EPA-AA-TEB-511-81-15

EPA Evaluation of the Treis Emulsifier Device Under Section 511 of the Motor Vehicle Information and Cost Savings Act

by

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July, 1981

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

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
EPA-AA-TEB-511-81-15		PB82 109711

4. TITLE AND SUBTITLE	5. REPORT DATE
EPA Evaluation of the Treis Emulsifier Device Under Section 511 of the Motor Vehicle Information and Cost Savings Act	July 1981
	6. PERFORMING ORGANIZATION CODE U275428
7. AUTHOR(S) Thomas J. Penninga	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Environmental Protection Agency, Office of Mobile Source Air Pollution Control, Test and Evaluation Branch, Ann Arbor, MI 48105	10. PROGRAM ELEMENT NO.
	11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS Same as box 9.	13. TYPE OF REPORT AND PERIOD COVERED Technical
	14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

This document announces the conclusions of the EPA evaluation of the "Treis Emulsifier" device under provisions of Section 511 of the Motor Vehicle Information and Cost Savings Act.

On February 17, 1981, the EPA received a request from Treis International for evaluation of a fuel saving device termed "Treis Emulsifier". This Device is designed to generate a gasoline, water-alcohol emulsion. The water is in finite droplet form, evenly dispersed throughout the gasoline and is claimed to prevent premature ignition or knock, and allow a more complete combustion. This is claimed to result in improved fuel economy, torque, and engine life.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Fuel Consumption Automobiles Engines	Fuel Economy Gas Saving Device	

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report)	21. NO. OF PAGES
release unlimited	unclassified	41
	20. SECURITY CLASS (This page) unclassified	22. PRICE

EPA Form 2220-1 (9-73)

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ENVIRONMENTAL PROTECTION AGENCY

[40 CFR Part 610]

[FRL _____]

FUEL ECONOMY RETROFIT DEVICES

Announcement of Fuel Economy Retrofit Device Evaluation for "Treis Emulsifier"

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 "Treis Emulsifier" device under provisions of Section 511 of the Motor Vehicle Information and Cost Savings Act.

BACKGROUND INFORMATION: 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 Federal Register 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 February 17, 1981, the EPA received a request from Treis International for evaluation of a fuel saving device termed "Treis Emulsifier". This Device is designed to generate a gasoline, water-alcohol emulsion. The water is in finite droplet form, evenly dispersed throughout the gasoline and is claimed to prevent premature ignition or knock, and allow a more complete combustion. This is claimed to result in improved fuel economy, torque, and engine life.

Availability of Evaluation Report: An evaluation has been made and the results are described completely in a report entitled: "EPA Evaluation of the Treis Emulisfier Device Under Section 511 of the Motor Vehicle Information and Cost Savings Act," report number EPA-AA-TEB-511-81-15 consisting of 35 pages including all attachments.

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
Phone: Federal Telecommunications System (FTS) 737-4650
Commercial 703-487-4650

Summary of Evaluation

EPA fully considered all of the information submitted by the Device manufacturer in the Application. The evaluation of the "Treis Emulsifier" device was based on that information. Additional information and test data was requested of the Applicant. No response to this request was received. Without the requested information, a thorough evaluation of the device cannot be made. Most importantly, the application did not describe the actual "Treis Emulsifier" device. Thus, an analysis of the feasibility of the device is not possible.

The test data submitted with the application raises many questions but does not indicate a significant fuel economy improvement. The testing perfotmed is contradictory and inconclusive. The test procedures used are not designed to indicate improvements in exhaust emission levels and urban fuel economy. The test procedures and test vehicles used do not agree with the installation instructions submitted with the application. The Applicant was requested to submit additional information concerning the testing data. No response was received by EPA.

Therefore, there is no technical basis to support any claims for a fuel economy or emission improvement due to the use of the "Treis Emulsifier".

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

Edward F. Tuerk
Acting Assistant Administrator
for Air, Noise, and Radiation

EPA Evaluation of the Treis Emulsifier Device 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:

Treis Emulsifier
Model A (for engines rated 15 mpg or better by EPA)
Model B (for engines rated 10-15 mpg by EPA)
Model C (for engines rated 10 mpg or less by EPA)

2. Inventor of the Device and Patents:

A. Inventor:

Paul R. Goudy, Jr.
2016 East Wood Place
Shorewood, WI 53211

B. Patent: Pending

3. Manufacturer of the Device:

Model Specialities, Inc.
300 E. Oak Street
Oak Creek, WI 53154

4. Manufacturing Organization Principals:

Arthur Gavlitta - President
Frank Ramon - Vice President
Stanley Lancar - Secretary/Treasurer

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

Treis International
20700 Miles
Cleveland, OH 44128

6. Applying Organization Principals:

Ken Landis - President
Paul Goudy - Vice President
Bruce Landis - Vice President

7. Description of Device:

A. Purpose of the Device (as supplied by Applicant):

"To increase gas mileage and prolong engine life through more efficient combustion."

B. Theory of Operation (as supplied by Applicant):

"The device generates a gasoline, water-alcohol emulsion (water-alcohol less than .5% by volume). The water in finite droplet form, evenly dispersed throughout the gasoline, performs the following functions:

1. Elevates the apparent ignition temperature of gasoline:
The ability of water to absorb large amounts of heat (in comparison to gasoline) allows it to cool the gasoline during compression, thus preventing premature ignition or knock.

The heat absorption of the water is greatly enhanced by its physical form since it's dispersed in droplets, not as a monomolecular vapor. This difference between the Treis device and available vapor injectors allows the use of much smaller percentages of water to accomplish the same cooling effect.

The difference is evident when one considers that the Treis device requires "heat of vaporization" to be absorbed in the combustion chamber to transform water droplets to water vapor.

2. More Complete Combustion:
The water droplets expand rapidly as they change to the vapor state. This expansion (explosion) causes the gasoline surrounding each droplet to be rapidly dispersed and thus a more even dispersion (vaporization) of gasoline is accomplished with the addition of water. The net result is an increase in the exposed gasoline surface available for combustion. More complete burning follows.

NOTE: This point (#2) is more applicable to carbureted automobiles where fuel tends to be dispersed in generally larger droplets than fuel injected autos.

3. Increased Torque:
The effects of #1 and #2 together tend to produce an even (generally circular) flame front which by eliminating spiked flame patterns (associated with knock) prolongs the burning process in the combustion chamber. Peak pressures are produced later than normal (at or near mid-stroke of the crankshaft) and therefore torque is increased.

4. Cleaner Combustion Chamber:
Point #1 necessarily produces this result. Extended engine life is expected, therefore, due to cleaner rings and valves.

C. Detailed Description of Construction (as supplied by Applicant):

1. Construction:
"See schematic drawing enclosed. The device was designed to withstand at least 300 psi." (NOTE: No schematic drawings were enclosed with the 511 Application.)

2. Operation:
"The device acts as an open ended water trap. It traps slugs of water (added to gas tank), disperses the water throughout the device and then allows the gasoline to scrub the water out of the device, thus forming an emulsion.

The invention relates to the addition of an additive, such as a mixture of water and alcohol, to the fuel of an engine. The additive is added upstream of the engine carburetor or fuel injectors. According to the invention a mixing apparatus schematically depicted in the accompanying drawings mixes the fuel and the additive to form a long lasting emulsion. Preferably, the mixer is of the type known as a static or motionless mixer to minimize the amount of energy used to effect mixing. The emulsion has a leaning effect enabling advancement of the spark before top dead center, an amount that improves fuel economy."

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

"The device is applicable to all gasoline powered automobiles. Sizing: See part #2 "Marketing Identification".

NOTE: The device has not been tested on diesels, however, it is expected that if applied to diesels the results would be:

a. Increased mpg
b. Increased torque
c. Cleaner engine internals
d. Quieter operation
e. Reduction in particulate emissions"

9. Costs (as supplied by Applicant):

No information was supplied in the application.

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

"The device should be installed in the fuel-line following the fuel system bypass (back to tank), but before the carburetor or the fuel injectors. The device has 1/4" female pipe threads and therefore can be easily mated to any fuel-line using standard fittings available at auto parts stores.

NOTE: The device does require disconnecting the fuel-line at the carburetor, therefore, it is suggested that, a) the battery be disconnected prior to installation, b) the engine be cold and, c) a qualified mechanic perform the installation."

11. Device Operation (as supplied by Applicant):

"After installation, 1/2 pint of 45% alcohol to 55% distilled water should be added to the gas tank. The car should be driven for 100-200 miles and then the initial spark advance should be set

between 12 and 15 B.T.D.C. No further water should be added until engine knock is heard upon acceleration. At that time, an additional 1/2 pint of mix should be added. Repeat as required to prevent engine knock."

12. Maintenance (claimed):

"None; except adding water."

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

"None"

14. Effects on Vehicle Safety (claimed):

"Reduces chance of fire in carburetor and intake manifold through reduced volatility of gasoline."

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

The applicant submitted data was in three parts, which are described below:

a. Bendix Corporation Data:
The Bendix data consists of 9 tests which, based on mileage calculations, appear to be Highway Fuel Economy Tests. The data indicates that standard dilute emission measurements were taken. In addition, fuel and water consumption were measured. The tests were run for varied spark timing and water consumption settings. The test vehicle was a 1979 Buick Regal with an 231 CID, V-6 engine. A summary of the test data is given below. Actual test data sheets are enclosed as an attachment.

