EPA-AA-TEB-511-82-7A

EPA Evaluation of the Energy Gas Saver Under Section 511 of the Motor Vehicle Information and Cost Savings Act

by

John C. Shelton

January 1982

Test and Evaluation Branch
Emission Control Technology Division
Office of Mobile Source Air Pollution Control
U.S. Environmental Protection Agency

6560-26

ENVIRONMENTAL PROTECTION AGENCY

[40 CFR Part 610]

[FRL ______________]

FUEL ECONOMY RETROFIT DEVICES

Announcement of Fuel Economy Retrofit Device Evaluation

for "Energy Gas Saver"

AGENCY: Environmental Protection Agency (EPA).

ACTION: Notice of Fuel Economy Retrofit Device Evaluation.

SUMMARY: This document announces the conclusions of the EPA evaluation of the "Energy Gas Saver" under provisions of Section 511 of the Motor Vehicle Information and Cost Savings Act.

<u>BACKGROUND INFORMATION:</u> Section 511(b)(1) and Section 511(c) of the Motor Vehicle Information and Cost Savings Act (15 U.S.C. 2011(b)) requires that:

(b)(1) "Upon application of any manufacturer of a retrofit device (or prototype thereof), upon the request of the Federal Trade Commission pursuant to subsection (a), or upon his own motion, the EPA Administrator shall evaluate, in accordance with rules prescribed under subsection (d), any retrofit device to determine whether the retrofit device increases fuel economy and to determine whether the representations (if any) made with respect to such retrofit devices are accurate."

(c) "The EPA Administrator shall publish in the <u>Federal Register</u> a summary of the results of all tests conducted under this section, together with the EPA Administrator's conclusions as to -

(1) the effect of any retrofit device on fuel economy;

(2) the effect of any such device on emissions of air pollutants; and

(3) any other information which the Administrator determines to be relevant in evaluating such device."

EPA published final regulations establishing procedures for conducting fuel economy retrofit device evaluations on March 23, 1979 [44 FR 17946].

ORIGIN OF REQUEST FOR EVALUATION: On June 5, 1981, the EPA received a request from the Energy Gas Saver Corporation for evaluation of a fuel saving device known as the "Energy Gas Saver". This device is claimed to reduce exhaust emissions and save fuel.

Availability of Evaluation Report: An evaluation has been made and the results are described completely in a report entitled: "EPA Evaluation of the Energy Gas Saver Under Section 511 of the Motor Vehicle Information and Cost Savings Act". This entire report is contained in two volumes. The discussions, conclusions and list of all attachments are listed in EPA-AA-TEB-511-82-7A, which consists of 11 pages. The attachments are contained in EPA-AA-TEB-511-82-7B, which consists of 115 pages. The attachments include correspondence between the applicant and EPA, and all documents submitted in support of the application.

Copies of this report may be obtained from the National Technical Information Service by using the above report number. Address requests to:

National Technical Information Service
U.S. Department of Commerce
Springfield, VA 22161
Telephone: (703) 487-4650 or FTS 737-4650

Summary of Evaluation

EPA fully considered all of the information submitted by the device manufacturer in his application. The description of the device and the supporting text did not indicate that the device would improve combustion efficiency. The test data submitted with the application was inconclusive.

While thorough mixing of fuel and air and even distribution among the cylinders will enhance the combustion process, there is no evidence that the use of this device will result in any improvements over an unmodified induction system. Adjustment of the ignition timing and idle fuel mixture with an exhaust gas analyzer to achieve the best possible emission readings may cause driveability problems in some vehicles. Based on EPA's engineering judgment, there is no reason to support any claims for improvements in fuel economy or exhaust emissions due to the use of the Energy Gas Saver.

FOR FURTHER INFORMATION CONTACT: Merrill W. Korth, Emission Control Technology Division, Office of Mobile Source Air Pollution Control, Environmental Protection Agency, 2565 Plymouth Road, Ann Arbor, Michigan 48105, (313) 668-4299.

Date

Kathleen Bennett
Assistant Administrator
for Air, Noise, and Radiation

EPA Evaluation of the "Energy Gas Saver" under Section 511 of the Motor Vehicle Information and Cost Savings Act

The following is a summary of the information on the device as supplied by the Applicant and the resulting EPA analysis and conclusions.

1. Marketing Identification of the Device:

   A. Energy Gas Saver

   B. Exhaust Extractor

2. Inventor of the Device and Patents:

   A. Inventor

      Mr. Donald C. Pletts
      143 Inlet Way
      Palm Beach Shores, FL 33404

   B. Patent

      Patent #4127093

      Patent #4216654

3. Manufacturer of the Device:

   Energy Insert Systems, Inc.
   143 Inlet Way
   Palm Beach Shores, FL 33404

4. Manufacturing Organization Principals:

   Mr. Donald C. Pletts - Principal Officer and Owner

5. Marketing Organization in U.S. making Application:

   A. Energy-Insert-System, Inc.

   B. Energy Gas Saver, Inc.

      Both Located at
      143 Inlet Way #5
      Palm Beach Shores, FL 33404

6. Applying Organization Principals:

   Mr. Donald C. Pletts - Principal Officer and Owner

7. Description of Device (as supplied by Applicant):

"This device is 1 31/32 inches thick and is made out of a high grade of cast aluminum. It contains 4 baffle plates and is used to mix the gas and air (vapor) that comes from a conventional carburetor with exhaust from the exhaust system of the engine. For some models there is available an electric heater for cold starts.

"This mix is vaporized further by heat and the mix is leaned outside of the carburetor as it enters the intake manifold.

"This unit fits under the carburetor and on the intake manifold. The amount of exhaust is controlled by a screw in orifice which is changed for different size engines.

"The extractor is fitted into the exhaust system just behind the catalytic convertor. A 1 1/2 in. (O.D.) flex tubing connects the extractor to the rear of the Energy Gas Saver which is filtered. The back pressure from the muffler forces the exhaust back into the Energy Gas Saver."

8. Applicability of the Device (as supplied by Applicant):

Thus far eight different units have been designed to fit a.l known American made automobiles and light trucks:

2 bbl for Ford (all models)	4 bbl for G. Motors
2 bbl for Chrysler "	4 bbl for Ford Products
2 bbl for Chevrolet "	1 bbl for Ford
2 bbl for G. Motors "	1 bbl for all other makes

9. Costs (as supplied by Applicant):

Not supplied.

10. Device Installation - Tools and Expertise Required (as supplied by Applicant):

See attached instructions for installation (Attachment B)

11. Device Operation (as supplied by Applicant):

Not supplied

12. Maintenance (claimed):

"Device filter should be changed every 10,000 miles or 6 months."

13. Effects on Vehicle Emissions (non-regulated) (claimed):

"There is no known reason why exhaust emissions should be increased when properly installed."

14. Effects on Vehicle Safety (claimed):

"The device will not cause any unsafe condition."

15. Test Results (Regulated Emissions and Fuel Economy) (submitted by Applicant):

See Attachment B.

16. Analysis

A. Description of the Device:

The device is judged to be adequately described. A description is contained under Section 8, Description of Device, of the application (Attachment B).

B. Applicability of the Device:

As stated in the application, the device is applicable to gasoline-powered vehicles equipped with carburetors.

C. Costs:

Not supplied.

D. Device Installation - Tools and Expertise Required:

A skilled mechanic with appropriate tools and an exhaust gas analyzer should be able to install the device, although complications could arise due to the alteration of carburetor linkages. The additional height of the carburetor could also prevent the hood from closing properly. Care is required in the installation of the Exhaust Extractor to prevent exhaust leaks and the flexible pipe must be routed in such a way as not to cause heat damage to any components.

E. Device Operation:

No operating instructions are required.

F. Device Maintenance:

It appears that the only maintenance required is the changing of the filter every 10,000 miles or 6 months.

G. Effects on Vehicle Emissions (non-regulated):

The device is claimed to lower emissions, but no data to support these claims were ever submitted.

H. Effects on Vehicle Safety:

One safety problem that might arise is heat damage from the flexible pipe between the Exhaust Extractor and the Energy Gas Saver. There is also the problem that the throttle linkage may not operate correctly.

I. Test Results Supplied by Applicant:

The applicant submitted test data from the Auto Club of Southern California. Unfortunately, this data included only the raw concentrations and not the grams per mile emission numbers. It is not possible to determine how these tests were run or to make valid comparisons from the data.

Test data were also submitted from Olson Engineering, Inc. These results were preliminary and were marked as such. A representative from Olson Engineering stated that this data was invalid for comparison purposes and was only intended for research or development purposes. Our concerns about the validity of these data are detailed in our letter to Energy Gas Saver, Inc. dated June 26, 1981 (Attachment D). Although the applicant responded to our letter (Attachment E), his response was insufficient to validate the results.

Thus, the applicant did not submit any valid test data in accordance with the Federal Test Procedure or the Highway Fuel Economy Test. The requirement for test data following these procedures is stated in the application test policy documents that EPA sends to potential applicants*. The applicant did state that Automotive Environmental Systems, Inc. of Los Angeles, CA would test the device in September 1981 and the results would be furnished to EPA. To our knowledge, this testing was not performed.

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* From EPA 511 Application test policy documents:

Test Results (Regulated Emissions and Fuel Economy):
Provide all test information which is available on the effects of the device on vehicle emissions and fuel economy.

The Federal Test Procedure (40 CFR Part 86) is the primary test which is recognized by the U.S. Environmental Protection Agency for the evaluation of vehicle emissions. The Federal Test Procedure and the Highway Fuel Economy Test (40 CFR Part 600) are the only tests which are normally recognized by the U.S. EPA for evaluating fuel economy of light duty vehicles. Data which have been collected in accordance with other standardized fuel economy measuring procedures (e.g. Society of Automotive Engineers) are acceptable as supplemental data to the Federal Test Procedure and Highway Fuel Economy Data will be used, if provided, in the preliminary evaluation of the device.

17. Conclusions

While thorough mixing of fuel and air and even distribution among the cylinders will enhance the combustion process, there is no evidence that the use of this device will result in any improvements over an unmodified induction system. Adjustment of the ignition timing and idle fuel mixture with an exhaust gas analyzer to achieve the best possible emission readings may cause driveability problems in some vehicles. Based on EPA's engineering judgment, there is no reason to support any claims for improvements in fuel economy or exhaust emissions due to the use of the Energy Gas Saver.

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Attachments to

EPA Evaluation of the Energy Gas Saver Under Section 511 of the Motor Vehicle Information and Cost Savings Act

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John C. Shelton

January 1982

Test and Evaluation Branch
Emission Control Technology Division
Office of Mobile Source Air Pollution Control
U.S. Environmental Protection Agency

List of Attachments

January 13, 1981

Mr. Richard Nelson
Energy Gas Saver, Inc.
1st American Building, Suite 104
701 U.S. Highway #1
North Palm Beach

Dear Mr. Nelson:

This letter is in response to your inquiry of 12/5/80 through the Secretary of State of Texas regarding an EPA evaluation of your device. The Environmental Protection Agency is charged by Congessional mandate to evaluate fuel economy and emission control devices. While the EPA does not actually "approve" such devices, it does conduct evaluations for the purpose of increasing the common knowledge in the area. For this reason, the outcome of any testing by EPA becomes public information. It is this information which may be cited although no claims can be made that any EPA findings constitute "approval" of the device or system.

Enclosed with this letter is a packet of materials which you will need to apply for an EPA evaluation of your device. This packet consists of 1) an application format, 2) a document entitled "EPA Retrofit and Emission Control Device Evaluation Test Policy" and 3) a copy of the applicable Federal Regulations.

In order for the EPA to conduct an evaluation of your device, we must have an application. Once you have reviewed all the documents in the packet, you should prepare an application in accordance with the guidelines of the application format. A critical part of the application is the substantiating test data. The required test results will have to be obtained at a laboratory of your choice. Such testing would be conducted at your expense. A list of laboratories which are known to have the equipment and personnel to perform acceptable tests has been included in the enclosed packet. If you desire, we can assist in the development of a satisfactory test plan.

There are, however, several aspects concerning testing at an outside laboratory which I would like to bring to your attention at this time:

Minimum Test Requirements - Although different types of devices may require a more complex test plan, the minimum we require involves two vehicles and two test sequences run in duplicate. The vehicles should be selected from those listed in Table 1; if possible. Each vehicle is to be set to manufacturer's tune-up specifications for the baseline tests.

The tests are conducted in a "back-to-back" manner, once with the vehicle in baseline condition and again with the device installed with no vehicle adjustments between tests. If installation of the device also involves some adjustments, e.g. timing, fuel-air mixture, choke or idle speed, another test sequence with only these adjustments should be inserted between the first and last. Also as a minimum, the test sequence shall consist of a hot-start LA-4 portion (bags 1 and 2) of the Federal Test Procedure (FTP) and a Highway Fuel Economy Test (HFET). The details of these tests are contained in the enclosed packet. Although only a hot-start FTP is required to minimize the costs to you, you are encouraged to have the entire cold-start test performed since any testing and evaluation performed by EPA will be based on the complete FTP and you may wish to know how a vehicle with your device performs over this official test. As a final requirement, the personnel of the outside laboratory you select should perform every element of your test plan. This includes preparation of the test vehicle, adjustment of parameters and installation of the device.

Submission of Data - We require that all test data obtained from the outside laboratories in support of your application be submitted to us. This includes any results you have which were declared void or invalid by the laboratory. We also ask that you notify us of the laboratory you have chosen, when testing is scheduled to begin, what tests you have decided to conduct, allow us to maintain contact with the laboratory during the course of the testing, and allow the test laboratory to directly answer any questions at any time about the test program.

Cost of the Testing - The cost of the minimum test plan (two vehicles, two test sequences in duplicate) described above should be less than $2000 per vehicle and less than $4000 for the total test at any of the laboratories on the list. You will have to contact them individually to obtain their latest prices.

Outcome of the Tests - Although it is impossible to accurately predict the overall worth of a device from a small amount of testing, we have established some guidelines which will help you determine whether the test results with your device should be considered encouraging. These values have been chosen to assure both of us that a real difference in fuel economy exists and that we are not seeing only the variability in the results. The table below presents the minimum number of cars that need to be tested for varying degrees of fuel economy improvement assuming a typical amount of variability in fuel economy measurement. For a minimum test plan which was conducted on a fleet of two cars, the average improvement should be at least 8%. If at least an 8% difference in average fuel economy can be shown, then we would be able to say stastically at the 80% confidence level that there is a real improvement.

Similarly, we would expect a minimum of 5% improvement for a fleet of 5 vehicles. Test results which display a significant increase in emission levels should be reason for concern.

Minimum Fuel Economy Improvements versus Size of Test Fleet

Fleet Size	Average Improvement Required
2	8%
3	7%
4	6%
5	5%
10	4%
25	2%

Once we receive your application, it will be reviewed to determine if it meets the requirements listed in the format. If your application is not complete, we will ask you to submit further information or data. After any missing information has been submitted, your application will be reconsidered and once it meets our requirements, you will be advised of our decision whether or not EPA will perform any confirmatory testing. Any EPA testing will be performed at no cost to you and you will be given the opportunity to concur with our test plan. Once this testing is complete, an evaluation report will be written. If no further testing is required, the report will be written solely on the basis of the test data submitted and our engineering analysis.

Despite the current backlog and increasing number of inquiries regarding fuel economy device evaluations, the EPA intends to process your application in as expeditious a manner as possible. We have established a goal of twelve weeks from the receipt of a complete application to the announcement of our report. The attainment of this objective requires very precise scheduling and we are depending on the applicant to respond promptly to any questions or to submit any requested data. Failure to respond in a timely manner will unduly delay the process. In the extreme case, we may consider lack of response as a withdrawal of the application.

I hope the information above and that contained in the enclosed documents will aid you in the preparation of an acceptable application for an EPA evaluation of your device. I will be your contact with EPA during this process and any subsequent EPA evaluation. My address is EPA, Motor Vehicle Emission Laboratory, 2565 Plymouth Road, Ann Arbor, Michigan, 48105. The telephone number is (313) 668-4200. Please contact me if you have any questions or require any further information.

Sincerely,

Merrill W. Korth, Device Evaluation Coordinator
Emission Control Technology Division

Enclosures

cc: Lucinda Watson, EPA, Region #6

mwk

Attachment B

ENERGY GAS SAVER INC.

June 5, 1981

Mr. Merrill W. Korth, Coordinator
Emission Control Technology Division
U. S. Environmental Protection Agency
Ann Arbor, Michigan 48105

Dear Mr. Korth:

Please refer to your letter of January 13, 1981 directed to Mr. Nelson of our company.

I thank you for the time you spent with me on the telephone las week.

As we discussed, I am sending you most of the material that we sent to the Air Resources Board of California.

In addition to this material, I am sending you an application as required by the E.P.A.

The test data that I am sending you includes the testing on the 1981 Ford Ltd. 302 V-8 with an automatic transmission overdrive with a Fuel Pressure Injector Carburetor. These tests include two (2) Base CVSII cold starts with the Urban Cycle Fuel Economy Test and one CVSII cold start with the Energy Gas Saver installed, including the Urban Cycle Fuel Economy Test. Also included is one (1) Highway Cycle Fuel Economy Base Test and one (1) Highway Cycle Fuel Economy Test with the "Energy Gas Saver" installed.

Also enclosed is a summary and average of all the tests that were done in California. Included in this summary is Ford Motor Company Base line testing for Urban and Highway M.P.G. Just for the record, I did not receive copies of all the print-outs on all the tests that we participated in.

I realize the testing on the 1977 Chev. Caprice (350 cu. in. engine) is obsolete. These tests do however indicate the following:

1. That the highway mileage of the base car was approximately 16 M.P.G.

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2. That removal of the catalytic convertor did not increase the gas mileage at all!

3. That emissions can substantially change to an extreme unsatisfactory condition with very little modification of the engine.

4. With our unit on the car and without the hot exhaust, the car now showed 18.42 M.P.G.

5. Also by control of the amount of Exhaust that we mix with the gas and air we were able to fluctuate the NOX as follow

    1. 5.9805
    2. 1.741
    3. .438

5. Also able to take HC from 3.0752 to 0.68 and .139

6. CO still remains somewhat high but went from 32.454 to 24.198 to 4.980.

   From this test we also learned how to control the CO percentage within standards

7. Exhibit N1 shows how we were able to reduce the CO to .00 Idle and.00/2500 R.P.M. Exhibit N2 shows the same type of tests run by Detroit Testing.

   You will note that this test was done in February 1978 and my test took place in Oct. 1978. They were able to reduce the CO from 4% Idle to .02% and CO .05% at 2500 to .04%. Also HC went from 280 P.P.M. at Idle to 110 P.P.M. and at 2500 R.P.M. 30 P.P.M. to .00 P.P.M.

   Also at the same time we were able to run this car on the highway with average mileage of 26 M.P.G. We had tests that went as high as 29.1 M.P.G. and this was done with the One gal. bottle of gas type of test.

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8. All the other test data that my companies conducted speak for themselves.

In California I decided not to use the electric heater that is available.

I also intend to conclude our testing in California in the near future. It is also my intention to run more tests on the 1981 Ltd Ford 302 V-8 with the automatic transmission overdrive in order to reduce the CO and eliminate the HC. I also plan to test a 1979 or 1980 Ford with a V8 engine.

When you have had time to absorb the materials I have sent you, I shall discuss with you our future testing. I would hope that some representative from E.P.A. might observe our next tests.

Yours very truly,

Donald C. Pletts, President
ENERGY GAS SAVER, INC.

Please use this address:

143 Inlet Way #5
Palm Beach Shores, Fl. 33404

Tel: 305-844-3617

ENERGY GAS SAVER INC.

MARCH 1981
CALIFORNIA TESTING ON A 1981 FORD LTD
302 V-8 ENGINE - OVERDRIVE & FUEL INJECTOR CARBURETOR

SUMMARY OF TESTS

HIGHWAY		MILES PER GAL.	URBAN
BASE TEST	WITH ENERGY-GAS SAVER	WITH ENERGY-GAS SAVER	BASE TEST
1) 22.937	1) 27.230	1) 18.26	1) [illegible]
2) 24.030	2) 29.213	2) 18.32	2) [illegible]
3) 27.740	3) 32.130	3) 23.09	3) [illegible]
	4) 38.870		
74.707	127.443	59.67	
Av. 24.90	31.86	19.89	

+ 6.96 Increase

+ 4.0 Increas[illegible]

SUMMARY OF BASELINE Tests

	FORD MOTOR CO. "49" STATE CERTIFICATION	AUTOMOBILE CLUB OF SOUTHERN CALIFORNIA	OLSON ENGINEERING
CO	1.61	3.372	1.372
CO2		595.262	493.856
HC	.28	.188	.158
NOXc	.81	.887	.598
Urban M.P.G.	16	14.749	17.867
Highway M.P.G.	26	22.937	27.742

ENERGY GAS SAVER INC.

SUMMARY OF HIGHWAY FUEL ECONOMY TESTS
(Hot 505 TRNS)

BASELINE TESTS

AUTO CLUB OF SOUTHERN CALIFORNIA	PPM	OLSON ENGINEERING	GRAMS PER MILE
CO	297.6		.432
CO2	14671.00		318.862
HC	24.7		.075
NOX	23.6		.504
	22.9 M.P.G. (Highway)		27.742 M.P.G.

WITH "ENERGY-GAS-SAVER" INSTALLED
(Hot 505 TRNS)

AUTO CLUB OF SOUTHERN CALIFORNIA

	PPM
CO	138
HC	12.1
NOX	10.1

29.213 M.P.G. Highway

OLSON ENGINEERING

GRAMS PER MILE

	Test #1	#2	#3
CO	.46	.65	.61
HC	.06	.07	.05
NOX	.186	.195	.28
	32.3 MPG	27.23	38.87

EMISSION REQUIREMENTS FOR 1981

CALIFORNIA			E.P.A. (49 States)	
CO	7.0	Carbon Monoxide	3.4	CO
HC	.39	Hydrocarbon	.41	HC
NOX	.4	Oxides of Nitrogen	1.0	nox

REQUIREMENTS FOR E.P.A. (U.S.) 1978

CO	15.0
HC	1.5
NOX	2.0

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SUMMARY AND AVERAGE OF EMISSION TESTING WITH ENERGY-GAS-SAVER INSTALLED

	HC		NOX		CO
	.220		.251		6.163
	.294		.340		4.725
Av.	.257	Av.	.295	Av.	5.444

BASELINE TESTS

HC	.280	NOX	.810	CO	2.610
	.188		.887		3.372
	.158		.598		1.372
Av.	.208	Av.	.765	Av.	2.451

Hydrocarbons (HC)

There is a 24% Increase over Base and 90% Under Requirements

Nitrogen Oxides (NOX

There is an improvement of 160% under Base tests and over 300% under EPA and 38% under California

Carbon Monoxide (CO)

There is a 122% increase over Base which can be substantially reduced.

This is still under California Standards and near E.P.A. Standards.

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DATE	03-26-81	ENG F	5.0CCC	CURB WT	NA	T ADB	71.0
TIME	0905	CID	5.0L	INERTIA	4000	T AWB	58.0
TEST #	12239	TRANS	AUTO	ARHP	11.9	REL HUM	45.0
TEST SE	HFET	CARB	1X2V	IRHP	9.6	BARO	30.06
VEHICLE	FORD	CAT	NA	FUEL	GASOLINE	CVS P	61.0
MODEL	LTD	A/C	YES	DYNO	516	DELTA P	71.0
YEAR	1981	ODO	5848	EAC	1	NOX CF	.896264
VIN	SEE BELOW	Vo	.281933	VPta	19.43319		

PURPOSE...HFET DEVICE!

HIGHWAY FUEL ECONOMY

CVS REVS 17709 VMIX 3950.96669 ROLL CTS 24282 MILES 10.4144

AMBIENT BAG		SAMPLE BAG		MASS DATA	
HC PPM	10.290	HC PPM	16.770	HC GRAMS	.477
CO PPM	2.143	CO PPM	49.974	CO GRAMS	6.255
NOx PPM	.900	NOx PPM	[illegible]	NOx GRAMS	2.834
CO2 %	.066	CO2 %	1.196	CO2 GRAMS	2326.162

WEIGHTED MASS EMISSIONS SUMMARY

HYDROCARBONS	CARBON MONOXIDE	OXIDES OF NITROGEN	CARBON DIOXIDE
GMS/MI	GMS/MI	GMS/MI	GMS/MI
.046	.610	.276	227.119

HIGHWAY CYCLE FUEL ECONOMY

38.87 MILES PER GALLON

DATE	03-25-81	ENG F	5.0CCC	CURB WT	NA	T ADB	70.0
TIME	1700	CID	302	INERTIA	4000	T AWB	60.0
TEST #	12237	TRANS	AUTO	ARHP	11.9	REL HUM	56.0
TEST SE	HFET	CARB	1X2V	IRHP	9.6	BARO	30.03
VEHICLE	FORD	CAT	NA	FUEL	GASOLINE	CVS P	61.0
MODEL	LTD	A/C	YES	DYNO	516	DELTA P	71.0
YEAR	1981	ODO	5820	EAC	1	NOX CF	.937456
VIN	SEE BELOW	Vo	.281933	VPta	18.78625		

PURPOSE...HFET DEVICE 2FABP33F6BB107888

HIGHWAY FUEL ECONOMY

CVS REVS 17644 VMIX 3931.84485 ROLL [illegible] MILES 10.1969

AMBIENT BAG		SAMPLE BAG		MASS DATA	
HC PPM	7.600	HC PPM	18.600	HC GRAMS	.767
CO PPM	.008	CO PPM	51.526	CO GRAMS	6.680
NOx PPM	.400	NOx PPM	10.400	NOx GRAMS	2.006
CO2 %	.041	CO2 %	1.866	CO2 GRAMS	332[illegible].530

WEIGHTED MASS EMISSIONS SUMMARY

HYDROCARBONS GMS/MI	CARBON MONOXIDE GMS/MI	OXIDES OF NITROGEN GMS/MI	CARBON DIOXIDE GMS/MI
.074	.652	.195	324.500

HIGHWAY CYCLE FUEL ECONOMY

27.232 MILES PER GALLON

DATE	03/26/81	ENG F	5.0 CCC	CURB WT	N/A	T ADB	70.0
TIME	0810	CID	5.0L	INERTIA	4000	T AWB	59.0
TEST #	12238	TRANS	AUTO	ARHP	11.9	REL HUM	52%
TEST SE	CVS II	CARB	1X2V	IRHP	9.6	BARO	30.07
VEHICLE	FORD	CAT	YES	FUEL	GASOLINE	CVS P	61.2
MODEL	LTD	A/C	YES	DYNO	516	DELTA P	72.0
YEAR	1981	ODO	5837	EAC	1	NOX CF	.919328
VIN	*SEE BELOW	Vo	.281536	VPta	18.78625		

PURPOSE...CVS II COLD START WITH DEVICE!

COLD TRANSIENT

CVS REVS 11721 VMIX 2610.84636 ROLL CTS 8311 MILES 3.5645

AMBIENT BAG		SAMPLE BAG		MASS DATA	
HC PPM	15.500	HC PPM	65.100	HC GRAMS	2.181
CO PPM	8.656	CO PPM	647.334	CO GRAMS	55.052
NOx PPM	1.200	NOx PPM	9.200	NOx GRAMS	1.055
CO2 %	.069	CO2 %	1.284	CO2 GRAMS	1653.803

COLD STABILIZED

CVS REVS 20031 VMIX 4461.89433 ROLL CTS 9173 MILES 3.93[illegible]2

AMBIENT BAG		SAMPLE BAG		MASS DATA	
HC PPM	13.380	HC PPM	18.630	HC GRAMS	.432
CO PPM	1.955	CO PPM	39.215	CO GRAMS	5.496
NOx PPM	1.000	NOx PPM	6.900	NOx GRAMS	1.322
CO2 %	.060	CO2 %	.687	CO2 GRAMS	1456.833

HOT TRANSIENT

CVS REVS 11806 VMIX 2629.78006 ROLL CTS 8355 MILES 3.5834

AMBIENT BAG		SAMPLE BAG		MASS DATA	
HC PPM	11.580	HC PPM	22.320	HC GRAMS	.494
CO PPM	4.567	CO PPM	131.146	CO GRAMS	11.001
NOx PPM	1.600	NOx PPM	11.900	NOx GRAMS	1.362
CO2 %	.057	CO2 %	.892	CO2 GRAMS	1144.560

WEIGHTED MASS EMISSIONS SUMMARY

HYDROCARBONS GMS/MI	CARBON MONOXIDE GMS/MI	OXIDES OF NITROGEN GMS/MI	CARBON DIOXIDE GMS/MI
.220	4.725	.340	376.049

PRELIMINARY DATA
NOT IN EXACT ACCORDANCE WITH
40 CFR 85.075-9 THRU 27

URBAN CYCLE FUEL ECONOMY

23.092 MILES PER GALLON

PRELIMINARY DATA
NOT IN EXACT ACCORDANCE WITH
40 CFR 85.075 - 9 THRU 27

OLSON ENGINEERING INC.

AUTOMOTIVE RESEARCH CENTER
HUNTINGTON BEACH CALIFORNIA

DATE	03/25/81	ENG F	5.0 CCC	CURB WT	N/A	T ADB	70.0
TIME	1430	CID	5.0L	INERTIA	4000	T AWB	60.0
TEST #	12235	TRANS	AUTO	ARHP	11.9	REL HUM	53%
TEST SE	CVS II	CARB	1X2V	IRHP	9.6	BARO	30.00
VEHICLE	FORD	CAT	YES	FUEL	GASOLINE	CVS P	60.5
MODEL	LTD	A/C	YES	DYNO	516	DELTA P	70.5
YEAR	1981	ODO	5802	EAC	1	NOX CF	.924253
VIN	*SEE BELOW	Vo	.2821315	VPta	18.78625		

PURPOSE...CVS II COLD START WITH DEVICE VIN# 2FABP33F6BB07888!

COLD TRANSIENT

CVS REVS 11715 VMIX 2613.14913 ROLL CTS 8574 MILES 3.6773

AMBIENT BAG		SAMPLE BAG		MASS DATA	
HC PPM	12.700	HC PPM	74.900	HC GRAMS	2.713
CO PPM	2.273	CO PPM	714.577	CO GRAMS	61.390
NOx PPM	.200	NOx PPM	8.000	NOx GRAMS	1.023
CO2 %	.047	CO2 %	1.382	CO2 GRAMS	18:5.409

COLD STABILIZED

CVS REVS 20121 VMIX 4488.19237 ROLL CTS 9290 MILES 3.9844

AMBIENT BAG		SAMPLE BAG		MASS DATA	
HC PPM	9.500	HC PPM	16.600	HC GRAMS	.566
CO PPM	.084	CO PPM	46.573	CO GRAMS	6.880
NOx PPM	.100	NOx PPM	4.200	NOx GRAMS	.922
CO2 %	.047	CO2 %	.884	CO2 GRAMS	1954.611

HOT TRANSIENT

CVS REVS 11778 VMIX 2627.20191 ROLL CTS 8570 MILES 3.6756

AMBIENT BAG		SAMPLE BAG		MASS DATA	
HC PPM	8.300	HC PPM	[illegible]	HC GRAMS	.832
CO PPM	2.081	CO PPM	[illegible]	CO GRAMS	22.717
NOx PPM	.100	NOx PPM	[illegible]	NOx GRAMS	.921
CO2 %	.047	CO2 %	1.111	CO2 GRAMS	1454.892

PRELIMINARY DATA
NOT IN EXACT ACCORDANCE WITH
40 CFR 85.075 - 9 THRU 27

WEIGHTED MASS EMISSIONS SUMMARY

HYDROCARBONS GMS/MI	CARBON MONOXIDE GMS/MI	OXIDES OF NITROGEN GMS/MI	CARBON DIOXIDE GMS/MI
.294	6.163	.251	475.270

URBAN CYCLE FUEL ECONOMY

18.258 MILES PER GALLON

OLSON ENGINEERING INC.

AUTOMOTIVE RESEARCH CENTER
HUNTINGTON BEACH CALIFORNIA

DATE	03/27/81	ENG F	5.0 CCC	CURB WT	N/A	T ADB	78.0
TIME	1740	CID	5.0	INERTIA	4000	T AWB	60.0
TEST #	12249	TRANS	AUTO	ARHP	11.9	REL HUM	34%
TEST SE	HFET	CARB	1X2V	IRHP	8.7	BARO	30.01
VEHICLE	FORD	CAT	YES	FUEL	GASOLINE	CVS P	61.0
MODEL	LTD	A/C	YES	DYNO	288	DELTA P	71.0
YEAR	1981	ODO	05901	EAC	1	NOX CF	.888076
VIN	*SEE BELOW	Vo	.281933	VPta	24.57420		

PURPOSE...HFET HOT W/O DEVICE BASELINE!

HIGHWAY FUEL ECONOMY

CVS REVS 17640 VMIX 3927.87417 ROLL CTS 24156 MILES 10.3603

AMBIENT BAG		SAMPLE BAG		MASS DATA	
HC PPM	5.460	HC PPM	16.770	HC GRAMS	.768
CO PPM	.831	CO PPM	[illegible]	CO GRAMS	4.433
NOx PPM	.200	NOx PPM	27.[illegible]	NOx GRAMS	5.162
CO2 %	.047	CO2 %	[illegible]	CO2 GRAMS	3255.789

PRELIMINARY DATA
NOT IN EXACT ACCORDANCE WITH
40 CFR 85.075 - 9 THRU 27

WEIGHTED MASS EMISSIONS SUMMARY

HYDROCARBONS GMS/MI	CARBON MONOXIDE GMS/MI	OXIDES OF NITROGEN GMS/MI	CARBON DIOXIDE GMS/MI
.075	.432	.504	318.862

HIGHWAY CYCLE FUEL ECONOMY

27.742 MILES PER GALLON

DATE	3/27/81	ENG F	50CCC	CURB WT	NA	T ADB	74
TIME	16	CID	5.0	INERTIA	4000	T AWB	60
TEST #	12248	TRANS	AUTO	ARHP	11.9	REL HUM	44%
TEST SE	CVS II	CARB	1X2V	IRHP	8.7	BARO	30.024
VEHICLE	FORD	CAT	YES	FUEL	GASOLINE	CVS P	61
MODEL	LTD	A/C	YES	DYNO	288	DELTA P	72
YEAR	1981	ODO	05893	EAC	1	NOX CF	.912604
VIN	2FABP33F6BB107	Vo	.281536	VPta	21.50526		

PURPOSE...CVS COLD BASELINE W/O DEVICE
!

COLD TRANSIENT

CVS REVS 11812 VMIX 2627.89925 ROLL CTS 8408 MILES 3.6061

AMBIENT BAG		SAMPLE BAG		MASS DATA	
HC PPM	4.400	HC PPM	32.300	HC GRAMS	1.217
CO PPM	1.022	CO PPM	182.582	CO GRAMS	15.740
NOx PPM	.200	NOx PPM	20.100	NOx GRAMS	2.587
CO2 %	.044	CO2 %	1.440	CO2 GRAMS	1908.912

COLD STABILIZED

CVS REVS 19997 VMIX 4448.87415 ROLL CTS 9177 MILES 3.9639

AMBIENT BAG		SAMPLE BAG		MASS DATA	
HC PPM	4.500	HC PPM	9.450	HC GRAMS	.381
CO PPM	.364	CO PPM	4.121	CO GRAMS	.554
NOx PPM	.200	NOx PPM	9.900	NOx GRAMS	2.135
CO2 %	.044	CO2 %	.909	CO2 GRAMS	2001.550

HOT TRANSIENT

CVS REVS 11804 VMIX 2626.11944 ROLL CTS 8395 MILES 3.6005

AMBIENT BAG		SAMPLE BAG		MASS DATA	
HC PPM	4.440	HC PPM	15.780	HC GRAMS	.503
CO PPM	.831	CO PPM	61.024	CO GRAMS	5.218
NOx PPM	.300	NOx PPM	[illegible]	NOx GRAMS	2.171
CO2 %	.041	CO2 %	[illegible]	CO2 GRAMS	1546.564

PRELIMINARY DATA
NOT IN EXACT ACCORDANCE WITH
40 CFR 85.075-9 THRU 27

WEIGHTED MASS EMISSIONS SUMMARY

HYDROCARBONS	CARBON MONOXIDE	OXIDES OF NITROGEN	CARBON DIOXIDE
GMS/MI	GMS/MI	GMS/MI	GMS/MI
.158	1.372	.598	493.856

URBAN CYCLE FUEL ECONOMY

17.867 MILES PER GALLON

ENERGY GAS SAVER INC.

