain master DACC curve table notebook. Have the Lab printout all tables monthly and rectify any errors found.

12. Keep an action file of incomplete Malfunction Reports and purge when completed report is received, trace tardy reports. Compare Malfunction Reports with Maintenance Log.

13. To act as custodian of all test and calibration data collected as a result of lab operations.

14. Update Q.A. Manual and Procurement notebook as required for contractual procedures or changes.

7.1.1 Weekly Curve Checks (WCC)

1. Check WCC forms and make sure all deflections are within their existing limits, if not, note this on the WCC forms.

2. Check strip charts and compare them to WCC forms, i.e concentrations, cylinder numbers, deflections.

3. If there are any changes complete the following:

   a. Run new curves (if applicable).

   b. Submit new curve to Lab for update into DACC table (s).

   c. New DACC curve table(s) must be printed, checked and initialed.

   d. Update master curve book and make one copy for EPA.

   e. Update any new working gas changes to the master span sheets. Double check.

   f. Update master weekly curve check forms. Double check.

   g. Supply Lab with new span sheets ASAP (before next test).

   h. File all obsolete curves and forms.

   i. Make copies of WCC and span sheets for EPA.

4. Ensure all forms are updated for next week's check.

7.1.2 Weekly Equivalency Checks

1. Verify wet and dry bulb readings with DACC using the sling psychrometer.

2. Verify CVS temperature reading using DACC, pyrometer gauge and Rustrak as compared to each other.

3. Verify soak temperature chart with ASTM thermometer (minimum 1 hour stabilization).

4. Verify barometer readings on the DACC and 7-day recorder against the mercury barometer.

5. Attach WB/DB/CVS strip charts to Weekly Equivalency form.

6. If any item is found to be out of calibration, immediately shut down laboratory until it is corrected. When corrected, perform an additional equivalency check to insure item was corrected.

7. Report cal gas cylinders with less than 300 pounds pressure to Department Manager.

7.1.3 Test Packet Inspection

1. Check outside front of packet.

   a. Inertia weight

   b. Actual and indicated horsepower

   c. Fuel tank capacity

   d. Shift points (may be in packet)

   e. All pertinent information on packet

2. Check outside back of packet

   a. Cold Soak time

   b. Mileage and dates

3. Check contents of packet

   a. Driveability form

   b. Starting Procedures and Shift Points

   c. Drivers trace

d. Analyzer Strip charts

e. WB/DB/CVS temp traces

f. Computer sheet

g. Evaporative strip charts and forms

7.2 Data Handling

For this project, EPA supplied data forms which were completed for each test vehicle. The forms required recording all pertinent test parameters, vehicle parameters, I&M observations and repairs, and emission test data.

This data was recorded either directly on the EPA data forms or transcribed from AESi generated test documents.

APPENDIX A

TELEPHONE QUESTIONNAIRE

OMB No. 2000-0027

TELEPHONE QUESTIONNAIRE

VEHICLE CONTROL NUMBER _____ DATE _____

ADMINISTERED BY _____

OWNER'S NAME _____

STREET ADDRESS _____

CITY _____ STATE _____ ZIP _____

(CALL NUMBER BELOW THAT IS MARKED WITH AN "X")

TELEPHONE (Home) ( ) _____ (Business) ( ) _____

BEST TIME TO CALL _____

****

"WE ARE AUTHORIZED BY FEDERAL LAW TO COLLECT THIS INFORMATION. WHILE YOU ARE NOT REQUIRED TO RESPOND, YOUR COOPERATION IS NEEDED TO MAKE THE RESULTS OF THIS INVESTIGATION VALID."

****

You have been selected from a list of 8,932 vehicle owners living in the L.A. and ORANGE COUNTIES area to participate in a study of tailpipe pollutants being conducted by the U.S. Environmental Protection Agency.

EPA is authorized by law to conduct this study and to offer incentives to you for your cooperation should you decide to participate. Your participation in this program is strictly voluntary and none of this information will be used against you in any way.

Your cooperation will help EPA's efforts to control air pollution due to car exhausts.

These are the conditions of the program:

- we ask that you bring your car into our testing facility where you will receive a late model rental car which will have a full tank of gas and unlimited mileage. This vehicle is yours to use without charge for the duration of the testing, which takes approximately ten (10) working days. During this time, we will be performing a series of tests on your car to measure tailpipe pollutants.