Test No.	HC	CO	NOx	Fuel Economy MPG	Timing	Water Consumption	Fuel Consumption (grams)
1	.773	2.938	1.205	21.996	Mfg. Spec.	0	1319.7
2*	1.425	2.622	1.142	21.315	Mfg. Spec.	36 ml.	1368.8
3	1.570	1.793	1.495	23.946	Mfg. Spec.	15 ml.	1233.17
4	.898	2.184	1.263	22.646	Mfr. Spec.	0	1303.8
5	.984	1.513	1.693	25.167	Mfr. Spec. + 10°	0	1186.88
6	1.175	1.457	1.542	25.665	Mfr. Spec. + 10°	10 ml. (50% Ethanol)	1134.00
7	.891	1.934	1.215	23.667	Mfr. Spec.	0	1238.33
8	1.024	1.343	1.648	25.378	Mfr. Spec. + 10°	10 ml. (50% Ethanol)	1163.2
9**	.036	.033	1.493	25.932	Mfr. Spec. + 10°	20 ml. (50% Ethanol)	1151.5

* noted as in doubt due to equipment malfunction

** catalyst added

b. Second Set of Data
This data is prefaced by a letter to the applicant from the inventor which describes HFET data taken by an "EPA approved laboratory" which is not named. Twelve HFET tests were run. Both engine-out and catalyst-out measurements were taken. Measurements of water/alcohol mixture consumed were also made. Several attachments listed on the prefacing letter were not included in the application. One of the attachments presents data taken previously at Systems Control, Inc. (SCI). SCI has since been recognized as a laboratory capable of performing appropriate tests. The SCI data also indicates several attachments describing the data which were not included in the application. A summary of the catalytic converter output data follows:

	gms/mi				Fuel Consumed/	H2O	% Water	% Alcohol
Test No.	HC	CO	NOx	MPG	per mile	in ml.	in Fuel	in Water
10	.113	5.227	1.409	21.478	123.6	0	-	-
11	.092	3.383	1.584	21.380	120.1	13	.8	-
12	.049	1.954	1.622	20.423	128.6	21	1.2	10
21	.135	4.081	1.553	21.300	133.2	12	.7	10
22	.033	1.553	1.119	27.239	132.3	75	4.1	20
23	.028	1.012	1.645	19.956	135.1	63	3.4	5
31	.075	2.200	1.612	20.607	138.9	35	1.8	5
32	2.411	63.654	.938	19.114	113.2	40	2.5	-
33	.019	.627	1.047	30.574	133.3	42	2.3	-
34	.023	.744	1.706	18.948	143.5	40	2.0	-
41	.023	1.126	1.788	19.666	137.4	31	1.6	-
42	.032	1.104	1.703	19.222	139.5	58	3.0	-

A copy of the test data is attached.

c. The SCI - Environmental Engineering Division Data
The SCI data consists of a baseline FTP and HFET sequence followed by an HFET run with the device. The SCI data summary discusses "Due to some problems with the device; it was decided not to run the full FTP". Therefore, only single HFET results are available for comparison. The tests were run on a 1978 Buick Regal. Six attachments noted in the SCI summary which presented the actual exhaust emission results were not included in the application. A summary of the test data is shown below. The SCI data is attached.

	gram/mile				
Test Type	HC	CO	NOx	MPG	Comments
1975 FTP	.70	9.5	1.4	17.0	Baseline
HFET	.13	2.5	1.6	22.4	Baseline
HFET	.08	.88	1.13	22.4	with Device

16. Testing by EPA:

No testing was performed by EPA. Until the additional requested information was supplied by the applicant, planning a confirmatory

test program was not possible.

17. Analysis

A. Description of the Device:

The purpose and theory of operation of the device were described on the Application. The device itself was never described since the noted attachments were not included with the application. A letter was sent to the Applicant on March 14, 1981, requesting the missing information. The letter also requested information regarding the test data, the device operation, and presented a test plan which would demonstrate the effect of installing the Treis Emulsifier. A copy of the letter is attached. The amount of water-alcohol consumed - less than 0.5% by volume - is much less than required by most available water injection systems to prevent engine auto-ignition. A calculation assuming steady state flow, adiabatic flame temperature, and stoichiometric air fuel ratio indicates that the .5% liquid water added to the fuel will lower the adiabatic flame temperature less than 5.0°F. Such a small benefit will not significantly influence auto-ignition characteristics of an engine. The fact that the emulsified water is a liquid state instead of a vaporized state will increase its ability to absorb heat. As noted above, however, the net heat absorbtion of .5% H_2O (liquid) by volume is very low.

The description of the device also indicates that vaporization of the liquid droplets increases vaporization of the gasoline. Because gasoline vaporizes at lower temperatures and higher pressures than water it is not apparent why vaporization of gasoline would be improved by introduction of water droplets. The claims for increased torque, cleaner combustion chamber, and extended engine life are based on lower combustion chamber temperature and better vaporization. No data was submitted to demonstrate increased torque, cleaner combustion chamber, and extended engine life. Therefore, no analysis of the validity of these claims can be made.

B. Applicability of the Device:

Without a description of the device, no analysis of the applicability of the device can be made.

C. Device Installation:

Without a description of the device, no analysis of the device installation instructions can be made.

D. Device Operation:

The operational instructions raised several questions which were not answered by the applicant. Most importantly, what about vehicles with manufacturer basic ignition timing specifications above 12°-15° B.T.D.C.? The adjustments required to retard the

timing to 12°-15° B.T.D.C. would definitely be in the direction to reduce fuel economy. The instructions do not indicate a course of action if "engine knock" is not heard upon acceleration.

The operational instructions do not appear to be applicable to all of the vehicles for which the device is sold. The instructions as submitted will result in many confused customers.

E. Device Maintenance:

No analysis of the device maintenance statements can be made without a complete device description.

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

No analysis of the device's impact on unregulated emissions can be made without additional information.

G. Effects on Vehicle Safety:

Without a complete description of the device, an analysis of the safety aspects of the device can not be made.

H. Test Results Supplied by Applicant:

The submitted data was run at three different laboratories.

Bendix Laboratory Data
The data is summarized above and enclosed as an attachment. The testing has several problems which reduce it's ability to demonstrate the effect of the "Treis Emulsifier".

1. The test vehicle was a 1979 Buick Regal (V-6, 231 CID engine) with only 111 miles at the beginning of testing, and 249 miles at the end. Vehicle emissions and fuel economy are known to be very unstable during the first several hundred miles. Most vehicle manufacturers accumulate a mimimum of 4000 miles before emission or fuel economy testing is attempted. Improvements in fuel economy and emissions are expected as engine friction is reduced, piston rings seat, and valve sealing improves. Readings taken at 100 miles have limited applicability to in-use vehicles.

2. The test procedure used in the Bendix testing appears to be a Highway Fuel Economy Test (HFET) which is used to determine highway fuel economy. The emissions of vehicles are measured in a different test - the Federal Test Procedure (FTP). The HFET emission numbers cannot be correlated to FTP (urban) emission levels. The fuel economy improvement noted on the HFET cycles again have limited applicability to urban driving. Because the HFET test was used, the Bendix data does not indicate how the "Treis Emulsifier" would improve vehicle emissions as compared to emission standards or how the device would improve urban fuel economy. In addition, the HFET tests run by Bendix Corporation do not appear to have been correct. According to the data, nine HFET sequences were run. Each HFET cycle

should consist of a preconditioning cycle and a sample cycle with a total mileage of about 20.4 miles. The Bendix data indicated that 138 miles were put on the car between the first and the last test. Assuming the odometer readings were taken at the beginning of the HFET test, nine HFET tests would require a minimum of 163 miles. Therefore, it appears that Bendix did not follow the Federal Register specified HFET test requirements. This problem again reduces the comparability of the Bendix data to other HFET and FTP test results.

3. The Bendix data, except for Test #9, appears to be run without the catalyst installed. Since most in-use vehicles do have catalysts, the non-catalyst emission data is not really relevent to what effect the Treis Emulsifier would have on emission levels.

4. It appears that the operational instructions supplied in the application were not followed during the Bendix testing.

a. The volume of water/alcohol mix is stated in the device description to be less than .5% by volume. Assuming a gasoline density of 6.138 lbs./gallon, the percentage of water by volume contained in the fuel used in Bendix Test Numbers 2, 3, 6, 8, and 9 were 3.58%, 1.65%, 1.209% 1.209%, and 2.36%. Therefore, the amount of fluid consumed during the testing was significantly above the upper maximum described in the applications.

b. The application device operation instructions indicate that after device installation, 100-200 miles should be driven, after which the timing should be adjusted. The Bendix data indicates 111 miles on the odometer at the beginning of testing and 249 miles at the end of testing. During the 138 miles, the vehicle was apparently altered from stock condition by addition of the device three times. Therefore, the 100-200 miles requirement could not have been followed during the Bendix testing.

c. The application specifies that the initial spark timing should be set between 12° and 15° B.T.D.C. The Bendix data indicates that testing was performed at manufacturer's specification and at manufacturer's specifications plus 10°. A search of manufacturer basic timing specification for 1979 Buick Regal 231 CID, V-6 engines indicate that 15° B.T.D.C. is the normal specification.

The Bendix testing at manufacturers timing specifications appear to be in compliance with the application operating instructions but the Bendix testing at "MFR. SPEC. + 10°" would be at 25° B.T.D.C., which is significantly different than what would result from following the operating instructions. Therefore, the Bendix testing with the "MFR. SPEC. + 10°" is not really applicable to the "Treis Emulsifier" as described in the application.