MARCH 1981
CALIFORNIA TESTING ON A 1981 FORD LTD
302 V-8 ENGINE - OVERDRIVE & FUEL INJECTOR CARBURETOR

SUMMARY OF TESTS

HIGHWAY		MILES PER GAL.	URBAN
BASE TEST	WITH ENERGY-GAS SAVER	WITH ENERGY-GAS SAVER	BASE TEST
1) 22.937	1) 27.230	1) 18.26	1) [illegible]
2) 24.030	2) 29.213	2) 18.32	2) [illegible]
3) 27.740	3) 32.130	3) 23.09	3) [illegible]
	4) 38.870		
74.707	127.443	59.67	
Av. 24.90	31.86	19.89	[illegible]5.8

+ 6.96 Increase

+ 4.0 Increase

SUMMARY OF BASELINE Tests

	FORD MOTOR CO. "49" STATE CERTIFICATION	AUTOMOBILE CLUB OF SOUTHERN CALIFORNIA	OLSON ENGINEERING
CO	1.61	3.372	1.372
CO2		595.262	493.856
HC	.28	.188	.158
NOXc	.81	.887	.598
Urban M.P.G.	16	14.749	17.867
Highway M.P.G.	26	22.937	27.742

ENERGY GAS SAVER INC.

-2-

SUMMARY OF HIGHWAY FUEL ECONOMY TESTS
(Hot 505 TRNS)

BASELINE TESTS AUTO CLUB OF SOUTHERN CALIFORNIA	PPM	BASELINE TESTS OLSON ENGINEERING GRAMS PER MILE
CO	297.6	.432
CO2	14671.00	318.862
HC	24.7	.075
NOX	23.6	.504
(Highway)	22.9 M.P.G.	27.742 M.P.G.

WITH "ENERGY-GAS-SAVER" INSTALLED
(Hot 505 TRNS)

AUTO CLUB OF SOUTHERN CALIFORNIA

	PPM
CO	138
HC	12.1
NOX	10.1

29.213 M.P.G. Highway

OLSON ENGINEERING

GRAMS PER MILE	Test #1	#2	#3
CO	.46	.65	.61
HC	.06	.07	.05
NOX	.186	.195	.28
	32.3 MPG	27.23	38.87

EMISSION REQUIREMENTS FOR 1981

CALIFORNIA			E.P.A. (49 States)	
CO	7.0	Carbon Monoxide	3.4	CO
HC	.39	Hydrocarbon	.41	HC
NOX	.4	Oxides of Nitrogen	1.0	nox

REQUIREMENTS FOR E.P.A. (U.S.) 1978

CO	15.0
HC	1.6
NOX	2.0

FIRST AMERICAN BUILDING • 701 U.S. HIGHWAY ONE • SUITE 104 • NORTH PALM BEACH, FL 33408 • 305/842-8558

ENERGY GAS SAVER INC.

SUMMARY AND AVERAGE OF EMISSION TESTING WITH ENERGY-GAS-SAVER INSTALLED

	HC		NOX		CO
	.220		.251		6.163
	.294		.340		4.725
Av.	.257	Av.	.295	Av.	5.444

BASELINE TESTS

HC	.280	NOX	.810	CO	2.610
	.188		.887		3.372
	.158		.598		1.372
Av.	.208	Av.	.765	Av.	2.451

Hydrocarbons (HC)

There is a 24% Increase over Base and 90% Under Requirements

Nitrogen Oxides (NOX

There is an improvement of 160% under Base tests and over 300% under EPA and 38% under California

Carbon Monoxide (CO)

There is a 122% increase over Base which can be substantially reduced.

This is still under California Standards and near E.P.A. Standards.

*** AUTO EXHAUST EMISSIONS AND FUEL CONSUMPTION ANALYSIS ***
*** E. P. A. CVS-2 URBAN CYCLE ***

--- GENERAL DESCRIPTION ---

VEHICLE: FORD	YEAR : 1981	MODEL : LTD	LICENSE NO : 183H102	DATE: 03-12-81
ACSC TEST NO : 1349	DRIVER: HOF	ENGINE CID : 302-8	CARB : 2-BARREL	AIR COND: YES
CONTROL NO : 0000	TESTER: JCW	TRANS AUTO : AUTO	ODOMETER : 5458	HP @ 50 MPH : 9.0
BAROMETER : 761.2MM HG	SOAK TEMP. 70 F	DRY BULB TEMP : 69 F	WET BULB TEMP : 59 F	INERTIA WT : 4000#

FUEL TYPE : GASOLINE   CLASS : PASSENGER CAR W/ OXIDATION CATALYST

EMISSION CONTROL : STOCK EMISSION CONTROL SYSTEM VIN3FABP33F5BB107888 IDLEHC=8.0PPM CO=0.07%

COMMENTS : COLD START BASELINE STOCK (ENERGY GAS SAVER) HP=64 IN 3RD GEAR @50 MPH

--- DYNAMOMETER TEST RUN ---

	1. NET CONCENTRATION PER PHASE IN PPM			2. MASS PER PHASE IN GRAMS			3. WT'D MASS EMISSION POLLUTANT
	COLD TRNS	STABLIZED	HOT TRNS	COLD TRNS	STABLIZED	HOT TRNS	GRAMS PER MILE
CO	288.789	10.723	284.941	23.962	1.522	23.633	3.372
CO2	17579.225	10677.329	14717.410	2293.910	2383.880	1919.564	595.262
HC	29.721	5.635	25.478	1.221	.456	1.046	.188
NOX	29.330	13.953	21.664	3.997	3.254	2.951	.887

--- OTHERS ---

RELATIVE HUMIDITY (R=RA) : 44 %

HUMIDITY CORR. FACTOR (KH) : .9180

HC REACTIVITY FACTOR : .890

CARBON BALANCE FUEL CONSUMPTION(MPG) :

URBAN... 14.749

HIGHWAY... 23.937

COMPOSITE ... 17.573

ENERGY GAS SAVER
TESTING RESULTS

EXHIBITS:

F - Ford Testing Results
G - Detroit Testing Lab, Inc. - letter
H - Detroit Testing Photos
I - Car-Bo-Tech, Inc. Gasoline Mileage Tests - Cadillac
J - Olson Labs, Inc.
K - Car-Bo-Tech, Inc. - Chevrolet
L - Testing Results - Energy Gas Saver and Eliminator
M - Detroit Testing Lab, Inc. - Report of Chemical Analysis
N - Autosense Vehicle Test Report
O - Detroit Mileage Testing
P - Warranty
Q - 1979 Gas Mileage Guide
Z - Installation Instructions

EXHIBIT E

Princeton University SCHOOL OF ENGINEERING AND APPLIED SCIENCE
DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING
JAMES FORRESTAL CAMPUS, PRINCETON, NEW JERSEY 08540

March 10, 1980

Mr. Donald C. Pletts
Apt. 203 Country Gardens
120 Sparrow Drive
Royal Palm Beach, Florida 33411

Dear Mr. Pletts:

I have reviewed your material. There have been many inventions to improve fuel distribution by preheating the gasoline either electrically or with exhaust gases. A good paper to read on the subject is by:

Hamburg & Hyland: "A vaporized Gasoline Metering System for I-C Engines", Society of Automotive Engineers, 760288

The effect of mixing hot exhaust gas with incoming fuel is to improve the distribution of fuel to the various cylinders. This increases horse power at a given throttle setting but reduces maximum horse power available. This reduces HC polution. Better distribution permits leaner operation and can save some fuel. Your must do a fair test (EPA driving cycle) to be credible. With both before and after experiments with properly adjusted carburetors and timeing.

The potential improvemnt of a good mixture lean engine over a normal properly adjusted carbureted engine is about 15%.

/s/
Prof. Enoch J. Durbin

It has long been thought that there was substantial advantages to a vaporized gasoline metering system over the present carburator metering system now found on most automobiles.

One of the major automotive manufacturers through its research and development department confirmed the following advantages of a vaporized gasoline metering system.

1. Vapor gasoline metering system provides a very uniform cylinder to cylinder distribution of air - fuel ratio as shown on the chart.
2. Essentially eliminates the transit varations in air - fuel ratio due to air flow changes and also load changes.
3. Exhibits minimal steady state time flucuations in air - fuel ratio.

Because of the above three listed facts, the in-line multiple cylinder engine used in automobiles of today can be more substantially leaned with a very much higher air - fuel ration than can the engine with the standard carburator fuel - air mixture. This condition increases gasoline milage.

This more so ideal vapor mixture air - gas ratio improves the exhaust emmission.

OLSON ENGINEERING INC.

AUTOMOTIVE RESEARCH CENTER
HUNTINGTON BEACH CALIFORNIA

DATE	3/27/81	ENG F	50CCC	CURB WT	NA	T ADB	74
TIME	16	CID	5.0	INERTIA	4000	T AWB	60
TEST #	12248	TRANS	AUTO	ARHP	11.9	REL HUM	44%
TEST SE	CVS II	CARB	1X2V	IRHP	8.7	BARO	30.024
VEHICLE	FORD	CAT	YES	FUEL	GASOLINE	CVS P	61
MODEL	LTD	A/C	YES	DYNO	288	DELTA P	72
YEAR	1981	ODO	05893	EAC	1	NOX CF	.912604
VIN	2FABP33F6BB107	Vo	.281536	VPta	21.50526		

PURPOSE...CVS COLD BASELINE W/O DEVICE
!

COLD TRANSIENT

CVS REVS 11812 VMIX 2627.89925 ROLL CTS 8408 MILES 3.6061

AMBIENT BAG		SAMPLE BAG		MASS DATA	
HC PPM	4.400	HC PPM	32.300	HC GRAMS	1.21
CO PPM	1.022	CO PPM	182.582	CO GRAMS	15.74
NOx PPM	.200	NOx PPM	20.100	NOx GRAMS	2.58
CO2 %	.044	CO2 %	1.440	CO2 GRAMS	908.91

COLD STABILIZED

CVS REVS 19997 VMIX 4448.87415 ROLL CTS 9177 MILES 3.9359

AMBIENT BAG		SAMPLE BAG		MASS DATA	
HC PPM	4.500	HC PPM	9.450	HC GRAMS	.381
CO PPM	.364	CO PPM	4.121	CO GRAMS	.554
NOx PPM	.200	NOx PPM	9.900	NOx GRAMS	2.135
CO2 %	.044	CO2 %	.909	CO2 GRAMS	2001.550

HOT TRANSIENT

CVS REVS 11804 VMIX 2626.11944 ROLL CTS 8395 MILES 3.6005

AMBIENT BAG		SAMPLE BAG		MASS DATA	
HC PPM	4.440	HC PPM	15.780	HC GRAMS	.503
CO PPM	.831	CO PPM	61.024	CO GRAMS	5.218
NOx PPM	.300	NOx PPM	17.0[illegible]	NOx GRAMS	2.171
CO2 %	.041	CO2 %	[illegible]	CO2 GRAMS	1546.564

WEIGHTED MASS EMISSIONS SUMMARY

HYDROCARBONS	CARBON MONOXIDE	OXIDES OF NITROGEN	CARBON DIOXIDE
GMS/MI	GMS/MI	GMS/MI	GMS/MI
.158	1.372	.598	493.856

URBAN CYCLE FUEL ECONOMY

17.867 MILES PER GALLON

PRELIMINARY DATA
NOT IN EXACT ACCORDANCE WITH
40 CFR 85.075-9 THRU 27

OLSON ENGINEERING INC.

AUTOMOTIVE RESEARCH CENTER
HUNTINGTON BEACH CALIFORNIA

DATE	03-26-81	ENG F	5.0CCC	CURB WT	NA	T ADB	71.0
TIME	0905	CID	5.0L	INERTIA	4000	T AWB	58.0
TEST #	12239	TRANS	AUTO	ARHP	11.9	REL HUM	45.0
TEST SE	HFET	CARB	1X2V	IRHP	9.6	BARO	30.06
VEHICLE	FORD	CAT	NA	FUEL	GASOLINE	CVS P	61.0
MODEL	LTD	A/C	YES	DYNO	516	DELTA P	71.0
YEAR	1981	ODO	5848	EAC	1	NOX CF	.896264
VIN	SEE BELOW	Vo	.281933	VPta	19.43319		

PURPOSE...HFET DEVICE!

HIGHWAY FUEL ECONOMY

CVS REVS 17709 VMIX 3950.96669 ROLL CTS 24282 MILES 10.4144

AMBIENT BAG		SAMPLE BAG		MASS DATA	
HC PPM	10.290	HC PPM	16.770	HC GRAMS	.47
CO PPM	2.143	CO PPM	49.974	CO GRAMS	6.25
NOx PPM	.900	NOx PPM	[illegible]	NOx GRAMS	2.83
CO2 %	.066	CO2 %	[illegible]	CO2 GRAMS	2326.16

PRELIMINARY DATA
NOT IN EXACT ACCORDANCE WITH
40 CFR 85.075-9 THRU 27

WEIGHTED MASS EMISSIONS SUMMARY

HYDROCARBONS GMS/MI	CARBON MONOXIDE GMS/MI	OXIDES OF NITROGEN GMS/MI	CARBON DIOXIDE GMS/MI
.046	.610	.276	227.119

HIGHWAY CYCLE FUEL ECONOMY

38.87 MILES PER GALLON

OLSON ENGINEERING INC.

AUTOMOTIVE RESEARCH CENTER
HUNTINGTON BEACH CALIFORNIA

DATE	03/26/81	ENG F	5.0 CCC	CURB WT	N/A	T ADB	70.0
TIME	0810	CID	5.0L	INERTIA	4000	T AWB	59.0
TEST #	12238	TRANS	AUTO	ARHP	11.9	REL HUM	52%
TEST SE	CVS II	CARB	1X2V	IRHP	9.6	BARO	30.07
VEHICLE	FORD	CAT	YES	FUEL	GASOLINE	CVS P	61.2
MODEL	LTD	A/C	YES	DYNO	516	DELTA P	72.0
YEAR	1981	ODO	5837	EAC	1	NOX CF	.919328
VIN	*SEE BELOW	Vo	.281536	VPta	18.78625		

PURPOSE...CVS II COLD START WITH DEVICE!

COLD TRANSIENT

CVS REVS 11721 VMIX 2610.84636 ROLL CTS 8311 MILES 3.5645

AMBIENT BAG		SAMPLE BAG		MASS DATA	
HC PPM	15.500	HC PPM	65.100	HC GRAMS	2.181
CO PPM	8.656	CO PPM	647.334	CO GRAMS	55.050
NOx PPM	1.200	NOx PPM	9.200	NOx GRAMS	1.055
CO2 %	.069	CO2 %	1.284	CO2 GRAMS	653.803

COLD STABILIZED

CVS REVS 20031 VMIX 4461.89433 ROLL CTS 9173 MILES 3.9042

AMBIENT BAG		SAMPLE BAG		MASS DATA	
HC PPM	13.380	HC PPM	18.630	HC GRAMS	.432
CO PPM	1.955	CO PPM	39.215	CO GRAMS	5.496
NOx PPM	1.000	NOx PPM	6.900	NOx GRAMS	1.322
CO2 %	.060	CO2 %	.687	CO2 GRAMS	1456.833

HOT TRANSIENT

CVS REVS 11806 VMIX 2629.78006 ROLL CTS 8355 MILES 3.5834

AMBIENT BAG		SAMPLE BAG		MASS DATA	
HC PPM	11.580	HC PPM	22.320	HC GRAMS	.494
CO PPM	4.567	CO PPM	131.146	CO GRAMS	11.001
NOx PPM	1.600	NOx PPM	11.900	NOx GRAMS	1.362
CO2 %	.057	CO2 %	.892	CO2 GRAMS	1144.560

PRELIMINARY DATA
NOT IN EXACT ACCORDANCE WITH
40 CFR 85.075 -9 THRU 27

WEIGHTED MASS EMISSIONS SUMMARY

HYDROCARBONS	CARBON MONOXIDE	OXIDES OF NITROGEN	CARBON DIOXIDE
GMS/MI	GMS/MI	GMS/MI	GMS/MI
.220	4.725	.340	376.049

URBAN CYCLE FUEL ECONOMY

23.092 MILES PER GALLON

D. R. Hamburg and J. E. Hyland
Engineering and Research Staff, Ford Motor Co.

ONE OF THE MOST widely accepted techniques for achieving the statutory NO_x standard of 0.4 gram/mile for automobiles is the use of a "reduction" catalytic converter. Unfortunately, such devices exhibit a relatively narrow range of air-fuel ratio over which useful conversion efficiency can be realized. This characteristic is illustrated in Figure 1 which shows the conversion efficiency versus air-fuel ratio for a typical noble metal reduction catalyst. It should be pointed out that the so-called three-way catalysts have an even narrower air-fuel ratio range over which efficient operation is possible. To effectively utilize catalytic converters to control NO_x, it is therefore necessary to employ a fuel metering system which provides very tight control of air-fuel ratio for both steady state and transient engine operation. A viable approach for obtaining the required tight control is to use feedback from a suitable engine exhaust gas sensor to "trim" an appropriate fuel metering system as depicted in Figure 2. (1-3)*

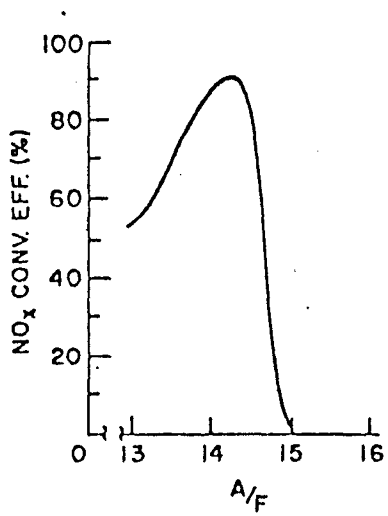

Fig. 1-Conversion efficiency versus air-fuel ratio for typical metal reduction catalyst

*Numbers in parentheses designate references at end of paper.

ABSTRACT

A prototype vaporized gasoline metering system is described which utilizes engine exhaust heat to vaporize liquid gasoline prior to being combined with inlet air. It is shown that the system (1) exhibits minimal time-fluctuations in air-fuel ratio, (2) essentially eliminates the transient variations in air-fuel ratio due to load changes, and (3) provides a very uniform cylinder-to-cylinder distribution of air-fuel ratio. [illegible] the vapor system at [illegible] is conside[illegible], and a CV[illegible]iction of the lean-limit [illegible]ated.

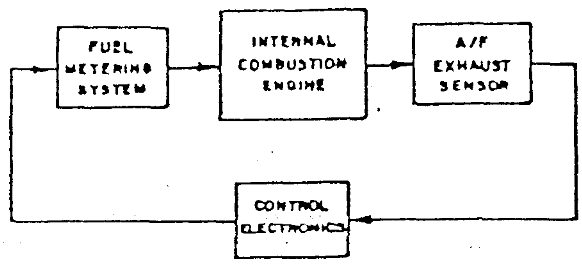

Fig. 2-Block diagram of basic A/F feedback system

BACKGROUND

Ford Motor Company became involved with such a system several years ago during the early development of the TiO_2 exhaust gas sensor. (4) At that time, the output of a prototype TiO_2 sensor was used successfully to control the air-fuel ratio produced by a Bendix electronic fuel injection system. As a result of this effort, the feasibility of the feedback concept was established. Because of the inherent complexity and attendant high production costs of fuel injection, however, it was decided to explore feedback using a much simpler fuel metering device. The particular device chosen for this exploration was a modified carburetor having an air-bypass adjustment which could be controlled electronically by the TiO_2 sensor. A simplified diagram of the basic carburetor showing the air-bypass section is presented in Figure 3. For clarity, actual carburetor details relating to such elements as the main metering system, the idle system, the power enrichment system, etc., are not shown in this diagram.

The air-bypass carburetor was installed on a 351 CID engine in a 1973 Ford Galaxie and evaluated on a chassis dynamometer. A typical recording of the open loop air-fuel ratio versus time as indicated by a TiO_2 exhaust sensor for this configuration operating at a 30 MPH steady-state cruise is shown in Figure 4. When the feedback loop which coupled the exhaust sensor to the air-bypass adjustment was closed and properly compensated to prevent instability, the recording of air-fuel ratio versus time shown in Figure 5 resulted. Examination of this recording reveals that although the long term drift has been eliminated, there is no appreciable reduction in the high-frequency fluctuations in the air-fuel ratio. The reason that feedback is incapable of reducing the high-frequency fluctuations is that the propagation delay through the engine imposes a fundamental limitation on the minimum response time of the closed loop system. To be more explicit, a change in air-fuel ratio occurring at the carburetor takes several engine revolutions before it can be detected in the engine exhaust

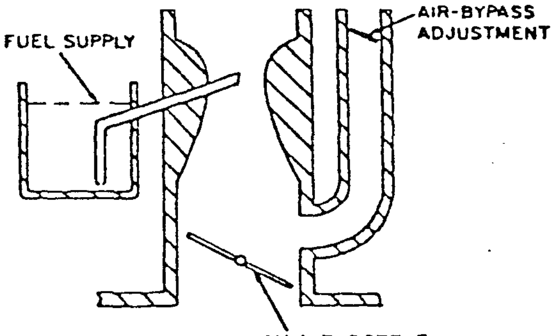

Fig. 3-Simple air-bypass carburetor

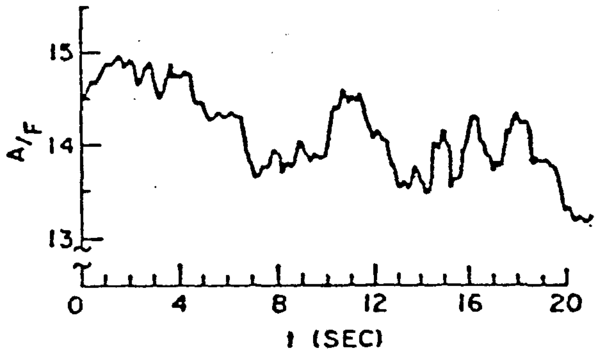

Fig. 4-Open loop air-fuel ratio versus time for air-bypass carburetor operating at 30 mph road load

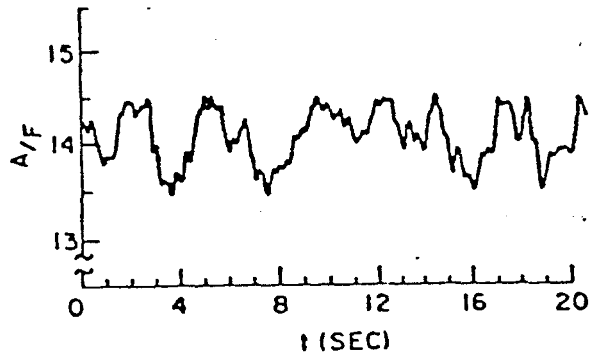

Fig. 5-Closed loop air-fuel ratio versus time for air-bypass carburetor operating at 30 mph road load

The ability to initiate any trimming of the air-bypass adjustment before several engine revolutions have occurred is therefore impossible, and any attempt to effect the necessary trim too rapidly after the change has been detected will result in an oscillatory condition.

It is thus apparent that since feedback cannot eliminate rapid fluctuations in air-fuel ratio, a fuel metering system should be employed which does not exhibit such fluctuations. Since it is generally believed that these fluctuations are caused to a great extent by random detachment of liquid gasoline from wet manifold and carburetor surfaces (5), it would appear that the difficulty could be circumvented by using a vaporized gasoline metering system such as described below.

GENERAL SYSTEM DESCRIPTION

The basic vaporized gasoline metering system utilizes engine exhaust heat to fully vaporize liquid gasoline entering an exhaust gas heat exchanger. The resulting gasoline vapors pass through a pressure regulating mechanism into the throat of a venturi through which engine intake air flows. The pressure regulating mechanism maintains a zero pressure differential between the gasoline vapors and the intake air at the entry ports to the venturi. This causes the fuel flow to be essentially proportional to airflow and thus produces a nearly constant air-fuel ratio independent of airflow as discussed in the following section. After passing through the venturi, the air and vaporized fuel are homogeneously mixed and subsequently enter the engine intake system through a suitable throttle. In order to compensate for variations in air-fuel ratio arising from changes in temperature, fuel composition, etc., feedback from an exhaust gas sensor is used to vary the area of the fuel metering orifice and thereby automatically maintain the desired air-fuel ratio. Since exhaust heat is generally not available prior to starting the engine, a supplementary heater is employed to vaporize the gasoline required to start and operate the engine until sufficient vapors are available from the exhaust heat exchanger. Provision is made to collect any gasoline condensate which is produced during the warm-up period and recirculate it back to the vaporizer without contaminating the main fuel supply.

BASIC METERING CONCEPT

The basic fuel metering element of the vaporized gasoline system is the venturi section shown in Figure 6. Engine intake air flows through this venturi and causes a pressure depression at the throat which draws in vaporized gasoline through the fuel nozzle located in the center of the venturi. When the vaporized gasoline and intake air are properly combined, the resulting homogeneous mixture will flow uniformly to all cylinders of the engine with negligible intake manifold wall-wetting and hence minimal time-fluctuations in air-fuel ratio. If properly implemented, the fuel metering venturi will produce an essentially constant air-fuel ratio independent of mass airflow through the venturi, and will thus result in the elimination of air-fuel ratio variations during transient engine operation. The necessary conditions required to produce the constant air-fuel ratio can be determined by examining the following expression which describes the air-fuel ratio for the metering venturi: (6)

$$\frac{A}{F} = K\left(\frac{A_A}{A_F}\right)\left(\frac{P_A}{P_F}\right)\left(\frac{T_A}{T_F}\right)^{-\frac{1}{2}}\left[\frac{\left(\frac{P_T}{P_A}\right)^{\frac{2}{\gamma_A}} - \left(\frac{P_T}{P_A}\right)^{\frac{\gamma_A+1}{\gamma_A}}}{\left(\frac{P_T}{P_F}\right)^{\frac{2}{\gamma_F}} - \left(\frac{P_T}{P_F}\right)^{\frac{\gamma_F+1}{\gamma_F}}}\right]^{\frac{1}{2}}$$

The derivation of this equation with definitions of the nomenclature used is given in Appendix A.

Referring to the above expression, if the fuel supply pressure P_F is made equal to the air supply pressure P_A, then

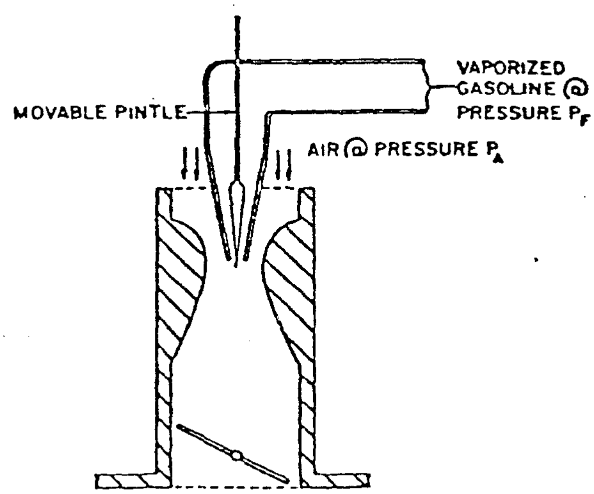

Fig. 6-Vapor system metering venturi

variations in the air-fuel ratio as a function of the venturi throat pressure P_T (and hence airflow) can be made quite small for the proper choice of the P_T range. This is illustrated in Figure 7 which shows air-fuel ratio as a function of airflow for an airflow range of 60 pph to 1200 pph. (This airflow range is typical for a 351 CID engine operating from idle to wide-open throttle.) The venturi cross-sectional area used to derive the plot of Figure 7 was chosen to provide values of P_T which were depressed from P_A by 0.1 inches of water at 60 pph and 45 inches of water at 1200 pph. If higher depression values for P_T were used, the variation in air-fuel ratio would be greater. Before discussing the implications of these small depression values, it should be pointed out that the actual air-fuel ratio established by the metering venturi is a function of the ratio of the air cross-sectional area A_A and the fuel cross-sectional area A_F. Either or both of these areas could thus be used to set the desired air-fuel ratio value as well as to provide a feedback trim mechanism to compensate for temperature variations, etc. In the basic metering venturi shown in Figure 6, adjustment of the fuel cross-sectional area is provided by movement of the tapered pintle rod within the fuel discharge nozzle.

As indicated above, in order for the metering venturi to yield an essentially constant air-fuel ratio independent of airflow, the fuel vapor supply pressure has to equal the air supply pressure, and the venturi throat depression has to be very small for low airflow values. To meet these requirements, a very accurate fuel pressure regulator is required which is capable of operating at the high temperatures necessary to vaporize gasoline. (A variable area venturi having a constant air-to-fuel area ratio could conceivably be used to relax these requirements, and such a device is being explored.) The pressure regulator selected for use in a laboratory evaluation of the vaporized gasoline metering system is a simple bladder-type regulator whose volume automatically changes to maintain its interior pressure equal to exterior pressure. In use, the bladder would have an input and an output port separated by an appropriate baffle structure, and vaporized gasoline would be supplied to the input port in a coarsely controlled manner so as to keep the bladder partially full. The output port would be connected to the fuel nozzle in the metering venturi and would deliver vaporized gasoline at a pressure equal to that exerted on the bladder. Since the air supply pressure for a conventional internal combustion engine is simply atmospheric pressure (neglecting the air cleaner), such a pressure regulating bladder with its exterior surface exposed to atmospheric pressure will make P_F P_A. If an air cleaner is employed, a housing placed over the bladder and referenced to the actual inlet pressure of the metering venturi will insure this condition.

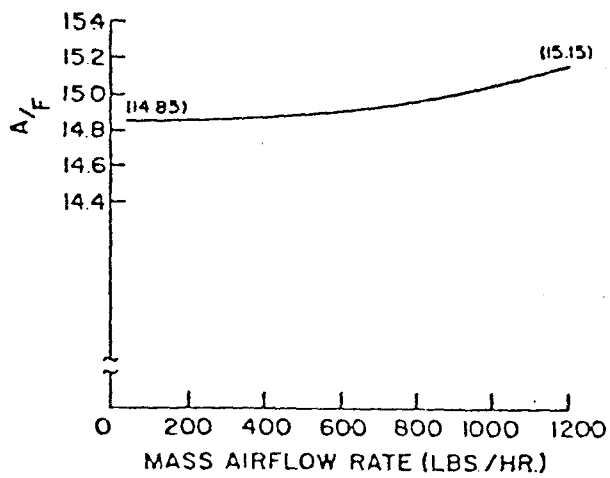

Fig. 7-Air-fuel ratio versus mass airflow rate for vapor metering system

EXPERIMENTAL SYSTEM

The basic vaporized gasoline metering concept discussed above has been implemented on a 351W V-8 engine coupled to a laboratory dynamometer. A diagrammatic representation of the complete system is shown in Figure 8. Referring to this diagram, operation of the system can be described as follows: Fresh gasoline is pressure fed from a main fuel tank to a small holding tank through a conventional float-actuated valve. The liquid gasoline in the holding tank is pumped through an electronically controlled coarse metering valve into a heat exchanger located in the engine exhaust system. The metering valve employed is a conventional electronic fuel injector whose "on" time is automatically controlled to regulate the fuel flow through the heat exchanger and hence the amount of gasoline vapors which are generated. The heat exchanger used is a conically shaped stainless steel tube helix having a total surface area of approximately 70 square inches, and is located inside the normal exhaust pipe just downstream from the "Y".

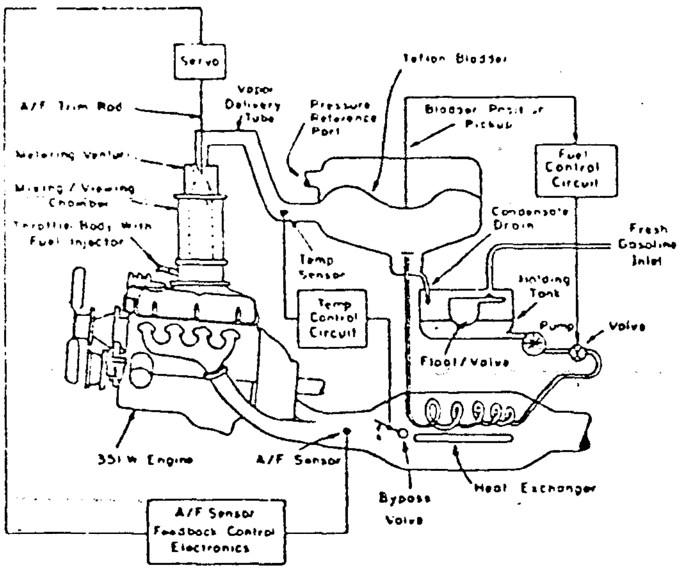

Fig. 8-Diagrammatic representation of vaporized gasoline delivery system

The gasoline vapors generated in the heat exchanger flow into the variable volume pressure regulator previously discussed and cause the bladder to billow up. The resulting displacement is sensed by a pickup whose output is fed back to the coarse fuel control and is used to automatically keep the bladder approximately half full of gasoline vapors. The particular bladder employed has a maximum volume of approximately 0.15 cubic foot and is constructed of 1 mil Teflon® PFA film which has a melting point of approximately 600° F. Since the gasoline currently being used in the laboratory is completely vaporized at approximately 400° F, the vapor temperature at the pressure regulator outlet is maintained at approximately 420° F by a simple closed-loop exhaust bypass control which regulates the amount of heat supplied to the heat exchanger. Any gasoline which condenses on interior surfaces of the pressure regulator and associated plumbing during warm-up is returned to the small holding tank and is subsequently re-vaporized. In this manner, the heavy gasoline fractions will not build up in the main fuel tank, but will be recirculated through the heat exchanger and finally consumed when the proper operating temperature is reached.

The outlet vapors from the pressure regulator pass through an insulated delivery tube and are discharged coaxially into the throat of the metering venturi. The venturi employed has a throat diameter of 1.3 inches while the fuel discharge nozzle has an orifice diameter of 0.31 inch. The fuel discharge nozzle is heated electrically to prevent cooling by the intake air which would otherwise cause condensation of fuel vapors on the nozzle. A tapered pintle capable of being positioned within the fuel nozzle is used to vary the orifice area and thus the air-fuel ratio. This pintle is connected to a servomechanism which can control the pintle position using feedback from an exhaust gas sensor located in the exhaust system.

The venturi is connected to the engine intake manifold through a mixing/viewing chamber mounted above a conventional butterfly-valve throttle body. The mixing/viewing chamber consists of a seven inch long cylindrical tube attached directly to the venturi exit port and mounted inside a somewhat larger air-tight chamber. The chamber itself, which is physically fastened to both the venturi and the throttle body, contains two viewing windows which make it possible to visually examine the outlet end of th venturi extension tube while the engine s running. At the point where the extens n tube connects to the venturi a circul swirling section having cant d fins ar d its circumference and a hole in its ce er is located inside the tube in order tc promote mixing of the air an fuel. T s particular design allows the pure gaso e vapors to pass through the center hole d avoid condensation on the cool swirling fins*, but imparts sufficient turbulence to the air to encourage downstream mixing of the air and fuel.

In order to expedite the initial fabrication and evaluation of the vaporized gasoline metering system, an electronic fuel injector was installed in the throttle body and is used routinely for cold engine starts. Vapors can be used to start the engine when cold, however, by employing an auxiliary vaporizer such as a battery-powered heater. One such system which was implemented uses a 500 watt electric vaporizer during engine cranking to supply gasoline vapors directly to a metering valve in the throttle body. As soon as the engine starts, a 2 KW electric vaporizer is automatically energized which fills the pressure regulator with gasoline vapors and enables normal fuel metering through the venturi nozzle instead of the throttle body. After approximately 20 seconds of operation using the electric

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*At atmospheric pressure, pure gasoline vapor has a dew point of $\approx 400°F$ while a mixture of air and gasoline vapor with an air-fuel ratio of 15:1 has a dew point of $\approx 125°F$.

vaporizer, sufficient exhaust heat is available to permit operation of the normal exhaust system vaporizer in place of the electric unit.*

INITIAL EXPERIMENTAL RESULTS

The initial laboratory evaluation of the vaporized gasoline metering system was performed to verify the anticipated system advantages previously noted in this paper. To be specific, it was anticipated that the open loop vaporized gasoline system would (1) exhibit minimal steady state high-frequency** time-fluctuations in air-fuel ratio, (2) essentially eliminate the transient variations in air-fuel ratio due to airflow changes, and (3) provide a very uniform cylinder-to-cylinder distribution of air-fuel ratio. The evaluation, which was performed using a 351W V-8 engine coupled to an absorption dynamometer, did in fact substantiate the expected results. Specifically, the open loop vapor system exhibited steady state time-fluctuations in air-fuel ratio of less than ± 1% for a wide range of engine operating loads and air-fuel ratios. Furthermore, the system displayed transient variations in air-fuel ratio of less than ± 1% for step changes in airflow exceeding 400%. Finally, the system consistently provided cylinder-to-cylinder air-fuel ratio distributions of within ± 0.75% for cylinders fed from each plane of the dual plane manifold used on the 351W engine.