Control #_____

- at the time the vehicle is delivered to us for testing, you will be required to sign a paper stating that the answers to the questions you will be asked are true and accurate to the best of your personal knowledge and belief. Again, none of this information will be used against you in any way.

The incentives which are awarded are as follows:

- If a full test program has been completed on your car, a full tank of gas and a $100 U.S. Savings Bond will be awarded.

- If your vehicle is rejected after being in the laboratory for two days, a full tank of gas and $100 U.S. Savings Bond will be awarded.

  The maintenance performed on your car will depend on program requirements.

Are you willing to participate? YES | | NO | |

If you are not, may we ask why not?_____

_____

_____

IF RESPONSE IS POSITIVE:

For the purpose of this study, I am going to ask you some questions about your car's maintenance and usage history. Again, I remind you that none of this information will be used against you in any way. You should answer these questions to the best of your knowledge and indicate when you are not sure of something.

Control #_____

1. What is the model year, transmission type, vehicle identification number and engine family? The engine family can be found on a decal located under the hood in the engine compartment.

MODEL_____ VEHICLE ID NO._____

MODEL YEAR_____ ENGINE FAMILY_____

TRANSMISSION: AUTOMATIC | | AIR CONDITIONED: YES | | NO | |

MANUAL | |

2. (a) Are you the original purchaser of the vehicle? YES | | NO | |

IF THE ANSWER IF NO, COMPLETE 2b.

(b) Was your vehicle privately owned prior to your purchase? YES | | NO | |

ELIMINATE IF ANSWER IS YES

3. Was the vehicle utilized as a demonstrator or owned by a company prior to your purchase?

YES | | NO | |

IF THE ANSWER IS YES, ELIMINATE VEHICLE.

4. When and where did you purchase the car?

WHEN_____ WHERE_____

5. (a) What is the approximate odometer reading?_____

ELIMINATE IF NOT BETWEEN 40,000 AND 50,000 MILES

(b) Has the odometer ever not functioned properly?

YES | | NO | |

ELIMINATE IF THERE IS A HIGH PROBABILITY THAT THE VEHICLES MILEAGE IS NOT BETWEEN 40,000 AND 50,000 MILES.

Control #_____

HAVE YOU EVER USED YOUR CAR FOR ANY OF THE FOLLOWING ACTIVITIES?

		YES	NO
6.	As a taxi?	___	___
7.	As a commercial delivery vehicle?	___	___
8.	To race in competitive speed events?	___	___

ELIMINATE IF RESPONSE TO 6 THROUGH 8 IS YES.

9. To pull trailers? ___ ___

OFTEN | | SOMETIMES | | NEVER | |

Weight, type_____

ELIMINATE IF RESPONSE TO 9 IS OFTEN. IF RESPONSE IS SOMETIME, PROCEED TO 10.

10. Has the vehicle been modified to permit trailer towing? YES | | NO | |

ELIMINATE IF TRAILER LOAD WAS EVER GREATER THAN MANUFACTURERS RECOMMENDED LIMITES.

11. Have you operated your car in severe dust conditions? YES | | NO | |

ELIMINATE FOR POSITIVE RESPONSE

12. What percent of the time would you estimate you drive on unpaved roads?

Percent of time_____ None | |

ELIMINATE IF OVER 5%

13. What percent of your driving is done in:

City_____%

Highway_____%

Control #_____

14. Have you operated your car on gasohol or an ethanol fuel blend?

NO | | YES | | If yes, what % of the time?_____

When was the most recent time?_____

15. This vehicle requires the use of unleaded fuel.

(a) Have you operated your car on leaded gasoline?

Never | | seldom | | often | | always | |

ELIMINATE IF RESPONSE IS OTHER THAN NEVER, THEN GO TO 15(b).
IF RESPONSE IS NEVER, GO TO 15(c).

(b) Why did you switch to leaded gasoline?

cost savings | | availability | | other | |_____

(c) Has the fuel pipe restrictor been removed from your car?