5. The results of combining like tests in the Bendix data to calculate the average fuel economy improvement are given below:

# of Tests	HC	CO	NOx	MPG Carbon Balance	Fuel Consumed Gravimetric	Comment
3	.854	1.252	1.228	22.77	1287.3	Baseline
1*	1.570	1.793	1.495	23.946	1233.17	15 ml of water consumed
1	.984	1.513	1.693	25.167	1186.9	(+) 10° Timing
2	1.099	1.400	1.595	25.522	1148.6	(+) 10° and 10 ml added
1**	N/A	N/A	1.493	25.932	1151.5	(+) 10° and 20 ml added

*left out questionable data due to equipment malfunction.
**CATALYST ADDED

Comparison of Bendix Data

Comparison	HC	CO	NOx	MPG	Fuel Consumed
Treis Emulsifier using 15 ml. of water with mfr. spec. timing	(+)83.84%	(-)23.77%	(-)21.74%	(+)5.16%	(+)4.02%
Treis Emulsifier using 10 ml. of water with timing advanced 10°	(+)11.69%	(-) 7.49%	(-) 5.79%	(+)1.41%	(+)3.32%
Treis Emulsifier using 20 ml. of water with timing advanced 10°	N/A	N/A	(-)11.81%	(+)3.04%	(+)2.98%

The cover letter on the Bendix data combines the fuel economy benefit of "Treis Emulsifier" and that of advancing the timing 10°. To analyze the "Treis Emulsifier", these two changes must be separated. When this is done, the improvements in fuel economy due to the "Treis Emulsifier" are shown to be from 1.41% to 5.16%. The emission results are varied on HC, but do show a consistent reduction in CO and NOx.

These averages do not indicate the scatter found in the data. Taking the three baseline tests as an indication of the testing accuracy, the following Coefficients of Variation are found.

	HC	CO	NOx	MPG	Fuel Consumed
Coefficient of Variation	8.22%	22.22%	2.53%	3.70%	3.35%

These calculations indicate that the variability of testing would mask improvements in fuel economy less than 3.70%.

The improvement in fuel economy noted for Treis Emulsifier compared to these numbers, is not very significant.

In summary, the Bendix data has several problems which preclude its ability to demonstrate the effect of the Treis Emulsifier. The testing itself was not applicable to the Treis Emulsifier since the operating instructions were not followed.

B. Second Set of Data

The analysis of this data will focus only on the converter out emissions. There are again several problems with this test data. They are:

1. The HFET testing procedure was used. This procedure is, as noted above in the Bendix data analysis, not applicable to emission standards or urban fuel economy.

2. The amount of water consumed during the test is tabulated in the test result summary above. The volume consumed is considerably higher than the .5% volume specified in the application. Th applicability of the data to the Treis Emulsifier data submitted in the application is thus in question.

3. One test in particular seems to be in error. Test #32 shows extremely high HC and CO and extremely low carbon balance fuel economy. The fuel consumed, however, shows much higher than normal fuel economy. An equipment malfunction or a serious transcriptional error is the only explanation for this data.

4. The scatter of the data is very bad. The carbon balance fuel economy varies from 18.95 to 30.57 mpg for apparently equivalent tests. The NOx, HC, CO_2 reading are not quite that scattered but do not allow very meaningful analysis. There appears to be no correla.ion between emissions and the amount of liquid consumed.

5. The "fuel consumed" values and the carbon balance fuel economy values do not appear to agree. The "fuel consumed" values demonstrate a severe fuel economy penalty for those tests where water/alcohol mixtures were used (up to 16.1% penalty). The carbon balance fuel economy data show an increase in fuel economy for two tests (26.82% and 42.35%). Other tests show a similar lack of correlation between apparent duplicate measurements.

6. No information was supplied by the applicant as to the laboratory which performed the testing. The laboratory is simply described in the application as "an EPA approved Laboratory". The EPA does not approve laboratories. No information on the vehicle tested, the ignition timing, or device installation was supplied.

7. This test data does not demonstrate if the Treis Emulsifier works as claimed. No conclusions on fuel economy are possible because of the problems noted above. There does appear to be a reduction in HFET HC and CO. The HFET NOx values appear to rise slightly.

C. The SCI Laboratory Data

The SCI data is tabulated above and is included as an attachment. The SCI data is included as an attachment to the "other" laboratory data covered in Part B. The baseline FTP cannot be compared as no FTP measurements were taken with the device installed. The SCI cover letter notes several problems that were encountered which might have interfered with running a full 1975 FTP Cold Start Emission Test. No explanation as to the nature of these problems was included in the application. Clarification of this point was requested in the EPA March 16, 1981 letter to the Applicant. The results then are two HFET tests. There were several problems noted with this test data:

1. Once again, HFET tests were run which, as noted above, have little value in comparison of emission levels or urban fuel economy.

2. Only one test was run in each configuration. Thus, no evaluation of test-to-test variability could be made.

3. The results indicate identical fuel economy - 22.4 mpg for both "baseline" and "with device" configuration. Thus, the data indicates then, no improvement in fuel economy due to the Treis Emulsifier.

4. The SCI letter notes five attachments include actual test data printouts. The five attachments were not included in the application.

5. No description of the test vehicle, the device used, the timing specifications, or the 100-200 miles required accumulation was included.

The conclusion to be drawn from this data is that two HFET's did indicate a reduction in HC and CO while fuel economy remained constant. The testing does not verify the claims made about the "Treis Emulsifier". Additional testing is required.

I. <u>EPA Testing of the Treis Emulsifier</u>

Because the Applicant submitted insufficient test data, a test plan was developed which, when complete, would demonstrate the results of installing a Treis Emulsifier. This plan was included in the March 16, 1981 letter. No response was received. Because EPA testing is used strictly in a confirmatory role, no EPA testing was performed. Several other devices tested by EPA have introduced water or water/alcohol mixture into the combustion chambers. In sufficient quantities, such additives can extend the detonation limits of the engine which, in turn, allows modifications which can improve fuel economy. The Treis Emulsifier introduces less than .5% mixture by volume. The EPA testing on other devices noticed no change in fuel economy for such small amounts of additives. Therefore, it is unlikely that

the .5% additive addition for the Treis Emulsifier will impact vehicle emissions or fuel economy.

18. Conclusions

The applicant submitted insufficient test data to prove that the "Treis Emulsifier" would improve fuel economy. The majority of the test data submitted was not applicable to the device described in the application. EPA testing of similar devices has failed to show a fuel economy benefit. Therefore, it is unlikely that installation of the Treis Emulsifier would result in a fuel economy benefit. No conclusions concerning effect on safety or unregulated emissions can be made.

List of Attachments

Attachment A "Bendix Corporation" Data.

Attachment B "Other Laboratory" Data.

Attachment C "SCI Laboratories" Data.

Attachemnt D March 14 1981 EPA letter from Charles Gray to Applicant.

Attachment A

June 20 27, 1979

Mr. Ken Landis
Treis International
2179 South Belvoir
Cleveland, Ohio 44118

Dear Ken,

Enclosed you will find copies of the test data as received from the emissions labs of the Bendix Corporation located at 900 West Maple Road, Troy, Michigan 48084. Additionally, you will find fuel consumption, water consumption and tune change data listed at the bottom of each test document. All but one test have been validated as accurate. Test #2 - Bendix #9062002, is in doubt because of an equipment malfunction, however, it is included for completeness.

The data shows that use of the device produced an EPA mileage increase of 12% (compare test #4 - Bendix #9062104 with test #8 - Bendix #9062208). This was also confirmed by an actual fuel consumption reduction of 12%.

Further analysis indicates that the mixture dispersed by the device operates in the following manner:

1. It effectively cleans the combustion chamber. This accounts for approximately 50% of the total benefit and produces a residual effect when the water is not added.

2. It raises the octane rating of the fuel and thus allows tune changes (spark advance) that would not be possible with current available low octane gasoline. This accounts for approximately 35% of the total benefit.

3. The mixture produces more thorough atomization during the compression stroke and thus more complete combustion results. This provides the remaining 15% of the total benefit.

The principles of operation as listed above show why the device will have a varying effect on different engines depending on their displacement, cleanliness, and compression ratios. Since the vehicle tested (a 1979 Buick Regal 231 V-6) had only 100 miles on it, cleaning was pointless, thus it is expected that the results shown are minimums.

Ken, with the exception of minor metering development, the device is ready to go to market. It will certainly be improved in the future, but currently, it is sufficiently developed to produce a measurable mileage increase of 10 to 30%. At your convenience, I would be pleased to explain the tests and conclusions in further detail.

Sincerely,

Paul R. Goudy, Jr.

EMISSION TEST REPORT NORTH CELL 6/20/79TIME= 4:58PM TEST 1
ECONOMY RUN

BAGI RAW DATA

VOLUME= 4168.
MH= 68.000
ABSOLUTE HUMIDITY= 75.00000
CO2 SAMPLE= 1.930
CO2 AMBIENT= 0.060
HC SAMPLE= 122.040
HC AMBIENT= 6.690
CO SAMPLE= 236.720
CO AMBIENT= 4.550
NOX SAMPLE= 54.920
NOX AMBIENT= 0.300

RUN#= 9006001 CAR#= REGAL OPERATOR= TB DRIVER= DM
CELL= N ODOMETER= 111.0 INERTIA= 3500.0 HP A/I 12.3 66.0

COMMENTS
TEST NO. ONE
BASE LINE
VOLUME= 4168. TEMPERATURE= 75. PRESSURE= 750.

	NOX CORR	F	GRAMS HC	CO	NOX	CO2	GRS/MI HC	CO	NOX	MPG ECONOMY
BAGI	1.000	0.853	7.913	30.652	12.340	1000.218	0.773	2.938	1.205	21.996

FUEL CONSUMPTION 1319.7 GRAMS

WATER CONSUMPTION 0

SPARK ADVANCE MFG. SPEC.