The steady state and transient air-fuel ratio values reported above were measured with a TiO_2 exhaust gas sensor having a time constant of approximately 0.25 seconds. (7) A typical time recording of the air-fuel ratio along with the corresponding engine torque is shown in Figure 9. In an effort to corroborate these results, similar measurements were made using an NDIR CO analyzer to indicate air-fuel ratio variations. Since the response time of the CO analyzer was much slower than the TiO_2 sensor, the resulting recordings did not reveal the rapid high-frequency fluctuations in air-fuel ratio observed with the TiO_2 sensor, but did

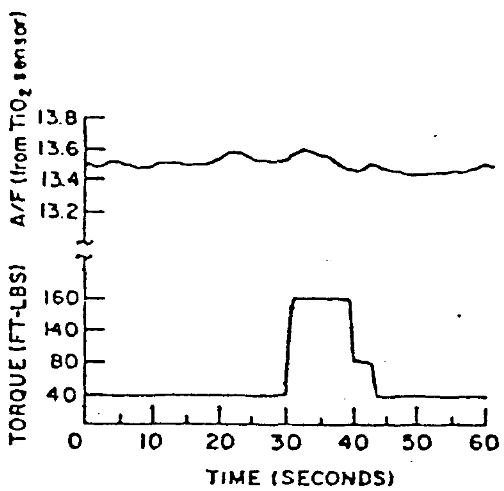

Fig. 9-Air-fuel ratio and engine torque versus time for 351W engine operating at 2000 rpm with open loop vapor system

show longer term fluctuations due to ... temperature and airflow variations. ... typical time recording of such an air ... characteristic together with the corresponding engine torque is shown ... Figure 10. The use of feedback from ... exhaust gas sensor to eliminate the low-frequency fluctuations in air-fuel ratio has been successfully demonstrated with the vapor system, and a detailed discussion of the feedback work will be included in a future paper.

The cylinder-to-cylinder air-fuel ratio distribution values reported were obtained using specially shaped sample probes located just downstream from each exhaust valve and connected through appropriate switching valves to conventional emission monitoring equipment. A typical cylinder-to-cylinder air-fuel ratio distribution achieved with the vapor system is shown in Figure 11. For comparison, a conventional liquid carburetor having the same venturi area and using the same mixing/viewing chamber as the vapor system was substituted for the vapor system, and a cylinder-to-cylinder distribution was obtained for the same engine operating condition. The resulting characteristic, shown in Figure 12, clearly illustrates the distribution advantage of a vapor system.

LEAN-LIMIT EXPERIMENTAL RESULTS

The vaporized gasoline metering system was originally devised as a scheme to provide very tight control of air-fuel ratio at values slightly rich of stoichiometry for use with NO_x catalysts. This is a very important application of

*The electric vaporizer has been used for "chokeless" cold starts at 70°F ambient temperature and air-fuel ratios near stoichiometry.

**In this context, high-frequency refers to values which are too high to be eliminated by feedback from an exhaust gas sensor.

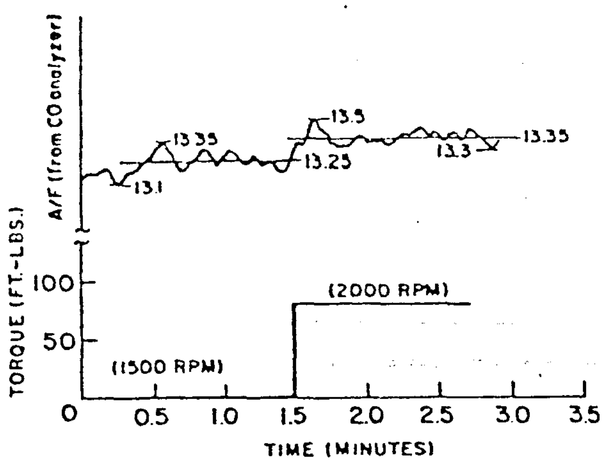

Fig. 10-Air-fuel ratio and engine torque versus time for 351W engine operating at 1500 rpm and 2000 rpm with open loop vapor system

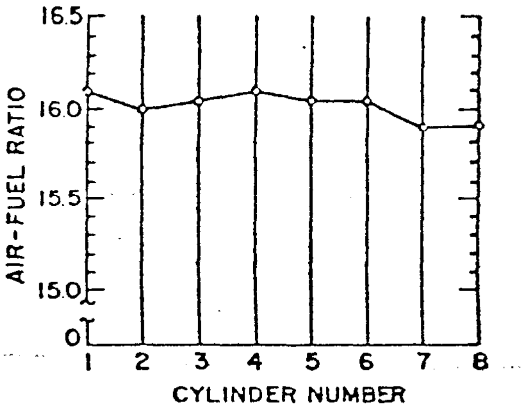

Fig. 11-Air-fuel ratio versus cylinder number for 351W engine operating at 2000 rpm, 40 ft-lb with vapor system

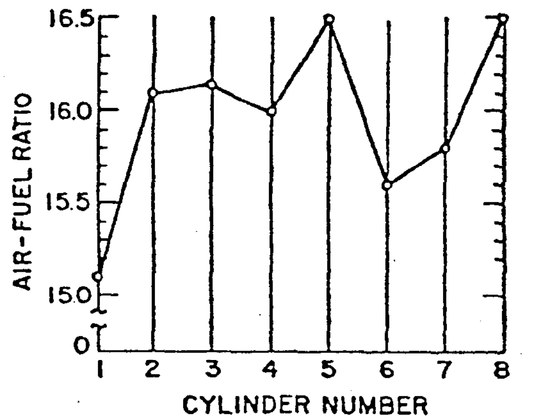

Fig. 12-Air-fuel ratio versus cylinder number for 351W engine operating at 2000 rpm, 40 ft-lb with conventional carburetor

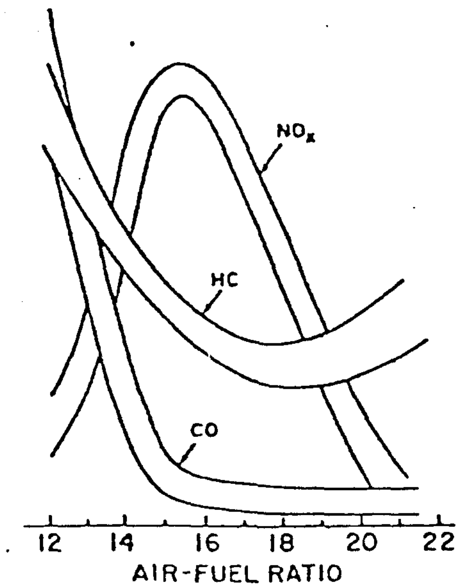

Fig. 13-Qualitative relationship of HC, NO_x, and CO emissions to air-fuel ratio

the vapor system and should be pursued further. However, the ability of the vapor system to provide a very uniform cylinder-to-cylinder distribution of air-fuel ratio with minimal time-fluctuations suggests that the system might also be useful in extending the lean misfire limit of a multi-cylinder engine. This is apparent since the engine operation would not be limited by a single "lean" cylinder as is the usual case. Instead, all cylinders would consistently receive the same air-fuel ratio and hence would be uniformly capable of operating at leaner air-fuel ratios. The use of extended lean-limit operation is an intriguing approach to the control of exhaust emissions, and is based on the relation of such emissions to air-fuel ratio shown qualitatively in Figure 13.

In order to evaluate the potential advantages of lean-limit vapor system operation, a CVS simulation method developed at Ford Motor Company was employed. (8) Basically, this technique utilizes emission and fuel consumption data obtained from steady state engine-dynamometer tests at specific speed-torque points to analytically predict the performance in a complete CVS cycle. The actual speed-torque points used are appropriately chosen to correspond to a particular powertrain-vehicle combination. The fundamental idea behind the simulation technique is that when an actual vehicle is operated over a CVS cycle, a unique trajectory or map is defined in the engine speed-torque-time space. The technique assumes that engine performance along this trajectory can be approximated by steady state operation at discrete speed-torque points for specific intervals of time. The particular speed-torque-time map

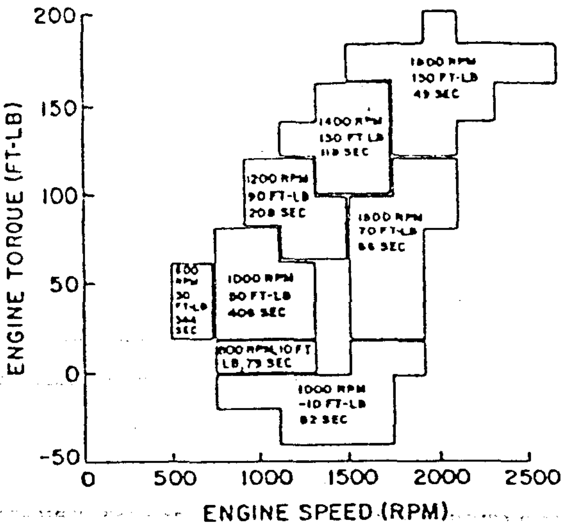

Fig. 14-Speed-torque-time map for CVS simulation of a 351W engine in a 5500 lb vehicle

employed for the lean-limit evaluation of the vapor system is shown in Figure 14. This map, with the particular segmentation shown, was developed for a 351W engine in a 5500 pound vehicle. Such an engine-vehicle combination was chosen for the simulated CVS cycle evaluation of the vaporized fuel metering system because comparable data using both conventional carburetion and electronic fuel injection were available from earlier work performed at Ford.

The previously described vapor system implemented on the 351W engine-dynamometer setup was operated at each of the speed-torque points specified in Figure 14 with the exception of the 1000 RPM, - 10 foot-pound point. This particular point could not be run because it required the use of a motoring dynamometer which was not available for the evaluation. At each speed-torque point explored, measurements of fuel consumption as well as CO, CO_2, HC, NO_x, and O_2 exhaust concentrations were obtained for various values of air-fuel ratio in the lean region. At each air-fuel ratio, the measurements were made for both MBT ignition timing as well as for a retard from MBT timing. The amount of retard used was arbitrarily chosen to give a torque loss of approximately 7% from the MBT value. The resulting torque loss was compensated for by increasing the throttle opening to give the correct torque value. In order to provide adequate combustion initiation at the lean air-fuel ratios, a high energy ignition system* with 0.100 in. gap spark plugs was used throughout the evaluation.

The experimental data obtained in the lean-limit evaluation of the vapor system were analytically processed and used to produce individual curves of HC and NO_x emissions (in grams) and fuel consumption (in pounds) versus air-fuel ratio for each speed-torque-time point explored. (Since the CO emissions were essentially invariant for the lean air-fuel ratios examined, CO emissions were not included in these plots.) A typical curve of HC, NO_x, and fuel consumption versus air-fuel ratio obtained in the lean-limit evaluation is shown in Figure 15. The complete set of curves for all the speed-torque-time points explored is presented in Appendix B. It should be emphasized that the emission and fuel consumption values given in each curve are calculated from steady state measurements to correspond to the time expended at each speed-torque point as dictated by the CVS simulation technique.

Each of the curves presented in Appendix B was examined to determine a "lean-limit" air-fuel ratio. In general, the particular air-fuel ratio chosen for each curve was a compromise between decreasing NO_x values and increasing HC and fuel consumption values. The results of this determination are tabulated in Figure 16 for the MBT situation and in Figure 17 for the retarded spark situation. The values used for the 1000 RPM, - 10 foot-pound point in these tables were estimates based on previous work with other systems.

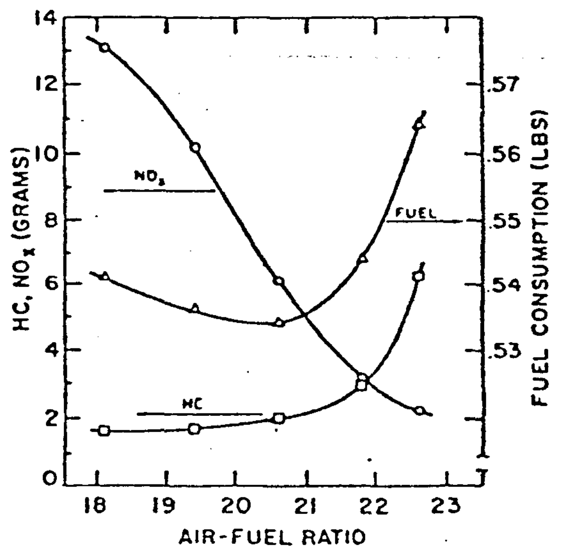

Fig. 15-HC, NO_x, and fuel consumption versus air-fuel ratio for 351W engine operating at 1400 rpm, 130 ft-lb for 118 s with vapor system and MBT timing

*The particular ignition system employed was a Ferroresonant Capacitive Discharge Ignition System developed at Ford Motor Company. (9)

SPEED (RPM)	TORQUE (FT-LB)	TIME (SEC)	A/F	HC (GMS)	NO_x (GMS)	CO (GMS)	FUEL (LBS)
600	30	364	18.0	6.60	.24	2.70	.333
800	10	79	15.7	2.34	.07	.56	.079
1000	-10	82	15.9	3.49	.015	5.61	.093
1000	50	406	20.0	8.10	1.42	5.94	.727
1200	90	208	22.0	6.60	1.90	5.71	.636
1400	130	118	21.8	2.95	3.13	4.84	.544
1800	70	66	21.5	1.60	.89	3.08	.270
1800	150	49	22.0	2.30	2.91	2.88	.321
		TOTALS		33.98	10.575	31.32	3.003

Fig. 16-Emission and fuel consumption values used for CVS cycle simulation of 351W engine with vapor system in 5500 lb vehicle-lean limit with MBT spark

SPEED (RPM)	TORQUE (FT-LB)	TIME (SEC)	A/F	HC (GMS)	NO (GMS)	CO (GMS)	FUEL (LBS)
600	30	364	18.0	4.68	.11	2.70	.379
800	10	79	16.7	.92	.03	.56	.091
1000	-10	82	15.9	3.49	.015	5.61	.093
1000	50	406	19.6	7.71	1.02	5.94	.761
1200	90	208	21.0	3.88	1.60	5.71	.664
1400	130	118	21.5	2.50	2.00	4.84	.560
1800	70	66	21.3	1.30	.70	3.08	.275
1800	150	49	22.0	1.71	1.54	2.88	.331
		TOTALS		26.39	7.015	31.32	3.154

Fig. 17-Emission and fuel consumption values used for CVS cycle simulation of 351W engine with vapor system in 5500 lb vehicle-lean limit with retarded spark

The complete CVS cycle prediction for the lean-limit vapor system operation was found by dividing the total HC, NO_x, CO, and fuel consumption values shown in Figures 16 and 17 by the total distance covered in the CVS cycle. The results of this prediction, which apply to a 351W engine in a 5500 pound vehicle, are shown in Figure 18 for both the MBT timing condition and the retarded timing condition. Also included in this figure for comparison are CVS predictions for the same engine-vehicle combination with (1) a vapor system having a constant air-fuel ratio of 19:1, (2) a conventional carburetor having a 1974 production calibration, and (3) an electronic fuel injection system having air-fuel ratio and timing optimized at each speed-torque point to give best fuel economy consistent with reasonable emission levels. Comparison of the results presented in Figure 18 indicates that lean-limit vapor system operation potentially provides

CONFIGURATION	HC (GM/MI)	NO_x (GM/MI)	CO (GM/MI)	FUEL (MPG)
VAPOR SYSTEM (Lean Limit-MBT)	4.6	1.4	4.2	15.3
VAPOR SYSTEM (Lean Limit-Retard)	3.5	.94	4.2	14.5
VAPOR SYSTEM (A/F≈19:1-MBT)	3.4	4.7	4.2	15.3
VAPOR SYSTEM (A/F≈19:1-Retard)	2.7	2.2	4.2	14.6
BASELINE CARB (Production Calib)	2.2	3.9	5.1	12.4
EFI (Best Economy)	4.3	3.4	4.4	13.9

Fig. 18-CVS cycle predictions for various configurations used with a 351W engine in a 5500 lb vehicle

appreciable improvements in fuel economy and NO_x emissions, but at the expense of higher HC levels.

SUMMARY

Evaluation of the vaporized gasoline metering system has shown that the system exhibits numerous beneficial characteristics which make it very appealing for use with conventional internal combustion engines. To be specific, it has been demonstrated that the vapor system (1) exhibits minimal steady state high-frequency fluctuations in air-fuel ratio, (2) displays negligible transient variations in air-fuel ratio for changes in engine load, (3) provides very uniform distribution of air-fuel ratio from cylinder to cylinder, and (4) enables cold engine starts at air-fuel ratios close to stoichiometry using vaporized gasoline supplied from an auxiliary electric vaporizer.

The first two characteristics listed above will permit very tight control of air-fuel ratio when coupled with feedback from an exhaust gas sensor. The third characteristic, in addition to the first two, will enable extended lean-limit operation which in turn will result in improvements in fuel economy and NO_x emissions as previously shown. In order for lean-limit operation to be viable, however, a practical method of lowering the HC levels as well as programming the air-fuel ratio as a function of engine load must be provided. The fourth characteristic listed above should result in significantly lower emission levels during the warm-up period following a cold engine start.

CONCLUSIONS

The favorable characteristics which have been demonstrated with the vaporized gasoline metering system justify its continued development as an alternative to more conventional fuel metering systems. It should be emphasized that the system described in this paper is an experimental one, however, and many unexplored areas must be investigated before production feasibility can be established. These unexplored areas include actual vehicle emission testing, low and high temperature starting and operation, practical component design and durability, and overall system safety.

ACKNOWLEDGEMENTS

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7. E. F. Gibbons, A. H. Meitzler, L. R. Foote, P. J. Zacmanidis, and G. L. Beaudoin, "Automotive Exhaust Sensors Using Titania Ceramics." Paper 750224 presented at the SAE International Automotive Engineering Congress, Detroit, February 1975.
8. P. N. Blumberg, "Powertrain Simulation: A Tool for the Design and Evaluation of Engine Control Strategies." Paper to be presented at the SAE International Automotive Engineering Congress, Detroit, February 1976.
9. J. R. Asik and B. Bates, "The Ferroresonant Capacitor Discharge Ignition (FCDI) System: A Multiple Firing CD Ignition with Spark Discharge Sustaining Between Firings." Paper to be presented at the SAE International Automotive Engineering Congress, Detroit, February 1976.

APPENDIX A

VENTURI METERING CONSIDERATIONS FOR A VAPOR CARBURETOR

NOMENCLATURE

- A/F = the air-fuel ratio
- A = the cross-sectional area at the venturi throat
- A_A = the air cross-sectional throat area
- A_F = the fuel cross-sectional throat area
- A_o = the cross-sectional area at the zero velocity state
- C_p = the fluid specific heat at constant pressure
- g_c = a proportionality constant
- h_o = the enthalpy of the fluid at zero velocity
- h = the enthalpy of the fluid at the venturi throat
- K = a constant = .2231 for gasoline and air
- m = the mass of the fluid
- $\dot{M}$ = the fluid mass flow rate
- $\dot{M}_A$ = the air mass flow rate
- $\dot{M}_F$ = the fuel vapor mass flow rate
- P = the pressure at the venturi throat
- P_A = the air pressure at the zero velocity state (supply pressure)
- P_F = the fuel pressure at the zero velocity state (supply pressure)
- P_o = the pressure at the zero velocity state
- P_T = the pressure at the venturi throat

R = the individual gas constant
R_A = the gas constant for air
R_F = the gas constant for fuel vapor
T = the absolute downstream or throat temperature
T_A = the absolute upstream air temperature
T_F = the absolute upstream fuel vapor temperature
T_o = the absolute upstream temperature
u = the internal energy at the venturi throat
u_o = the internal energy at the zero velocity state
v = the velocity at the venturi throat
v_o = the velocity at the stagnation point
V = the volume at the venturi throat
V_o = the volume at the zero velocity state
Z = the elevation at the venturi throat
Z_o = the elevation at the zero velocity state
γ = the specific heat ratio (C_P/C_V) for gas
γ_A = the specific heat ratio (C_P/C_V) for air
γ_F = the specific heat ratio (C_P/C_V) for fuel vapor
ρ = the density at the venturi throat
ρ_o = the density at the zero velocity state

SUBSONIC MASS FLOW THROUGH A VENTURI METER

The behaviour of the mass flow per unit time of a gas through a venturi meter can be predicted given the following assumptions: 1) the fluid in question is assumed to obey the perfect gas law and 2) the flow may be treated as isentropic one dimensional steady flow of a compressible fluid. Such a system is shown in Figure A-1 where the subscripted quantities refer to conditions in a large reservoir upstream of the venturi and the unsubscripted quantities refer to conditions at the throat of the venturi.

The first law of thermodynamics (conservation of energy) states that

$$u_o + P_oV_o + \frac{v_o^2}{2g_c} + mg_cZ_o =$$

$$u + PV + \frac{v^2}{2g_c} + mg_cZ \qquad \text{(A-1)}$$

For the system being evaluated,

$$v_o = 0$$

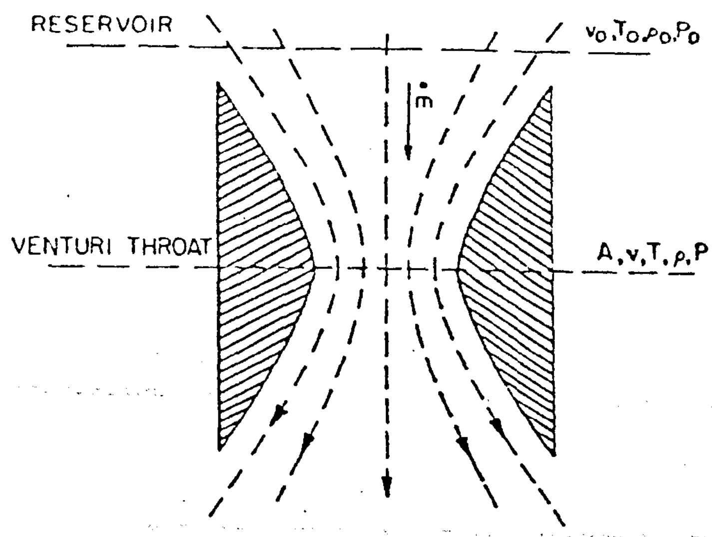

Fig. A-1-Basic venturi meter

$$Z_o = Z$$

Using these conditions and the definition of enthalpy ($h = u + PV$), Equation A-1 reduces to

$$h_o = h + \frac{v^2}{2g_c} \qquad \text{(A-2)}$$

For a perfect gas, the following conditions hold:

$$C_P = \frac{h_o - h}{T_o - T}$$

and

$$C_P = \frac{\gamma}{\gamma - 1} R$$

Furthermore, for a perfect gas during an isentropic process, it can be shown that

$$\frac{T}{T_o} = \left(\frac{P}{P_o}\right)^{\frac{\gamma-1}{\gamma}}$$

Substituting these relationships into Equation A-2 and solving for v yields

$$v = \left\{\frac{2g_c\gamma RT_o}{\gamma - 1}\left[1 - \left(\frac{P}{P_o}\right)^{\frac{\gamma-1}{\gamma}}\right]\right\}^{\frac{1}{2}} \qquad \text{(A-3)}$$

The continuity equation (conservation of mass) states that

$$\rho_o v_o A_o = \rho v A = \dot{M} \qquad (A-4)$$

Substituting Equation A-3 into Equation A-4 yields

$$\dot{M} = \rho A \left\{ \frac{2g_c \gamma R T_o}{\gamma - 1} \left[1 - \left(\frac{P}{P_o} \right)^{\frac{\gamma-1}{\gamma}} \right] \right\}^{\frac{1}{2}} \qquad (A-5)$$

Again for a perfect gas during an isentropic process, it can be shown that

$$\rho = \frac{P_o}{RT_o} \left(\frac{P}{P_o} \right)^{\frac{1}{\gamma}}$$

Substituting this relationship into Equation A-5 and rearranging gives the desired form of the mass flow rate equation:

$$\dot{M} = \frac{P_o A}{T_o^{1/2}} \left[\frac{2g_c \gamma}{(\gamma - 1)R} \right]^{\frac{1}{2}} \cdot \left[\left(\frac{P}{P_o} \right)^{\frac{2}{\gamma}} - \left(\frac{P}{P_o} \right)^{\frac{\gamma+1}{\gamma}} \right]^{\frac{1}{2}} \qquad (A-6)$$

Equation A-6 is only valid for subsonic flow; i.e., when the ratio of static to total pressure at the venturi throat (P/P_o) is greater than the critical pressure ratio.* When the critical pressure ratio is reached, the velocity of mass flow at the venturi throat becomes sonic and, by definition of sonic flow, the maximum mass flow rate for fixed area and upstream conditions is attained.

METERING PRINCIPLE APPLIED TO TWO GAS PHASE FLUIDS

From Equation A-6, the mass flow rate equation for air through a venturi meter is

$$\dot{M}_A = \frac{P_A A_A}{T_A^{1/2}} \left[\frac{2g_c \gamma_A}{(\gamma_A - 1)R_A} \right]^{\frac{1}{2}} \cdot \left[\left(\frac{P_T}{P_A} \right)^{\frac{2}{\gamma_A}} - \left(\frac{P_T}{P_A} \right)^{\frac{\gamma_A+1}{\gamma_A}} \right]^{\frac{1}{2}} \qquad (A-7)$$

When air flows through a venturi with a constant upstream pressure P_A, Equation A-7 states that a pressure $P_T < P_A$ is experienced at the throat of the venturi. As the mass flow rate $\dot{M}_A$ increases, the pressure at the throat decreases; this is the basis of the metering principle of the venturi. Referring to Figure 6, if a fuel vapor nozzle is placed with its opening at the venturi throat, the throat pressure $P_T = f(\dot{M}_A)$ can be used to meter the mass flow rate of fuel vapor as a function of mass flow rate of air. Accordingly, from Equation A-6, the mass flow rate of fuel vapor is

$$\dot{M}_F = \frac{P_F A_F}{T_F^{1/2}} \left[\frac{2g_c \gamma_F}{(\gamma_F - 1)R_F} \right]^{\frac{1}{2}} \cdot \left[\left(\frac{P_T}{P_F} \right)^{\frac{2}{\gamma_F}} - \left(\frac{P_T}{P_F} \right)^{\frac{\gamma_F+1}{\gamma_F}} \right]^{\frac{1}{2}} \qquad (A-8)$$

Since the air-fuel ratio at the venturi throat is equal to the ratio of the mass of air to the mass of fuel, it follows from Equations A-7 and A-8 that

$$\frac{A}{F} = \frac{\dot{M}_A}{\dot{M}_F} = \left(\frac{P_A}{P_F} \right) \left(\frac{A_A}{A_F} \right) \left(\frac{T_F}{T_A} \right)^{\frac{1}{2}} \left[\frac{\gamma_A (\gamma_F - 1) R_F}{\gamma_F (\gamma_A - 1) R_A} \right]^{\frac{1}{2}} \cdot \left[\frac{\left(\frac{P_T}{P_A} \right)^{\frac{2}{\gamma_A}} - \left(\frac{P_T}{P_A} \right)^{\frac{\gamma_A+1}{\gamma_A}}}{\left(\frac{P_T}{P_F} \right)^{\frac{2}{\gamma_F}} - \left(\frac{P_T}{P_F} \right)^{\frac{\gamma_F+1}{\gamma_F}}} \right]^{\frac{1}{2}}$$

Assuming that γ_A and γ_F are constant over the temperature range of interest, the following constant is defined:

$$K = \left[\frac{\gamma_A (\gamma_F - 1) R_F}{\gamma_F (\gamma_A - 1) R_A} \right]^{\frac{1}{2}}$$

---

*The critical pressure ratio is defined as

$$\left(\frac{P}{P_o} \right)_{CRIT} = \left(\frac{2}{\gamma + 1} \right)^{\frac{\gamma}{\gamma-1}}$$

Therefore, the air-fuel ratio for a metering venturi is

$$\frac{A}{F} = K\left(\frac{A_A}{A_F}\right)\left(\frac{P_A}{P_F}\right)\left(\frac{T_A}{T_F}\right)^{-\frac{1}{2}}\left[\frac{\left(\frac{P_T}{P_A}\right)^{\frac{2}{\gamma_A}} - \left(\frac{P_T}{P_A}\right)^{\frac{\gamma_A+1}{\gamma_A}}}{\left(\frac{P_T}{P_F}\right)^{\frac{2}{\gamma_F}} - \left(\frac{P_T}{P_F}\right)^{\frac{\gamma_F+1}{\gamma_F}}}\right]^{\frac{1}{2}}$$

APPENDIX B

The curves of HC, NO_x, and fuel consumption versus air-fuel ratio obtained in the lean limit evaluation of the 351W engine equipped with the vaporized fuel metering system are shown in Figures B-1 through B-14. These figures are presented on the following pages.

