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EPA Evaluation of the Cyclone-Z Device Under Section 511 of the Motor Vehicle Information and Cost Savings Act

by

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

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Disclaimer: Portions of this document are illegible.

16. ABSTRACT

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

The evaluation of the "Cyclone-Z" device was conducted upon receiving an application from the marketer. The device is claimed to improve fuel economy and driveability and to reduce exhaust emissions.

EPA fully considered all of the information submitted by the applicant. The evaluation of the "Cyclone-Z" device was based on that information, EPA's engineering judgement, and its experience with other air bleed devices. Although the device may significantly reduce carbon monoxide emissions for some vehicles, it will probably not have a significant effect on hydrocarbons, nitrogen oxides, or fuel economy. Additionally, EPA has no reason to believe that the device can cause a noticeable difference in starting, warm-up, power, or piston ring blow-by as claimed.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Exhaust Emissions Fuel Consumption Motor Vehicles [illegible] Tests	Air Bleed Fuel Economy	

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EPA Evaluation of the Cyclone-Z Device Under Section 511 of the Motor Vehicle Information and Cost Savings Act

The Motor Vehicle Information and Cost Savings Act requires that EPA evaluate fuel economy retrofit devices and publish a summary of each evaluation in the Federal Register.

EPA evaluations are originated upon the application of any manufacturer of a retrofit device, upon the request of the Federal Trade Commission, or upon the motion of the EPA Administrator. These studies are designed to determine whether the retrofit device increases fuel economy and to determine whether the representations made with respect to the device are accurate. The results of such studies are set forth in a series of reports, of which this is one.

The evaluation of the "Cyclone-Z" was conducted upon the application of a marketer of the device. The device is claimed to improve fuel economy and driveability and to reduce exhaust emissions. The Cyclone-Z is classified by EPA as an air bleed device.

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

1. Title

   Application for Evaluation of Cyclone-Z under Section 511 of the Motor Vehicle Information and Cost Savings Act.

2. Identification Information:

   a. Marketing Identificaton of the Product:

      "This device, which is manufactured in Japan under the name Uzumaki, will be sold in this country under the name Cyclone-Z. The name Cyclone-Z will be registered as a trade name in the immediate future."

   b. Inventor and Patent Protection:

      (1) Inventor

         "Hanaya Co., Ltd., and specifically Mr. T. Omori, invented this device and have applied for a patent".

      (2) Patent

         "A copy of the patent application is enclosed." [Attachment A of this evaluation].

c. Applicant:

(1) Name and Address:

"This application is filed by Kana Corporation, a Colorado corporation, 1653 Vine Street, Denver, Colorado, 80206."

(2) Principals:

"Mr. Carl Urich is the principal owner and Chairman of Kana Corporation, while Mr. Edward E. Simon, Jr., is the President."

(3) "Louis A. Bluestein, the Vice President of Kana Corporation is authorized to represent the company. Our telephone number is (303) 394-2001."

d. Manufacturer of the Product:

(1) Name and Address:

"Manufacturing will be done by Hanaya Co., Ltd., Marunouchi Yaesu Building, 421-A1, 2-6-1 Marunouchi, Chiyoda-ku, Tokyo, 100 Japan".

(2) Principals:

"Hanaya's officers are Kyoji Usui, President, Akaira Osako, Vice President, T. Omori and K. Tanaka, Directors".

3. Description of Product:

a. Purpose:

"Both the objectives and theories of the Cyclone-Z are described in documents previously mailed to you [Attachment B]. A new, more compact brochure is enclosed [Attachment C] for additional reference.

[For the readers convenience, the following are appropriate excerpts from Attachments B and C of this evaluation.]

"... our main purpose of this venture is to help all countries, their societies and people."

"To solve the world's auto gas emission and fuel-saving problems ...."