EMISSION TEST REPORT NORTH CELL 6/20/79TIME= 5:38PM TEST 2
ECONOMY RUN

BAG1 RAW DATA
VOLUME= 4157.
HUI= 55.000
ABSOLUTE HUMIDITY= 54.00000
CO2 SAMPLE= 1.980
CO2 AMBIENT= 0.050
HC SAMPLE= 223.210
HC AMBIENT= 9.530
CO SAMPLE= 212.230
CO AMBIENT= 5.340
NOX SAMPLE= 57.400
NOX AMBIENT= 0.370

RUN#= 9062002 CAR#= REGAL OPERATOR= TB DRIVER= DM
CELL= N ODOMETER= 125.0 INERTIA= 3500.0 HP A/I 12.3 60.0

COMMENTS
TEST NO. TWO
WATER
VOLUME= 4157. TEMPERATURE= 75. PRESSURE= 750.

	NOX CORR	F	GRAMS HC	CO	NOX	CO2	GRS/MI HC	CO	NOX	MPG ECONOMY
BAG1	9.910	0.849	14.594	26.857	11.098	4176.193	1.425	2.622	1.142	21.315

FUEL CONSUMPTION 1368.8 GRAMS
WATER CONSUMPTION 36 ml
SPARK ADVANCE MFG. SPEC.

Gustavo

EMISSION TEST REPORT NORTH CELL 6/21/79TIME= 5:55PM TEST 3
ECONOMY RUN

BAGI MAN DATA
VOLUME= 4175.
MI= 57.000
ABSOLUTE HUMIDITY= 50.00000
CO2 SAMPLE= 1.200
CO2 AMBIENT= 0.050
HC SAMPLE= 245.400
HC AMBIENT= 10.800
CO SAMPLE= 143.250
CO AMBIENT= 2.800
NOX SAMPLE= 76.000
NOX AMBIENT= 0.400

RUN= 2062103 CAR#= REGAL OPERATOR= TB DRIVER= DN
CELL= N ODOMETER= 186.0 INERTIA= 3500.0 HP A/I 12.3 60.0

COMMENTS
06-21-79 TEST NO. ONE
WITH WATER
VOLUME= 4175. TEMPERATURE= 75. PRESSURE= 750.

	NOX CORR	F	GRAMS HC	CO	NOX	CO2	GMS/MI HC	CO	NOX	MPG ECONOMY
BAGI	0.895	0.800	16.083	18.363	15.308	3716.226	1.570	1.793	1.495	23.946

FUEL CONSUMPTION 1233.17 GRAMS

WATER CONSUMPTION 15 ml

SPARK ADVANCE MFG. SPEC.

EMISSION TEST REPORT NORTH CELL 6/21/79TIME= 6:17PM TEST 4
ECONOMY RUN

BAGE RAW DATA
VOLUME= 4170.
RH= 57.000
ABSOLUTE HUMIDITY= 50.00000
CO2 SAMPLE= 1.870
CO2 AMBIENT= 0.050
HC SAMPLE= 144.600
HC AMBIENT= 11.000
CO SAMPLE= 174.500
CO AMBIENT= 2.800
NOX SAMPLE= 64.500
NOX AMBIENT= 0.600

RUN#= 9062104 CAR#= REGAL OPERATOR= TB DRIVER= DM
CELL= N ODOMETER= 200.0 INERTIA= 3500.0 HP A/I 12.3 60.0

COMMENTS
06-21-79 TEST NO. TWO
BASE-LINE
VOLUME= 4170. TEMPERATURE= 75. PRESSURE= 750.

	NOX CORR	F	GRAMS HC	CO	NOX	CO2	GMS/MI HC	CO	NOX	MPG ECONOMY
BAGE	0.895	0.858	9.198	22.366	12.931	3950.438	0.898	2.184	1.263	22.642

FUEL CONSUMPTION 1303.8 GRAMS
WATER CONSUMPTION 0
SPARK ADVANCE MFG. SPEC.

EMISSION TEST REPORT NORTH CELL 6/21/79TIME= 10:20PM TEST 5
ECONOMY RUN

BAGI RAW DATA
VOLUME= 4194.
RH= 57.000
ABSOLUTE HUMIDITY= 50.00000
CO2 SAMPLE= 1.070
CO2 AMBIENT= 0.040
HC SAMPLE= 153.230
HC AMBIENT= 6.920
CO SAMPLE= 119.550
CO AMBIENT= 1.000
NOX SAMPLE= 85.620
NOX AMBIENT= 0.380

RUN#= 9062105 CAR#= REGAL OPERATOR= TH DRIVER= TH
CELL= N ODOMETER= 215.0 INERTIA= 3500.0 HP A/I 12.3 60.0

COMMENTS
06-21-79 TEST NO. THREE (10:40)
BASE-LINE
VOLUME= 4194. TEMPERATURE= 75. PRESSURE= 750.

	NOX CORR	F	GRAMS HC	CO	NOX	CO2	GMS/MI HC	CO	NOX	MPG ECONOMY
BAGI	0.895	0.873	10.074	15.501	17.336	3555.593	0.984	1.513	1.693	25.167

FUEL CONSUMPTION 1186.88 GRAMS

WATER CONSUMPTION 0

SPARK ADVANCE MFG. SPEC. + 10°

EMISSION TEST REPORT NORTH CELL 6/21/79TIME= 11:42PM TEST 6
ECONOMY RUN

BAGI RAW DATA
VOLUME= 4205.
RH= 57.000
ABSOLUTE HUMIDITY= 50.00000
CO2 SAMPLE= 1.040
CO2 AMBIENT= 0.050
HC SAMPLE= 188.990
HC AMBIENT= 15.650
CO SAMPLE= 115.370
CO AMBIENT= 2.320
NOX SAMPLE= 77.940
NOX AMBIENT= 0.500

RUN#= 9062106 CAR#= REGAL OPERATOR= TB DRIVER= TB
CELL= N ODOMETER= 225.0 INERTIA= 3500.0 HP A/I 12.3 60.0

COMMENTS
06-21-79 TEST NO. FOUR (PM)
WITH WATER
VOLUME= 4205. TEMPERATURE= 75. PRESSURE= 750.

	NOX CORR	F	GRAMS HC	CO	NOX	CO2	GMS/MI HC	CO	NOX	MPG ECONOMY
BAGI	0.895	0.875	12.029	14.922	15.795	3480.248	1.175	1.457	1.542	25.065

FUEL CONSUMPTION 1134.0 GRAMS

WATER CONSUMPTION 10 ml (50% ETHYL ALC.)

SPARK ADVANCE MFG. SPEC. + 10°

EMISSION TEST REPORT NORTH CELL 6/22/79TIME= 4:11PM TEST 7
ECONOMY RUN

BAG1 RAW DATA
VOLUME= 4223.
HH= 56.000
ABSOLUTE HUMIDITY= 50.00000
CO2 SAMPLE= 1.770
CO2 AMBIENT= 0.050
HC SAMPLE= 141.130
HC AMBIENT= 10.050
CO SAMPLE= 151.530
CO AMBIENT= 1.640
NOX SAMPLE= 61.080
NOX AMBIENT= 0.340

RUN#= 9062207 CAR#= REGAL OPERATOR= TB DRIVER= DM
CELL= N ODOMETER= N/A INERTIA= 3500.0 HP A/I 12.3 60.0

COMMENTS
06-22-79 TEST NO. ONE OF THE DAY
BASE-LINE
VOLUME= 4223. TEMPERATURE= 75. PRESSURE= 750.

	NOX CORR	F	GRAMS HC	CO	NOX	CO2	GRAMS/MI HC	CO	NOX	MPG ECONOMY
BAG1	0.895	0.866	9.127	13.807	12.441	3780.848	0.891	1.934	1.215	23.667

FUEL CONSUMPTION 1238.33 GRAMS

WATER CONSUMPTION 0

SPARK ADVANCE MFG. SPEC.

EMISSION TEST REPORT NORTH CELL 6/22/79TIME= 3:58PM TEST 8
ECONOMY RUN

BAGI RAW DATA

VOLUME= 4235.
RH= 52.000
ABSOLUTE HUMIDITY= 46.00000
CO2 SAMPLE= 1.050
CO2 AMBIENT= 0.050
HC SAMPLE= 161.740
HC AMBIENT= 11.460
CO SAMPLE= 104.990
CO AMBIENT= 1.600
NOX SAMPLE= 83.970
NOX AMBIENT= 0.380

RUN#= 900?208 CAR#= REGAL OPERATOR= TB DRIVER= DM
CELL= N ODYMETER= N/A INERTIA= 3500.0 HP A/I 12.3 60.0

COMMENTS
06-22-79 TEST NO. TWO OF THE DAY
WITH WATER AND ALCOHOL (50/50) SPARK ADVANCE= 10 DEGREES ABOVE MANUFACTURE
VOLUME= 4235. TEMPERATURE= 75. PRESSURE= 750.

	NOX CORR	F	GRAMS HC	CO	NOX	CO2	GRS/MI HC	CO	NOX	MPG ECONOMY
BAGI	0.880	0.875	10.486	13.758	16.883	3527.048	1.024	1.343	1.648	25.378

FUEL CONSUMPTION 1163.2 GRAMS

WATER CONSUMPTION 10 ml (50% ETHYL ALC.)

SPARK ADVANCE MFG. SPEC. + 10°

EMISSION TEST REPORT NORTH CELL 6/23/79 TIME= 11 AM TEST 9
ECONOMY RUN

BAGI RAW DATA

VOLUME= 4237.
RH= 70.000
ABSOLUTE HUMIDITY= 68.00000
CO2 SAMPLE= 1.030
CO2 AMBIENT= 0.040
HC SAMPLE= 11.590
HC AMBIENT= 7.200
CO SAMPLE= 3.830
CO AMBIENT= 1.410
NOX SAMPLE= 09.100
NOX AMBIENT= 0.320

RUN#= 900221C CAR#= BUICK OPERATOR= DEM DRIVER= DEM
CELL= N ODOMETER= 249. INERTIA= 3500. HP A/I 12.3 60.