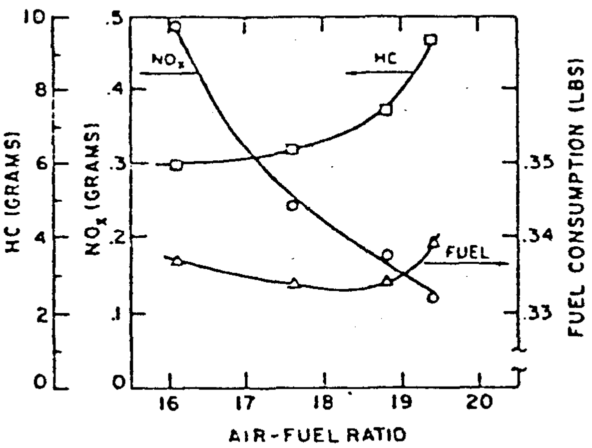

Fig. B-1-600 rpm, 30 ft-lb, 364 s operating point with MBT timing

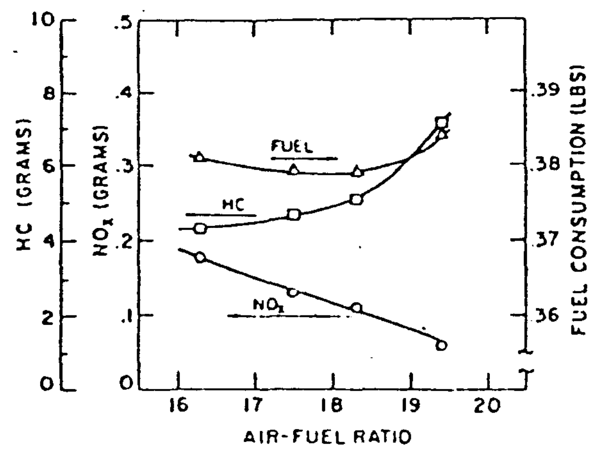

Fig. B-2-600 rpm, 30 ft-lb, 364 s operating point with retarded timing

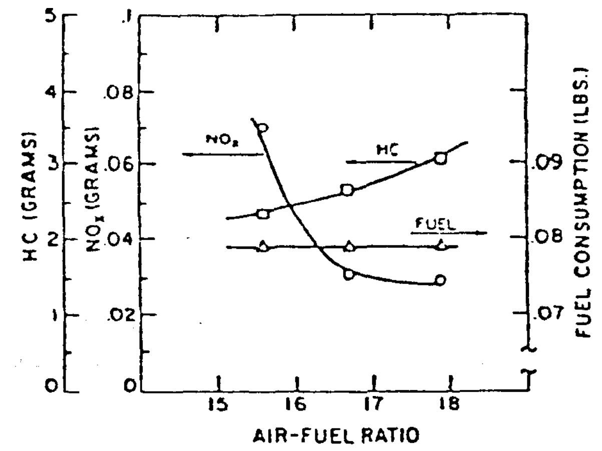

Fig. B-3-800 rpm, 10 ft-lb, 79 s operating point with MBT timing

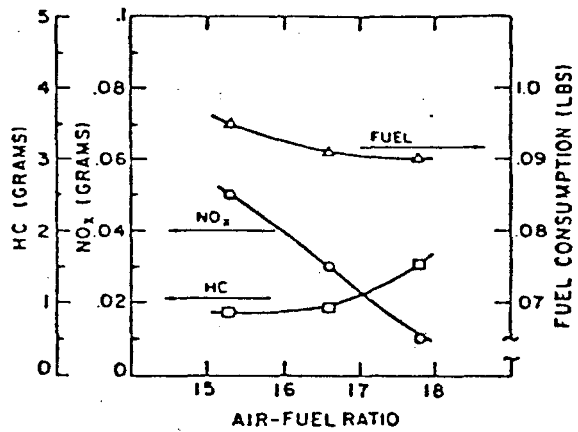

Fig. B-4-800 rpm, 10 ft-lb, 79 s operating point with retarded timing

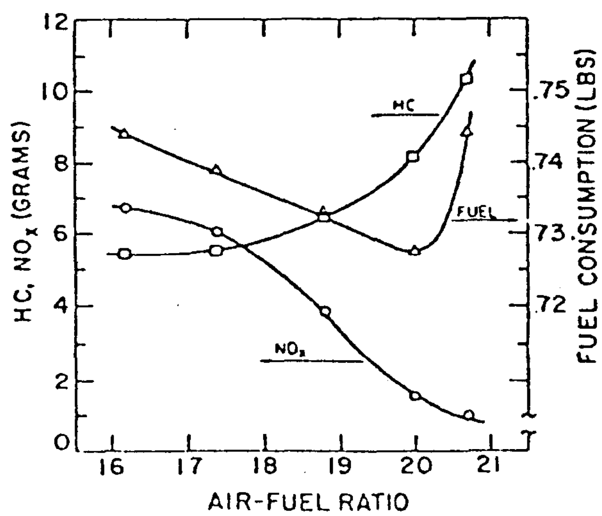

Fig. B-5-1000 rpm, 50 ft-lb, 406 s operating point with MBT timing

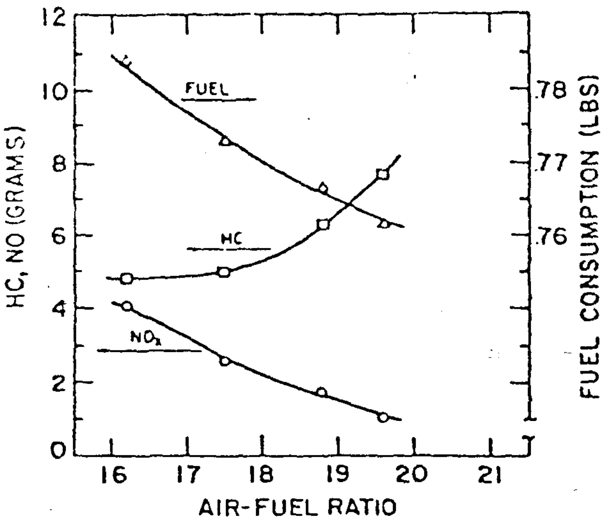

Fig. B-6-1000 rpm, 50 ft-lb, 406 s operating point with retarded timing

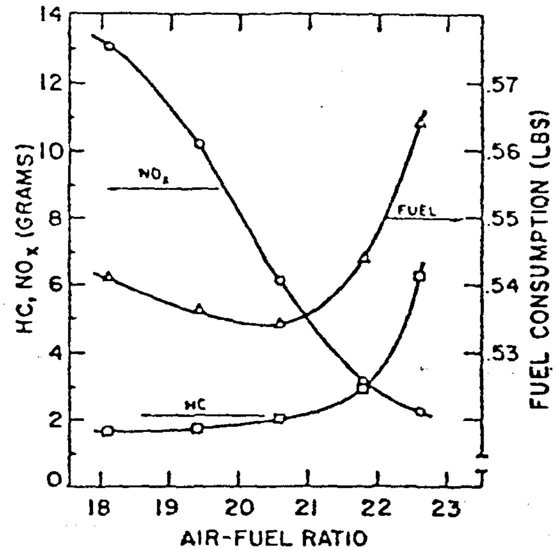

Fig. B-9-1400 rpm, 130 ft-lb, 118 s operating point with MBT timing

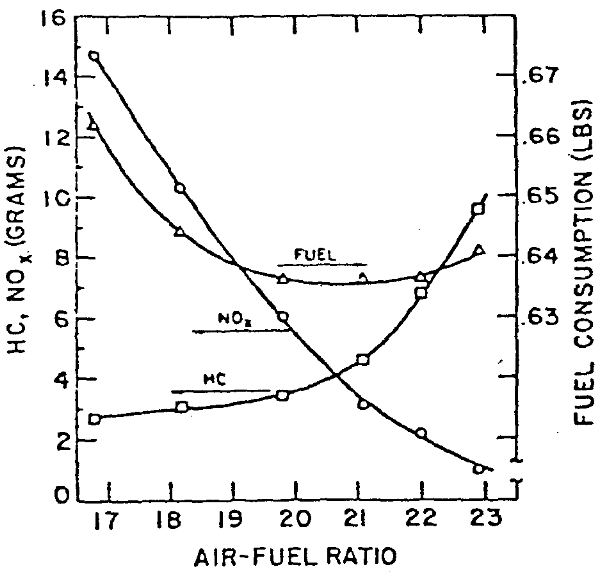

Fig. B-7- 1200 rpm, 90 ft-lb, 208 s operating point with retarded timing

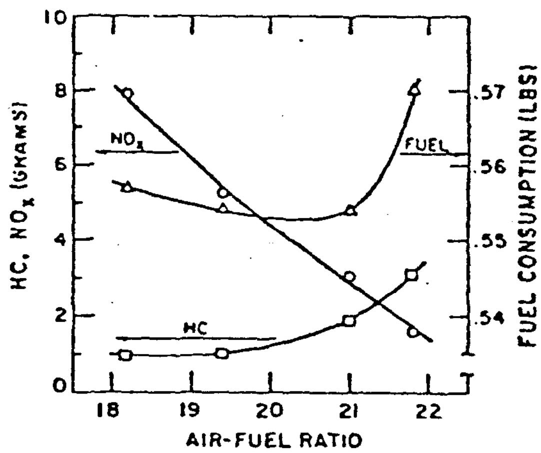

Fig. B-10-1400 rpm, 130 ft-lb, 118 s operating point with retarded timing

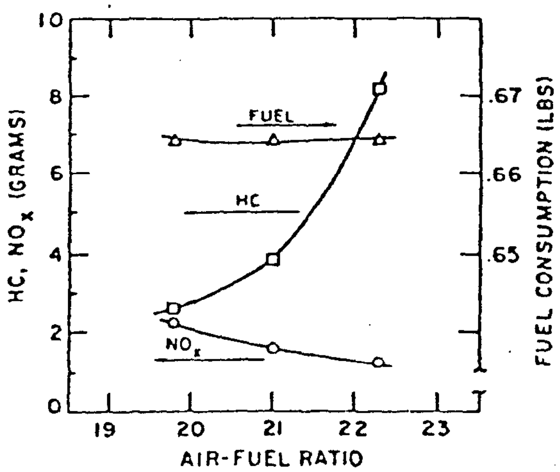

Fig. B-8-1200 rpm, 90 ft-lb, 208 s operating point with retarded timing

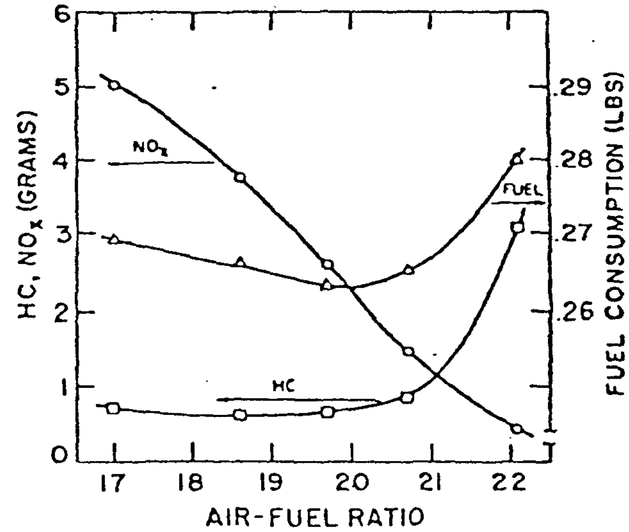

Fig. B-11-1800 rpm, 70 ft-lb, 66 s operating point with retarded timing

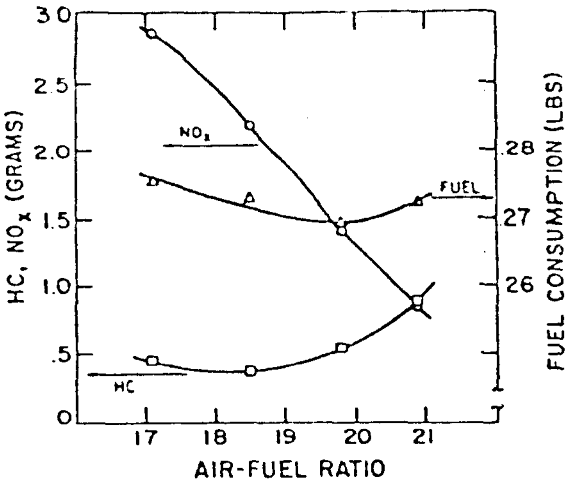

Fig. B-12-1800 rpm, 70 ft-lb, 66 s operating point with retarded timing

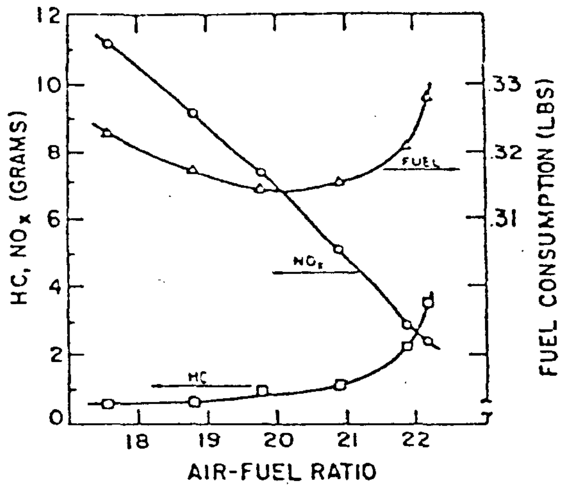

Fig. B-13-1800 rpm, 150 ft-lb, 49 s operating point with MBT timing

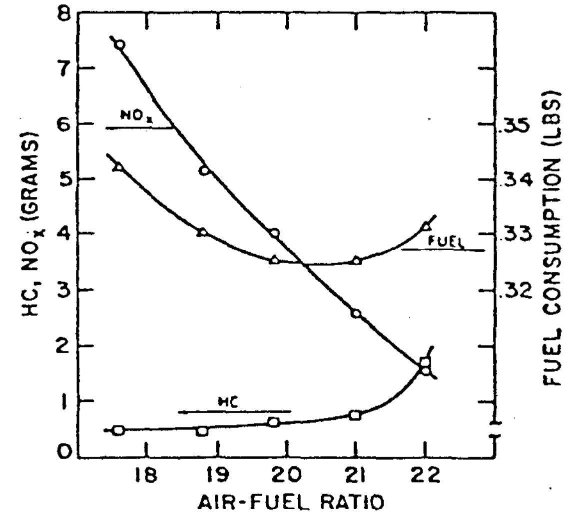

Fig. B-14-1800 rpm, 150 ft-lb, 49 s operating point with retarded timing

EXHIBIT G

Detroit Testing Laboratory, Inc.

ESTABLISHED 1903

[illegible] NORTHEND AVENUE OAK PARK MICHIGAN 48237 (313) 398-2100 TELEX 23 5459

May 15, 1978

Car-Bo-Tech, Inc.
145 Ocean Avenue
Palm Beach Shores, Florida 33404

Attn: Suzanne Pletts, Executive
Vice President

Dear Mrs. Pletts:

In confirmation of our telephone conversation of May 12, 1978, with Mr. Donald Pletts, the Car-Bo-Tech unit submitted by you on a 1977 Chevrolet Caprice for testing was tested as received and was not disassembled or removed from the test car.

The unit does not harm the engine in any way foreseen by us in our testing and inspection.

Yours truly,

Leslie T. Viland
Project Engineer

William R. Martin, Manager
Mechanical & Hydraulic Testing

LTV/WRM/jk

EXHIBIT I

"Energy-Gas-Saver"

CAR-BO-TECH, INC.

145 Ocean Drive #502

Palm Beach Shores, Florida 33404

Phone 842-8558

October 30, 1976

GASOLINE MILEAGE TESTS

1970 Cadillac Fleetwood

Testing was conducted by the Company, and usually with one or more passengers as witnesses, for the purpose of testing gasoline mileage. Since the gas mileage tests may be verified by anyone who would care to ride in one of the test vehicles only significant results are being reported. Over 10,000 miles were driven in the 1970 Cadillac Fleetwood while doing the gasoline tests. The gallon bottle test was deemed by the Company to be the most accurate and was conducted on the highways in actual traffic. The driver turns off the fuel pump line and allows the gas to flow into the carburetor from the gallon bottle. When the gallon is completely used the engine stops and the car rolls to a stop and the mileage is recorded. Tests were conducted in many types of conditions. As the Company's product was improved so was the improvement in gasoline mileage and also better exhaust emission resulted.

On October 14, 1976 the latest casted unit on the 1970 Cadillac obtained 19.4 miles on one gallon of gas. Testing conditions were ideal. This unit is the casted unit that will go into production to be used on General Motors automobiles with 4-barrel carburetors.

The best mileage obtained on the last prototype model (quadrojets) before casting was 19.1 miles on one gallon of gas. The average mileage of tests on this model was 18.6 per gallon.

Regular gas (89 octane) was used on all of the above tests. High octane tests were conducted with no appreciable improvement in the mileage or drive ability on the 1970 Fleetwood Cadillac.

A series of mileage tests were conducted with the Cadillac test car as follows on July 6. 1976.

Auto with original carburetor, coil, wires, but in as near perfect tune as possible but without the Company's product: Regular gas 12.6 miles on one gallon of gas: Unleaded gas 11.8 miles on one gallon of gas.

The original gas mileage test done by the Company in 1975 on this Cadillac Fleetwood with the original equipment produced 12.6 miles on on gallon of gas.

"Energy-Gas-Saver"
CAR-BO-TECH, INC.
145 Ocean Drive #502
Palm Beach Shores, Florida 33404
Phone 842-8558

Gasoline Mileage Tests
October 30, 1976
Page 2

New radial tires were added to the car as well as new shocks. There was no increase in gasoline mileage. Many tests were conducted which produced 17 to 18 miles per gallon.

Summary of Gasoline Mileage Results using Regular Gasoline on Highway

1970 CADILLAC

Car with original equipment	12.7 miles on one gallon of gas
Car with Company product installed	19.4 miles on one gallon of gas
Car with Company product installed	19.1 miles of one gallon of gas

```
TASK? 75

                              OLSON LABS, INC.
EXHAUST EMISSIONS         HOT 505
1975 MASS TEST
SITE #? 2,   . MODEL?  CHEVROLET,     CLASS?  CLASSIC,      LIST #? ,
RUN#? 1,  DATE? 2-7-78,  CVS#? 407-01,,  PROJ#?  DTL,,
WET BULB? 52,  DRY BULB? 72,  BAROM-C?  29.54,
CVS INPUT
  VOL/REV?  .2816,
   TRANS COLD
REVS? 10531, INLT PRES? 40.2, INLT TMP?  110,
   STAB COLD
REVS? 0, INLT PRES? 0, INLT TMP?  0,
   TRANS HOT
REVS? 0, INLT PRES? 0, INLT TMP?  0,
ABS. H=  025.30   HUCF=  00.810

  VMIX=  02440    VMIX=  00000    VMIX=  00000
BAG READINGS IN CONC
   TRANS COLD
     BACKGROUND

HC? 8.10,  CO? 4.62, CO2? .064, NOX? 0,,
     SAMPLE

HC? 284.10,  CO? 1452.08, CO2? 1.607, NOX? 200.45,,
   STAB COLD
     BACKGROUND

HC? 0,  CO? 0, CO2? 0, NOX? 0,,
     SAMPLE

HC? 0,  CO? 0, CO2? 0, NOX? 0,,
   TRANS HOT
     BACKGROUND

HC? 0,  CO? 0, CO2? 0, NOX? 0,,
    SAMPLE

HC? 0,  CO? 0, CO2? 0, NOX? 0,,
MASS EMISSIONS IN GM
   TRAN COLD
HC=  011.04  CO= 116.51  CO2=  01963  NOXC=  01.47  NOX=  026.49
   TAB COLD
HC=  000.00  CO= 000.00  CO2=  00000  NOXC=  000.00  NOX= 00.00
   TRANS HOT
HC=  00000  CO= 000.00  CO2=  00000  NOXC=  000.00  NOX=  000.00
SUM
```

SUMMARY - EXHAUST EMISSIONS IN GRAMS/MILE

HC=3.0752   CO=32.454 CO_2=546.80 NOX_c=5.9805   NOX=7.378

MPG= 16.092

```
TASK? 75

                         OLSON LABS, INC.
EXHAUST EMISSIONS            HOT 505
1975 MASS TEST
SITE #? 2,   MODEL?  CAP.,    CLASS?  CHEV,    LIST #? 1,
RUN#? 1,  DATE? 2/23/78,  CVS#? 407-01,,  PROJ#?  DTL,,
WET BULB? 54,  DRY BULB? 76,  BAROM-C?  29.02,
CVS INPUT
  VOL/REV?  .2819,
   TRANS COLD
REVS? 10533, INLT PRES? 39.5, INLT TMP?  111,
   STAB COLD
REVS? , INLT PRES? , INLT TMP? ,
   TRANS HOT
REVS? , INLT PRES? , INLT TMP?  ,
ABS. H=  027.53   HUCF=  00.817

  VMIX=  02396   VMIX=  00000   VMIX=  00000
BAG READINGS IN CONC
   TRANS COLD
     BACKGROUND

HC? 10.9,  CO? 2.31, CO2? .037, NOX? .1,,
     SAMPLE

HC? 71.7,  CO? 1101.56, CO2? 1.618, NOX? 59,,
   STAB COLD
     BACKGROUND

HC? ,  CO? , CO2? , NOX? ,,
     SAMPLE

HC? ,  CO? , CO2? , NOX? ,,
   TRANS HOT
     BACKGROUND

HC? ,  CO? , CO2? , NOX? ,,
     SAMPLE

HC? ,  CO? , CO2? K, NOX? ,,
MASS EMISSIONS IN GM
   TRANS COLD
HC=  002.43  CO= 086.87  CO2=  01970  NOXC=  006.25  NOX=  007.64
   STAB COLD
HC=  000.00  CO= 000.00  CO2=  00000  NOXC=  000.00  NOX=  000.00
   TRANS HOT
HC=  000.00  CO= 000.00  CO2=  00000  NOXC=  000.00  NOX=  000.00
```

SUMMARY - EXHAUST EMISSIONS IN GRAMS/MILE

HC= 0.68 CO= 24.198 CO_2= 548.7465 NOX_c= 1.741

MPG= 16.6

HIGHWAY DRIVING CYCLE FOR FUEL ECONOMY

SITE #? 2, DATE? 2-23-78,

MAKE? , MODEL? , YEAR? ,

LICENSE #? , STATE? , ODOMETER? ,

RUN#? 2B, CVS#? 407-01, PROJ#? DTL,

WET BULB? 54, DRY BULB? 76, BAROM-C? 29.01,

CVS INPUT

VOL/REV? .2818,

REVS? 15921, INLT PRES? 39.9, INLT TMP? 111,
ABS. H= 027.56 HUCF= 00.817 VMIX= 03535

BAG READINGS IN CONC

BACKGROUND
HC? 10.70, CO? 4.20, CO2? .036,

SAMPLE
HC? 68.30, CO? 419.70, CO2? 2.619,

MPG= 018.42

EXHIBIT J

TASK? 2,
TASK? 75

OLSON LABS, INC.

```
EXHAUST EMISSIONS
1975 MASS TEST
SITE #? 2,    MODEL? CAP.,     CLASS? CHEV,     LIST #? 1,
RUN#? 1,  DATE? 2/23/78,  CVS#?.407-01,,  PROJ#?  DTL,,
WET BULB? 54,  DRY BULB? 76,  BAROM-C?  29.00,
CVS INPUT
 VOL/REV?  .2919,
  TRANS COLD
REVS? 10533, INLT PRES? 39.5, INLT TMP?  111,
  STAB COLD
REVS? , INLT PRES? , INLT TMP?  ,
  TRANS HOT
REVS? , INLT PRES? , INLT TMP?  ,
ABS. H=  027.53   HCCF=  00.817

 VMIX=  02396    VMIX=  00000    VMIX=  00000
BAG READINGS IN CONC
  TRANS COLD
   BACKGROUND

HC? 10.9,  CO? 2.31, CO2? .037, NOX? .1,,
   SAMPLE

HC? 71.7,  CO? 1101.56, CO2? 1.618, NOX? 59,,
  STAB COLD
   BACKGROUND

HC? ,  CO? , CO2? , NOX? ,,
   SAMPLE

HC? ,  CO? , CO2? , NOX? ,,
  TRANS HOT
   BACKGROUND

HC? ,  CO? , CO2? , NOX? ,,
   SAMPLE

HC? ,  CO? , CO2? K, NOX? ,,
MASS EMISSIONS IN GM
  TRANS COLD
HC=  002.43  CO= 086.57  CO2=  01970  NOXC=  006.25  NOX=  007.64
  STAB COLD
HC=  000.00  CO= 000.00  CO2=  00000  NOXC=  000.00  NOX=  000.00
  TRANS HOT
HC=  000.00  CO= 000.00  CO2=  00000  NOXC=  000.00  NOX=  000.00
SUMMARY-EXHAUST EMISSIONS IN GMS/MI
HC=  00.139  CO= 04.980  CO2=  0112.9 NOXC=  00.358  NOX=  00.439
```

MID-SIZE CARS

Manufacturers: Manufacturer Car Line	Fuel Economy: Estimated MPG	Fuel Economy: Average Annual Fuel Costs	Vehicle Description: Engine Description CID/Cyl Type	Transmission	Fuel System	Body Type Interior Space Passenger/Trunk or Cargo (Cu. Ft.)
FORD						
FAIRMONT	20	$525	140(2.3L)/4	M4	2	2DR-95/17
	20	$525	140(2.3L)/4	A3	2	4DR-96/17
	19	$552	200(3.3L)/6	M4	1	
	18	$584	200(3.3L)/6	A3	1	
	16	$656	302(5.0L)/8	A3	2	
LTD II	14	$750	302(5.0L)/8	A3	2	2DR-93/16
	13	$807	351(5.8L)/8 (MENG)	A3	2	4DR-101/16
THUNDERBIRD	14	$750	302(5.0L)/8	A3	2	2DR-95/16
	13	$807	351(5.8L)/8 (WENG)	A3	2	
	13	$807	351(5.8L)/8 (MENG)	A3	2	
LINCOLN-MERCURY						
CONTINENTAL MARK V	12	$875	400(6.6L)/8	A3	2	2DR-99/18
COUGAR	14	$750	302(5.0L)/8	A3	2	2DR-92/16
	13	$807	351(5.8L)/8 (WENG)	A3	2	4DR-100/16
	13	$807	351(5.8L)/8 (MENG)	A3	2	
ZEPHYR	20	$525	140(2.3L)/4	M4	2	2DR-95/17
	20	$525	140(2.3L)/4	A3	2	4DR-96/17
	19	$552	200(3.3L)/6	M4	1	
	18	$584	200(3.3L)/6	A3	1	
	16	$656	302(5.0L)/8	A3	2	
OLDSMOBILE						
CUTLASS SALON	18	$552	231(3.8L)/6	A3	2	2DR-97/16
	17	$617	260(4.3L)/8	M5	2	4DR-101/16
	19	$552	260(4.3L)/8	A3	2	
	25	$360	260(4.3L)/8 (DIESEL)	M5	FI	
	24	$375	260(4.3L)/8 (DIESEL)	A3	FI	
	15	$700	305(5.0L)/8 (GM-CHEV)	M4	4	
	17	$617	305(5.0L)/8 (GM-CHEV)	A3	4	
CUTLASS SUPREME	19	$552	231(3.8L)/6	A3	2	2DR-97/18
	17	$617	260(4.3L)/8	M5	2	
	19	$552	260(4.3L)/8	A3	2	
	25	$360	260(4.3L)/8 (DIESEL)	M5	FI	
	24	$375	260(4.3L)/8 (DIESEL)	A3	FI	
	15	$700	305(5.0L)/8 (GM-CHEV)	M4	4	
	17	$617	305(5.0L)/8 (GM-CHEV)	A3	4	
TORONADO	16	$656	350(5.7L)/8 (GM-OLDS)	A3	4	2DR-101/17
	21	$428	350(5.7L)/8 (DIESEL)	A3	FI	
PLYMOUTH						
VOLARE	18	$584	225/6	M3	1	2DR-89/16
	16	$584	225/6	M4	1	4DR-100/16
	18	$584	225/6	A3	1	
	18	$584	225/6	A3	2	
	16	$656	318/8	A3	2	
PONTIAC						
GRAND PRIX	19	$552	231(3.8L)/6	A3	2	2DR-96/16
	18	$584	301(4.9L)/8	A3	2	

MID-SIZE CARS

Manufacturers: Manufacturer Car Line	Fuel Economy: Estimated MPG	Fuel Economy: Average Annual Fuel Costs	Vehicle Description: Engine Description CID/Cyl Type	Transmission	Fuel System	Body Type Interior Space Passenger/Trunk or Cargo (Cu. Ft.)
PONTIAC						
GRAND PRIX	16	$656	301(4.9L)/8	M4	4	
	17	$617	301(4.9L)/8	A3	4	
LEMANS/GRAND AM	19	$552	231(3.8L)/6	A3	2	2DR-96/17
	18	$584	301(4.9L)/8	A3	2	4DR-102/17
	16	$656	301(4.9L)/8	M4	4	
	17	$617	301(4.9L)/8	A3	4	

LARGE CARS

Manufacturers: Manufacturer Car Line	Fuel Economy: Estimated MPG	Fuel Economy: Average Annual Fuel Costs	Vehicle Description: Engine Description CID/Cyl Type	Transmission	Fuel System	Body Type Interior Space Passenger/Trunk or Cargo (Cu. Ft.)
BUICK						
ELECTRA	15	$700	350(5.7L)/8 (GM-BUICK)	A3	4	2DR-108/20
	14	$750	403(6.6L)/8	A3	4	4DR-111/20
LESABRE	18	$584	231(3.8L)/6	A3	2	2DR-107/21
	17	$617	301(4.9L)/8	A3	2	4DR-111/21
	15	$700	350(5.7L)/8 (GM-BUICK)	A3	4	
CADILLAC						
DEVILLE/BROUGHAM	20	$450	350(5.7L)/8 (DIESEL)	A3	FI	2DR-107/20
	14	$750	425(7.0L)/8	A3	4	4DR-109/20
	12	$875	425(7.0L)/8	A3	FI	
LIMOUSINE	10	$1050	425(7.0L)/8 (CALIF)	A3	4	4DR-116/18
CHEVROLET						
IMPALA/CAPRICE	15	$700	250(4.1L)/6	A3	1	2DR-106/20
	16	$656	305(5.0L)/8	A3	2	4DR-111/20
	16	$656	350(5.7L)/8 (GM-CHEV)	A3	4	
CHRYSLER						
NEWPORT/NEW YORKER	17	$617	225/6	A3	2	4DR-108/21
	16	$656	318/8	A3	2	
	14	$750	360/8	A3	2	
DODGE						
ST. REGIS	17	$617	225/6	A3	2	4DR-108/21
	16	$656	318/8	A3	2	
	14	$750	360/8	A3	2	

GASOLINE MILEAGE TESTS

The mileage tests conducted by the Company on the five (5) test automobiles were done at an average speed of 55 M.P.H. on highways and in traffic. City driving tests were conducted at speeds from 0 to 30 M.P.H.

Detroit Testing Laboratory, Inc., conducted a series of gasoline mileage tests on the Company's 1977 Chevrolet Caprice Classic V8 (350 cu.in.) automobile in cold weather (25° to 31° F.). Mileage tests results are generally much better in warm temperatures (70° - 90°). The Eliminator (Exhaust Return) was not functioning properly during these tests and had it been, results would have been more favorable, as shown by the recent tests.

The tests in Detroit, Michigan, did however confirm the original mileage tests conducted by the Company, both the original mileage of 16.2 M.P.G. without the "Energy Gas Saver" and 22.9 M.P.G. tests with the "Energy Gas Saver'

The principle purpose of having the tests conducted in Detroit, Michigan, was to aid and assist the Company in its "Engineering" of its product. Upon returning to Florida, corrections and modifications were made on the gas saving system which resulted in additional increases in gasoline milage, (29.1 M.P.G.).

The EPA type of testing was conducted by Olson Laboratories, Lavonia, Michigan, who are approved and accepted by the U.S. Government for this type of work. One of their tests confirmed that the Company's product installed with a catalytic converter did not violate the "Emission Exhaust Standards" as prescribed by the Clean Air Act of 1973 (and as amended in 1978). This means that the Company, or its designated agents, dealers or distributors, may legally install the gas saving system on vehicles that now are equipped with Emission Exhaust Devices. They will be furnished proper documentation from the Company in due time.

The EPA type of gasoline mileage test results were 16.092 M.P.G. 16.6 M.P.G. and 18.42 M.P.G. while the actual road mileage tests ranges from 20.2 M.P.G. to 24.7 M.P.G.

Many more gasoline mileage tests have been conducted by the Company since returning from Detroit, Michigan. The 1977 Chevrolet Caprice Classic test car now has over 12,000 miles of testing. Besides the 1-gallon bottle test and the tank test, the Company has an electronic computer installed in the test car which measures Instant Miles Per Gallon of Gasoline, Average Miles Per Gallon of Gasoline, Amount of Gasoline consumed, Distance in Miles travelled and the Time consumed Per Trip or Per Test.

On a testing trip to the West Coast of Florida, the 1977 Caprice Classic averaged 21.4 M.P.G. on the round trip of 379.3 miles with the air conditioner on, city driving and shopping trips. Individual tests were also conducted during this trip.

September 1978

1977 Chevrolet Caprice Classic (350 cu. in. V8 Engine)

Catalytic Converter Operating - 52 to 55 Av. Miles Per Hour - 84° to 88° F. 10 M.P.H. Wind South - Tires 28 lbs - Shell No-Lead Gas (91.5 Octame) Driver and One Passenger, luggage, full tank of gas.

	No Air Conditioning	With Air Conditioning
One Gallon Bottle Test (Highway)	25.4 M.P.G.	23.6 M.P.G.
Computer (Highway)*	26.2 M.P.G.	24.4 M.P.G.
One Gallon Bottle Test (Highway)	25.8 M.P.G.	24.0 M.P.G.
Computer (City Driving)	19.6 M.P.G.	17.8 M.P.G.

1977 Chevrolet Caprice Classic (350 cu. in. V8 Engine)

Catalytic Converter Removed - 52 to 55 Av. Miles Per Hour 88° F, Wind 10 Var. Tires 28 lbs - Shell Regular Gas (90.6 Octame) 800 lbs (driver, 2 passengers luggage, gasoline.)

	No Air	With Air	With E.G.R.	No E.G.R.
One Gallon Bottle Test (Highway)	22.5	21.7	22.3	22.5
Computer Test (Highway)*	23.0	21.8	22.3	22.5

1977 Chevrolet Caprice Classic (350 cu. in. V8 Engine)

Catalytic Converter Removed - 52 to 55 Av. Miles Per Hour, 85° F, Wind 5 Var. Tires 28 lbs - Shell Regular Gas (90.6 Octame) 450 lbs weight (driver, one passenger & full tank of gas.)

	No Air, No E.G.R.	With Air, With E.G.R.
One Gallon Bottle Test (Highway)	27.9 M.P.G.	22.8 M.P.G.
Computer Test (Highway)*	32.0 Av. M.P.G.*	25.0 M.P.G.
One Gallon Bottle Test (Highway)	29.1 M.P.G.	24.7 M.P.G.
Computer Test (Highway)*	32.7 Av. M.P.G.	25.5 M.P.G.

* No Start Up

September 1978

CAR-BO-TECH., INC.
145 Ocean Avenue #502
Palm Beach Shores, Florida 33404
Tel (305) 842-8558

SUMMARY OF THE GASOLINE MILEAGE RESULTS ON THE FIVE TEST CARS

RESULTS OF HIGHWAY DRIVING

TEST CAR	ORIGINAL MILEAGE	GAS SAVER SYSTEM INSTALLED	NUMBER OF MILES INCREASE	% OF MILES INCREASE	ADDITIONAL MILES PER TANK OF GAS
1. 1970 Cadillac Fleetwood (472 cu.in. V8 engine)	13	19	6	46	144
2. 1974 Chevrolet Classic Convertible (350 cu. in. V8 engine)	15	22	7	46	154
3. 1976 Oldsmobile Cutlass Supreme (350 cu. in. V8 engine)	15	24	9	64	198
4. 1969 Cadillac Coupe de Ville Convertible (472 cu. in. V8 engine)	13	22	9	64	216
5. 1977 Chevrolet Caprice Classic (350 cu. in. V8 engine)	17	29	12	70	240
Average	14.6	23.2	8.6	58	190.4

Average % increase in Mileage 58%

Average increase in number of miles 8.6 miles

Average increase in number of miles per Tank of Gasoline 190.4 miles

September 1978

There have been two completely different types of testing conducted on the Company's product "Exhaust GasSaver".

The first type of testing is for the purpose of measuring the automobile internal combustion engine exhaust pollutants.

The second type of testing is for the purpose of measuring the actual gasoline mileage obtained by the test automobiles that have an "Exhaust GasSaver" installed.

ENGINE EXHAUST POLLUTANTS TEST RESULTS

The measuring of engine exhaust pollutants, also known as "exhaust emission control standards" for automobiles, were conducted by independent operators who received payment from the Company for their services.

There were many exhaust pollution tests conducted. Every time a major change was made on the "Exhaust GasSaver" the unit was then tested on the test car by one of the indep-ent shops in the area. Most of the tests were done on a 1970 Cadillac Fleetwood with a 472 cu.in. engine. This test car had 61,473 miles at the beginning of the tests and now has in excess of 76,000 miles. No engine work was done on the car other than changes of the oil, coil, ignition wires, points, plugs, condensor, oil filters, air filters and the changing of 2 rocker arms and 4 lifters. The curb weight of the car is 5,260 lbs. This 1970 Cadillac Fleetwood has a 4-barrel quadrojet Rochester carburetor. Tests were also conducted on a 1974 Chev. Caprice Convertible with a 350 cu.in. engine and a 2-barrel carburetor. The curb weight of this test car is 4,580 lbs. and the vehicle has 74,064 miles.

On February 21, 1976 a most significant exhaust emission pollutants test took place done by the independent shop known as Computerway Automotive Repair Service, Stuart, Florida. The test was conducted by Marc H. Ducote, Shop Manager. This particular test was witnessed by the following people: Marc M. Ducote, Stuart, Florida: Donald R. Findlay, Palm Beach: Kenny Scarborough, West Palm Beach, Florida and Donald C. Pletts from the Company. This test was conducted on a Hamilton Standard Computer. A copy of the test, marked # 1, is attached. The exhaust emissions requirements for a 1970 model automobile are as follows: California (HC) 350, (CO) 4%; Chicago (HC) 500, (CO) 4%. The United States requirements for this vehicle are 275 P.P.M. hydrocarbons (HC) and 1.5% carbon monoxide (CO). As this test shows the maximum amount of CO shown on both idle and at 2500 R.P.M. shows .93% and .02% of carbon monoxide. The requirements for hydrocarbons allowed by the U. S. Government is 275 P.P.M. As can be seen by this test only 150 and 60 P.P.M. of hydrocarbons came from the exhaust of this car engine. As can be seen on the print out copy of this test there is an emissions check A and an emissions check B. The significance between the emissions check A and B is that emission check B was done after an adjustment was made in the amount of recycled exhaust that was allowed to enter the "Exhaust GasSaver". From many tests, the Company was able to ascertain the best method and proper place to inject the exhaust gases as well as the correct amount of exhaust gases.

The next test shown is marked # 2 and was conducted on March 11, 1976 with the same equipment on the same engine when it had 67,000 miles. Computerway Automotive Repair Service also conducted this test. As shown on the print out copy of this test all the exhaust emissions were well below the United States, California and all other State standards.

The test marked # 3 was also conducted by the same operator and took place on August 19, 1975. The significance of this test is that at idle speed (650 R.P.M.) this same 472 cu.i engine showed excellent emission results (80 P.P.M. hydrocarbon and .01% carbon monoxide). This was done on one of the Company's earliest models.

The test marked # 4 is a most significant test done by the same operator on November 14,1975. Section A of the test show the emissions from the engine with the original carburetor on the engine with none of the Company's emission equipment attached. Th hydrocarbon content ofthis test (620 P.P.M. and 500 P.P.M.) and th carbon monoxide content (2.69 and .15 per cent) of this test is wa above the acceptable requirements level of emissions set by the States and the U.S. Government. Section C of the test is also of extreme importance because it shows that the "Exhaust-Returner" returns to the engine compartment 96% of the same amount of hydrocarbons that goes out of the exhaust pipe and 79% of the carbon monoxide. Section B of the test shows high content of hydrocarbon and carbon monoxide gases in the engine compartment with the pipe open in the engine compartment from the "Exhaust-Returner".

The test marked # 5 is self-explanatory as it shows the various settings on the test car such as timing, coil available voltage, voltage drop, cylinder head compression, R.P.M. at idle, dwell, timing, spark plug voltage, spark plug load test, battery voltage, etc.

The test marked # 6 shows how bad the exhaust emissions can be from an engine when it is not properly operating. This tes was done by Computerized Automotive Center of Lake Park, Florida. The hydrocarbons are an unbelievable 2,060 and 2,060 P.P.M. and th carbon monoxide at 4.10% and 10.12%. All of this, of course, completely unacceptable by any standards.

Tests marked # 7 and # 8 give all the current engine settings on the 1970 Cadillac Fleetwood test car. The Company's latest unit was installed for these tests. This was the first of the casted units made out of an aluminum alloy.

Test # 9 again shows improved lower emission exhaust pollutants:

	Idle (600 R.P.M.	2500 R.P
Hydrocarbons (P.P.M.)	70 90	50
Carbon Monoxide (%)	.44 .46 .67	.04 .02

Test # 10 is the chemical analysis of the solid pollutant (particulates) that were collected in the Company's "Exhaust GasSav This test was conducted by Everglades Laboratories, Inc., of West P Beach, Florida.

Test # 11 was conducted on a 1974 model Chevrolette Capri Convertible with a 350 cu.in. engine and a 2-barrel carburetor. Th is the first vehicle that the Company built a 2-barrel unit for and also using a 350 cu.in. General Motors engine. This print out test shows all the engine settings and also the satisfactory exhaust pollutants emission check. This test was also conducted by Compute way Automotive Repair Service.

Chart # 12 gives the exhaust emission standards for the States of Arizona, California, Nevada, New Jersey, New York and the city of Chicago.

Gasoline Mileage Tests The second type of testing was conducted by the Company, and usually with one or more passengers as witnesses, for the purpose of testing gasoline mileage. Since the gas mileage tests may be verified by anyone who would care to ride in one of the test vehicles only significant results are being reported. Over 10,000 miles were driven in the 1970 Cadillac Flee wood while doing the gasoline tests. The gallon bottle test was deemed by the Company to be the most accurate and was conducted on the highways in actual traffic. The driver turns off the fuel pum line and allows the gas to flow into the carburetor from the gallo bottle. When the gallon is completely used the engine stops and the car rolls to a stop and the mileage is recorded. Tests were conducted in many types of conditions. As the Company's product was improved so was the improvement in gasoline mileage and also better exhaust emission resulted.

On October 14, 1976 the latest casted unit on the 1970 Cadillac obtained 19.4 miles on one gallon of gas. Testing condit were ideal. This unit is the casted unit that will go into production to be used on General Motors automobiles with 4-barrel carburetors.

The best mileage obtained on the last prototype model (quadrojets) before casting was 19.1 miles on one gallon of gas. The average mileage of tests on this model was 18.6 miles per gallon.

Regular gas (89 octane) was used on all of the above tests. High octane tests were conducted with no appreciable improvement in the mileage or drive ability on the 1970 Fleetwood Cadillac.

A series of mileage tests were conducted with the Cadillac test car as follows on July 6, 1976.

Auto with original carburetor, coil, wires, but in as near perfect tune as possible but without the Company's product: Regular gas 12.6 miles on one gallon of gas: Unleaded gas 11.8 miles on one gallon of gas.

The original gas mileage test done by the Company in 1975 on this Cadillac Fleetwood with the original equipment produced 12.6 miles on one gallon of gas.

New radial tires were added to the car as well as new shocks. There was no increase in gasoline mileage. Many tests were conducted which produced 17 to 18 miles per gallon.

Summary of Gasoline Mileage Results using Regular Gasoline on Highway

1970 CADILLAC

Car with original equipment	12.7 miles on one gallon of gas
Car with Company product installed	19.4 miles on one gallon of gas
Car with Company product installed	19.1 miles of one gallon of gas

1974 CHEVROLET

Car with original equipment	14.6 miles on one gallon of gas
Car with engine modification	16.5 miles on one gallon of gas
Car with Company product installed	19.4 miles on one gallon of gas
	20.0 " " "
	20.4 " " "
	20.6 " " "

Three different gasoline octanes were tested on this car on March 24, 1977 with the following results:

Regular gas (85.9 octane)	19.0 miles per gallon
No-lead gas (88 octane)	21.6 " " "
High Test gas (95 octane)	22.0 " " "

On May 4th, 5th. and 6th. of this year (1977) the pany conducted tests on a 1976 model Oldsmobile Cutlass preme, with a 350 cu.in. engine and a four-barrel quadrot carburetor. The "Energy GasSaver" unit installed on is car is the 2nd. casted model that will go into production.