"The Cyclone-Z has been developed based on the combustion engineering theory for better and higher combustion efficiency."

b. Theory of Operation:

[See Attachments B and C of this evaluation]

c. Construction and Operation:

[See Attachments A, B, and C of this evaluation]

d. Specific Claims for the Product:

"At the present time, specific claims are not made with respect to the device. However, a general claim will be made that the Cyclone-Z improves gasoline mileage, reduces emissions, and improves driveability."

"The Cyclone-Z has been developed based on the combustion engineering theory for better and higher combustion efficiency. It increases power, is economical and very efficient in reducing auto emissions." [Excerpt from page one of Attachment C].

e. Cost And Marketing Information:

"While the product should retail in the $200.00 range, that price may vary. It will be marketed by America First Marketing Corporation, of Oklahoma."

4. Product Applicability, Installation, Operation, Safety and Maintenance:

a. Applicability:

"Essentially, the Cyclone-Z is applicable to all types of internal combustion gasoline engines which have carburetors. It is not applicable to diesel engines, nor cars with fuel injection; and it appears not to assist cars using other non-gasoline fuels. It is possible that some later model cars with more sophisticated emissions control systems may be less affected or adversely affected by the device, but these effects are still under study."

b. Installation - Instructions, Equipment, and Skills Required:

"Installation and operating instructions are enclosed [Attachment A of this evaluation]. The only other maintenance required will be the replacement of the air filter approximately every 6 months."

c. Operation:

[See Attachment A of this evaluation.]

d. Effects on Vehicle Safety:

"We are not aware of any safety problems with the Cyclone-Z. Thus far, malfunctions have been traced to improper installation and certain defects in manufacture."

e. Maintenance:

"This product will cause improved engine efficiency as the device is used. As a result, engine idling speeds may need adjustment over time.

"The only other maintenance required will be the replacement of the air filter approximately every 6 months." [Excerpt from Section 4.b. of the application]

5. Effects on Emissions and Fuel Economy:

a. Unregulated Emissions:

[The applicant did not address unregulated emissions.]

b. Regulated Emissions and Fuel Economy:

"Previously you have received test results obtained in Japan [Attachment D of this evaluation]; and I am enclosing herewith a copy of the test results obtained from Automotive Testing Laboratories, Inc. [Attachment E].

"When properly installed, the Cyclone-Z should cause a significant reduction in regulated emissions, particularly hydrocarbons and carbon monoxide. In addition, the Cyclone-Z should provide a significant improvement in mileage.

"It is believed that these results are more apparent in road testing using standard commercial fuels rather than indolene. Dynamometer tests with indolene fuel are not consistent with the results received in actual driving under less controlled conditions. This inconsistency may possibly be attributable to recently discovered adverse effects of air shipment on the mechanical parts of Cyclone-Z."

6. Analysis

a. Description:

(1) The primary purpose of the device, as given by the applicant, is to improve fuel economy and reduce exhaust emissions. Based on the information submitted by the applicant, EPA judges the applicant's statement to be appropriate.

(2) Based on the theory of operation and the description provided by the applicant, the device appears to be of mechanical design and is intended to bleed additional air into the engine at a rate which is a function of both engine load and altitude. (Most air bleed devices provide additional air at a rate which varies only with engine load.) The additional air is introduced into the engine's Positive Crankcase Ventilation (PCV) line and is claimed to cause a more turbulent air/fuel mixture within the combustion chamber and thereby improve the combustion process.

In addition to the two documents (Attachments B and C) referred to by the applicant, EPA also considered Attachment A and determined that the theory of operation and the description were not entirely adequate for two reasons. First, it was not clear that the device was only mechanical in design or whether there were electronics associated with it. Second, it was not clear as to how additional air injected into the PCV line could cause a more turbulent air/fuel mixture within the combustion chamber.

EPA judges the device as indeed being capable of bleeding additional air into the PCV line. However, without additional information and data, EPA does not know for sure whether the air bleed rate is controlled by the load and altitude controls within the device so as to cause a constant air/fuel ratio as claimed by the applicant. EPA asked for additional information to clarify these areas but the applicant did not respond to this request (Attachment F).