COMMENTS

WATER & ALCOHOL
VOLUME= 4237. TEMPERATURE= 74. PRESSURE= 709.

	NOX CORR	F	HC	CO	NOX	CO2	HC	CO	NOX	MPG ECONOMY
		********** GRAMS **********					******* GMS/MI *******			
BAGI	0.908	0.878	0.304	0.337	15.289	3503.744	0.036	0.033	1.493	25.932

FUEL CONSUMPTION 1151.5 GRAMS

WATER CONSUMPTION 20 ml (50% ETHYL ALC.)

SPARK ADVANCE MFG. SPEC + 10°

CATALYST ADDED

Mr. Kenneth J. Landis
Treis International
C/O Allied Decals, Inc.
20700 Miles Avenue
Cleveland, Ohio 44128

Dear Ken,

During the week of February 5, 1979, a series of Highway Fuel Economy Tests (HFET) were performed by an EPA approved laboratory in accordance with Federal Test Procedures (FTP).

The information gathered (Attachment 2) during the tests not only confirmed previous infra-red exhaust analyses (Attachment 3), earlier HFETs (Attachment 3), and 3,000 miles of on road testing, but it also determined the operational parameters of mixing water in gasoline using the Treis Process.

The data was analyzed graphically with adjustments being made to allow for the type of mixer in use during each experiment. No modifications or adjustments were made to the automobile under test with the exception of bypassing its fuel pump and replacing it with a Holley 110 gph electric pump.

The results of the aforementioned analysis show that the addition of 1.5% to 2.5% water (by volume) to gasoline can be accomplished economically, reducing hydrocarbon (HC) and carbon monoxide (CO) emissions 55% and 60%, respectively, while increasing mileage by at least 10%. In addition, no adverse effect was shown on oxides of nitrogen (NOx).

A summary of the analysis follows.

1. Hydrocarbons. A reduction of HC emissions was found to be dependent on the amount of water added and the type of mixer used (Attachment 1, Figure 1). An optimal amount of water was found to effect the greatest HC reduction (approximately 2% by volume). This reduction was accomplished without a corresponding increase in NOx levels, and thus, can be attributed to an increase in ignition efficiency. (If the mixture were leaned instead, NOx would rise.) An adjustment was made to the data to compensate for mixer type, the results are shown in Attachment 1, Figure 2. Data variance was reduced and thus it is concluded that mixer type also plays a significant role in HC reduction.

   Hydrocarbon emissions are a good measure of ignition efficiency, therefore a low grams per mile figure is essential for high mileage and minimum polution.

Mr. Ken Landis
Treis International 2179 S. Belvoir
Cleveland, Ohio 44118

1. The exhaust emission improvement on the Highway Fuel Economy Test, although not directly comparable to the 1975 FTP Cold start procedure, was approximately 38% for the HC constituents and 65% for the CO constituent. NO_x increased 25% and fuel economy remained unchanged. Due to the repeatability of the test procedure, these results could change significantly from test to test. From past experience, HC can vary by 16%, CO by 10%, NO_x and fuel economy by 7%.

2. The direction of HC, CO, and NO_x are all consistent with recognized engine phenomenon. As combustion becomes more efficient, HC and CO are reduced and NO_x is increased. The fact that this vehicle used a catalytic converter clouds this somewhat, however, the changes seen were rather dramatic.

Attachment 1 gives the baseline exhaust emission results and fuel economy for the 1975 FTP. Attachment 2 gives the fuel economy results for the Baseline Highway Fuel Economy test. Attachment 3 gives the exhaust emission results in grams/mile for the Baseline Highway Fuel Economy test.

Attachment 4 gives the fuel economy results for the vehicle in the modified condition for the Highway Fuel Economy test.

Attachment 5 gives the exhaust emission results in grams/mile for the modified Highway Fuel Economy test.

Attachment 6 gives a approximate summary of charges to perform the tests and service to date, you will receive an exact figure within two weeks.

Thank you for the opportunity to serve you. You will receive a refund check from Systems Control, Inc. If we can be of further service, don't hesitate to call on us.

Sincerely,

Joseph M. Gall
Director, Livonia Operations

cc: Paul Goudy
J. Harkins
J. Randall
C. Mathers
D. Orrin

Note: All water percentages by weight.