Test marked # 13 shows the satisfactory emission ck with the 2500 R.P.M. test showing the lowest results any of the previous tests:

Hydrocarbons (P.P.M.)	40
Carbon Monoxide (%)	.01

The gasoline mileage tests were as anticipated, substantial improvement over the car before installation the "Energy GasSaver":

76 OLDSMOBILE CUTLASS SUPREME

Car with original equipment (on highway)	14.1 miles on one gallon of gas
Car installed with "Energy GasSaver" (on highway)	26.4 miles on one gallon of gas
Car installed with "Energy GasSaver" (mixed driving)	20.2 miles on one gallon of gas
Car installed with "Energy GasSaver" (City driving)	15.4 miles on one gallon of gas

[illegible] Engine [illegible]
February 21, 1978 [illegible]
12 Noon

VEHICLE TE[ST RE]PORT

TEST NUMBER	ACCEPTABLE LOW LIMIT	TEST VALUE	ACCEPTABLE HIGH LIMIT
01500			
AIDN-0008 ANY CAR, V8			
A. 933 EMISSIONS CHECK			
Idle 570 RPM			
933 EMISSIONS CHECK *			
IDLE 67	----	230	280
68	----	1.39	2.50
2500 RPM 86	----	80	280
87	----	.17	2.50
B. 933 EMISSIONS CHECK * * *			
Idle 67	----	150	280
68	----	.93	2.50
2500 RPM 86	----	60	280
87	----	.02	2.50

* Original Carburetor on Ferrari[?] Converter Blender with Separator Connected

*** Same as * but after adjustment on Valves in Accumulator

Tested by Mark H. Ducote in the Presence of 1. Donald C. Pitts
2. Kenny [illegible]
3. Marc M. Ducote
4. Donald Findley

A. California Standards

1975-77	HC PPM	Comp.
	[illegible]	40
1972-77	AZ .275	3.5
	8M 350	4.0

B. Change Standards

1970 74	350	4.0
75 -	250	1.5

TEST NUMBER	TEST DESCRIPTION	UNITS
001	BATTERY VOLTAGE – PRECONDITIONED	VOLTS
002	BATTERY CURRENT DRAIN	AMPS
003	SPARE	
004	SPARE	
005	COIL PRIMARY VOLTAGE (+)	VOLTS
006	DISTRIBUTOR POINT VOLTAGE DROP	VOLTS
007	SPARE	
008	SPARE	
009	CRANKING STARTER CURRENT (LOW LIMIT)	AMPS
010	CRANKING STARTER CURRENT (HIGH LIMIT)	AMPS
011	STARTER CABLE VOLTAGE DROP	VOLTS
012	BATTERY TO RELAY VOLTAGE DROP	VOLTS
013	STARTER CONTROL VOLTAGE	VOLTS
014	BATTERY CRANKING VOLTAGE	VOLTS
015	BATTERY TO COIL VOLTAGE DROP	VOLTS
016	CRANKING RPM	RPM
017	SPARE	
018	COIL AVAILABLE VOLTAGE (K_V PROBE IN COIL TOWER)	K VOLTS
019	COIL AVAILABLE VOLTAGE	K VOLTS
020	DISTRIBUTOR ROTOR GAP VOLTAGE	K VOLTS
021–028	SPARK PLUG FIRING VOLTAGE	K VOLTS
029	DWELL–CRANKING	DEGREES
030	BASIC TIMING–CRANKING (VACUUM DISCONNECTED)	DEGREES
031–038	RELATIVE CYLINDER COMPRESSION	PERCENT
039	SPARE	
040	CURB IDLE	RPM
041–048	CYLINDER POWER CONTRIBUTION	PERCENT
049	DWELL	DEGREES
050	BASIC TIMING (NO VACUUM)	DEGREES
051–058	SPARK PLUG FIRING VOLTAGE	K VOLTS
059	COIL AVAILABLE VOLTAGE (KV PROBE IN COIL TOWER)	K VOLTS
060	COIL AVAILABLE VOLTAGE	K VOLTS
061	ROTOR GAP VOLTAGE	K VOLTS
062	DISTRIBUTOR CAPACITOR TEST	COUNTS LEVEL
063	COIL TEST	K VOLTS
064	FAST IDLE	RPM
065	LOW CURB IDLE	RPM
066	MANIFOLD VACUUM	PSIA.
067	HYDROCARBON CONTENT	PPM
068	CARBON MONOXIDE CONTENT	PERCENT
069	SPARE	
070	BATTERY TO COIL VOLTAGE DROP	VOLTS
071–078	SPARK PLUG LOAD TEST	K VOLTS
079–085	SPARE	
086	HYDROCARBON CONTENT	PPM
087	CARBON MONOXIDE CONTENT	PERCENT
088	DWELL	DEGREES
089	MECHANICAL ADVANCE	DEGREES
090	TOTAL ADVANCE	DEGREES
091	SPARE	
092	BATTERY TO COIL VOLTAGE DROP	VOLTS
093	COIL AVAILABLE VOLTAGE	K VOLTS
094	SPARE	
095	BATTERY VOLTAGE	VOLTS
096	REGULATOR BATTERY VOLTAGE	VOLTS
097	SPARE	
098	ALTERNATOR OUTPUT VOLTAGE	VOLTS
099	SPARE	
100	SPARE	

* INDICATES OUT OF LIMIT CONDITION
M INDICATES MANUALLY ENTERED TEST VALUE

Hamilton Standard U A

Burroughs

759485 1

1970 Cadillac Eldorado [illegible] March 11, 1976
472 cu in Engine
67,000 Miles
19.1 miles per gal (highway)

VEHICLE TEST REPORT

TEST NUMBER	ACCEPTABLE LOW LIMIT	TEST VALUE	ACCEPTABLE HIGH LIMIT
P01500			
AIDN-0008 ANY CAR, V8			
2500 RPM 86	----	70	280
87	----	.02	2.50
Idle 67	----	150	280
600 RPM 68	----	.90	2.50

Original Carburetor on Fuesenden Converter-Blender (Latest Model) with Injector Connected

Tested by Mark H. Ducote in the presence of 1. Donald Phelts
2. Kenny Scarbrough

TEST NUMBER	TEST DESCRIPTION	UNITS
001	BATTERY VOLTAGE – PRECONDITIONED	VOLTS
002	BATTERY CURRENT DRAIN	AMPS
003	SPARE	
004	SPARE	
005	COIL PRIMARY VOLTAGE (+)	VOLTS
006	DISTRIBUTOR POINT VOLTAGE DROP	VOLTS
007	SPARE	
008	SPARE	
009	CRANKING STARTER CURRENT (LOW LIMIT)	AMPS
010	CRANKING STARTER CURRENT (HIGH LIMIT)	AMPS
011	STARTER CABLE VOLTAGE DROP	VOLTS
012	BATTERY TO RELAY VOLTAGE DROP	VOLTS
013	STARTER CONTROL VOLTAGE	VOLTS
014	BATTERY CRANKING VOLTAGE	VOLTS
015	BATTERY TO COIL VOLTAGE DROP	VOLTS
016	CRANKING RPM	RPM
017	SPARE	
018	COIL AVAILABLE VOLTAGE (KV PROBE IN COIL TOWER)	K VOLTS
019	COIL AVAILABLE VOLTAGE	K VOLTS
020	DISTRIBUTOR ROTOR GAP VOLTAGE	K VOLTS
021–028	SPARK PLUG FIRING VOLTAGE	K VOLTS
029	DWELL—CRANKING	DEGREES
030	BASIC TIMING CRANKING (VACUUM DISCONNECTED)	DEGREES
031–038	RELATIVE CYLINDER COMPRESSION	PERCENT
039	SPARE	
040	CURB IDLE	RPM
041–048	CYLINDER POWER CONTRIBUTION	PERCENT
049	DWELL	DEGREES
050	BASIC TIMING (NO VACUUM)	DEGREES
051–058	SPARK PLUG FIRING VOLTAGE	K VOLTS
059	COIL AVAILABLE VOLTAGE (KV PROBE IN COIL TOWER)	K VOLTS
060	COIL AVAILABLE VOLTAGE	K VOLTS
061	ROTOR GAP VOLTAGE	K VOLTS
062	DISTRIBUTOR CAPACITOR TEST	COUNTS LEVEL
063	COIL TEST	K VOLTS
064	FAST IDLE	RPM
065	LOW CURB IDLE	RPM
066	MANIFOLD VACUUM	PSIA
067	HYDROCARBON CONTENT	PPM
068	CARBON MONOXIDE CONTENT	PERCENT
069	SPARE	
070	BATTERY TO COIL VOLTAGE DROP	VOLTS
071–078	SPARK PLUG LOAD TEST	K VOLTS
079–085	SPARE	
086	HYDROCARBON CONTENT	PPM
087	CARBON MONOXIDE CONTENT	PERCENT
088	DWELL	DEGREES
089	MECHANICAL ADVANCE	DEGREES
090	TOTAL ADVANCE	DEGREES
091	SPARE	
092	BATTERY TO COIL VOLTAGE DROP	VOLTS
093	COIL AVAILABLE VOLTAGE	K VOLTS
094	SPARE	
095	BATTERY VOLTAGE	VOLTS
096	REGULATOR BATTERY VOLTAGE	VOLTS
097	SPARE	
098	ALTERNATOR OUTPUT VOLTAGE	VOLTS
099	SPARE	
100	SPARE	

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Hamilton Standard

* INDICATES OUT OF LIMIT CONDITION
M INDICATES MANUALLY ENTERED TEST VALUE

759485 1

Burroughs

REPAIR SERVICE, INC.
P O Box 2734
1748 Palm Beach Rd.
Stuart, FL 33494
287-2044

71

(3.)

7-8

12:30 – 1:30 PM

VEHICLE TEST REPORT

TEST NUMBER	ACCEPTABLE LOW LIMIT	TEST VALUE	ACCEPTABLE HIGH LIMIT
01500 1970 Cadillac 472 Cu. In. Engine			
AIDN-0008 ANY CAR, V8			
933 EMISSIONS CHECK			
650 RPM IDLE 67	----	80	280
68	----	.01	2.50
2500 RPM 86	----	390*	280
87	----	.99	2.50

TIMING

IDLE – 28°

2000 RPM – 41°

MARK DUCOTE did the testing in the Presence of Eugene & Donald Pletts

TEST NUMBER	TEST DESCRIPTION	UNITS
001	BATTERY VOLTAGE – PRECONDITIONED	VOLTS
002	BATTERY CURRENT DRAIN	AMPS
003	SPARE	
004	SPARE	
005	COIL PRIMARY VOLTAGE (+)	VOLTS
006	DISTRIBUTOR POINT VOLTAGE DROP	VOLTS
007	SPARE	
008	SPARE	
009	CRANKING STARTER CURRENT (LOW LIMIT)	AMPS
010	CRANKING STARTER CURRENT (HIGH LIMIT)	AMPS
011	STARTER CABLE VOLTAGE DROP	VOLTS
012	BATTERY TO RELAY VOLTAGE DROP	VOLTS
013	STARTER CONTROL VOLTAGE	VOLTS
014	BATTERY CRANKING VOLTAGE	VOLTS
015	BATTERY TO COIL VOLTAGE DROP	VOLTS
016	CRANKING RPM	RPM
017	SPARE	
018	COIL AVAILABLE VOLTAGE (KV PROBE IN COIL TOWER)	K VOLTS
019	COIL AVAILABLE VOLTAGE	K VOLTS
020	DISTRIBUTOR ROTOR GAP VOLTAGE	K VOLTS
021–028	SPARK PLUG FIRING VOLTAGE	K VOLTS
029	DWELL–CRANKING	DEGREES
030	BASIC TIMING-CRANKING (VACUUM DISCONNECTED)	DEGREES
031–038	RELATIVE CYLINDER COMPRESSION	PERCENT
039	SPARE	
040	CURB IDLE	RPM
041–048	CYLINDER POWER CONTRIBUTION	PERCENT
049	DWELL	DEGREES
050	BASIC TIMING (NO VACUUM)	DEGREES
051–058	SPARK PLUG FIRING VOLTAGE	K VOLTS
059	COIL AVAILABLE VOLTAGE (KV PROBE IN COIL TOWER)	K VOLTS
060	COIL AVAILABLE VOLTAGE	K VOLTS
061	ROTOR GAP VOLTAGE	K VOLTS
062	DISTRIBUTOR CAPACITOR TEST	COUNTS
063	COIL TEST	K VOLTS
064	FAST IDLE	RPM
065	LOW CURB IDLE	RPM
066	MANIFOLD VACUUM	PSIA
067	HYDROCARBON CONTENT	PPM
068	CARBON MONOXIDE CONTENT	PERCENT
069	SPARE	
070	BATTERY TO COIL VOLTAGE DROP	VOLTS
071–078	SPARK PLUG LOAD TEST	K VOLTS
079–085	SPARE	
086	HYDROCARBON CONTENT	PPM
087	CARBON MONOXIDE CONTENT	PERCENT
088	DWELL	DEGREES
089	MECHANICAL ADVANCE	DEGREES
090	TOTAL ADVANCE	DEGREES
091	SPARE	
092	BATTERY TO COIL VOLTAGE DROP	VOLTS
093	COIL AVAILABLE VOLTAGE	K VOLTS
094	SPARE	
095	BATTERY VOLTAGE	VOLTS
096	REGULATOR BATTERY VOLTAGE	VOLTS
097	SPARE	
098	ALTERNATOR OUTPUT VOLTAGE	VOLTS
099	SPARE	
100	SPARE	

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* INDICATES OUT OF LIMIT CONDITION
M INDICATES MANUALLY ENTERED TEST VALUE

Hamilton Standard

759485-1

(6.) No. 14

VEHICLE TEST REPORT

(6.)

TEST NUMBER	ACCEPTABLE LOW LIMIT	TEST VALUE	ACCEPTABLE HIGH LIMIT
01000			
1970 Cadillac Fleetwood 472 Cu. In. Engine			
AIDN-0008 ANY CAR, V8			
933 EMISSIONS CHECK			
Carburetor 67 } *Idle*	----	620*	280
68	----	2.69*	2.50
86 } *2500 RPM.*	----	500*	280
87		.15	2.50
933 EMISSIONS CHECK			
with ... to Engine Compartment 67 } *Idle*	----	690*	280
68	----	3.27*	2.50
86 } *2500 RPM.*	----	630*	280
87	----	.15	2.50
933 EMISSIONS CHECK			
Reduction 67 } *Idle*	*-26.5%*	600*	280
68	*-22.1%*	2.12	2.50
86 } *2500 RPM*	*-9.6%*	480*	280
87	*-29.9%*	.11	2.50

TEST NUMBER	TEST DESCRIPTION	UNITS
001	BATTERY VOLTAGE — PRECONDITIONED	VOLTS
002	BATTERY CURRENT DRAIN	AMPS
003	SPARE	
004	SPARE	
005	COIL PRIMARY VOLTAGE (+)	VOLTS
006	DISTRIBUTOR POINT VOLTAGE DROP	VOLTS
007	SPARE	
008	SPARE	
009	CRANKING STARTER CURRENT (LOW LIMIT)	AMPS
010	CRANKING STARTER CURRENT (HIGH LIMIT)	AMPS
011	STARTER CABLE VOLTAGE DROP	VOLTS
012	BATTERY TO RELAY VOLTAGE DROP	VOLTS
013	STARTER CONTROL VOLTAGE	VOLTS
014	BATTERY CRANKING VOLTAGE	VOLTS
015	BATTERY TO COIL VOLTAGE DROP	VOLTS
016	CRANKING RPM	RPM
017	SPARE	
018	COIL AVAILABLE VOLTAGE (KV PROBE IN COIL TOWER)	K VOLTS
019	COIL AVAILABLE VOLTAGE	K VOLTS
020	DISTRIBUTOR ROTOR GAP VOLTAGE	K VOLTS
021-028	SPARK PLUG FIRING VOLTAGE	K VOLTS
029	DWELL-CRANKING	DEGREES
030	BASIC TIMING-CRANKING (VACUUM DISCONNECTED)	DEGREES
031-038	RELATIVE CYLINDER COMPRESSION	PERCENT
039	SPARE	
040	CURB IDLE	RPM
041-048	CYLINDER POWER CONTRIBUTION	PERCENT
049	DWELL	DEGREES
050	BASIC TIMING (NO VACUUM)	DEGREES
051-058	SPARK PLUG FIRING VOLTAGE	K VOLTS
059	COIL AVAILABLE VOLTAGE (KV PROBE IN COIL TOWER)	K VOLTS
060	COIL AVAILABLE VOLTAGE	K VOLTS
061	ROTOR GAP VOLTAGE	K VOLTS
062	DISTRIBUTOR CAPACITOR TEST	COUNTS LEVEL
063	COIL TEST	K VOLTS
064	FAST IDLE	RPM
065	LOW CURB IDLE	RPM
066	MANIFOLD VACUUM	PSIA
067	HYDROCARBON CONTENT	PPM
068	CARBON MONOXIDE CONTENT	PERCENT
069	SPARE	
070	BATTERY TO COIL VOLTAGE DROP	VOLTS
071-078	SPARK PLUG LOAD TEST	K VOLTS
079-085	SPARE	
086	HYDROCARBON CONTENT	PPM
087	CARBON MONOXIDE CONTENT	PERCENT
088	DWELL	DEGREES
089	MECHANICAL ADVANCE	DEGREES
090	TOTAL ADVANCE	DEGREES
091	SPARE	
092	BATTERY TO COIL VOLTAGE DROP	VOLTS
093	COIL AVAILABLE VOLTAGE	K VOLTS
094	SPARE	
095	BATTERY VOLTAGE	VOLTS
096	REGULATOR BATTERY VOLTAGE	VOLTS
097	SPARE	
098	ALTERNATOR OUTPUT VOLTAGE	VOLTS
099	SPARE	
100	SPARE	

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Hamilton Standard U A

* INDICATES OUT OF LIMIT CONDITION
M INDICATES MANUALLY ENTERED TEST VALUE

759485-1

VEHICLE TEST REPORT

01402 *1970 Cadillac Fleetwood 472 CID Engine*

AIDN-0311 CA 472A, V8

TEST NUMBER	ACCEPTABLE LOW LIMIT	TEST VALUE	ACCEPTABLE HIGH LIMIT
31	75	89	100
32	75	91	100
33	75	95	100
34	75	96	100
35	75	100	100
36	75	97	100
37	75	97	100
38	75	98	100
920 PRIMARY IGNITION			
5	6.3	7.5	----
6	----	.1	.3
40	540	560	660
49	28.0	30.3	32.0
70	----	5.6	6.0
62	6	8	8
0 R/C - PRIMARY IGNITION			
921 SECONDARY IGNITION			
40	540	590	660
50	6.5	28.4*	8.5
51	7.0	9.3	16.0
52	7.0	9.0	16.0
53	7.0	9.3	16.0
54	7.0	9.2	16.0
55	7.0	9.2	16.0
56	7.0	8.8	16.0
57	7.0	10.1	16.0
58	7.0	9.7	16.0
71	----	.0	8.0
72	----	1.6	8.0
73	----	1.0	8.0
74	----	1.1	8.0
75	----	.8	8.0
76	----	1.0	8.0
77	----	.0	8.0
78	----	1.8	8.0
60	22.0	23.6	----

Test

TEST NUMBER	TEST DESCRIPTION	UNITS
001	BATTERY VOLTAGE - PRECONDITIONED	VOLTS
002	BATTERY CURRENT DRAIN	AMPS
003	SPARE	
004	SPARE	
005	COIL PRIMARY VOLTAGE (+)	VOLTS
006	DISTRIBUTOR POINT VOLTAGE DROP	VOLTS
007	SPARE	
008	SPARE	
009	CRANKING STARTER CURRENT (LOW LIMIT)	AMPS
010	CRANKING STARTER CURRENT (HIGH LIMIT)	AMPS
011	STARTER CABLE VOLTAGE DROP	VOLTS
012	BATTERY TO RELAY VOLTAGE DROP	VOLTS
013	STARTER CONTROL VOLTAGE	VOLTS
014	BATTERY CRANKING VOLTAGE	VOLTS
015	BATTERY TO COIL VOLTAGE DROP	VOLTS
016	CRANKING RPM	RPM
017	SPARE	
018	COIL AVAILABLE VOLTAGE (Kv PROBE IN COIL TOWER)	K VOLT
019	COIL AVAILABLE VOLTAGE	K VOLT
020	DISTRIBUTOR ROTOR GAP VOLTAGE	K VOLT
021-028	SPARK PLUG FIRING VOLTAGE	K VOL
029	DWELL-CRANKING	DEGRE
030	BASIC TIMING-CRAN... (VACUUM DISCONNECTED)	DEGRE
031-038	RELATIVE CYLINDER COMPRESSION	PERCE
039	SPARE	
040	CURB IDLE	RPM
041-048	CYLINDER POWER CONTRIBUTION	PERCE
049	DWELL	DEGRE
050	BASIC TIMING (NO VACUUM)	DEGRE
051-058	SPARK PLUG FIRING VOLTAGE	K VOL
059	COIL AVAILABLE VOLTAGE (KV PROBE IN COIL TOWER)	K VOL
060	COIL AVAILABLE VOLTAGE	K VOL
061	ROTOR GAP VOLTAGE	K VOL
062	DISTRIBUTOR CAPACITOR TEST	COUNT LEVEL
063	COIL TEST	K VOL
064	FAST IDLE	RPM
065	LOW CURB IDLE	RPM
066	MANIFOLD VACUUM	PSIA
067	HYDROCARBON CONTENT	PPM
068	CARBON MONOXIDE CONTENT	PERC
069	SPARE	
070	BATTERY TO COIL VOLTAGE DROP	VOLT
071-078	SPARK PLUG LOAD TEST	K VOL
079-085	SPARE	
086	HYDROCARBON CONTENT	PPM
087	CARBON MONOXIDE CONTENT	PERC
088	DWELL	DEGR
089	MECHANICAL ADVANCE	DEGR
090	TOTAL ADVANCE	DEGR
091	SPARE	
092	BATTERY TO COIL VOLTAGE DROP	VOL
093	COIL AVAILABLE VOLTAGE	K VO
094	SPARE	
095	BATTERY VOLTAGE	VOL
096	REGULATOR BATTERY VOLTAGE	VOL
097	SPARE	
098	ALTERNATOR OUTPUT VOLTAGE	VOL
099	SPARE	
100	SPARE	

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* INDICATES OUT OF LIMIT CONDITION
M INDICATES MANUALLY ENTERED TEST VALUE

Hamilton U

VEHICLE TEST REPORT

TEST NUMBER	ACCEPTABLE LOW LIMIT	TEST VALUE	ACCEPTABLE HIGH LIMIT
01402			
AIDN-0311			
01	----	7.3	7.9
0 R/C - SECONDARY IGNITION			
933 EMISSIONS CHECK			
67	----	~~[illegible]~~	[illegible]
933 EMISSIONS CHECK			
600 67	----	2060*	280
68	----	4.10*	2.50
2500 86	----	2060*	280
87	----	10.12*	2.50
393 R/C - EMISSIONS SYSTEM			

TEST NUMBER	TEST DESCRIPTION	UNITS
001	BATTERY VOLTAGE – PRECONDITIONED	VOLTS
002	BATTERY CURRENT DRAIN	AMPS
003	SPARE	
004	SPARE	
005	COIL PRIMARY VOLTAGE (+)	VOLTS
006	DISTRIBUTOR POINT VOLTAGE DROP	VOLTS
007	SPARE	
008	SPARE	
009	CRANKING STARTER CURRENT (LOW LIMIT)	AMPS
010	CRANKING STARTER CURRENT (HIGH LIMIT)	AMPS
011	STARTER CABLE VOLTAGE DROP	VOLT
012	BATTERY TO RELAY VOLTAGE DROP	VOLT
013	STARTER CONTROL VOLTAGE	VOLT
014	BATTERY CRANKING VOLTAGE	VOLT
015	BATTERY TO COIL VOLTAGE DROP	VOLT
016	CRANKING RPM	RPM
017	SPARE	
018	COIL AVAILABLE VOLTAGE (Kv PROBE IN COIL TOWER)	K VOL
019	COIL AVAILABLE VOLTAGE	K VOL
020	DISTRIBUTOR ROTOR GAP VOLTAGE	K VOL
021–028	SPARK PLUG FIRING VOLTAGE	K VOL
029	DWELL–CRANKING	DEGR
030	BASIC TIMING CRANKING (VACUUM DISCONNECTED)	DEGR
031–038	RELATIVE CYLINDER COMPRESSION	PERC
039	SPARE	
040	CURB IDLE	RPM
041–048	CYLINDER POWER CONTRIBUTION	PERC
049	DWELL	DEGR
050	BASIC TIMING (NO VACUUM)	DEGR
051–058	SPARK PLUG FIRING VOLTAGE	K VO
059	COIL AVAILABLE VOLTAGE (KV PROBE IN COIL TOWER)	K VO
060	COIL AVAILABLE VOLTAGE	K VO
061	ROTOR GAP VOLTAGE	K VO
062	DISTRIBUTOR CAPACITOR TEST	COU LEV
063	COIL TEST	K VO
064	FAST IDLE	RPM
065	LOW CURB IDLE	RPM
066	MANIFOLD VACUUM	PSIA
067	HYDROCARBON CONTENT	PPM
068	CARBON MONOXIDE CONTENT	PER
069	SPARE	
070	BATTERY TO COIL VOLTAGE DROP	VOL
071–078	SPARK PLUG LOAD TEST	K VC
079–085	SPARE	
086	HYDROCARBON CONTENT	PPM
087	CARBON MONOXIDE CONTENT	PER
088	DWELL	DEG
089	MECHANICAL ADVANCE	DEG
090	TOTAL ADVANCE	DEG
091	SPARE	
092	BATTERY TO COIL VOLTAGE DROP	VOL
093	COIL AVAILABLE VOLTAGE	K V
094	SPARE	
095	BATTERY VOLTAGE	VOL
096	REGULATOR BATTERY VOLTAGE	VOL
097	SPARE	
098	ALTERNATOR OUTPUT VOLTAGE	VOL
099	SPARE	
100	SPARE	

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* INDICATES OUT OF LIMIT CONDITION
M INDICATES MANUALLY ENTERED TEST VALUE

Hamilton Standard

VEHICLE TEST REPORT

NUMBER	ACCEPTABLE LOW LIMIT	TEST VALUE	ACCEPTABLE HIGH LIMIT
0			
-0008 ANY CAR, V8			
5	5.0	12.0	----
6	----	.1	.3
31	75	89	100
32	75	90	100
33	75	61	100
34	75	81	100
35	75	92	100
36	75	98	100
37	75	100	100
38	75	98	100
40	300	350	2000
49	----	33.0	90.0
58	----	32.2	90.0
51	7.0	11.6	16.0
52	7.0	11.7	16.0
53	7.0	11.6	16.0
54	7.0	10.7	16.0
55	7.0	10.7	16.0
56	7.0	11.0	16.0
57	7.0	12.0	16.0
58	7.0	11.2	16.0
71	----	1.3	8.0
72	----	1.2	8.0
73	----	.0	8.0
74	----	2.4	8.0
75	----	1.6	8.0
76	----	2.5	8.0
77	----	2.5	8.0
78	----	.6	8.0
95	12.7	14.0	15.5
60	22.0	21.5*	----
70	----	9.4*	8.0
50	----	18.0	60.0
90	----	61.4*	60.0
49	----	28.8	90.0
59	22.0	21.5*	----
50	----	12.6	60.0
61	----	2.5	7.5
62	6	5*	[illegible]
49	----	30.6	90.0
50	----	13.7	60.0
5	5.0	.0*	----

TEST NUMBER	TEST DESCRIPTION	UNITS
001	BATTERY VOLTAGE - PRECONDITIONED	VOLT
002	BATTERY CURRENT DRAIN	AMPS
003	SPARE	
004	SPARE	
005	COIL PRIMARY VOLTAGE (+)	VOLT
006	DISTRIBUTOR POINT VOLTAGE DROP	VOLT
007	SPARE	
008	SPARE	
009	CRANKING STARTER CURRENT (LOW LIMIT)	AMPS
010	CRANKING STARTER CURRENT (HIGH LIMIT)	AMPS
011	STARTER CABLE VOLTAGE DROP	VOLT
012	BATTERY TO RELAY VOLTAGE DROP	VOLT
013	STARTER CONTROL VOLTAGE	VOLT
014	BATTERY CRANKING VOLTAGE	VOLT
015	BATTERY TO COIL VOLTAGE DROP	VOLT
016	CRANKING RPM	RPM
017	SPARE	
018	COIL AVAILABLE VOLTAGE (K_V PROBE IN COIL TOWER)	K VO
019	COIL AVAILABLE VOLTAGE	K VO
020	DISTRIBUTOR ROTOR GAP VOLTAGE	K VO
021–028	SPARK PLUG FIRING VOLTAGE	K VO
029	DWELL–CRANKING	DEGF
030	BASIC TIMING–CRANKING (VACUUM DISCONNECTED)	DEGF
031–038	RELATIVE CYLINDER COMPRESSION	PERC
039	SPARE	
040	CURB IDLE	RPM
041–048	CYLINDER POWER CONTRIBUTION	PERC
049	DWELL	DEGF
050	BASIC TIMING (NO VACUUM)	DEGF
051–058	SPARK PLUG FIRING VOLTAGE	K VO
059	COIL AVAILABLE VOLTAGE (KV PROBE IN COIL TOWER)	K VO
060	COIL AVAILABLE VOLTAGE	K VO
061	ROTOR GAP VOLTAGE	K VO
062	DISTRIBUTOR CAPACITOR TEST	COU LEV
063	COIL TEST	K VO
064	FAST IDLE	RPM
065	LOW CURB IDLE	RPM
066	MANIFOLD VACUUM	PSI
067	HYDROCARBON CONTENT	PPM
068	CARBON MONOXIDE CONTENT	PER
069	SPARE	
070	BATTERY TO COIL VOLTAGE DROP	VOL
071–078	SPARK PLUG LOAD TEST	K VO
079–085	SPARE	
086	HYDROCARBON CONTENT	PPM
087	CARBON MONOXIDE CONTENT	PER
088	DWELL	DEG
089	MECHANICAL ADVANCE	DEG
090	TOTAL ADVANCE	DEG
091	SPARE	
092	BATTERY TO COIL VOLTAGE DROP	VOL
093	COIL AVAILABLE VOLTAGE	K V
094	SPARE	
095	BATTERY VOLTAGE	VOL
096	REGULATOR BATTERY VOLTAGE	VOL
097	SPARE	
098	ALTERNATOR OUTPUT VOLTAGE	VOL
099	SPARE	
100	SPARE	

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* INDICATES OUT OF LIMIT CONDITION
M INDICATES MANUALLY ENTERED TEST VALUE

milton U
ndard R

VEHICLE TEST REPORT

TEST NUMBER	ACCEPTABLE LOW LIMIT	TEST VALUE	ACCEPTABLE HIGH LIMIT
01500			
AIDN-0008			
60	[illegible]	[illegible]	----
51	7.0	[illegible]	16.0
52	7.0	9.5	16.0
53	7.0	10.4	16.0
54	7.0	11.6	16.0
55	7.0	11.4	16.0
56	7.0	11.3	16.0
57	7.0	10.9	16.0
58	7.0	10.4	16.0
933	EMISSIONS CHECK		
67	----	70	280
68	----	.44	2.50

TEST NUMBER	TEST DESCRIPTION	UNITS
001	BATTERY VOLTAGE – PRECONDITIONED	VOLTS
002	BATTERY CURRENT DRAIN	AMPS
003	SPARE	
004	SPARE	
005	COIL PRIMARY VOLTAGE (+)	VOLTS
006	DISTRIBUTOR POINT VOLTAGE DROP	VOLTS
007	SPARE	
008	SPARE	
009	CRANKING STARTER CURRENT (LOW LIMIT)	AMPS
010	CRANKING STARTER CURRENT (HIGH LIMIT)	AMPS
011	STARTER CABLE VOLTAGE DROP	VOLTS
012	BATTERY TO RELAY VOLTAGE DROP	VOLTS
013	STARTER CONTROL VOLTAGE	VOLTS
014	BATTERY CRANKING VOLTAGE	VOLTS
015	BATTERY TO COIL VOLTAGE DROP	VOLTS
016	CRANKING RPM	RPM
017	SPARE	
018	COIL AVAILABLE VOLTAGE (Kv PROBE IN COIL TOWER)	K VOLTS
019	COIL AVAILABLE VOLTAGE	K VOLTS
020	DISTRIBUTOR ROTOR GAP VOLTAGE	K VOLTS
021–028	SPARK PLUG FIRING VOLTAGE	K VOLTS
029	DWELL—CRANKING	DEGREE
030	BASIC TIMING-CRANKING (VACUUM DISCONNECTED)	DEGREE
031–038	RELATIVE CYLINDER COMPRESSION	PERCEN
039	SPARE	
040	CURB IDLE	RPM
041–048	CYLINDER POWER CONTRIBUTION *	PERCEN
049	DWELL	DEGREE
050	BASIC TIMING (NO VACUUM)	DEGREE
051–058	SPARK PLUG FIRING VOLTAGE	K VOLT
059	COIL AVAILABLE VOLTAGE (KV PROBE IN COIL TOWER)	K VOLT
060	COIL AVAILABLE VOLTAGE	K VOLT
061	ROTOR GAP VOLTAGE	K VOLT
062	DISTRIBUTOR CAPACITOR TEST	COUNTS LEVEL
063	COIL TEST	K VOLT
064	FAST IDLE	RPM
065	LOW CURB IDLE	RPM
066	MANIFOLD VACUUM	PSIA
067	HYDROCARBON CONTENT	PPM
068	CARBON MONOXIDE CONTENT	PERCE
069	SPARE	
070	BATTERY TO COIL VOLTAGE DROP	VOLTS
071–078	SPARK PLUG LOAD TEST	K VOLT
079–085	SPARE	
086	HYDROCARBON CONTENT	PPM
087	CARBON MONOXIDE CONTENT	PERCE
088	DWELL	DEGRE
089	MECHANICAL ADVANCE	DEGRE
090	TOTAL ADVANCE	DEGRE
091	SPARE	
092	BATTERY TO COIL VOLTAGE DROP	VOLTS
093	COIL AVAILABLE VOLTAGE	K VOL
094	SPARE	
095	BATTERY VOLTAGE	VOLTS
096	REGULATOR BATTERY VOLTAGE	VOLTS
097	SPARE	
098	ALTERNATOR OUTPUT VOLTAGE	VOLTS
099	SPARE	
100	SPARE	

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* INDICATES OUT OF LIMIT CONDITION
M INDICATES MANUALLY ENTERED TEST VALUE

Hamilton Standard U A

VEHICLE TEST REPORT

Burroughs

TEST NUMBER	ACCEPTABLE LOW LIMIT	TEST VALUE	ACCEPTABLE HIGH LIMIT
01500			
AIDN-0008			
933	EMISSIONS CHECK		
67	----	0	280
68	----	.67	2.50
86	----	0	280
87	----	.02	2.50
933	EMISSIONS CHECK		
67	----	90	280
68	----	.46	2.50
86	----	50	280
87	----	.04	2.50

TEST NUMBER	TEST DESCRIPTION	UNIT
001	BATTERY VOLTAGE - PRECONDITIONED	VOL
002	BATTERY CURRENT DRAIN	AMP
003	SPARE	
004	SPARE	
005	COIL PRIMARY VOLTAGE (+)	VOL
006	DISTRIBUTOR POINT VOLTAGE DROP	VOL
007	SPARE	
008	SPARE	
009	CRANKING STARTER CURRENT (LOW LIMIT)	AMP
010	CRANKING STARTER CURRENT (HIGH LIMIT)	AMP
011	STARTER CABLE VOLTAGE DROP	VOL
012	BATTERY TO RELAY VOLTAGE DROP	VOL
013	STARTER CONTROL VOLTAGE	VOL
014	BATTERY CRANKING VOLTAGE	VOL
015	BATTERY TO COIL VOLTAGE DROP	VOL
016	CRANKING RPM	RPM
017	SPARE	
018	COIL AVAILABLE VOLTAGE (K_V PROBE IN COIL TOWER)	K VC
019	COIL AVAILABLE VOLTAGE	K VC
020	DISTRIBUTOR ROTOR GAP VOLTAGE	K VC
021-028	SPARK PLUG FIRING VOLTAGE	K VC
029	DWELL-CRANKING	DEG
030	BASIC TIMING CRANKING (VACUUM DISCONNECTED)	DEG
031-038	RELATIVE CYLINDER COMPRESSION	PER
039	SPARE	
040	CURB IDLE	RPM
041-048	CYLINDER POWER CONTRIBUTION	PER
049	DWELL	DEG
050	BASIC TIMING (NO VACUUM)	DEG
051-058	SPARK PLUG FIRING VOLTAGE	K V
059	COIL AVAILABLE VOLTAGE (KV PROBE IN COIL TOWER)	K V
060	COIL AVAILABLE VOLTAGE	K V
061	ROTOR GAP VOLTAGE	K V
062	DISTRIBUTOR CAPACITOR TEST	COL LEV
063	COIL TEST	K V
064	FAST IDLE	RPM
065	LOW CURB IDLE	RPM
066	MANIFOLD VACUUM	PSI
067	HYDROCARBON CONTENT	PPI
068	CARBON MONOXIDE CONTENT	PEI
069	SPARE	
070	BATTERY TO COIL VOLTAGE DROP	VOI
071-078	SPARK PLUG LOAD TEST	K V
079-085	SPARE	
086	HYDROCARBON CONTENT	PP
087	CARBON MONOXIDE CONTENT	PE
088	DWELL	DE
089	MECHANICAL ADVANCE	DE
090	TOTAL ADVANCE	DE
091	SPARE	
092	BATTERY TO COIL VOLTAGE DROP	VC
093	COIL AVAILABLE VOLTAGE	K
094	SPARE	
095	BATTERY VOLTAGE	VC
096	REGULATOR BATTERY VOLTAGE	VC
097	SPARE	
098	ALTERNATOR OUTPUT VOLTAGE	VC
099	SPARE	
100	SPARE	

9

* INDICATES OUT OF LIMIT CONDITION
M INDICATES MANUALLY ENTERED TEST VALUE

Hamilton Standard U A

759485 1

EVERGLADES LABORATORIES, INC.