YES | | NO | |

ELIMINATE FOR POSITIVE RESPONSE

16. Have there been any problems with the catalytic converter?

YES | | NO | |

If yes, describe _____

17. Have you ever operated your car so as to cause it to idle for extended periods of time? (i.e., for more than 15 minutes)

NO | | YES | | APPROX. NO. OF TIMES_____

18. (a) Has your car ever overheated? YES | | NO | |

_____ no. of times

(b) How long was it driven in an overheated condition?_____

(c) How did you know it was overheated?_____

(d) What did you do?_____

IF RESPONSE IS POSITIVE: ELIMINATE IF VEHICLE HAS OVERHEATED MORE THAN ONCE. IF VEHICLE HAS OVERHEATED ONCE ELIMINATE IF RESPONSE TO (b) IS MORE THAN THREE MILES.

Control #_____

19. Has your vehicle even been involved in an accident? YES | | NO | |

If answer is yes, indicate what type of damage and the extent of damage to the engine, carburetor, drive train, cooling system, fuel tank, ignition system, emission control system or exhaust system.

_____

_____

ELIMINATE IF THERE WAS DEFINITE DAMAGE TO ENGINE, CARBURETOR, DRIVE TRAIN, COOLING SYSTEM, FUEL TANK, IGNITION SYSTEM, EMISSION CONTROL SYSTEM, OR EXHAUST SYSTEM.

THE REMAINING QUESTIONS WILL DEAL WITH THE MAINTENANCE HISTORY OF YOUR VEHICLE.

20. Have you kept records of the maintenance and repairs performed on your vehicle?

YES | | NO | |

21. Would you allow them to be reviewed and duplicated?

YES | | NO | |

22. (a) Is your car equipped with non-factory installed air-conditioning?

YES | | NO | |

(b) If yes, was it installed at a dealership?

YES | | NO | |

ELIMINATE IF RESPONSE TO 22(b) IS NEGATIVE.

23. Have any of the following special devices been installed on your vehicle other than standard parts made by the vehicle manufacturer?

(a) exhaust headers _____

(b) camshaft equipment _____

(c) ignition equipment _____

(d) carburetor components _____

Control #____________

Question 23 Continued

(e) fuel tank ____________

(f) other (describe)________________________

____

ELIMINATE IF ANY ANSWER TO (a), (b), (c), OR (d), IS POSITIVE.

24. Have you ever used synthetic oil in your car?

YES | | NO | |

25. How may oil, and oil filter changes have you had? If filter change was performed indicate by check mark in provided space.

DATE________ OIL CHANGE | |	DATE________ OIL CHANGE | |
MILEAGE________ OIL FILTER | |	MILEAGE________ OIL FILTER | |
PERFORMED BY________	PERFORMED BY________
DATE________ OIL CHANGE | |	DATE________ OIL CHANGE | |
MILEAGE________ OIL FILTER | |	MILEAGE________ OIL FILTER | |
PERFORMED BY________	PERFORMED BY________
DATE________ OIL CHANGE | |	DATE________ OIL CHANGE | |
MILEAGE________ OIL FILTER | |	MILEAGE________ OIL FILTER | |
PERFORMED BY________	PERFORMED BY________
DATE________ OIL CHANGE | |	DATE________ OIL CHANGE | |
MILEAGE________ OIL FILTER | |	MILEAGE________ OIL FILTER | |
PERFORMED BY________	PERFORMED BY________

Control #_____

26. Were the oil and oil filter changed during the first 14 months and 8,500 - 12,000 miles after purchasing the car? (See EPA criteria for number of months and mileage.) (See question 25 to verify this answer.)

YES | | NO | |

ELIMINATE FOR NEGATIVE RESPONSE

27. What was the longest period of months and mileage your car has gone between oil changes? (See question 25 to verify or calculate this answer.)

MONTHS_____ MILEAGE_____

ELIMINATE IF EITHER MORE THAN THE NUMBER OR MONTHS OF MILES SPECIFIED BY EPA.

28. What is the longest period of months and mileage your car has gone between oil filter changes? (See question 25 to verify or calculate this answer.)

MONTHS_____ MILEAGE_____

ELIMINATE IF EITHER MORE THAN THE NUMBER OF MONTHS OR MILES SPECIFIED BY EPA.

29. What was the approximate date of your last oil and oil filter change? (See question 25 to verify)

OIL CHANGE: DATA_____ MILEAGE_____

PERFORMED BY_____

OIL FILTER CHANGE: DATE_____ MILEAGE_____

PERFORMED BY_____

30. How may times has your vehicle received a routine tune-up maintenance, such as ignition (or spark) timing adjustment, carburetor adjustment and spark plug replacement? If possible, please state what was performed during the tune-up.