Figure 1

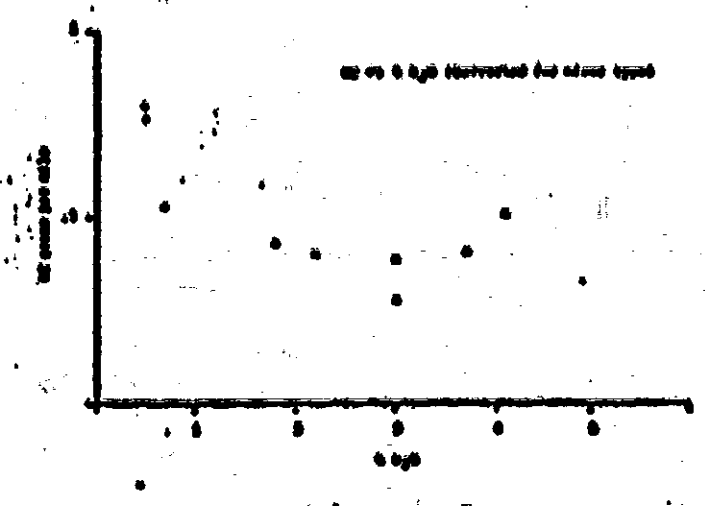


Figure 2

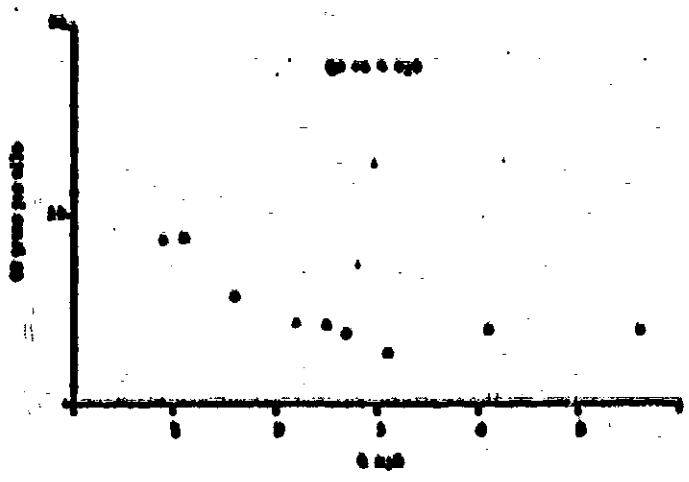


Figure 3

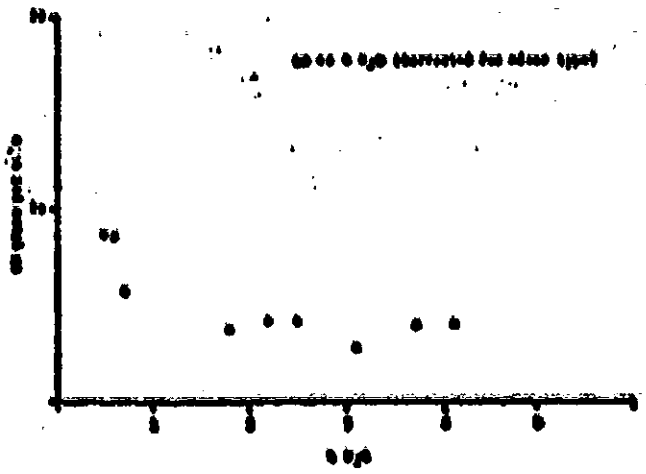


Figure 4

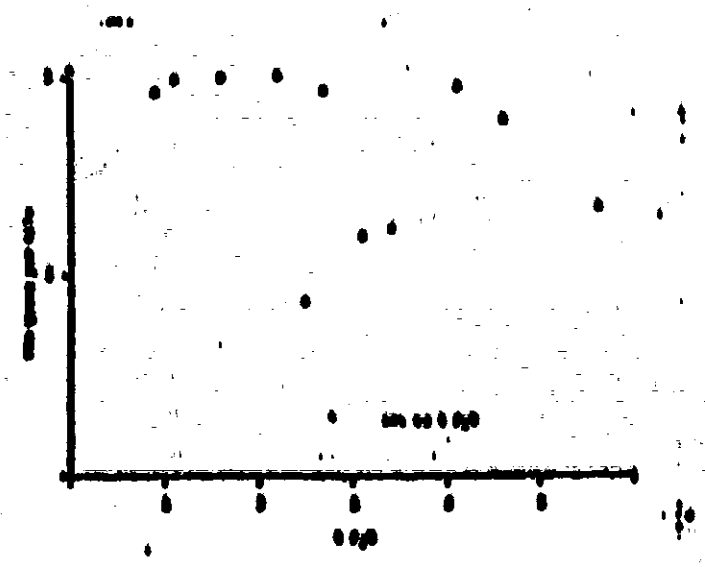


Figure 5

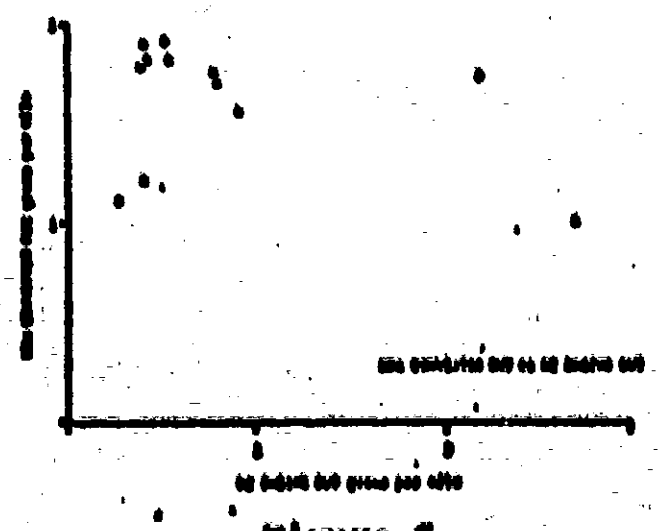


Figure 6

TE - DATA

Run	Date	Temp1[5]	Temp2[5]	Average[5]	HC[1]	CO[1]	NO_x[1]	NO_xC[1]	CO_2[1]	Miles	MPG[2]	Fuel[6]	Fuel/M	H_2O[3]	H_2O/H[3]	H_2O/ Air[4]	H_2O/ Fuel[7]	ZAll/ Water	ZAll/ Fuel[8]	Mix Elements	Val Tu
ENGINE - OUT																					
10	2/07	838	779	809	.516	11.261	2.046	1.852	392.5	10.08	21.485	1243.9	123.6	Baseline							
11	2/07	821	860	841	.802	8.698	1.977	1.825	398.9	10.09	21.383	1212	120.1	13	1.29	1.1	.8			8	
12	2/07	806	906	855	.536	5.615	2.000	1.735	426.8	10.10	20.626	1299	128.6	21	2.08	1.6	1.2			8	
21	2/08	817	868	843	.767	8.568	1.932	1.708	400.5	10.12	21.314	1348	133.2	12	1.19	.9	.7	10	.09	12	
22	2/08	868	889	879	.406	3.833	1.326	1.218	318.6	10.13	27.229	1340	132.3	75	7.40	5.6	4.1	10	.56	12	
23	2/08	782	847	860	.387	20.083	1.774	1.630	412.3	10.14	19.963	1370	135.1	63	6.21	4.6	3.4	20	.92	12	
31	2/09	809	851	830	2.182	6.120	.860	.795	416.0	10.26	28.669	1425	138.9	35	3.41	2.5	1.8	5	.33	18	
32	2/09	635	783	719	2.216	63.738	1.226	1.140	356.1	10.33	19.090	1169	113.2	40	3.87	3.4	2.5	5	.47	12	
33	2/09	813	867	850	.228	7.733	1.196	1.122	285.6	10.27	30.528	1389	133.3	62	6.09	3.1	2.3			18	
36	2/09	826	855	841	.428	3.659	1.939	1.820	461.1	10.26	18.956	1469	143.5	40	3.91	2.7	2.0			12	
41	2/10	836	855	845	.401	4.171	2.007	1.893	443.3	10.31	19.672	1417	137.4	31	3.01	2.2	1.6			18	
42	2/10	809	851	830	.308	3.979	1.948	1.810	453.8	10.21	19.225	1424	139.5	38	3.68	4.1	3.0			18	
CONVERTER - OUT																					
10	2/07	838	779	809	.113	5.227	1.532	1.409	406.7	10.08	21.478	1243.9	123.6	Baseline							
11	2/07	821	860	841	.052	3.383	1.719	1.586	409.5	10.09	21.380	1212	120.1	13	1.29	1.1	.8			8	
12	2/07	806	906	855	.049	1.954	1.817	1.672	438.3	10.10	20.623	1299	128.6	21	2.08	1.6	1.2			8	
21	2/08	813	868	843	.135	6.081	1.757	1.553	409.8	10.12	21.300	1348	133.2	12	1.19	.9	.7	10	.09	12	
22	2/08	868	889	879	.033	1.553	1.218	1.219	323.3	10.13	27.239	1340	132.3	75	7.40	5.6	4.1	10	.56	12	
23	2/08	872	847	860	.028	1.012	1.791	1.665	443.1	10.14	19.956	1370	135.1	63	6.21	4.6	3.4	20	.92	12	
31	2/09	809	851	830	.075	2.200	1.743	1.612	427.0	10.25	28.607	1425	138.9	35	3.41	2.5	1.8	5	.33	18	
32	2/09	635	783	719	2.411	63.636	1.007	.938	356.7	10.33	19.116	1169	113.2	40	3.87	3.4	2.5	5	.47	12	
33	2/09	813	867	850	.019	.627	1.117	1.067	289.2	10.27	30.576	1389	133.3	62	6.09	3.1	2.3			18	
36	2/09	826	855	841	.023	.746	1.818	1.706	467.2	10.26	18.968	1469	143.5	40	3.91	2.7	2.0			12	
41	2/10	836	855	845	.023	1.126	1.897	1.788	449.5	10.31	19.686	1417	137.4	31	3.01	2.2	1.6			18	
42	2/10	809	851	830	.032	1.106	1.833	1.703	459.9	10.21	19.222	1424	139.5	38	3.68	4.1	3.0			18	

Notes

(1) Grams per mile (Federal Test Procedure, 1972)

(2) Calculated MPG = 2421/[.866(HC) + .429 (CO) + .273 (CO_2)]

(3) H_2O is at approximately = grams

(4) Grams (density 6.177 lb/gal or .74 grams/ml)

(5) Degrees F measured from exhaust manifold

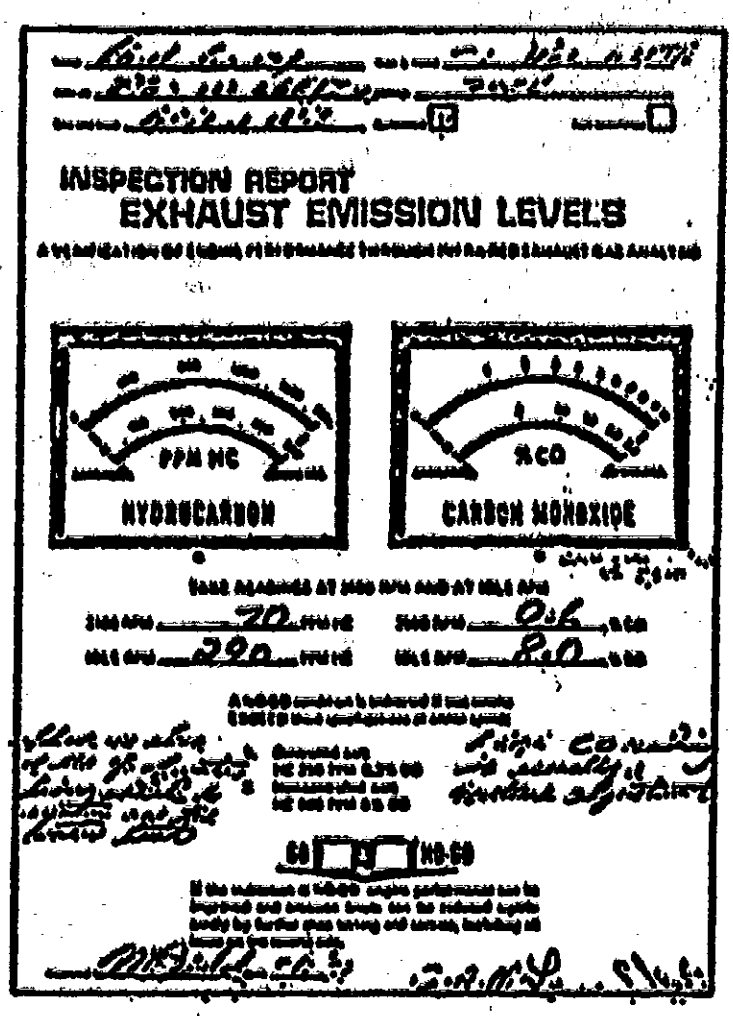
(6) [H_2O/fuel] x 100 (Approximate; assumed all H_2O = grams)

(7) $\frac{[H_2O \times .74 \text{ grams/ml}] \times 100}{\text{Fuel}}$ (Approximate. No correction for temperature, or pressure.)

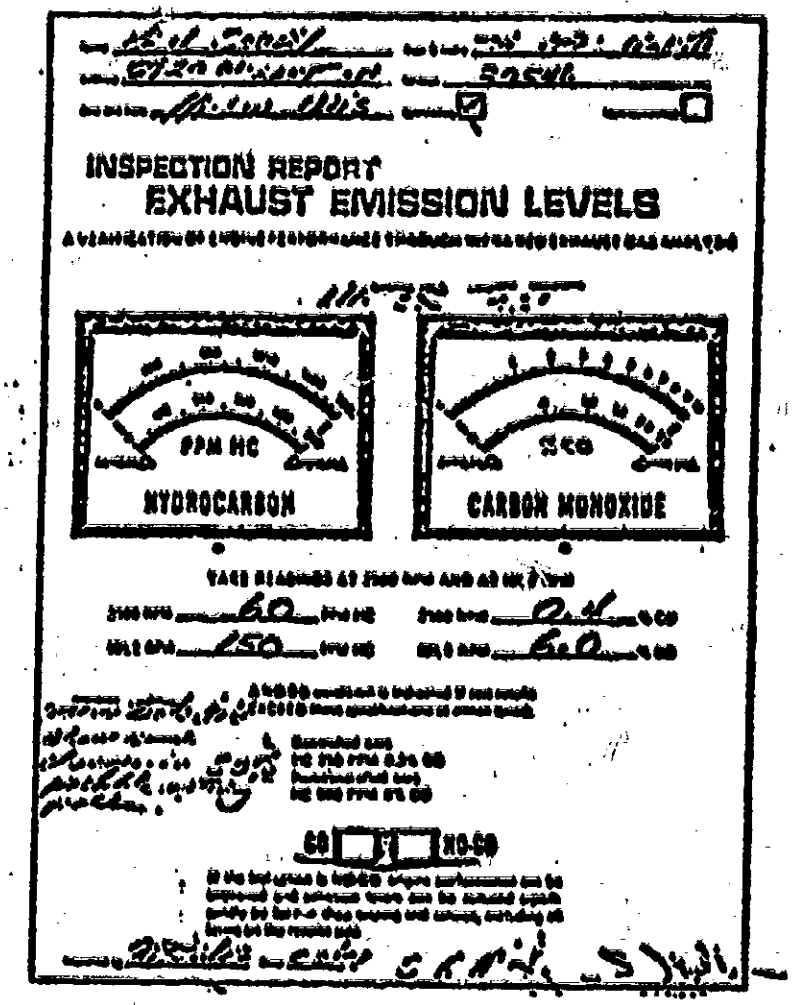
(8) [% Al/Water] x [% H_2O/fuel]