5049 SOUTHERN BOULEVARD
WEST PALM BEACH, FLORIDA 33406
PHONE (305) 689-7820

CLIENT
ADDRESS

CAR-BO-TECH
145 OCEAN AVE , APT 502
PALM BEACH SHORES, FL 33404

SAMPLE NUMBER

LAB: 45

CLIENT:

DATE

COL:

REC: 10-27-76

RESIDUE FOR IRON, LEAD, HYDROCARBON TESTING

SAMPLED BY: CLIENT

ACID DIGESTION OF SOLID: REPORT

IRON 24.5%

LEAD 4.7%

EXTRACTION WITH VOLATILE SOLVENT - WEIGHT LOSS

HYDROCARBONS (EXTRACTABLE WITH PETROLEUM ETHER) 7.8%

10

12-7-76
DATE

B Martin
BENJAMIN MARTIN, PH.
DIRECTOR

VEHICLE TEST REPORT

Caprice 2 i
74064 mi

TEST NUMBER	ACCEPTABLE LOW LIMIT	TEST VALUE	ACCEPTABLE HIGH LIMIT
01500			
AIDN-0005 ANY CAR, V8			
P 1	12.1	12.5	----
5	5.0	7.5	----
6	----	.1	.3
31	75	94	100
32	75	96	100
33	75	97	100
34	75	99	100
35	75	100	100
36	75	99	100
37	75	99	100
38	75	98	100
40	300	610	3000
95	12.7	14.5	15.5
49	----	30.1	90.0
51	7.0	8.3	16.0
52	7.0	12.8	16.0
53	7.0	11.0	16.0
54	7.0	8.5	16.0
55	7.0	10.8	16.0
56	7.0	8.2	16.0
57	7.0	10.8	16.0
58	7.0	11.0	16.0
71	----	1.6	8.0
72	----	.8	8.0
73	----	3.6	8.0
74	----	2.7	8.0
75	----	1.7	8.0
76	----	.5	8.0
77	----	1.5	8.0
78	----	2.4	8.0
70	----	5.5	8.0
59	22.0	23.7	----
50M	----	12.0	60.0
933 EMISSIONS CHECK			
68	----	2.16	2.50
86	----	50	280
87	----	.47	2.50
67	----	160	250
51	7.0	9.1	16.0
52	7.0	11.0	16.0

TEST NUMBER	TEST DESCRIPTION	UNIT
001	BATTERY VOLTAGE – PRECONDITIONED	VOL
002	BATTERY CURRENT DRAIN	AMP
003	SPARE	
004	SPARE	
005	COIL PRIMARY VOLTAGE (+)	VOL
006	DISTRIBUTOR POINT VOLTAGE DROP	VOL
007	SPARE	
008	SPARE	
009	CRANKING STARTER CURRENT (LOW LIMIT)	AMP
010	CRANKING STARTER CURRENT (HIGH LIMIT)	AMP
011	STARTER CABLE VOLTAGE DROP	VOL
012	BATTERY TO RELAY VOLTAGE DROP	VOL
013	STARTER CONTROL VOLTAGE	VOL
014	BATTERY CRANKING VOLTAGE	VOL
015	BATTERY TO COIL VOLTAGE DROP	VOL
016	CRANKING RPM	RPM
017	SPARE	
018	COIL AVAILABLE VOLTAGE (Kv PROBE IN COIL TOWER)	K V
019	COIL AVAILABLE VOLTAGE	K V
020	DISTRIBUTOR ROTOR GAP VOLTAGE	K V
021–028	SPARK PLUG FIRING VOLTAGE	K V
029	DWELL–CRANKING	DEG
030	BASIC TIMING-CRANKING (VACUUM DISCONNECTED)	DEG
031–038	RELATIVE CYLINDER COMPRESSION	PER
039	SPARE	
040	CURB IDLE	RPM
041–048	CYLINDER POWER CONTRIBUTION	PER
049	DWELL	DEG
050	BASIC TIMING (NO VACUUM)	DEG
051–058	SPARK PLUG FIRING VOLTAGE	K V
059	COIL AVAILABLE VOLTAGE (KV PROBE IN COIL TOWER)	K V
060	COIL AVAILABLE VOLTAGE	K V
061	ROTOR GAP VOLTAGE	K V
062	DISTRIBUTOR CAPACITOR TEST	COI LEV
063	COIL TEST	K V
064	FAST IDLE	RPM
065	LOW CURB IDLE	RPM
066	MANIFOLD VACUUM	PS
067	HYDROCARBON CONTENT	PP
068	CARBON MONOXIDE CONTENT	PE
069	SPARE	
070	BATTERY TO COIL VOLTAGE DROP	VO
071–078	SPARK PLUG LOAD TEST	K V
079–085	SPARE	
086	HYDROCARBON CONTENT	PP
087	CARBON MONOXIDE CONTENT	PE
088	DWELL	DE
089	MECHANICAL ADVANCE	DE
090	TOTAL ADVANCE	DE
091	SPARE	
092	BATTERY TO COIL VOLTAGE DROP	VO
093	COIL AVAILABLE VOLTAGE	K
094	SPARE	
095	BATTERY VOLTAGE	VC
096	REGULATOR BATTERY VOLTAGE	VC
097	SPARE	
098	ALTERNATOR OUTPUT VOLTAGE	VC
099	SPARE	
100	SPARE	

* INDICATES OUT OF LIMIT CONDITION
M INDICATES MANUALLY ENTERED TEST VALUE

Hamilton Standard
U
A

EXHAUST EMISSION STANDARDS

Compare car average with Arizona standards to determine pass or fail.

ARIZONA EMISSION STANDARDS Model Year	LARGE ENGINES		SMALL ENGINES	
	CO %	HC ppm	CO %	HC ppm
1968 and later	3.0	300	4.0	400
1961 - 1967	4.5	500	5.0	600
1962 and older	5.0	600	6.0	800

STATE OF NEVADA

EXHAUST EMISSION STANDARDS

Model Year of Vehicle	CO (%)	HC (ppm)
Up to and including 1967	7.5	1500
1968 1969	5.0	600
1970	4.0	400
*1971 1974	4.0	400
*1975 and later	xx	xx

*Vehicle engine must be tuned to the manufacturer's emission control specifications.

xxTo be promulgated at a later date.

STATE OF NEW JERSEY

EXHAUST EMISSION INSPECTION STANDARDS

(Light-duty vehicles)

MODEL YEAR OF VEHICLES	EFFECTIVE July 5, 1972		EFFECTIVE July 1, 1974		EFFECTIVE July 1, 1975	
	CO(%)	HC(ppm)	CO(%)	HC(ppm)	CO(%)	HC(ppm)
Up to and including 1967	10.00	1600	8.5	1400	7.5	1200
1968-1969	8.0	800	7.0	700	5.0	600
1970 1974	6.0	600	5.0	500	4.0	400
1975 and later						

*To be by amendment

STATE OF NEW YORK

EXHAUST EMISSION STANDARDS

MOTOR VEHICLE	EXHAUST EMISSION CONTROL TYPE*	EFFECTIVE IMMEDIATELY		EFFECTIVE January 1, 1974	
		CO(%)	HC(ppm)	CO(%)	HC(ppm)
1967 and earlier		7.5	1200	6.6	1000
1968 and 1969	A.I.	5.0	600	4.0	500
	E.M.	6.0	700	5.0	600
1970 and later	A.I.	4.0	450	3.0	350
	E.M.	5.0	700	4.0	450

*A.I. indicates air injection type emission control systems.
E.M. indicates engine modification type emission control systems.

(Hot Engine Idling)

MODEL YEAR	CO (%)	HC (ppm)
Prior to 1968	6	1000
1968 1969	5	600
1970 1974	4	500
1975 and after	1.5	250

Q. *I hear many complaints about poor fuel economy and poor engine performance. What can I do to resolve these problems for my customers?*

A. Emission controls have been blamed for poor gas mileage. However, a recent report from the Environmental Protection Agency states that fuel economy should not suffer more than 5 to 7% as a result of emission control devices. Much of the decrease in gas mileage is a result of increased weight of the vehicle, power consuming options, and incorrect carburetion. Remember that emission controls are as much a part of the operation of an engine as its spark plugs, and emission analyzing equipment is required to properly repair and adjust late-model vehicles.

Q. *The Federal laws deal with new vehicle certification. Wh[illegible] should I be concerned?*

A. It's a fact that the Federal laws are primarily aimed a[illegible] new car manufacturers, however stiff penalties are im[illegible] posed on anyone who disables an emission control de[illegible] vice. Furthermore, many State and local government[illegible] are enacting laws that deal with the maintenance o[illegible] emission systems. Some of these standards are show[illegible] here for reference. Today's automotive technician mus[illegible] understand emission control systems and be proper[illegible] equipped to service them.

EXAMPLES OF PUBLISHED SPECIFICATIONS

STATE OF CALIFORNIA

EXHAUST EMISSION STANDARDS

Standard Domestic Vehicles 140 CID or Greater	HC ppm	CO %
1955-65	1200	8.0
1966-69 Air Injection	400	4.0
Engine Modification	500	7.0
1970 71 (AI & EM)	350	4.0
1972 73 Air Injection	275	2.5
Engine Modification	350	4.0
Imported Vehicles and Compact Domestic Vehicles Under 140 CID		
1955-67	1900	8.0
1968-69 Air Injection	500	5.0
Engine Modification	400	7.9
1970-71 Air Injection	500	3.0
Engine Modification	600	5.0

EXHIBIT M

Detroit Testing Laboratory, Inc.

8720 NORTHEND AVENUE OAK PARK, MICHIGAN 48237 (313) 398 2100

LAB NUMBER	CLIENT'S ORDER	DATE RECEIVED	REPORT DATE
802097-D		2-6-78	4-7-78

REPORT FOR

Supplemental Report

Car-Bo-Tech, Inc.
145 Ocean Avenue
Palm Beach Shores, Florida 33404

Attn: Suzanne Pletts, Executive
Vice President

SUBJECT: Report of Chemical Analysis.

DESCRIPTION OF SAMPLE:

Deposit from engine manifold.

WORK REQUESTED:

Chemical analysis.

RESULTS:

Carbon (Organic)	41.3%
Ash (Inorganic)	58.7%
	100.0%

Analysis of Inorganic Ash (58.7% of total)

Component	
Aluminum Oxide	50.0%
Iron Oxide	42.8%
Lead Oxide	5.5%
Zinc Oxide	0.3%
Copper Oxide	0.2%
Silicon	1.1%
Magnesium Oxide	Trace
Manganese Oxide	Trace
Calcium Oxide	Trace
	99.9%

DETROIT TESTING LABORATORY, INC.

Leslie T. Viland
Project Engineer

William R. Martin, Manager
Mechanical & Hydraulic Testing

LTV/WRM/jk

EVERGLADES LABORATORIES, INC.

5049 SOUTHERN BOULEVARD
WEST PALM BEACH, FLORIDA 33406
PHONE (305) 689-7520

CLIENT
ADDRESS

CAR-BO-TECH
145 OCEAN AVE , APT 502
PALM BEACH SHORES, FL 33404

SAMPLE NUMBER

LAB	45
CLIENT	

DATE

COL	
REC	10-27-76

RESIDUE FOR IRON, LEAD, HYDROCARBON TESTING

SAMPLED BY: CLIENT

ACID DIGESTION OF SOLID: REPORT

IRON 24.5%

LEAD 4.7%

EXTRACTION WITH VOLATILE SOLVENT - WEIGHT LOSS

HYDROCARBONS (EXTRACTABLE WITH PETROLEUM ETHER) 7.8%

10

12-7-76
DATE

BENJAMIN MARTIN, PH.D.
DIRECTOR

VEHICLE TEST REPORT

12,750 Miles

Oct. 12 1978 With Cat Conv. On 1977 Chev Caprice Classic 350 cu in V8

TEST NUMBER 01802	ACCEPTABLE LOW LIMIT	TEST VALUE	ACCEPTABLE HIGH LIMIT
AIDN-7097 CH 350A, V8			
1	12.1	12.6	----
40	450	540	550
933 EMISSIONS CHECK			
520 RPM 67	----	60	200
68	----	.00	1.50
2500 RPM 86	----	0	200
87	----	.00	1.00
0 R/C - EMISSIONS SYSTEM			
40	450	520	550
70	----	.4	2.0
51	8.0	8.5	21.0
52	8.0	11.6	21.0
53	8.0	10.5	21.0
54	8.0	10.7	21.0
55	8.0	10.8	21.0
56	8.0	10.9	21.0
57	8.0	10.3	21.0
58	8.0	10.5	21.0
71	8.0	8.6	27.0
72	8.0	14.0	27.0
73	8.0	14.5	27.0
74	8.0	15.6	27.0
75	8.0	14.3	27.0
76	8.0	16.3	27.0
77	8.0	11.3	27.0
78	8.0	14.6	27.0

29 M.P.G.

Test Conducted by
Computerway Automotive
Stuart, Florida
Marc H. Ducote

Timing 14° Jet .74 Plugs .050

TEST NUMBER	TEST DESCRIPTION	UNITS
001	BATTERY VOLTAGE – PRECONDITIONED	VOLTS
002	BATTERY CURRENT DRAIN	AMPS
003	SPARE	
004	SPARE	
005	COIL PRIMARY VOLTAGE (+)	VOLTS
006	DISTRIBUTOR POINT VOLTAGE DROP	VOLTS
007	SPARE	
008	SPARE	
009	CRANKING STARTER CURRENT (LOW LIMIT)	AMPS
010	CRANKING STARTER CURRENT (HIGH LIMIT)	AMPS
011	STARTER CABLE VOLTAGE DROP	VOLTS
012	BATTERY TO RELAY VOLTAGE DROP	VOLTS
013	STARTER CONTROL VOLTAGE	VOLTS
014	BATTERY CRANKING VOLTAGE	VOLTS
015	BATTERY TO COIL VOLTAGE DROP	VOLTS
016	CRANKING RPM	RPM
017	SPARE	
018	COIL AVAILABLE VOLTAGE (K_V PROBE IN COIL TOWER)	K VOLTS
019	COIL AVAILABLE VOLTAGE	K VOLTS
020	DISTRIBUTOR ROTOR GAP VOLTAGE	K VOLTS
021–028	SPARK PLUG FIRING VOLTAGE	K VOLTS
029	DWELL-CRANKING	DEGREES
030	BASIC TIMING-CRANKING (VACUUM DISCONNECTED)	DEGREES
031–038	RELATIVE CYLINDER COMPRESSION	PERCENT
039	SPARE	
040	CURB IDLE	RPM
041–048	CYLINDER POWER CONTRIBUTION	PERCENT
049	DWELL	DEGREES
050	BASIC TIMING (NO VACUUM)	DEGREES
051–058	SPARK PLUG FIRING VOLTAGE	K VOLTS
059	COIL AVAILABLE VOLTAGE (KV PROBE IN COIL TOWER)	K VOLTS
060	COIL AVAILABLE VOLTAGE	K VOLTS
061	ROTOR GAP VOLTAGE	K VOLTS
062	DISTRIBUTOR CAPACITOR TEST	COUNTS LEVEL
063	COIL TEST	K VOLTS
064	FAST IDLE	RPM
065	LOW CURB IDLE	RPM
066	MANIFOLD VACUUM	PSIA
067	HYDROCARBON CONTENT	PPM
068	CARBON MONOXIDE CONTENT	PERCENT
069	SPARE	
070	BATTERY TO COIL VOLTAGE DROP	VOLTS
071–078	SPARK PLUG LOAD TEST	K VOLTS
079–085	SPARE	
086	HYDROCARBON CONTENT	PPM
087	CARBON MONOXIDE CONTENT	PERCENT
088	DWELL	DEGREES
089	MECHANICAL ADVANCE	DEGREES
090	TOTAL ADVANCE	DEGREES
091	SPARE	
092	BATTERY TO COIL VOLTAGE DROP	VOLTS
093	COIL AVAILABLE VOLTAGE	K VOLTS
094	SPARE	
095	BATTERY VOLTAGE	VOLTS
096	REGULATOR BATTERY VOLTAGE	VOLTS
097	SPARE	
098	ALTERNATOR OUTPUT VOLTAGE	VOLTS
099	SPARE	
100	SPARE	

* INDICATES OUT OF LIMIT CONDITION
M INDICATES MANUALLY ENTERED TEST VALUE

Hamilton Standard
DIVISION OF UNITED AIRCRAFT CORPORATION

3 A

Detroit Testing Laboratory, Inc.

DATA SHEET

SAMPLE IDENTIFICATION AND NUMBER: 1972 Chevrolet Car

DATE: Feb. 21, 1973

D.T.L. NO.

REPORT NO. 802097 D

DATA BY: L. Viland

HC and CO Exhaust Emissions at Idle and 2500 RPM no load

Spark Plug gap — .040" as received.
(GM Specification — .045")
These tests were made with the .040 gap.
After tests, gaps were reset to .045"
before emission tests at Olson Laboratories.

	ppm HC	% CO	
As received (Original Idle Adjustment)			
– At Idle (560 RPM in Drive Gear)	280 ppm	4 %	
– At 2500 RPM – No load	30 ppm	.05%	
After adjustment for CO			
– At Idle (560 RPM – Drive Gear)	110 ppm	.02%	
" " " " " "	100 ppm.	.06%	HC not...
– At 2500 RPM – No Load	0	.04%	

These tests made using a
Scott Research Laboratories
Model III Exhaust Emission Analyzer

ENERGY GAS SAVER INC.

Manufactured by ENERGY INSERT SYSTEMS, INC.

L I M I T E D   W A R R A N T Y

ENERGY INSERT SYSTEMS, INC. warrants to the first purchaser at retail that this ENERGY-GAS-SAVER manufactured by ENERGY INSERT SYSTEMS, INC. will be free from defects in workmanship and materials for a period of twelve (12) months from the date of original retail purchase or 12,000 miles, whichever occurs first. Defects caused by abuse, accidents, modifications, negligence, misuse or other causes beyond the control of ENERGY INSERT SYSTEMS, INC. are not covered by this Warranty.

If the ENERGY-GAS-SAVER proves defective within the warranty period, ENERGY INSERT SYSTEMS, INC. will at its option, either repair or replace the unit. Repair or replacement will be without charge if the defect appears.

To obtain warranty service, simply mail the unit postpaid and insured to the Company or go to an authorized dealer of the Company's.

In addition to the above Warranty, it is further warranteed that with a proper installation, your vehicle shall increase in gasoline mileage or you may receive your money back by returning the unit to the Company. (Any installation charge is not refundable).

ENERGY INSERT SYSTEMS, INC.

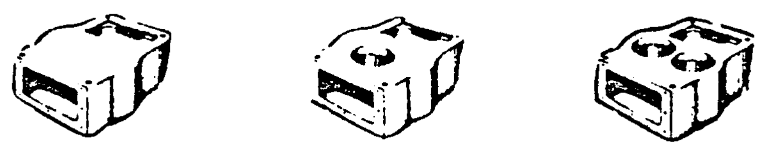
ENERGY-GAS-SAVER, INC.

FIRST AMERICAN BUILDING • 701 U.S. HIGHWAY ONE • SUITE 104 • NORTH PALM BEACH, FL 33408 • 305/842-8558

INSTRUCTIONS FOR INSTALLING
"ENERGY GAS SAVER" AND "EXHAUST EXTRACTOR"

A. "Energy Gas Saver"

1. First verify that the unit is the proper one that fits the correct carburator, engine size and make of automobile.
2. Remove the carburator from automobile.
3. Carefully clean the carburator and manifold surfaces; make sure the old gasket is removed as well as all the dirt. Do not reuse the old gasket.
4. Must have clean and flat surface to assure proper fit and no vacuum leaks. Check for vacuum leaks.
5. Place "Energy Gas Saver" unit on intake manifold with the single primary opening facing upward and forward as illustrated below.



1 - 2 - 3 - barrel

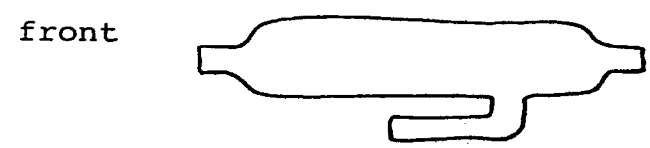
NOTE: The exhaust fitting for the flex tubing always goes toward the rear.

6. Place carburator on top of "Energy Gas Saver" and make sure that the carburator barrels open all the way without hitting or without binding.
7. While the two units are sitting on maniford, measure and cut the 5/16 studs to proper lengths to secure the two units to the intake manifold.
8. Remove carburator and "Energy Gas Saver" from manifold.
9. Install studs in manifold and install "Energy Gas Saver" base gasket.
10. Install "Energy Gas Saver" on studs.
11. Place carburator base gasket on top of "Energy Gas Saver" and place carburator on top.
12. Reattach all the linkage and reinstall all carburator components.

NOTE: Slight modification may be required on fuel, vacuum and linkage systems due to the new height of carburator.

B. Extractor

1. These instructions are for installing the exhaust extractor on vehicles equipped with or without a catalytic converter. On the vehicles with a catalytic converter, it is installed as close as possible to the "catalytic converter". If there is no "catalytic converter" it should be installed as close as possible to the front of the vehicle.
2. The extractor is installed in the exhaust system and connected with a 1½" I.D. flex tubing to the rear of the "Energy Gas Saver" unit.
3. The extractor must be installed with the smaller return pipe that connects the flex tubing facing toward the engine as illustrated:



4. Raise the automobile up and find a section of exhaust pipe near the front of the vehicle where the extractor will fit. Also, find a straight section of pipe for the extractor.
5. After you have established where to install the extractor, cut an old section of exhaust pipe out.
6. Install the extractor in that section and either weld or clamp in place.
7. The 1½" I.D. flexible pipe is to be installed between the "Energy Gas Saver" unit and the extractor.

NOTE: Flexible pipe must be run in such a way as <u>will not</u> cause damage to any components due to exhaust heat.

8. Clamp flexible tubing to the "Extractor" and the "Energy Gas Saver" unit.

C. Adjusting System

1. Double check all components to assure proper installation and no vacuum leaks.
2. Start automobile.
3. Set timing 2 to 4° more advanced than factory specs.

NOTE: If pinging occurs, retard timing slightly to correct.

4. Adjust carburator fuel mixture with exhaust gas analyzer to assure best possible emission readings.
5. Reset idle speed to factory specs and as low as possible with the air conditioning on.

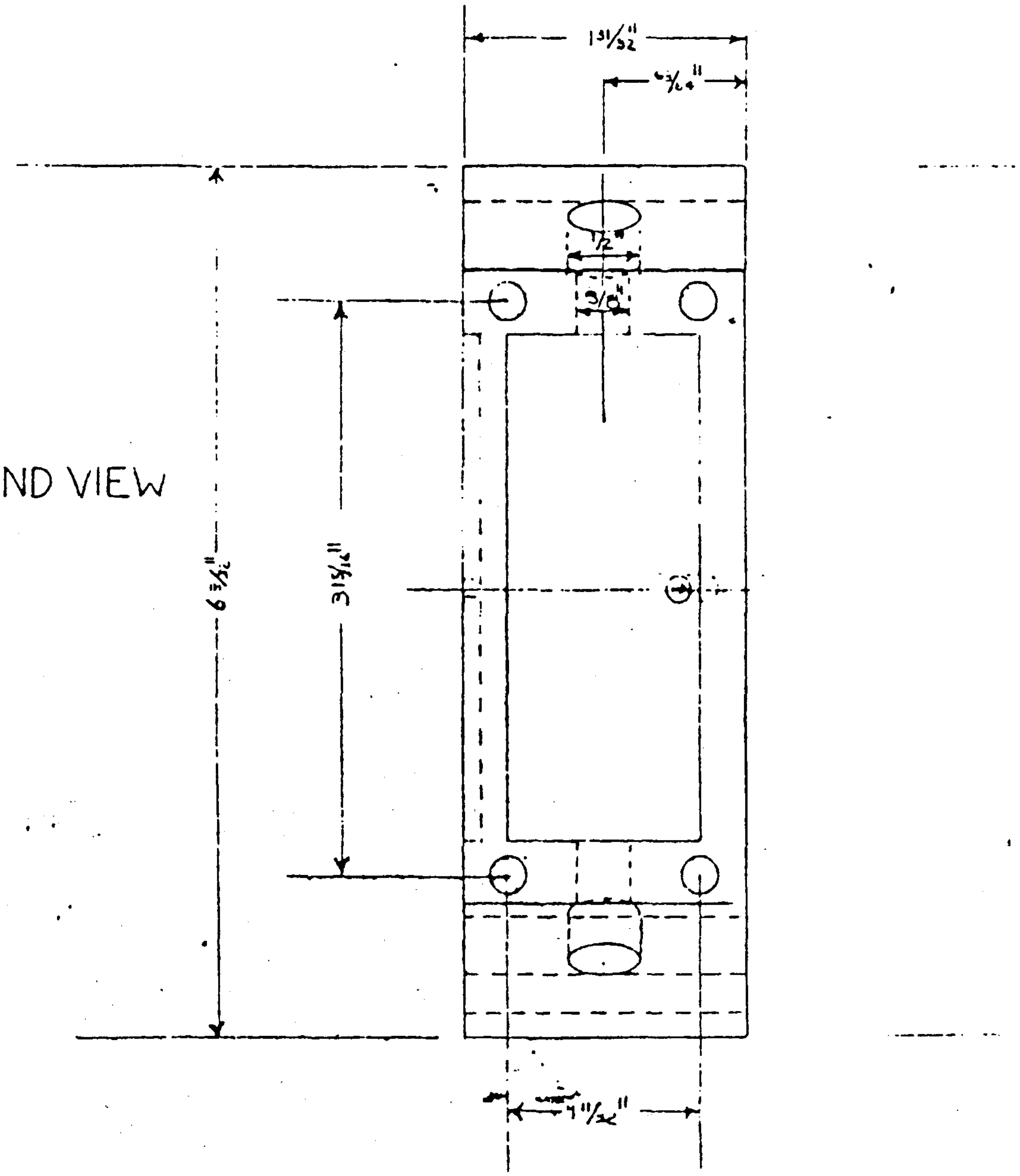
A CARBURETOR MIXING BLOCK FOR:

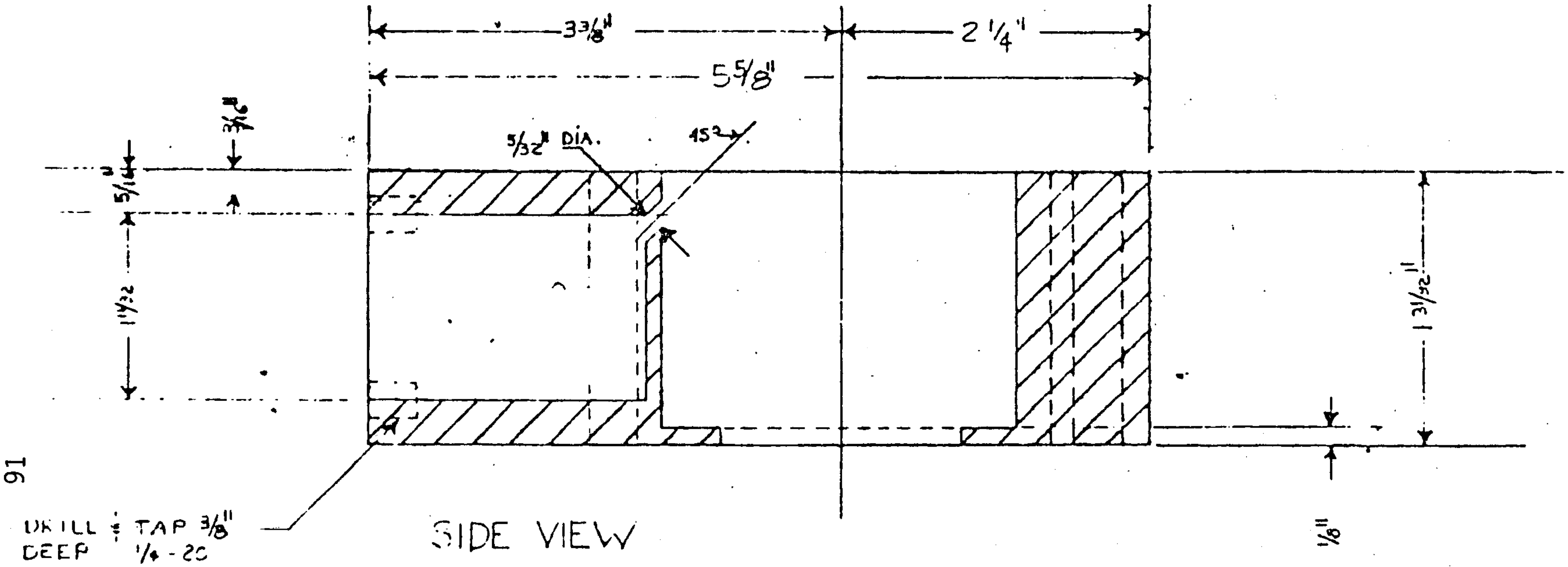
ENERGY INSERT SYSTEMS INC.

U.S. PATT. 412-7093 #201

302 CU.IN. FORD 2 BBL BAFFLE PLATES 2A (2B)
351 HOLLY 2 BBL
330

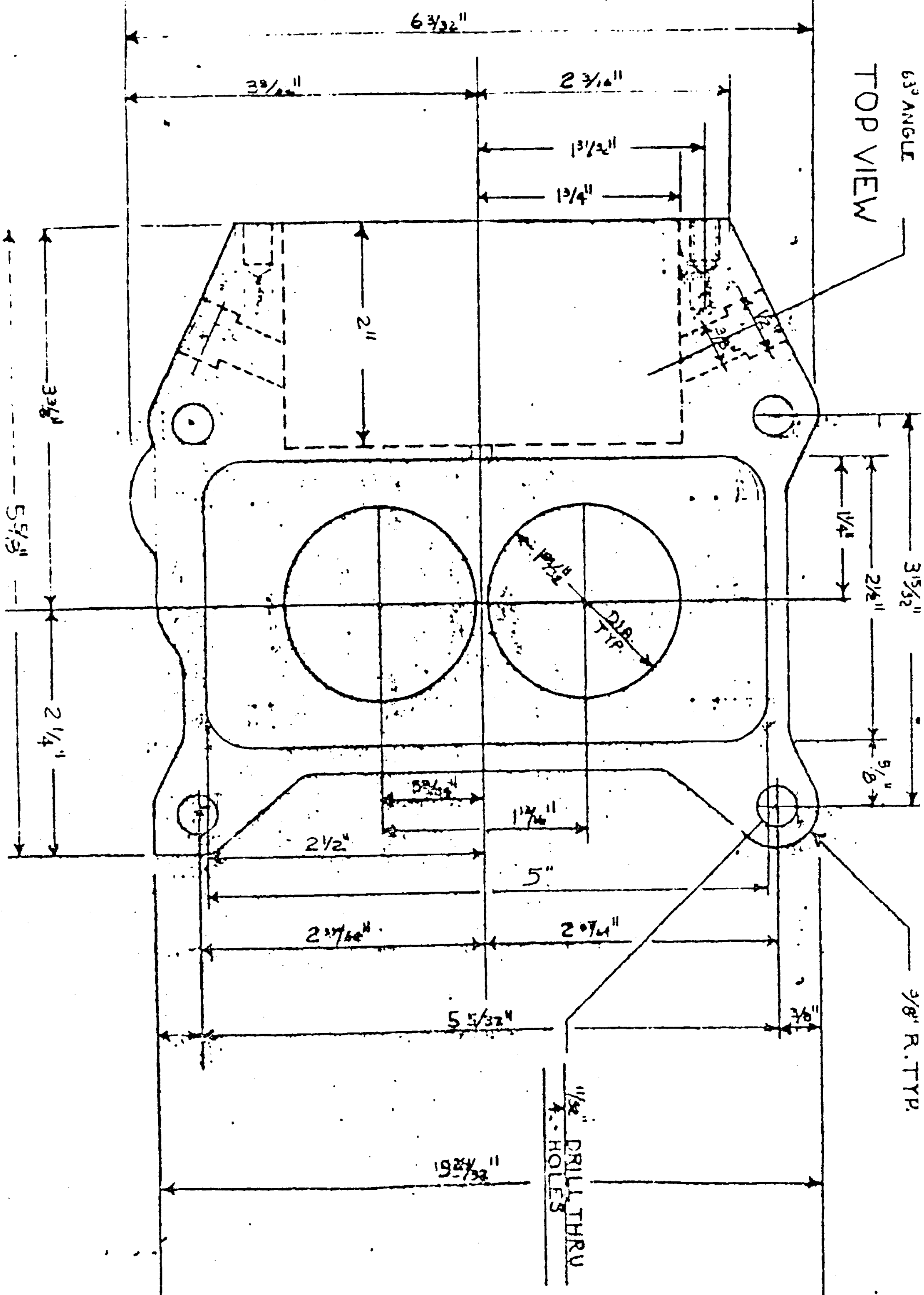
END VIEW





SIDE VIEW

ALUM ALLOY CASTING


TOP VIEW
63° ANGLE
3/8" R. TYP.
11/32" DRILL THRU
4-HOLES
DIA. TYP.
5"
2"
2 1/2"
2 1/4"
1 3/4"
1 1/4"
2 1/2"

93

A CARBURETOR MIXING BLOCK FOR:

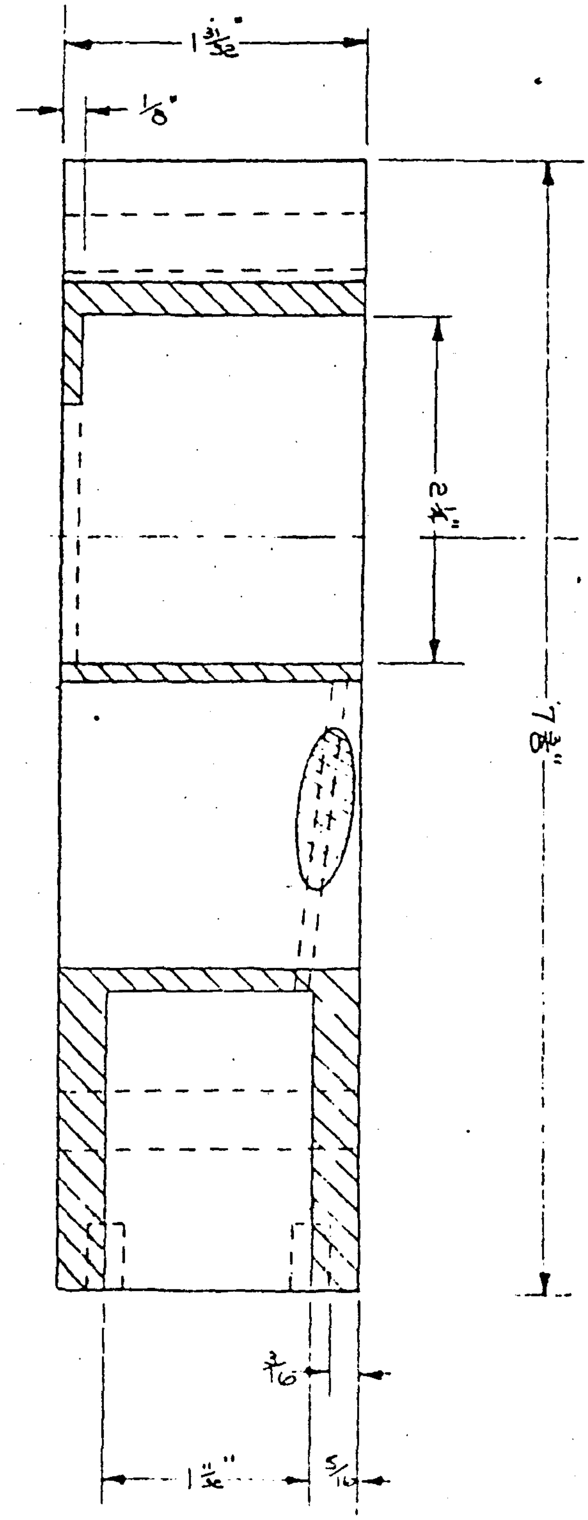
ENERGY INSERT SYSTEM INC.