DATE_____| | IGNITION TIMING | | CARBURETOR ADJUSTMENT

MILEAGE_____| | SPARK PLUG REPLACEMENT

PERFORMED BY_____

Control #_____

Question 30 Continued

DATE_____| | IGNITION TIMING | | CARBURETOR ADJUSTMENT

MILEAGE_____| | SPARK PLUG REPLACEMENT

PERFORMED BY_____

DATE_____| | IGNITION TIMING | | CARBURETOR ADJUSTMENT

MILEAGE_____| | SPARK PLUG REPLACEMENT

PERFORMED BY_____

DATE_____| | IGNITION TIMING | | CARBURETOR ADJUSTMENT

MILEAGE_____| | SPARK PLUG REPLACEMENT

PERFORMED BY_____

ELIMINATE IF NOT TUNED-UP IN ACCORDANCE WITH MANUFACTURERS' RECOMMENDATIONS.

31. What other scheduled maintenance has been performed?

DATE_____ MILEAGE_____

PERFORMED BY_____

DESCRIPTION_____

32. What is the largest amount of money you have spent for repairs to your car?

_____ dollars

_____ do not know

WHAT_____

WHY_____

WHEN_____

WHERE_____

Control #_____

33. (a) Has any unscheduled maintenance (i.e., maintenance to correct a problem) been performed on your vehicle in the following area?

	YES	NO
ENGINE	___	___
CARBURETOR	___	___
DRIVE TRAIN	___	___
EXHAUST SYSTEM	___	___
IGNITION SYSTEM	___	___
COOLING SYSTEM	___	___
FUEL TANK	___	___
EMISSION CONTROL SYSTEM	___	___

(b) If the answer to any of the above items is yes, please describe what, why, when, where.

WHAT_____

WHY_____

WHEN_____

WHERE_____

ELIMINATE IF UNSCHEDULED MAINTENANCE PERFORMED BY OTHER THAN DEALERSHIP.

34. To the best of your knowledge, have any vehicle settings been misadjusted or have the emission control system components been altered, modified or disconnected?

YES | | NO | |

If yes, explain what, when, where.

WHAT_____

WHEN_____

WHERE_____

ELIMINATE IF EMISSION SYSTEM COMPONENTS HAVE BEEN ALTERED OR MODIFIED.

Control #_____

35. (a) Have you observed any of the following performance problems?

	NEVER	OCCASIONALLY	FREQUENTLY
HARD STARTING	_____	_____	_____
POOR COLD PERFORMANCE	_____	_____	_____
POOR ACCELERATION	_____	_____	_____
HESITATION	_____	_____	_____
STALLING	_____	_____	_____
BACKFIRE	_____	_____	_____
ENGINE KNOCK	_____	_____	_____

Any other performance problems?_____

(b) What was done to eliminate the peformance problem(s)? What, when, and where

WHAT_____

WHEN_____

WHERE_____

WHAT_____

WHEN_____

WHERE_____

(c) Did the answer to 35(a) problems you mentioned occur:

| | When you first purchased the car

| | With normal use but prior to any maintenance performed on your car

| | After maintenance by_____

(d) Do you still experience performance problems?_____

Described_____

_____

Control #_____

Question 35 Continued

(e) Would you say the general performance of your vehicle at the present time is:

| | Better than when you purchased it

| | Worse than when you purchased it

| | About the same as when you purchased it

36. (a) Has your vehicle been involved in a recall?

| | no

| | yes, approximate date_____

Describe the recall_____

_____

(b) Did you take your car to a dealership for the recall repair?

yes | | no | |

37. Has you car been equipped with rust proofing or undercoating?

| | no | | yes If yes, when and by whom_____

_____

38. Has your vehicle received body or glass repairs or been partially or totally repainted?

| | no | | yes If yes: When_____

Described_____

39. Has your vehicle been equipped with interior or exterior modifications such as special seats, upholstery or a vinyl roof which were not factory installed?

| | no | | yes If yes, described_____

_____

I have read and agree that the answers to these questions are true and accurate to the best of my personal knowledge. _____

 Signature Date