Attachment 2

May 2, 1978 Infra-Red Exhaust Analysis



No Water

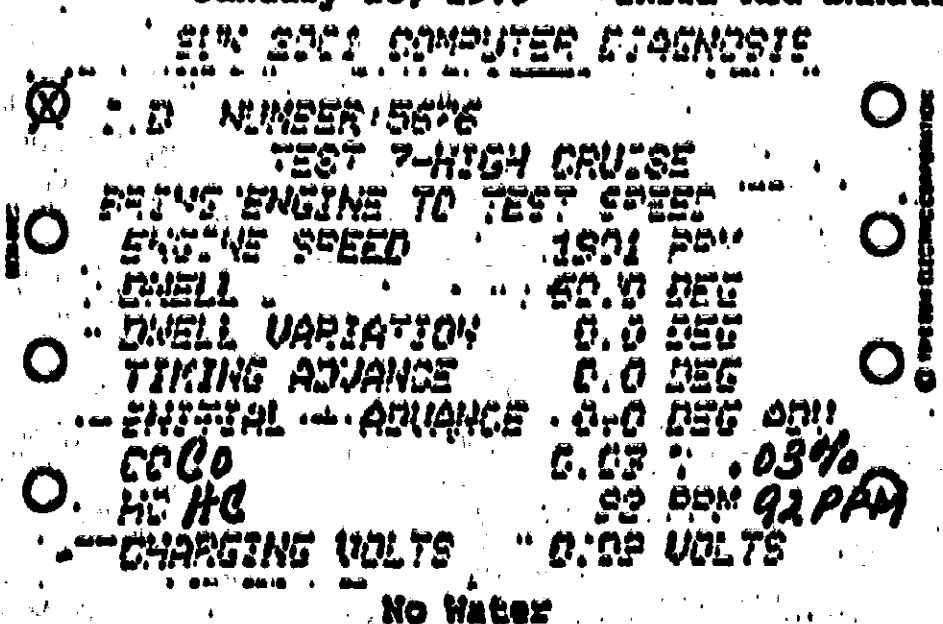


Water

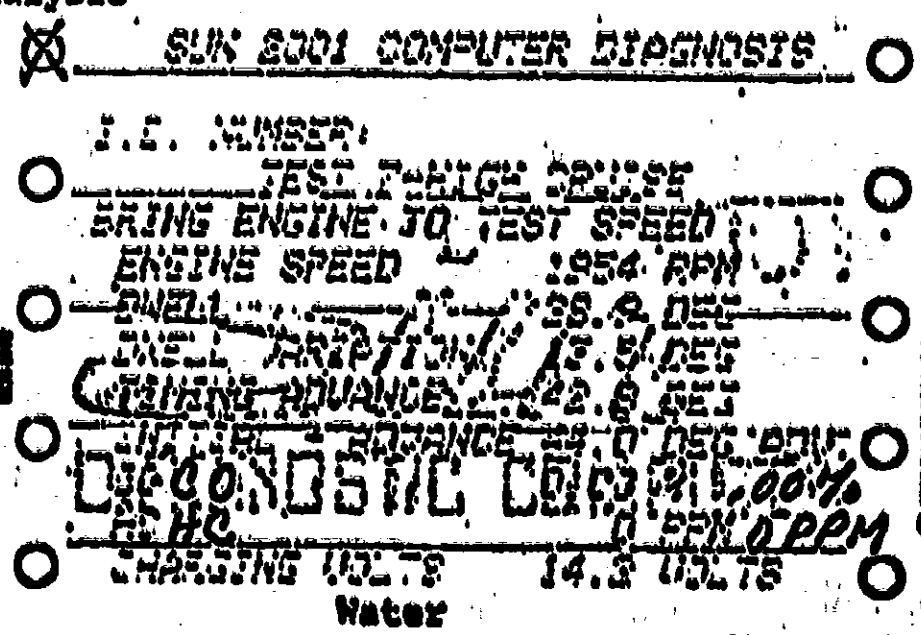
December 27, 1978

	HC	CO	NOx	MPG
FTP	.70 gr/M	9.5 gr/M	1.4 gr/M	17.0
HFET	.13 gr/M	2.5 gr/M	1.6 gr/M	22.4
HFET Water	.08 gr/M	.88 gr/M	2.13 gr/M	22.4

January 13, 1979 Infra-Red Exhaust Analysis



No Water



Water

1984 LDT meet stds. at all altitudes
1985 HDT NO_x std. 75% below 1973 Gasoline HDT level

CALIFORNIA

1978 LDT Stds. include Diesel
Car End-of-Line Tests apply through 8500# GVW
Fuel Filler Specs. for Vapor Recovery— see pass. car

Gasoline HDT Evap. 6 g/Test (SHED) by Design
1980 Gasoline Truck Evap. 2 g/Test (SHED); by Design for HDT
1981 Higher optional NO_x Stds. for 100,000 mi. Cert.
Listed req'ts. (Trucks ≤ 6500# GVW) subject to Fed. Waiver/ Restrictions on Allowable Maintenance; "Fixed" Idle Mixture.
HFET NO_x Std. 2.0 × FTP Std.

Passenger Car

		1968 No Control	1969 (50 CA)	1970	1971	1972	1973	1974	1975	1977[a]	1978	1980	1981
		75 FTP	1970 FTP (Tailpipe Cont'd.)			1972 FTP gpm (CVS)			1975 FTP gpm (CVS)				
Exhaust Emissions	HC	10.6	275 ppm	2.2 gpm		3.4 CA 2.5			1.5 CA 0.9	1.5 CA .41	.41 CA .39[b]	.41 CA .39[b]	
	CO	84	1.5%	23 gpm		39			15 CA 9.0	15 CA 9.0	7.0 CA 6.6	3.4[c] CA 0.4[c]	
	NO_x	4.1			CA 4 gpm	CA 3 gpm on 75 FTP	3	2 CA 2	3.1 CA 2.0	2.0 CA 1.5	2.0 CA 1.6	1.0[d] CA 0.4[d]	
Evap. g/Test	Trap			CA 6	6	2			2				
	SHED	30.6[e]									6	6 CA 2	
Crankcase		4.1 gpm	[e] Uncontrolled Evap. 30.6 g/Test = 4.2 gpm										

NOTES:
FTP = Federal Test Procedure
ppm = parts per million
gpm = grams/mile
CVS = constant volume sampler (true mass meas.)
CA means California only
GVW = Gross Vehicle Weight, IW = Inertia Wt.
HFET = Highway Fuel Economy Test
[a]1977 (only) Cars sold in specified High Altitude Counties req'd. to meet stds at High Altitude
[b]Non-CH_4 Std.; .41 total HC w/CH_4 correction is optional for 1980
[c]Possible 2 yr. waiver to 7 gpm
[d]Possible waiver to 1.5 gpm for innovative technology or diesel
[e]CA option to 1981 Fed. CO/NO_x stds.: 7.0/0.7 — must carry over to '82. Selection of '81 Fed. option requires 7.0/0.4 for '82. CA CO/NO_x for '82: 7.0/0.4.

Equivalent Test Results for different test procedure (based on 1970-71 cars, not applicable to pre-control cars):

	1970 FTP		1972 FTP		1975 FTP
HC	2.2 gpm	=	4.6 gpm	=	4.1 gpm
CO	23 gpm	=	47 gpm	=	34 gpm
NO_x	4.0 gpm	=	6.0 gpm	=	6.2 gpm

ADDITIONAL CAR REQUIREMENTS

1972 No Crankcase Emissions Allowed Tampering by Service Industry, Dealers, etc. Prohibited Fuel Filler Must Exclude Leaded Fuel Nozzles (Catalyst Veh.) Exhaust Standards Apply to Diesel w/Test Modif. Assembly Line Test Requirement — SEA
1981 Possible High Altitude Stds. — to represent same % reduction as sea level req'ts.
1984 All cars meet stds. at all altitudes

CALIFORNIA — IN ADDITION TO FED. CAR REQ'TS.

1970 HC Subject to CH_4 Correction
End-of-Line Exhaust Test
Fuel Filler Specs. for Vapor Recovery
Individual Veh. Delay till 1982 possible depending on extent of body changes.
1980 Gasoline Car Exh. Stds. apply to Diesels Higher optional NO_x Stds. for 100,000 mi. Cert.
All listed req'ts. subject to Federal Waiver Restrictions on Allowable Maintenance; "Fixed" Idle Mixture Required; HFET NO_x Std. 1.33 × FTP Std.