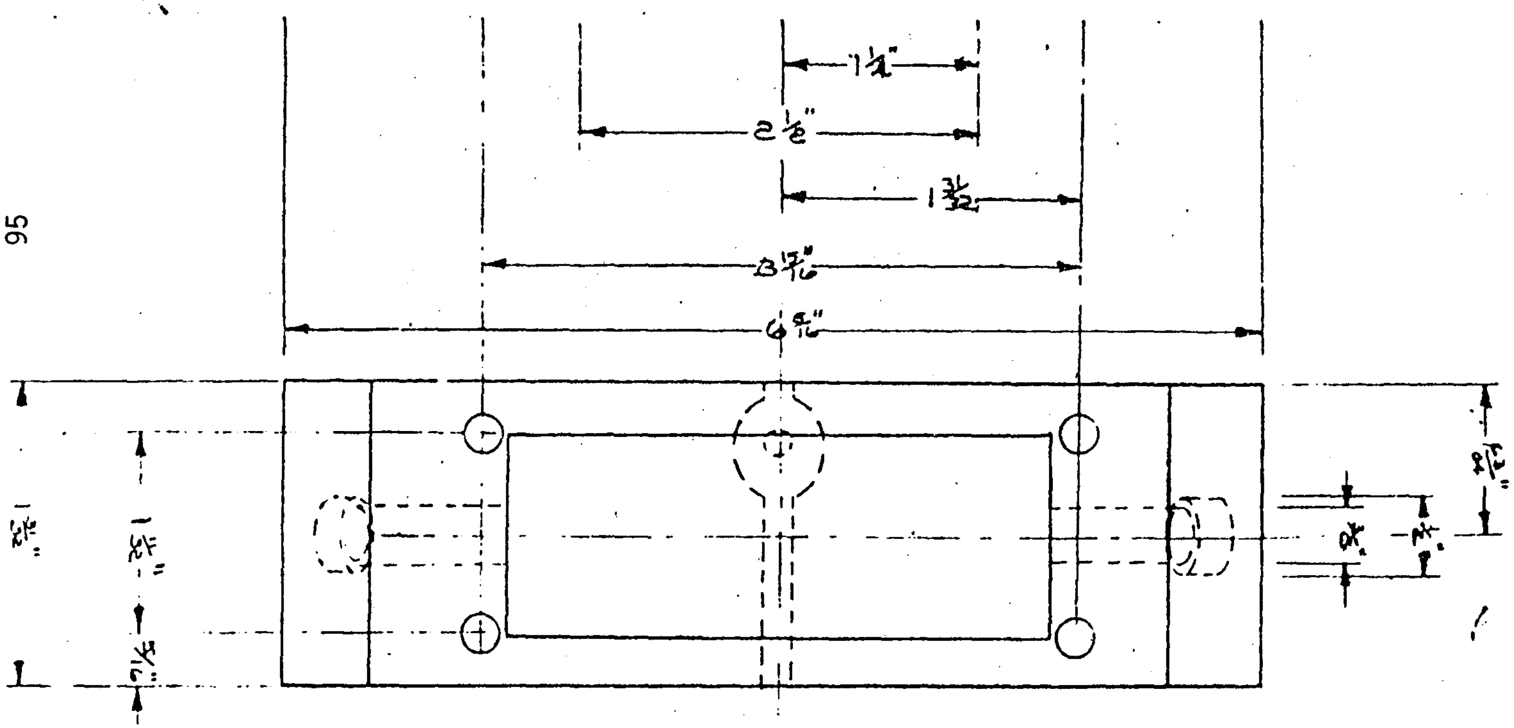
U.S. PATT. 412-7093 #301

(4) BBL. (FORD) H, (HOLLY), (CHYSLER)

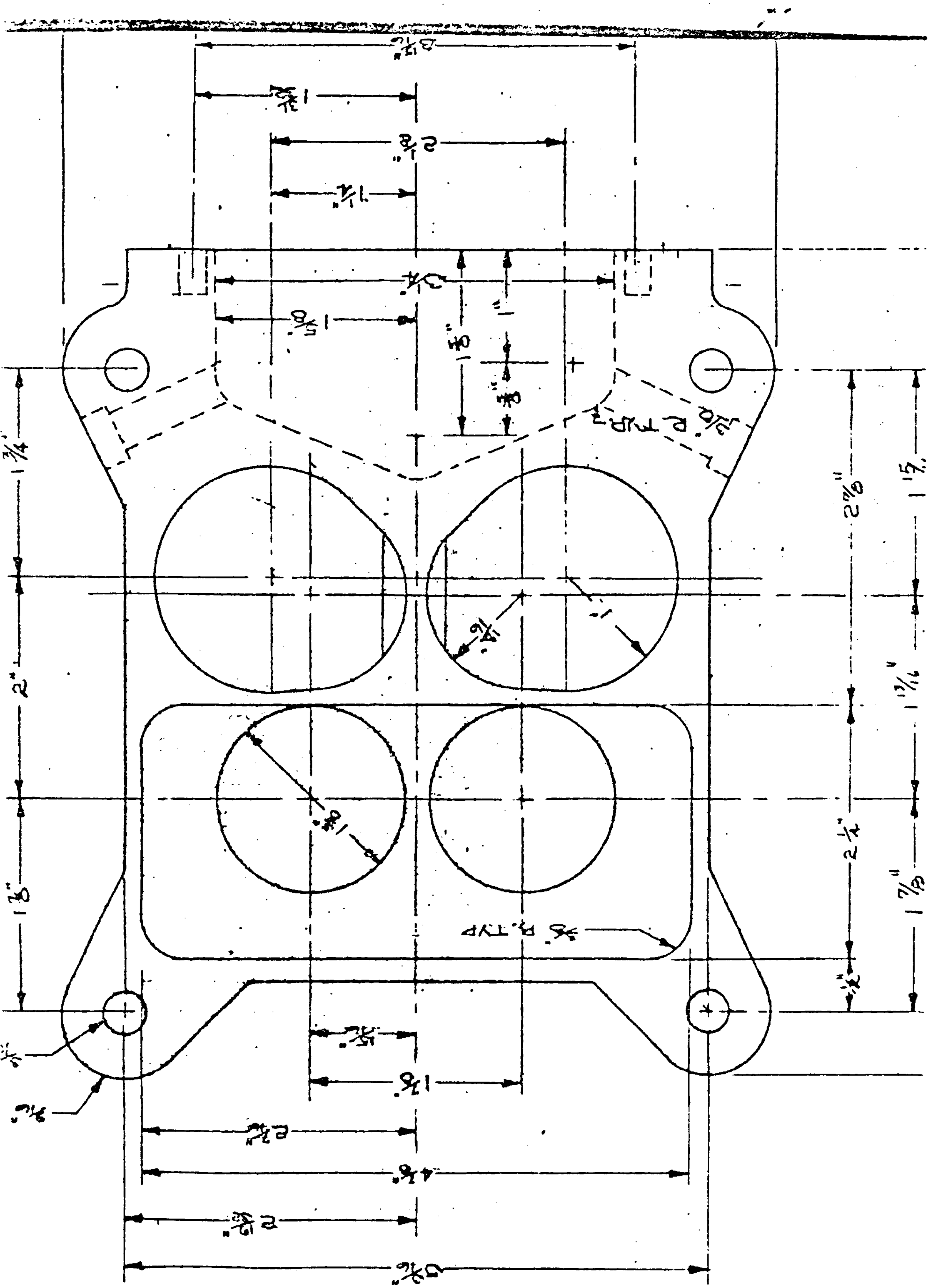
(TAKES BAFFLE 6.A & 6 B

END VIEW

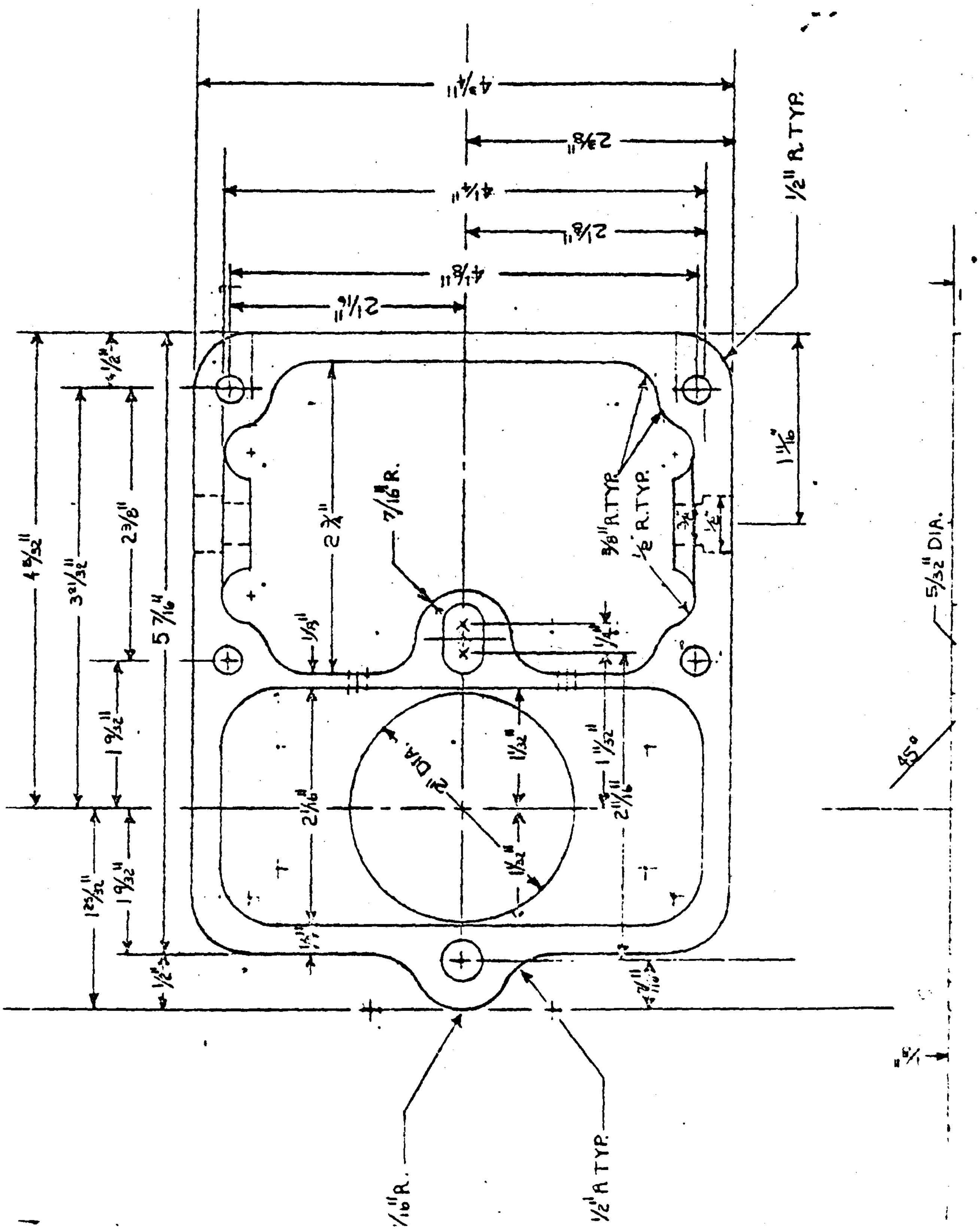




SIDE VIEW



TOP VIEW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NOW, THEREFORE, THESE Letters Patent ARE TO GRANT UNTO THE SAID CLAIMANT(S) AND THE SUCCESSORS, HEIRS OR ASSIGNS OF THE SAID CLAIMANT(S) FOR THE TERM OF SEVENTEEN YEARS FROM THE DATE OF THIS GRANT, SUBJECT TO THE PAYMENT OF ISSUE FEES AS PROVIDED BY LAW, THE RIGHT TO EXCLUDE OTHERS FROM MAKING, USING OR SELLING THE SAID INVENTION THROUGHOUT THE UNITED STATES.

In testimony whereof *I have hereunto set my hand and caused the seal of the* Patent and Trademark Office *to be affixed at the City of Washington this twenty-eighth day of November in the year of our Lord one thousand nine hundred and seventy-eight, and of the Independence of the United States of America the two hundred and third.*

Attest:

Keith C. Mason

Attesting Officer.

Donald W. Banner

Commissioner of Patents and Trademarks

ENERGY GAS SAVER INC

December 6, 1980

K. D. Drachand, Acting Chief
Mobile Source Control Division
Air Resources Board
9528 Telstar Avenue
El Monte, California 91731

Dear Mr. Drachand:

Enclosed is our application for a motor vehicle add-on device. The purpose of this application is for an exemption from the provisions of the California Vehicle Code Section 27156. Even though our Energy Gas Saving system does not modify the vehicle's emission control system, we would still like to apply for an exemption from the prohibitions of Section 27156 of the Vehicle Code in order for us to legally advertise, offer for sale, sell or install in the State of California.

This system has had extensive testing on numerous vehicles and has never been known to increase emissions from the exhaust system. In fact, to our knowledge it is the only system that extracts solid pollutants (particulates) from the exhaust of the automobile engine.

Also, to our knowledge, our Energy Gas Saving system is the only gas saver that is scientifically proven. What in effect happens is that the vapor mix of gas and air from the carburator is mixed with hot exhaust and this mixture is further vaporized and this allows for a leaner mix into the combustion chambers of the engine. One of our exhibits (Exhibit F) is the research done on vaporization by Ford Motor Company, which is self-explanatory. Professor Enoch J. Durbin of Princeton University School of Engineering states in a letter to me, that vaporization does save fuel and his percentage figure is approximately 15%. An ercerpt of this letter is attached as Exhibit E.

It is our firm belief that in addition to the 15% savings in gasoline by vaporizing the vapor with heat, we save at least another 15% by doing the following. Replacing the air filter that comes on the vehicles with a 360° "high performance" air filter manufactured by FRAM Corporation. Also the "plellum" created by the mixing chamber helps increase the gasoline mileage the same as a high riser on a racing car. The idle setting for engines with this system can more readily be set at normal according to factory specifications because of the even buring of the fuel mixture. The manufacturers normally have their idles set much higher than factory specifications to overcome the roughness.

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It is our intention to have tests done by Olson Laboratories and/or Southern California AAA for both exhaust emissions to qualify for the State of California and also for mileage testing. These two vehicles will be tested prior to the installation of our Energy Gas Saving equipment and tested after the installation of our Energy Gas Saving equipment.

The signature of the authorized representative signing this statement is the inventor, president of the company and majority stockholder.

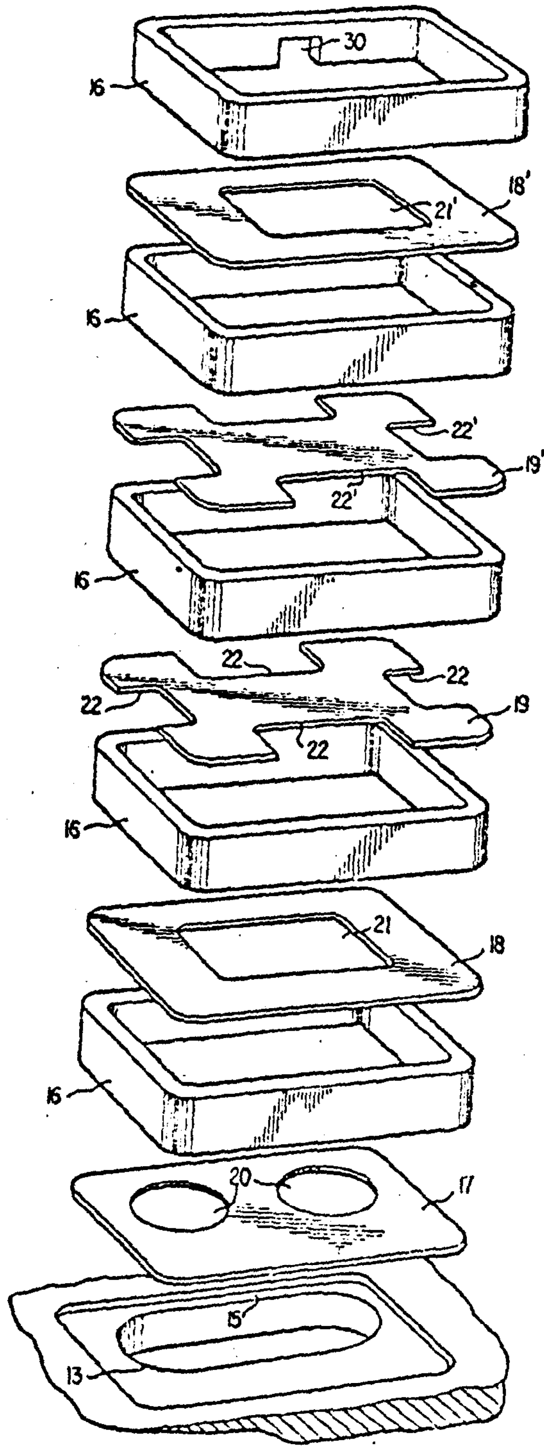
We appreciate your prompt approval for our exemption from the prohibitions of Section 27156 of the California Vehicle Code.

Very truly yours,

Donald C. Pletts

DCP/tas

FIG.3



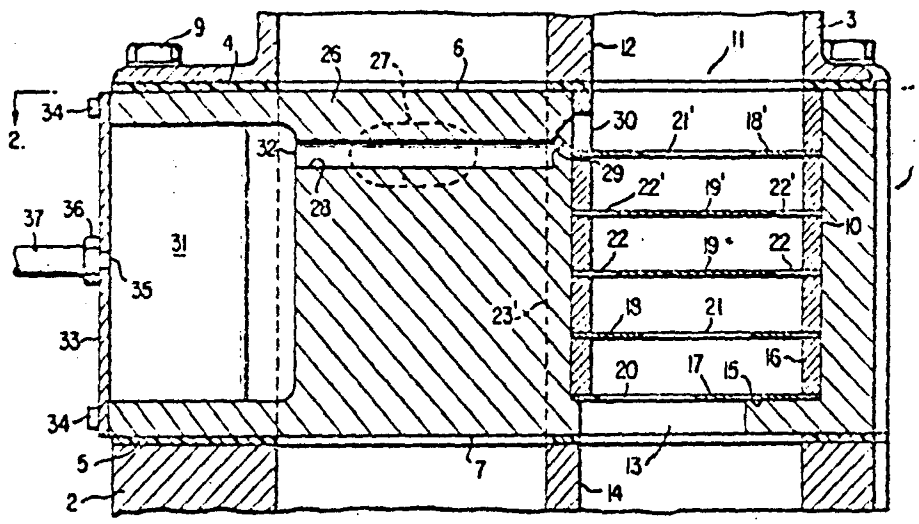

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FIG.1

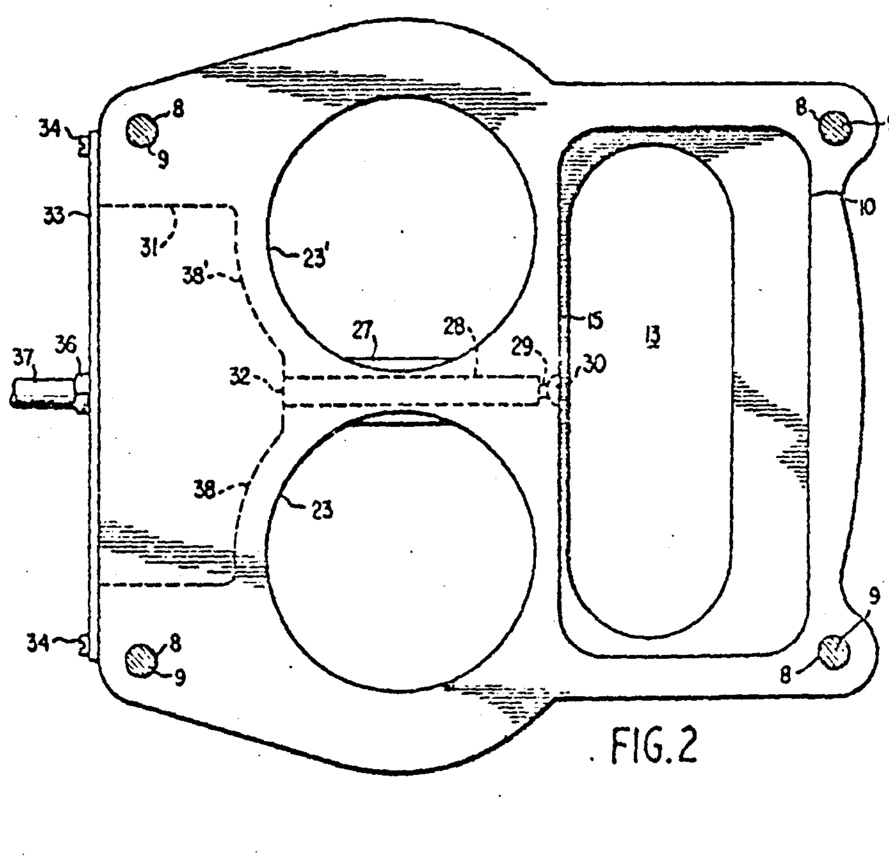
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FIG.2

United States Patent [19]

[11] 4,127,093

[45] Nov. 28, 1978

Pletts

[54] EXHAUST RECYCLE MIXER

[75] Inventor: Donald C. Pletts, Palm Beach Shores, Fla.

[73] Assignee: Car-Bo-Tech Inc., Palm Beach Shores, Fla.

[21] Appl. No.: 775,834

[22] Filed: Mar. 9, 1977

[51] Int. Cl.² F02M 25/06

[52] U.S. Cl. .... 123/119 A

[58] Field of Search .... 123/119 A, 141

[56] References Cited

U.S. PATENT DOCUMENTS

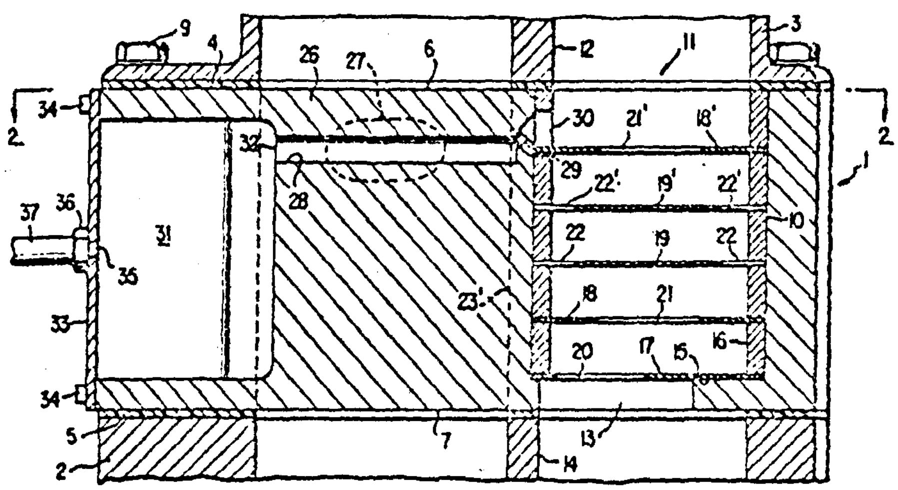
3,459,162	8/1969	Burwinkle et al.	123/141 X
3,530,843	9/1970	Fessenden	123/119 A
3,580,233	5/1971	Busse	123/119 A
3,878,823	4/1975	Vartanian	123/119 A

Primary Examiner—Wendell E. Burns
Attorney, Agent, or Firm—Sherman & Shalloway

[57] ABSTRACT

A fuel/air and recycled-exhaust mixer is disclosed which is devoid of valves or interruptions in the exhaust-recycle path and which is effective with multi-barrel and multi-stage carburetors, either as original equipment for new vehicles or as a conversion unit for existing vehicles.

8 Claims, 3 Drawing Figures



portions which is operable over substantial ranges of engine speeds and with multiple-stage carburation without valving the exhaust-recycle flow and while accomodating variations in entrained matter and heat content of the recycled exhaust.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects of the invention, as well as a better understanding thereof, may be derived from the following description and accompanying drawings, in which:

FIG. 1 is a sectional elevation of the preferred form of mixer;

FIG. 2 is a plan view thereof and taken on lines 2—2 of FIG. 1, and

FIG. 3 is an exploded view of the staggered-flow insert of the mixing chamber.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in the drawings, the preferred form of mixer of the present invention comprises a body 1 of cast aluminum alloy, or a comparable material, shaped to fit between an automotive intake manifold 2 and its appropriate carburetor 3 with interposed gaskets 4 and 5 closing against the adjacent flange surfaces 6 and 7 of the mixer body. The body also includes four bolt bores 8 for receiving assembly bolts 9 therethrough to engage mating fittings in the carburetor and manifold. As shown in the drawings, the mixer is shaped to fit the four-barrel carburetors of large-displacement, General Motors automotive engines.

The body 1 has a rectangular primary fuel/air duct 10 extended therethrough between an inlet 11 underlying the first-stage barrels 12 of the carburetor and an outlet 13 overlying the inlet 14 of the manifold. The outlet 13 of the primary duct is preferably rectangular, as shown, but may take any desired shape.

Adjacent the outlet 13, the body has a ledge 15 supporting a series of alternating spacers 16 and plates 17-19 loosely positioned therein. As best shown in FIG. 3, the lowermost plate 17 has a pair of ports 20 overlying the outlet 13. The next plate 18 has a centered, rectangular port 21; the next two plates 19, 19' have four notched ports 22 in their periphery and the uppermost plate 18' has a centered, rectangular port 21'.

The spaced, inward and outwardly ported plates 17-18 thus provide a staggered or zig-zag flow path through the primary fuel/air duct and a consequent thorough mixing of the several components of the combustion charge passing through the duct. Other forms of staggered-flow assemblies may be employed, if desired, but the disclosed series of loose plates and loose, peripheral spacers are especially advantageous with regard to simplicity of cost and installation and their lack of service requirements. The overall assembly is simply retained in the primary fuel/air duct between the ledge 15 and a portion of the flange or gasket associated with the carburetor.

The body 1 also includes a pair of second-stage or secondary fuel/air ducts 23 and 23' which are aligned with the outlets of the two second-stage barrels of the carburetor and communicate therewith via inlets 24, 24' and with the intake manifold via outlets 25, 25; respectively. A wall 26 intermediate the secondary ducts 23 and 23' has a thickened portion 27 in its upper region near the inlets 24 and 24' and has a bore 28 of about one-fourth inch diameter extended therethrough to adjacent the primary duct 10. The upper portion of the primary duct 10 has a delivery bore 29 of about one-eighth inch diameter intersecting the bore 28 and opening the bore 28 to the inlet portion of the primary duct 10. The uppermost spacer 16 is notched or otherwise relieved as at 30, to provide free communication of the bore 29 and the primary duct.

As best shown in FIG. 2, the body includes a settling chamber 31 extended along and partially between the secondary ducts 23 and 23' and in direct communication via a port 32 with the bore 28 which passes between the secondary ducts. The chamber 31 is closed by a plate 33 secured on the body by screws 34 about its periphery. The plate has a threaded inlet port 35 for receiving a fitting 36 associated with an exhaust return line 37. Preferably, the port 35 is located at a level below the level of the transfer port 32 and duct 28.

The chamber 31 thus includes a substantial volume and further provides for heat-transfer contact with the resulting thin, curvate walls 38, 38' of the secondary ducts 23 and 23'.

In operation, the mixer is installed between the carburetor and manifold, as shown, and the tube 37 is connected to a point or points in the exhaust system intermediate the exhaust manifold and a muffler or resonator.

When the engine is then started, exhaust gases are drawn through an uninterrupted flow path from the point of connection in the exhaust system through to the inlet zone of the primary fuel/air duct 10. In the primary duct, the exhaust-recycle is thoroughly mixed with the fresh fuel/air mixture and delivered to the engine as part of the fuel charge.

Any particulate matter returned with the exhaust is free to fall out of entrainment in the enlarged settling chamber 31. Accumulations thereof may be removed quickly with a screwdriver at intervals coinciding with other services such as oil changes.

The intimate association of the returned gases with a large internal area of the mixer body allows the body to absorb heat freely from the gases, adjacent the second-stage ducts 23, 23', before the recycled gases are presented to the fresh fuel/air mixture and thereby help accomodate fluctuations in exhaust-gas temperatures while retaining the heat value in the flow path of the carburation.

It is important to note that the mixer of the present system is the essence of simplicity, being entirely without metering valves, check valves or similar close-tolerance complications.

However, it is significant that, in spite of its simplicity and lack of complex and sensitive adjustments, the mixer of the present invention is capable of extremely effective performance of fuel economy and pollutant-reduction over a wide range of engine-operating conditions.

As stated before, the specific shape of the mixer disclosed in the drawings is intended for use with large-displacement, General Motors blocks. A mixer as disclosed herein has been so tested and proven most effective.

The test vehicle was a 1970 Cadillac Fleetwood having a 472CID engine, more than 70,000 miles, and its original four-barrel carburetor, a "Rochester Quadro Jet". The vehicle has a curb weight of 5,260 pounds.

When used in the "carburetor" tests reported below, the vehicle was thoroughly tuned for optimum gas mileage with the carburetor as installed at the factory.

In the "carb/mixer" tests, the vehicle was altered only by addition of the mixer intermediate the carburetor and intake and an exhaust take-off in the system to supply the exhaust recycle

In the mileage tests, a one-gallon reservoir and a recently-checked speedometer were used for measurement, with the following average results:

Carburetor	Carb/Mixer
"regular" fuel - 12.6 mph	19.4 mph
"no-lead" fuel - 11.8 mph	19.1 mph

Accordingly, it is apparent that the present invention provides not only a dramatic increase in miles per gallon of gasoline, but accomplishes performance and economy with regular gas, instead of the high-octane premium gases normally necessary in that engine.

However, the mileage performance is only a part of the surprising results provided by the present invention. Emission analyses were conducted by a commercial test facility, in both the "carburetor" and "carb/mixer" configurations, with the following results:

	Carburetor		Carb/Mixer	
	Hydro-carbons	Carbon Monoxide	Hydro-carbons	Carbon Monoxide
Idle (650 rpm)	2000 ppm	4.10%	40 ppm	0.46%
Run (2500 rpm)	2000 ppm	10.12%	30 ppm	0.04%

Therefore, it is apparent that the new mixer drastically reduces the hydrocarbon and carbon monoxide contents of the exhaust gases finally emitted, to the point that a seven year old car with more that seventy thousand miles can operate well below the upper limits for hydrocarbons (250 - 280 ppm) and for carbon monoxide (1.5 - 2.5%) now specified or forthcoming in some of the more severe jurisdictions. This is accomplished without catalytic converters or other complexities or sophistications.

The present invention thus provides a simple exhaust recycle system which equals or exceeds the performances of the more complex prior systems.

Various changes may be made in the details of the invention, as disclosed, such as adaptation to different carburetors and engines, without sacrificing the advantages thereof or departing from the scope of the appended claims.

What is claimed is:

1. A charge-forming mixer for internal combustion engines having a carburetor, an intake member and an exhaust member, said mixer comprising
- a body having
- at least one fuel/air duct extended therethrough, said fuel/air duct having
- an inlet for receiving a fuel/air mixture from the carburetor and
- an outlet for discharging a combustible mixture therefrom to the intake member,
- means defining a staggered flow path for fluids passed enroute from said inlet to said outlet,

- a settling chamber on a side of said body remote from said fuel/air duct,
- a transfer duct extended in heat transfer relationship through a wall of said body, said duct including,
- a transfer aperture communicating with said settling chamber and
- a delivery aperture in communication with said fuel/air duct adjacent said inlet, and
- recycling means for recycling a portion of the exhaust gases from the exhaust member to the settling chamber, said recycling means including an unobstructed recycle path free of valves.

2. A charge-forming mixer according to claim 1 in which said settling chamber is formed internally in said body.

3. A charge-forming mixer according to claim 2 in which said recycling means includes an exhaust inlet port positioned in said settling chamber at a level below said transfer aperture.

4. A charge-forming mixer according to claim 3 in which said body includes a second fuel/air duct and said transfer duct is positioned at least in part in a wall between said first and second fuel/air ducts.

5. A charge-forming mixer according to claim 3 in which said body includes first and second secondary fuel/air ducts positioned to receive a supplemental flow of fuel and air, and said transfer duct is positioned at least in part in a wall separating said secondary ducts.

6. A charge-forming mixer according to claim 5 in which said settling chamber is positioned at least partially intermediate said secondary fuel/air ducts and in close heat-transfer relationship therewith.

7. A conversion unit for engines having four-barrel, two-stage carburetors comprising
- a body having
- a carburetor flange and
- an intake flange,
- a primary fuel/air duct opening between said flanges and positioned to underly said primary carburetor barrels,
- means defining a staggered flow path for fluids passed through said primary fuel/air duct,
- a pair of secondary fuel/air ducts positioned individually to underly the secondary third and fourth barrels of the carburetor and opening between said flanges,
- a settling chamber adjacent said secondary fuel/air ducts,
- a transfer duct within a wall separating said pair of secondary fuel/air ducts,
- said transfer duct including
- a transfer aperture communicating with said settling chamber and
- a delivery aperture communicating with said primary fuel/air duct adjacent said inlet, and
- means for freely admitting recycled exhaust gases into said settling chamber for unobstructed passage into said primary fuel/air duct via a recycle path free of valves.

8. A conversion unit according to claim 7 in which said settling chamber is integral with said body and has a portion positioned at least partially intermediate said secondary fuel/air ducts.

* * * * *

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In testimony whereof *I have hereunto set my hand and caused the seal of the* **Patent and Trademark Office** *to be affixed at the City of Washington this twelfth day of August in the year of our Lord one thousand nine hundred and eighty, and of the Independence of the United States of America the two hundred and fifth.*

Attest:

[signature] Baltimore
Attesting Officer.

[signature] Sidney A. Diamond
Commissioner of Patents and Trademarks.

United States Patent [19]

Pletts

[11] 4,216,654

[45] Aug. 12, 1980

[54] FUEL COMPONENT EXTRACTOR

[76] Inventor: Donald C. Pletts, 145 Ocean Ave., #502 Palm Beach Shores, Fla. 33404

[21] Appl. No.: 935,849

[22] Filed: Aug. 22, 1978

[51] Int. Cl.² F02M 25/06

[52] U.S. Cl. 60/311; 55/456; 123/568, 60/279

[58] Field of Search .... 123/119 A, 60/311, 279, 55/456, 457

[56] References Cited

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2,025,362	12/1935	Starr	123/119 A
2,147,671	2/1939	Pratt	123/119 A
2,860,618	11/1958	Mansfield	123/119 A
3,397,682	8/1968	Rigan	123/119 A
3,435,810	4/1969	Busse	123/119 A
3,495,385	2/1970	Glass	60/311
3,530,843	9/1970	Fessenden	123/119 A
3,579,981	5/1971	Gau	123/119 A
3,580,233	5/1971	Busse	123/119 A

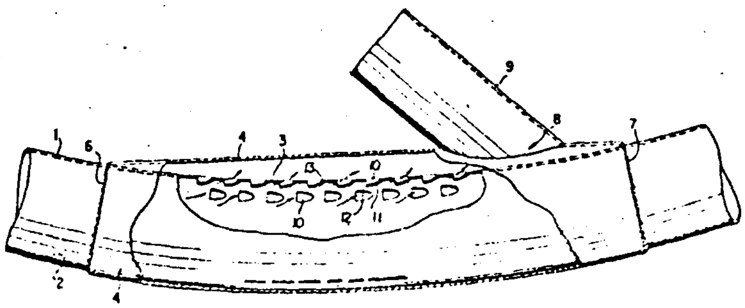
Primary Examiner—Wendell E. Burns
Attorney, Agent, or Firm—Sherman & Shalloway

[57] ABSTRACT

An exhaust extractor is disclosed in which a curvate path is provided for installation in the exhaust system of a vehicle and has an external chamber for receiving extracted fuel constituents of the exhaust for supply to the intake of the vehicle engine while precluding re-ingestion of undesirable particulate and pollutant matter. A main duct carries a plurality of inwardly directed transfer scoops for interception and transfer of usable particulates and other fractions of the exhaust into the external chamber at selected portions of the periphery of the main duct away from the outer portion of the curvate path therein to minimize the transfer of heavy particulates or solids to the external chamber and the remainder of the exhaust recycle system.