FUEL ECONOMY

GM NATIONWIDE PRODUCTION-WEIGHTED AVERAGE FUEL ECONOMY
EPA Driving Schedule—55% CITY/45% Highway

Model Year		Passenger Cars GM Average mpg	Passenger Cars Cumulative Improvement over 1974	Light Duty Trucks (Under 8,000 # GVW) GM Average mpg	Light Duty Trucks Cumulative Improvement over 1974
1974	Actual	12.0		11.3	
1975	Actual	15.4	28%	14.4	28%
1976	Actual	16.9	39%	15.9	41%
1977	Actual	17.8	48%	17.0	51%
1978	Forecast	18.0	50%	17.0	51%

ENERGY ACT

Standards:

Model Year	Passenger Cars mpg	Passenger Cars Cumulative Improvement over 1974	Light Duty Trucks mpg
1978	18	50%	None
1979	19	58%	[a]17.2 (0-6000 lbs.) (2WD)
1980	20	67%	[a]18 (0-3500 lbs.) (2WD)
1981	22	83%	[a]19 (0-3500 lbs.) (2WD)
1982	24	100%	
1983	26	118%	
1984	27	125%	
1985	27.5	129%	

[a]4WD (13.9 mpg (1979); 14.0 mpg (1980); 15.5 mpg (1981)

Penalties:
- $5 per 1/10 mpg below applicable fuel economy standard (see above) x total model year production.

  (Financial credit given for exceeding standard which may be applied back one model year and any excess may be applied forward one model year; credit usable only in class or category of automobile where it was earned.)
- $1,000 per automobile for violation of the labeling provisions of the law.
- $10,000 per day for any person violating provisions of the law other than the average fuel economy standards.

December 29, 1978

Mr. Ken Landis
Treis International
2179 S. Belvoir
Cleveland, Ohio 44118

Dear Mr. Landis:

SCI was contracted to procure, tune and test a vehicle to verify the potential of your device to influence the vehicles exhaust emissions and/or fuel economy for the recognized EPA required test schedule. Due to some problems with the device, it was decided not to run the full EPA Cold Urban Driving cycle (FTP), but use the EPA Highway Fuel Economy Test (HWFET) to generate the most usable data.

A 1978 Buick Regal was located and brought to the Laboratory; tuned and tested in the production or baseline configuration. The test results run December 27, 1978 are:

1975 Cold Emission Test (FTP)

MPG	Hydrocarbons (HC)	Carbon Monoxide (CO)	Oxides of Nitrogen (NO_x)
17.0	.70 gr/mi	9.5 gr/mi	1.4 gr/mi

Highway Fuel Economy Test (HWFET)

22.4	.13 gr/mi	2.5 gr/mi	1.6 gr/mi

The device was installed on the vehicle, but several problems were encountered which might have interferred with running the full 1975 FTP Cold Start Emission Test. It was decided to run a Highway Fuel Economy Test (HWFET) due to its less severe testing requirements.

The results for this test run December 28, 1978 are:

MPG	HC	CO	NO_x
22.4	.08 gr/mi	.88 gr/mi	2.13 gr/mi

The conclusions that can be drawn from these two tests are encouraging.

Attachment D

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
ANN ARBOR, MICHIGAN 48105

March 16, 1981

OFFICE OF
AIR, NOISE AND RADIATION

Mr. Kenneth J. Landis, President
Treis International
20700 Miles
Cleveland, OH 44128

Dear Mr. Landis:

The EPA has received your February 17, 1981 application for evaluation of the Treis Emulsifier under Section 511 of the Motor Vehicle Information and Cost Savings Act. A preliminary review of your application has been made. This review has raised several questions about the device and the supporting test information. In addition, the supporting test data does not indicate the results of installing the Treis Emulsifier on the average in-use vehicle. In order to determine the effect of the device on in-use vehicles, a test plan has been assembled which when completed will indicate to EPA the feasibility of your device.

Please answer the following questions about the information submitted on your application:

a. Please send a copy of the patent application including the device description and data supporting these claims. Please indicate the patent application number.

b. The description of the Treis Emulsifier indicates enclosed schematic drawings. No drawings of the device were included with the application. Please submit the missing schematics.

c. The method of emulsification of water is not clear. Perhaps the missing schematic drawings will clarify the operation of the device. It is not understood if the alcohol-water additive is added seperately upstream at the carburetor or if the alcohol-water additive is trapped and then added.

d. The device operation instructions raised several questions:

1). What type of alcohol should be used?

2). What about the late model cars with manufacturer basic ignition specifications of 12°-15° B.T.D.C.?

3). What if engine knock is not heard upon acceleration?

4). Please send the installation/operation brochure supplied to the consumer with the device.

5). What should be "repeated as required "to prevent engine knock?

e. The vehicle maintenance section indicates only water should be added. Does the alcohol-water mix switch to a just water after break in? If so, how does the water get to the carburetor without alcohol to hydrate the water?

e. The questions regarding the submitted test data are divided into three parts:

1. Bendix Laboratory Data

(a). The car had only 100 total miles at the time of the baseline tests. Vehicular emissions and fuel economy are not stabilized at 100 miles. EPA requires 4000 miles on certification vehicles to ensure stabilized emissions. This fact puts into question the results of the Bendix vehicle testing.

(b). The test procedure used was apparently the Highway Fuel Economy Test Procedure. This test sequence is used to determine fuel economy in highway type driving. The emissions during the HFET have not been related to air quality and do not necessarily indicate the emissions during driving the FTP.

(c). The Bendix data indicates a 6.2% improvement in fuel economy due to the water emulsification and 8.6% due to timing advance. The fuel economy gains due to increasing the basic timing 10° cannot be attributed to the Treis Emulsifier.

(d). The Bendix data other than test #9 were apparently run without a catalyst. The indicated emission changes due to the Treis Emulsifier cannot be related to present catalyst-equipped vehicles.

(e). Please indicate how water consumption was measured.

(f). Please indicate manufacturer basic timing specification.

(g). The vehicle mileage indicates that the operational instructions in the 511 were not followed. In particular 100-200 miles were not put on the vehicle with the device installed. Please indicate why you feel this data is applicable.

2. The Other Laboratory Data

(a). What is meant by "type of mixer"?

(b). How was the amount of water and water/alcohol mixture used measured?

(c). Please indicate which tests #31-HC on Attachment 3 is in question.

(d). The same problems of applicability of HEFT data to in-use urban emission standards exist as within the Bendix data.

(e). What is heading"Mix Elements" in Attachment 2?

(f). Please identify vehicle used for this testing. Include odometer, engine type, fuel used, etc.

(g). There are several questionable data points which indicate a problem with the analysis of the exhaust gas.

(1). The fuel used does not compare with the Carbon Balance fuel economy numbers. Test numbers #22 and #33 show increases in fuel consumed over baseline (1369 and 1340 grams vs. 1246 grams), but the carbon balance data shows fuel consumption reduction (30.574 and 27.239 vs. 21.478 mpg). Please explain this inconsistency.

(2). Test #32 shows abnormally high CO which is not at all reduced by the convertor. This appears to inconsistent with other data which showed a significant reduction in CO through the convertor. Please explain this apparent anomilie.

(3). Other than the two tests #22 and #33, no improvement in the carbon balance fuel economy was noted. These two tests were not repeatable as noted by similar condition tests #23 and #32 which both showed a significant decrease in fuel economy. Please explain the large (60%) difference in fuel economy.

(h). Please indicate the name of the Laboratory

3. The SCI Laboratory Data

(a). Please indicate the problems encountered which might have interferred with running the full 1975 Cold Start Emission Test.

(b). Please describe the 1978 Buick Regal as to engine type, weight, test fuel, mileage, etc. Is this the same vehicle as tested at Bendix?

(c). Please include Attachments 1, 2, 3, 4 and 5 to the SCI report.

(d).. The results indicate a reduction in HC and CO, an increase in NOx, and no change in fuel economy. This data does not agree with the other data which indicated a change in fuel economy. Please address this apparent inconsistency.

Further testing is required to demonstrate the feasibility of the Treis Emulsifier as a fuel economy improver. In accordance with FR Vol. 44, Part 610.30(a), a test plan has been designed to demonstrate the validity of the claims made for the device. Completion of the following test program will allow EPA to satisfactorily evaluate your device:

a. A minimum of two vehicles should be tested using a test sequence consisting of a hot-start LA-4 portion (bags 1 and 2) of the Federal Test Procedure (FTP) and a Highway Fuel Economy Test (HFET). Although only the 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.

b. The laboratory doing the testing must be selected from the list of EPA recognized laboratories (attached).

c. 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 device installation.

d. The installations and operational instructions given in your 511 Application must be followed exactly.

e. A minimum of two vehicles should be tested in duplicate in each test configurations. Select the vehicle from the attached table #1. Select a maximum of one pre-1975 vehicle. Any test vehicle should have a minimum of 4000 odometer miles.

f. All test data obtained from the outside laboratory in support of your application should be submitted to us including void or invalid tests.

g. Notify us of the laboratory you have chosen, when testing is scheduled to begin, what test you have decided to conduct, and maintain contact with us during the laboratory testing.

h. The devices used on this testing must be production models of the Treis Emulsifier.

These tests must be run at your expense. Upon completion and transmittal of the EPA data, along with the requested information noted above, an evaluation of your device will be made including any confirmatory EPA testing considered necessary. If such confirmatory testing is required you will be contacted for your approval of our in-house test plan. Any testing at EPA will be at the expense of the U.S. Government. In order

to expedite the processing of your application, we must require that the requested information and test data be submitted by April 28, 1981. If you have any questions concerning this matter, please contact me at 313-668-4299.

Sincerely,

Merrill W. Korth

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

Enclose:
1. Lab List
2. Table 1

c[redacted]T. Penninga
511 File (Treis Emulsifier)