3 Claims, 2 Drawing Figures

FIG. 2



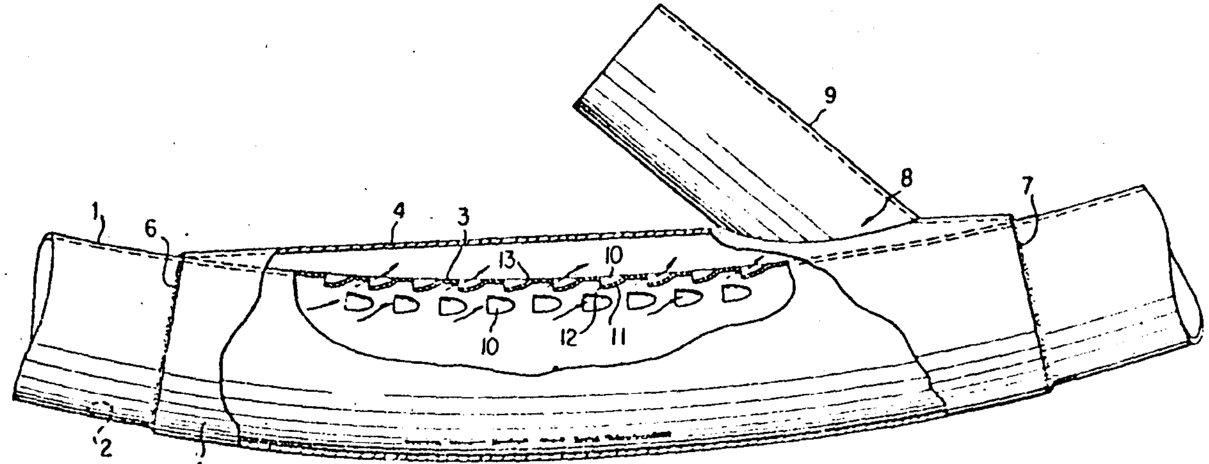


FIG. 1

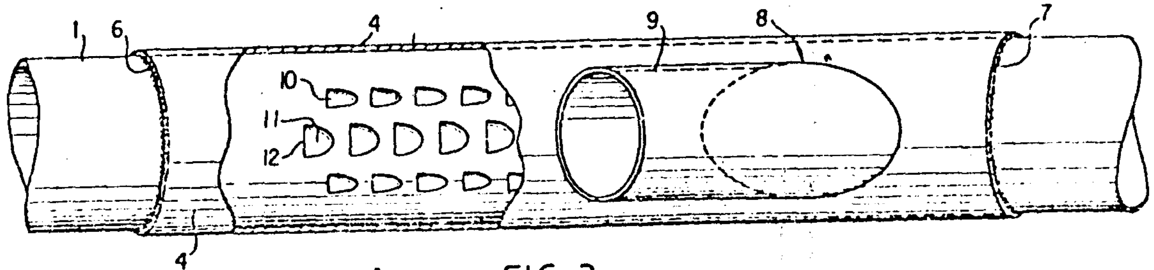


FIG. 2

FUEL COMPONENT EXTRACTOR

BACKGROUND OF THE INVENTION

The present invention is concerned with the return of selected portions of exhaust gases from internal combustion engines for utilization in the forming of subsequent charges for the intake of the engine and is concerned, more particularly, with an extractor for the exhaust system which returns a high quantity of the usable exhaust fraction while passing the undesirable and problematical components through for discharge.

PRIOR ART STATEMENT AND DISCUSSION

The most relevant prior art of which I am aware comprising the following United States patents:

U.S. Pat. No. 3,435,810 to Busse,
U.S. Pat. No. 3,530,843 to Fessenden; and
U.S. Pat. No. 3,580,233 to Busse.

U.S. Pat. No. 3,435,810 discloses a separator for exhaust gases which imparts a whirling motion to the gases to establish relatively separate streams of heavier and lighter components so that the light-component stream can be recycled to the intake of the engine.

U.S. Pat. No. 3,530,843 discloses an exhaust separator which includes an axial tube centrally located within the unit to pass the central, heavier portion of the exhaust, while the more desirable portions thereof are withdrawn from the chamber surrounding the axial tube for supply to a charge-forming mixer at the engine intake.

U.S. Pat. No. 3,580,233 discloses a separator of the type disclosed in the Busse U.S. Pat. No. 3,435,810 in conjunction with a swirling mixer for the recycled exhaust.

The prior attempts at separation of desirable exhaust fractions, as represented by the above-listed patents, are functional and can be used to recycle exhaust gases to the intake of a combustion engine. However, none of the prior art devices achieves a selective separation and recycle of the most desirable constituents of the exhaust without either imposing a substantial back-pressure on the engine or, eventually, accumulating and then transferring undesirable solid portions of the exhaust.

In the separator disclosed in the Busse U.S. Pat. Nos. 3,435,810 and 3,580,233, the enforced swirling of the exhaust gases imposes a considerable back-pressure on the system so that, although the efficiency of the engine is partially improved by the recycle of portions of the exhaust, a substantial part of the increase is lost to the need to overcome the back-pressure imposed by the efficiency-improving attempt.

In the separator of the Fessenden patent, the chamber surrounding the central, axial pipe is subject to accumulation of solids and, eventually, transfer of those solids through the recycle system to the fuel/exhaust mixer with consequent blockage of susceptible portions of the system.

Therefore, the prior forms of exhaust separators have not been found to be satisfactory in all respects, since they either involve mechanical complexities and high pressure drops or, if they are mechanically simple in construction, they are subject to undesirable misoperation after a period of use.

SUMMARY OF THE INVENTION

In general, the preferred form of extractor of the present invention comprises an exhaust duct section which is curved on an arc and which is in communication with an external chamber via a plurality of relatively small, inwardly-deflected wall portions positioned along the inner portion of the wall, the outer portion of the wall being imperforate and forming a smooth path for the through-passage of the heavier portions of the exhaust, including the heavier particulate components.

OBJECTS OF THE INVENTION

It is an object of the present invention to provide an exhaust extractor for exhaust recycle systems which is simple in structure, imposes no additional back-pressure on the engine, and is reliable in its extracting function over extended periods of usage.

It is another object of the present invention to provide a simple and reliable extractor for exhaust gases which will extract the usable exhaust portions for recycle with a minimum of the undesirable portions included.

It is another object of the present invention to provide a simple and reliable exhaust extractor which imposes a low back-pressure while imposing an inertial force on the exhaust components and passing the heavier portion of the constituents through the separator.

It is another object of the present invention to provide a simple and reliable exhaust extractor which imposes a low back-pressure while imposing an inertial force on the exhaust stream and intercepting and removing the lighter and usable constituents from the exhaust system.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects of the invention and a better understanding thereof may be derived from the following description and the accompanying drawings, in which:

FIG. 1 is a side view, partly cut away, of the preferred form of exhaust extractor of the invention; and

FIG. 2 is a top view, partly cut away, of a portion of FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in the drawings, the preferred form of extractor is in the form of an insert for incorporation in the exhaust system of vehicles for their conversion with an exhaust-recycle system to improve their efficiency and emission performance. It is to be understood, however, that the extractor of the present invention is quite appropriate for use as original equipment in such systems.

A particularly advantageous system is disclosed in my copending application Ser. No. 775,834, filed Mar. 9, 1977, and titled "EXHAUST RECYCLE MIXER." The extractor of the present invention has been found to be especially effective with the mixer disclosed in that application, but it is to be understood that the new extractor of the present invention may be used in any exhaust recycling system which may be found effective.

The new extractor comprises a section of exhaust duct 1 which defines a relatively gently curved path and includes an outer curvate wall 2 and an inner curvate wall 3. A sleeve 4 of similar exhaust pipe material surrounds the curved portion of the duct 1 and is welded thereto at its ends 6 and 7 to form an external chamber

5 [illegible] the inner wall 3. If desired, the chamber 5 may be formed by [illegible] other than a sleeve, such as a [illegible] as a [illegible] chamber is present [illegible] wall 3. The [illegible] may include portions of [illegible] walls toward the outer wall but is effective only at the [illegible] of the inner wall and the adjacent transition areas as will be apparent hereinafter. While the disclosed curvate form of duct is preferred, it is to be understood that other forms of fabrications may be employed as long as they provide a gently curved, low back pressure curvate flow path through the extractor.

The sleeve is provided with a takeoff aperture 8 in communication with the chamber 5 and a connector 9 for connection thereof with the exhaust/fuel mixer. The duct 1 carries a large number of small apertures 10 in its inner wall 3 which provide communication between the interior thereof and the external chamber 5 to transfer exhaust components to the chamber for recycle.

The apertures 10 preferably are formed by punching depressed wall portions 11 radially inwardly of the inner wall so that the depressed walls intercept exhaust components adjacent the inner wall for deflection into the chamber 5. It has been found advantageous to form the depressed portions with their leading edges 12 one-sixteenth to one-eighth of an inch inward from the inner surface 13 of the inner wall, and with an aperture size of about three-eighths of an inch in length and width, when the duct 1 is in the order of two and one-half inches diameter. While the foregoing dimensions are preferred for a duct of two and one-half inch diameter, it is to be understood that these dimensions may be varied for different-sized extractors. The resultant scoop or depressed wall portion thus forms a partially curvate deflector for the interception and removal of the desired exhaust portion of usable gases and light particulates.

In operation with exhaust gases flowing therethrough, as shown in FIG. 1, the heavier gases and solids are concentrated outwardly of the curve of the duct by inertia and tend to follow the outer wall 2 which, by reason of its being imperforate, channels these undesirable components toward the outlet and away from the chamber 5 without the imposition of complex vanes, swirlers or the like. The lighter gases and particulates which are appropriate for recycle and use in the engine are thus presented in the inner portion of the curved duct 1 and are intercepted by the depressed walls or scoops 11 and diverted into the chamber 5 for recycle via the connector 9 with a minimum of disturbance of the main flow of exhaust through the duct.

Therefore, it is apparent that the extractor of the present invention achieves its objects and provides an effective, selective extraction of the usable exhaust con-

stituents without imposing high, self defeating restrictions to flow, and consequent loss of engine efficiency.

Further, the new extractor has achieved its purpose in the reduction of recycled solids which tend to accumulate in the recycle system and to reduce the effectiveness of the system over long periods of usage.

Finally, it is apparent that the new extractor not only exceeds the prior units in its effectiveness and reliability, but also achieves its special advantages with an extremely simple structure free of complex diverters and of zones requiring servicing or periodic cleanout.

Various changes may be made in the details of the invention, as disclosed, without sacrificing the advantages thereof or departing from the scope of the appended claims.

What is claimed is:

1. An extractor for fuel components of an exhaust stream comprising:

(a) a curved duct for exhaust gases, said duct defining
(b) a curvate longitudinal interior flow path therethrough to impart a transverse inertial force on exhaust gases flowing longitudinally through said curvate flow path,
(c) a chamber exterior of said curvate flow path,
(d) transfer means for transferring fuel components from the inner arcuate portion of said curvate flow path to said chamber,
(e) said transfer means including a plurality of apertures in said duct along the inner arcuate portion of said curvate flow path and
(f) a deflector adjacent each aperture and extended into the inner arcuate portion of said curvate flow path, said deflectors being formed integrally with a wall of said duct and deformed therefrom to form said apertures.

2. The extractor of claim 1 in which said chamber encloses the area of said duct wall having the apertures therein.

3. An extractor for fuel components of an exhaust stream comprising:

(a) a duct for exhaust gases, said duct including
(b) a curvate wall portion at least partially defining the inner arcuate portion of a curvate flow path,
(c) said curvate wall having
(d) a plurality of deformed areas therein, said deformed areas each defining
 an aperture in said curvate wall and
 a deflector extended into an adjacent zone of said curvate flow path, and
(e) a chamber formed at least in part by said curvate wall and adapted to receive fuel components of the exhaust stream via said apertures for transfer to an exhaust recycle system.

* * * * *

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

Business Reply Mail

FIRST CLASS PERMIT NO. 107 WEST PALM BEACH, FL

POSTAGE WILL BE PAID BY

ENERGY GAS SAVER, INC.
SUITE 104
701 U.S. HIGHWAY 1
NORTH PALM BEACH, FL 33408

SUMMARY OF THE GASOLINE MILEAGE RESULTS ON THE FIVE TEST CARS OF HIGHWAY DRIVING

Test Car	Original Mileage	Gas Saver System Installed	Number Of Miles Increase	Additional Miles Per Tank of Gas
1 '70 Cadillac Fleetwood (472 cu in V8 engine)	13	19	6	144
2 '74 Chev Classic Convertible (350 cu in V8 engine)	15	22	7	154
3 '76 Olds Cutlass Supreme (350 cu in V8 engine)	15	21	6	132
4 '69 Cadillac Coupe de Ville Convertible (472 cu in V8 engine)	13	20	7	109
5 '77 Chev Caprice Classic (350 cu in V8 engine)	18	25	7	140
Average	14.8	21.4	6.6	151.8

Average increase in number of miles — 6.6 miles
Average increase in number of miles per tank of gasoline — 151.8 miles

Testing done by: Detroit Testing, Computerway and Car-Bo-Tech, Inc., September 1978

BULK RATE
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ENERGY GAS SAVER INC.

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SUITE 104 • NORTH PALM BEACH, FLORIDA 33408

ENERGY
GAS
SAVER

Please send me ____________ Energy Gas Saver System(s) at $299.95 installed.
(Include 4% Florida state sales tax $12.00)

To go on a 19 ______, ______________ ☐ automobile ☐ van ☐ pick-up ☐ other _ ☐ 6 ☐ 8 cylinder.

To go on a 19 ______, ______________ ☐ automobile ☐ van ☐ pick-up ☐ other _ ☐ 6 ☐ 8 cylinder.

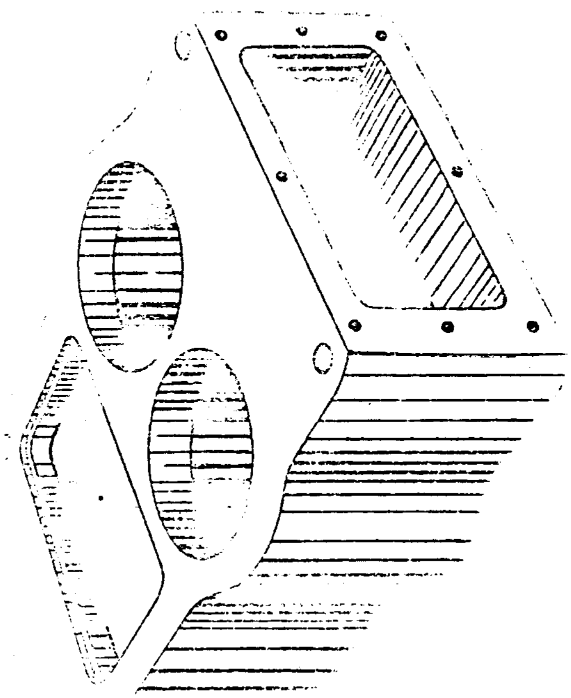
Name ______________________________ ☐ Check ☐ Visa # __________

Address ______________________________ ☐ Master Charge # __________

City ______________ State ____ Zip ______ ☐ Carte Blanche # __________

Phone ______________ Area Code ________ ☐ American Express # __________

Guaranteed to improve your gas mileage or your money back for the cost of the unit.



ENERGY GAS SAVER

Attachment C

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

ANN ARBOR, MICHIGAN 48105

OFFICE OF
AIR, NOISE AND RADIATION

June 23, 1981

Mr. Donald C. Pletts, President
Energy Gas Saver, Inc.
143 Inlet Way #5
Palm Beach Shores, FL 33404

Dear Mr. Pletts:

Please find enclosed an updated copy of the EPA recognized independent laboratory list.

Sincerely,

Merrill W. Korth

Merrill W. Korth, Device Evaluation Coordinator
Test and Evaluation Branch

Enclosure

cc. J. White
511 file "Energy Gas Saver"

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

ANN ARBOR, MICHIGAN 48105

June 26, 1981

OFFICE OF
AIR, NOISE AND RADIATION

Mr. Donald C. Pletts
143 Inlet Way #5
Palm Beach Shores, FL 33404

Dear Mr. Pletts:

We have completed our preliminary evaluation of your application, material, and test plan for the "Energy Gas Saver" device. Our comments are as follows:

1. Since you intend to use test results from Olson Engineering, Inc. in support of your application for an EPA evaluation, we feel that you should have submitted your application or otherwise contacted us before the testing was performed there in March, 1981. This would have given us on opportunity to comment on your test plan before the tests were performed.

2. During the testing at Olson Engineering on the 1981 Ford LTD 302 V-8, the as-received baseline test should have been performed first, before the test with the "Energy Gas Saver" installed. We suggest that you test a second vehicle which is not equipped with overdrive or throttle body injection, as these are not representative of the vehicle population.

3. Also, what were the tuneup procedures before each test sequence at Olson Engineering, and were all components of the "Energy Gas Saver" removed before the baseline tests? Have all the results from tests at Olson Engineering been submitted to us?

4. Your installation instructions require that timing be set 2 to 4° more advanced than factory specifications, and that the carburetor fuel mixture be readjusted. If this is done, a separate test sequence is required with only these adjustments and without the "Energy Gas Saver" installed. Were these adjustments made on your test vehicle? If so, please detail the procedures used.

5. From the Olson Engineering test data sheets, we noticed that a different dynamometer was used for the baseline tests than was used for the tests with the device. This is inconsistent with our guidelines for properly evaluating a device.

6. For tests on the 1981 Ford at Automobile Club of Southern California, no data sheet was submitted for tests with the "Energy Gas Saver" installed.

7. The other data submitted with your application from the various sources is of some value, but we do not consider it as valid data to be used in place of current test data from an independent laboratory as described in my letter dated January 13, 1981.

We hope the above comments are helpful to you in conducting a test program to evaluate "Energy Gas Saver". In order for us to conduct our evaluations in a timely manner we have established a schedule for each. I ask that you respond to this letter by July 13, 1981 and that you submit the results from your latest tests by August 3, 1981.

If you have any questions, please feel free to contact me. My telephone number is (313) 668-4299.

Sincerely,

Merrill W Korth

Merrill W. Korth, Device Evaluation Coordinator
Test and Evaluation Branch

Attachment E

ENERGY GAS SAVER INC.

July 9, 1981

Mr. Merrill W. Korth
Devise Evaluation Coordinator
Test and Evaluation Branch
U. S. E. P. A.
Ann Arbor, Michigan 48105

Dear Mr. Korth:

Please refer to your letter of June 26, 1981.

1. When I went to California in March of this year, I did not plan on having tests done by Olson Engineering, Inc. Also my plan was to obtain an exemption from the Air Resourse Board of California, in order to sell the "Energy-Gas-Saver" in California.

2. The Air Resourse Board gave me permission to have "Olson" do the tests with the Energy-Gas-Saver before doing the baseline test. You'll note that you have a baseline test done by the "Auto Club of Southern California". Also you have records of Ford Motor Company certification tests.

3. The 1981 Ford Ltd. with a 302 V-8 Engine was checked as per Company specifications including Idle on the carburetor. The Idle is the only adjustment that can be made on this vehicle. A copy of all the "Olson" tests are enclosed. The extractor was not removed from the exhaust system, it was however blocked off.

4. No adjustments were made on this vehicle, for any of the tests. (no adjustments could be made). I understand your requirments for testing in the event adjustment are made different than baseline.

5. Because of the sizable changes in the testing "Olson" used both of their dynamometers.

6. The Auto Club of Southern California would not give me the results of their test with the Unit installed. These results are however included in the summary sheet.

7. The purpose of sending you all the test data was to show how much research had been done on the "Energy-Gas-Saver".

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ENERGY GAS SAVER INC.

Mr. Merrill W. Korth
July 9, 1981
Page 2

Since you allow Hot Start LA-4 testing, I would like to bring to your attention the Hot Start tests done by "Olson" as shown on page 2 of the enclosed "Summary of Highway Fuel Economy Tests".

You'll note the Baseline test by "Olson" is higher in HC and NOX than all three Hot Start tests done with the "Energy Gas Saver". Also test #1 is approximately the same on CO. I believe that if you converted the Auto Club of Southern California P.P.M. to Grams this Baseline test would be some what higher than the Olson test.

I am also enclosing the data I received from a California testing laboratory which I shall discuss with you on the telephone.

It is my intention to test a 1979 Ford with a 302-V8 Engine that does not have a closed loop feed back system and without an overdrive transmission. The testing laboratory will contact you prior to the starting of our next tests.

Yours very truly,

Donald C. Pletts
President

DCP/edy
Enclo.

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AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC. ■ 7300 BOLSA AVENUE, WESTMINSTER, CALIFORNIA 92683 ■ 714 897-0333

A subsidiary of Clayton Manufacturing Company

June 29, 1981

Mr. Don Pletts
Energy Gas Saver
143 Inlet Way #5
Palm Beach Shores, FL 33404

Dear Mr. Pletts:

AESi is pleased to submit the following quotation and proposal for testing services:

PRICE QUOTATION

See attached Quotation.

TERMS

Payment is by cashier's check upon delivery of vehicle to AESi. There is a $300 minimum fee if the vehicle fails to complete an FTP for safety or mechanical reasons due to the vehicle.

All applicants attempting certification under Section 511 of the Motor Vehicle Information and Cost Savings Act must develop a test plan with EPA officials if EPA approval is desired. This is the responsibility of the applicant, not AESi.

TESTING

The vehicles will receive a baseline Hot Start LA-4 and a Highway Fuel Economy test. The vehicles will be tested on Indolene unleaded test fuel as prescribed in the Federal Register. A second (replicate) LA-4 and HFET sequence will be performed. These tests will be audited according to EPA requirements before acceptance.

Following confirmation of test quality, your device will be added in the vehicle by our mechanic. An additional set of LA-4 and HFET tests will then be performed.

An option that is available, should you desire, is the installation of a fuel flow meter to provide actual fuel consumed during emissions test and mileage accumulation. The price for installation, data collection, and reporting and vehicle restoration is $200.

AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC.

SCHEDULE

We require a two week notice to schedule your vehicle for testing. The test and compilation of results will take approximately 6 days.

DEVICE

The test device will be provided by you.

VEHICLE

The test vehicle may be provided by you or you may choose to have AESi procure a vehicle at $30.00/day for a minimum of 6 days (4 days to perform tests, 1 day for vehicle preparation and 1 day for vehicle restoration and return).

All Section 511 applicants are reminded that test vehicles must meet emissions standards in baseline tests. If an applicant supplied vehicle fails a baseline test, the applicant must pay for this test. If an AESi supplied 1981 vehicle fails a baseline test the applicant will not be charged for this test.

RESULTS

Certified test results will be provided in letter report form only to you or to a person designated by you in writing. Original test result documentation will be retained by AESi to substantiate the test results. This information is kept in strictest confidence.

AGREEMENT

A copy of our testing agreement is attached. Please read it carefully as it contains limitations on our liability and restrictions on the use and applicability of the test results.

I appreciate the opportunity to provide you with this quotation. If you require additional information please do not hesitate to contact me.

Sincerely,

Alan D. Jones
Project Engineer

ADJ:mra

Encls

AEST
AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC.
7300 BOLSA AVENUE WESTMINSTER, CAL 92683
PHONE 714 897-0333

DATE PAGE OF

QUOTATION Q-2883

ACCT. CUSTOMER NO.

TO: ENERGY GAS SAVER
143 Inlet Way #5
Palm Beach Sores, FL 33404

Attention: Mr. Don Pletts

SHIP TO:

REFERENCE	CONTACT DATE	TERMS:
	06/24/81	Cashier's Check-Payment in Advance

RESALE YES NO	TAX %	DATE REQUIRED	SHIP DATE	SHIP BY:	F.O.B.

ITEM	QUANTITY	PART NUMBER DESCRIPTION	NET UNIT PRICE	AMOUNT
1	2	Vehicle Parameter Checks	35.00	70.00
2	2	LA-4/HFET Baseline	600.00	1,200.00
3	2	LA-4/HFET Baseline Replicate	600.00	1,200.00
4	2 hrs	Device Installation	40.00/hr	80.00
5	2	Vehicle Parameter Checks	35.00	70.00
6	2	LA-4/HFET w/Device	600.00	1,200.00
7	2	LA-4/HFET w/Device Replicate	600.00	1,200.00
		THIS QUOTATION IS VALID UNTIL AUGUST 29, 1981		

THIS QUOTATION SUBJECT TO TERMS AND CONDITIONS ON REVERSE SIDE

TOTAL AMOUNT 5,020.00

CONTACT BY: ADJ ADJ

PREPARED BY: ADJ:MRA:06/29

AUTHORIZED BY: R. A. Cassidy

AESi

VEHICLE EMISSIONS TESTING AGREEMENT

THIS AGREEMENT LIMITS THE LIABILITY OF AESi, PLEASE READ CAREFULLY

1. AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC., (AESi), agrees to conduct the vehicle emissions tests specified below in general accordance with the procedures prescribed by the United States Environmental Protection Agency, or as otherwise described below. All testing will be done in the AESi Westminster, California, vehicle emissions testing laboratory.

2. AESi herewith offers to perform the following tests and support activities for the firm fixed price stated below.

QUANTITY	-- DESCRIPTION -- TEST TYPE, VEHICLE TYPE, SPECIAL PROCEDURES, ETC.	SCHEDULED DATE	UNIT PRICE	TOTAL
		TOTAL FIRM FIXED PRICE		

☐ CHECK

☐ CASH

3. Payment in full must be received by AESi prior to the commencing of testing. The price quoted above covers only those items stipulated above. Any additional work must be covered by a new agreement.

4. AESi agrees to perform the activities specified above within two weeks of the date of this agreement. AESi will notify the customer of each scheduled test time at least 24 hours prior to the test time. It is the responsibility of the customer to furnish the test vehicles at the scheduled time. If the vehicle is not available for testing at the scheduled time, an additional charge of $100 will be made to the customer. If any devices are to be installed on the vehicles prior to testing, or other additional work performed, such work will be quoted separately.

5. AESi will mail to the customer a letter describing the testing procedures and presenting the test results within one week of the completion of the testing. The results will be presented in terms of hydrocarbon (HC), carbon monoxide (CO), carbon dioxide (CO_2), and corrected oxides of nitrogen (NOxC), in grams per mile, as well as the calculated fuel economy in miles per gallon. Motorcycle emissions are reported in grams per kilometer and fuel consumption in liters per 100 kilometers. The customer agrees not to use AESi's name or letter of results or any parts thereof in connection with any advertising, sales or promotional purposes without specific prior written approval from an officer of AESi.

6. AESi agrees to hold the customer's test results in strictest confidence and will not divulge such results to any other party without specific written authorization from the customer. AESi will make no representations or assume any responsibility for implied results or assumed information other than the specified data as they appear in the complete written final report letter.

7. AESi agrees to maintain the security of the customer's systems and/or devices while in the possession of AESi and to hold in confidence all proprietary information disclosed to AESi. Reciprocally, the customer agrees to honor AESi's laboratory security requirements, which restrict access to testing areas.

SEE REVERSE SIDE

8. The customer acknowledges and understands that (i) AESi does not inspect vehicles submitted for testing to AESi for mechanical defects or problems prior to testing, (ii) during testing AESi may be unable to detect any mechanical or other defects or problems affecting the vehicle, including those defects and problems which may, in connection with such testing, potentially result in substantial damage to the vehicle, prior to completion of such testing, and (iii) as a result, although the vehicle will be tested under circumstances substantially similar to normal driving conditions, the vehicle may nevertheless suffer substantial damage during testing in the event that mechanical or other defects or problems exist prior to testing or develop during testing. *IN CONNECTION THEREWITH, NOTWITHSTANDING ANY SHOWING OF NEGLIGENCE ON THE PART OF AESi OR ITS REPRESENTATIVES, THE CUSTOMER HEREBY AGREES TO INDEMNIFY AND HOLD AESi HARMLESS AGAINST ANY AND ALL CLAIMS, ACTIONS, CAUSES OF ACTION, SUITS, DEBTS, CONTROVERSIES, LOSSES, DEMANDS, PROCEEDINGS, DAMAGES, LIABILITIES, COSTS AND EXPENSES, INCLUDING ATTORNEY'S FEES, ARISING OUT OF OR RESULTING FROM THE TESTING, POSSESSION, USE OR STORAGE OF THE VEHICLE BY AESi.*

9. AESi SHALL HAVE NO LIABILITY FOR THEFT, COLLISION, FIRE OR DAMAGE OF ANY KIND WHATSOEVER DURING THE TESTING, STORAGE, USE OR POSSESSION OF THE VEHICLE BY AESi FOR ANY REASON WHATSOEVER INCLUDING, WITHOUT LIMITATION, THE NEGLIGENCE OF AESi OR ITS REPRESENTATIVES EXCEPT WHEN DUE TO THE WILLFUL FAULT OR GROSS NEGLIGENCE OF AESi OR ITS AUTHORIZED REPRESENTATIVES, AND IN THAT EVENT, ONLY TO THE EXTENT OF THE DIMINUTION IN THE RETAIL USED CAR VALUE OF THE VEHICLE ON THE DATE OF DELIVERY OF POSSESSION TO AESi. IN NO EVENT SHALL AESi BE LIABLE FOR LOSS OF USE OF THE VEHICLE OR FOR LOSS OF OR DAMAGE TO ANY ARTICLES LEFT IN THE VEHICLE OR FOR ANY OTHER FORM OF INCIDENTAL OR CONSEQUENTIAL DAMAGE.

10. AS A CONDITION OF ANY LIABILITY ON THE PART OF AESi, UPON RECEIPT OF THE VEHICLE FROM AESi, (i) THE CUSTOMER SHALL IMMEDIATELY INSPECT THE VEHICLE IN ALL RESPECTS FOR DAMAGE OR DEFECT, (ii) IN CASE OF DAMAGE, THE CUSTOMER SHALL DEMAND REPAIRS BEFORE THE VEHICLE IS REMOVED FROM AESi'S POSSESSION, AND (iii) AESi SHALL BE ENTITLED TO MAKE OR ORDER ANY REPAIRS.

11. AESi disclaims any representation whatsoever that the tests performed by AESi will provide results which will permit the vehicle tested to be certified for sale in accordance with the U.S. Environmental Protection Agency regulations or any other applicable federal, state or local governmental statute, rule, order, law or regulation.

12. This agreement will be formally entered into on the latest date signed below by duly authorized representatives of both parties: THIS AGREEMENT LIMITS THE LIABILITY OF AESi, PLEASE READ CAREFULLY.

Name: ______________________________

Address: ______________________________

Signature: ______________ Date: __________

Business Phone: ______________

Home Phone: ______________

AUTOMOTIVE ENVIRONMENTAL SYSTEMS, INC.
7300 Bolsa Avenue
Westminster, CA 92683

Signature: ______________ Date: __________

Att ch.

ENERGY GAS SAVER INC.

August 21, 31

Mr. Merrill . Korth, Device Evaluation Coordinator
Test and Ev ıation Branch
U. S. E. P.
Ann Arbor, chigan 48105

Dear Merrill:

As per our telephone conversation of August 17, 1981, I am submitting a test plan for your approval.

A. Test Vehicle #One - 1979 Ford Thunderbird (302-V8 Engine)
Testing to be done by A.E.S.I. of Westminster, California

a. 1 Vehicle Parameter check. (Factory specifications)
b. 1 LA-4/HFET Baseline (Hot Start)
c. 1 LA-4/HFET Baseline (Hot Start) Replicate
d. Device Installed by Testing Facility
e. 1 Vehicle Parameter Check with divice installed
f. 1 LA-4/HFET with Device (Hot Start)
g. 1 LA-4/HFET with Device (Hot Start) Replicate

These tests shall start on September 14, 1981.

B. Test Vehicle #Two - 1981 Ford Ltd. (302-V8 Engine) Auto Overdrive Transmission

a. 1 Vehicle Parameter Check (Factory specifications)
b. 1 SECVS 11 Cold Start Baseline
c. 1 LA-4/HFET Baseline (Hot Start)
d. 1 LA-4/HFET Baseline (Hot Start) Replicate
e. Device Installed by Testing Facility
f. 1 Vehicle Parameter Check with device installed
g. 1 SECVS 11 Cold Start with device installed
h. 1 LA-4/HFET with device installed (Hot Start)
i. 1 LA-4/HFET with device installed (Hot Start) Replicate

Vehicle #Two tests shall begin on September 21, 1981. The fuel to be used is Indolene Unleaded Test Fuel.

I trust this test plan shall be to your satisfaction.

Yours very truly,

Donald C. Pletts
President

DCP/edy cc: AESI

FIRST AMERICAN BUILDING • 701 U.S. HIGHWAY ONE • SUITE 1 • NORTH PALM BEACH, FL 33408 • 305/845-6105 • 1-800-432-3589

Septem ?, 1981

Mr. Donald C. Pletts, President
Energy Gas Saver
143 Inlet Way #5
Palm Beach Shores, FL 33404

Dear Mr. Pletts:

We have evaluated your latest test plan which we received on August 26, 1981. Our comments are as follows:

1. We would prefer that both vehicles not be equipped with the same engine. Each of the test vehicles you propose are equipped with 302 CID engines. We suggest that you replace one of these Fords with a late model GM car with a popular engine, preferably a V-6.

2. Is vehicle #2 the same test vehicle that was used earlier for tests at Olson Engineering?

3. Each vehicle should be completely original for the as-received tests and must not contain any modifications to the exhaust or emission systems.

4. How much does the installation of the device upset the configuration of the carburetor linkages, choke tubes, and the exhaust system?

5. Is any mileage accumulation required before the full benefit of the device is realized?

6. Are the test vehicles to be equipped with special air cleaners and will the hood close? We are concerned that additional height of the carburetor will cause a problem.

7. Although your test plan does not provide for any adjustments when the device is installed by the testing facility, we ask that certain checks should be performed before and after the installation of the device. These checks should include basic engine parameters and for the 1981 vehicle, we ask that the engine receive appropriate electronic checks to ensure that the sophisticated control systems on these vehicles are working properly.

8. On test vehicle #2, test sequence b includes a "SECVS 11 Cold Start Baseline". What is this test cycle?

We hope the above comments are helpful to you in conducting a test program to evaluate "Energy Gas Saver". We ask that you submit the results from your latest tests by October 15, [illegible]. If you have any questions, please contact me. My telephone number is (213) 668-4299.

Sincerely,

Merrill W. Korth, Device Evaluation Coordinator
Test and Evaluation Branch

October 29, 1981

Mr. Donald C. Pletts, President
Energy Gas Saver
143 Inlet Way #5
Palm Beach Shores, FL 33404

Dear Mr. Pletts:

In my letter to you of September 2, 1981, I explained the requirements for testing of "Energy Gas Saver" by an independent laboratory recognized by EPA. I also presented several other questions to you at that time. I asked that you respond to my letter by October 15, 1981. We have not received your response. Since you have not supplied EPA with appropriate test data for "Energy Gas Saver", we have insufficient data to support your claim for its fuel economy benefit.

Under the provisions of Section 511 of the Motor Vehicle Information and Cost Savings Act, EPA is required to evaluate your device on the basis of available information and publish the results of our evaluation in the Federal Register. We have begun to prepare our report.

Please contact me immediately if you do not understand this course of action. My telephone number is (313) 668-4299.

Sincerely,

Merrill W. Korth
Device Evaluation Coordinator
Test and Evaluation Branch

cc. 511 file (Energy Gas Saver)
J. Shelton

FEDERAL REGISTER TYPESETTING REQUEST

REQUESTOR: Complete items 1, 2, 7, 8, 9, 10, 11 and 12. Retain copy number 7 and submit the balance with manuscript copy to the Hq Federal Register Office.
HQ FEDERAL REGISTER OFFICE: Complete items 3, 4, 5 and 6. Retain copy number 6 and submit balance to Hq. Printing Management.

TITLE
Announcement of Fuel Economy Device Evaluation for "Energy Gas Saver"

2. SUBMITTING ACTIVITY

3. ASSIGNED FRL NUMBER *(include alpha & numeric characters for identification.)*

4. OPEN REQUISITION NUMBER

5. BILLING CODE

6. FORWARDED TO GSA, NARS--SIGNATURE

DATE

7. NUMBER OF MANUSCRIPT PAGES: 4

8. ESTIMATED NUMBER OF COLUMNS: 2

9. ESTIMATED COST: $272.00

10. FINANCIAL DATA

FMO USE (a) 1–13	DT (b) 14	DOCUMENT CONTROL NO. (c) 15–20	ACCOUNT NO. (d) 31–40	OBJECT CLASS (e) 41–44	AMOUNT (f) DOLLARS 45–54	CTS 55–56
2 . . . 0 . 0		B20179	2AHT56BOT0	2402	272	00
2 . . . 0 . 0						
2 . . . 0 . 0						

11. SIGNATURE: (a) REQUESTING OFFICER
John White for John Shelton

(b) DATE 1/21/82

(c) TELEPHONE NUMBER FTS 374-8429

12. SIGNATURE: (a) FEDERAL REGISTER DESIGNEE
(I certify that the funds listed above are available and reserved.)
Kathleen Walsh

(b) DATE 2-17-82

(c) TELEPHONE NUMBER 374-8400

EPA Form 2340-15 (1-81)

COPY 1 PRINTING MANAG[illegible]