(3) The applicant states a general claim for the device is that it improves fuel economy and driveability and reduces emissions. Additionally, it is claimed in Attachment B that the device also improves combustion efficiency and power and also reduces piston ring blow-by gas. Further, in Attachment C the claim is made that the device causes improved starting and shorter warm-up periods.

The applicant did not submit information and data which adequately supported all the claims made for the device. Based on EPA's understanding of the device, there is doubt that the device can cause some of the benefits claimed (e.g., improved power, starting, and warm-up, and reduced gas blow-by). For other benefits, i.e., improved fuel economy and reduced emissions, EPA believes that except for carbon monoxide, the device is unlikely to cause any significant change. EPA requested additional information and data, however, the applicant did not submit any (Attachment F).

(4) The cost of the device, as given by the applicant, is approximately $200. EPA estimates that installation time would not exceed one hour and assuming a shop rate of $20 per hour, the installation cost would be an additional $20. Thus, total cost would be approximately $220. If use of the device did result in a 10% improvement in fuel economy (and assuming a cost of $1.40 per gallon of fuel), a vehicle averaging 20 MPG would have to be driven approximately 35,000 miles to recover the cost.

b. Applicability, Installation, Operation, Safety and Maintenance:

(1) Applicability:

The applicability of the product as stated in the application, in general, seems appropriate. The applicant did not state whether one model was applicable to all vehicles. Since there are adjustment features within the device, one model may possibly apply to all vehicles. EPA asked the applicant to clarify this concern, however, he did not respond (Attachment F).

It should be noted that the applicant states, "it is possible that some later model cars with more sophisticated emissions control systems may be less affected or adversely affected by the device". EPA agrees that for some recent model vehicles which are designed and calibrated with extremely lean air/fuel mixtures, it is possible that further enleanment of the mixture may result in driveability problems (e.g., hesitation and stalling). For the most recent models with feedback carburetors, any change attributable to the device would likely be automatically negated by the controls.

(2) Installation - Instructions, Equipment and Skills Required:

The applicant did not submit a copy of the installation instructions intended for purchasers of the device. EPA requested that a copy be submitted along with a list of those tools required to perform the installation (Attachment F). However, the applicant did not submit any.

Based upon the description of the device and also considering the general installation instructions given within the patent (Attachment A), EPA judges that an individual having a basic understanding of engines should experience no difficulty installing the device.

It was also judged that common hand tools found in most homes would be sufficient to perform the installation. EPA believes a real obstacle for most individuals will be the required adjustments after device installation. The instructions given within the patent state that a tachometer and an exhaust gas analyzer are used when performing the adjustments. While some individuals may have a tachometer, few have access to an exhaust analyzer. Therefore, most purchasers will find it necessary to have the adjustments performed by a commercial service facility.

(3) Operation:

Based on the design of the device, EPA has judged that a controlling action by the driver is not required in order for the device to function properly.

(4) Effects on Vehicle Safety:

EPA judges that for most vehicles the device should not pose any safety related problems. However, for some recent models which have the carburetor calibrated for very lean air/fuel ratios, the further addition of air by the device may cause adverse driveability problems, i.e., hesitation and stalling, which under certain driving conditions may be considered unsafe.

(5) Maintenance:

The applicant states that the only additional maintenance required is the changing of the air filter (located on top of the device) every six months. EPA judges this to be a relatively simple operation and should cause no problem. Not stated in the application was the source or cost of such filters. Another concern was that noted in Section 4.e. of the application wherein it is stated that engine idling speeds may need adjustment after some time. EPA asked the applicant whether the device will have to be adjusted as done during initial installation (Attachment F), i.e., with a tachometer and an engine exhaust gas analyzer. EPA also inquired as to the availability and cost of the air filters. The applicant did not respond to these questions. If the tachometer and gas analyzer are required for adjustment, then this would likely necessitate that the purchaser have the service performed at a commercial facility. This of course would extend the mileage interval to recover the cost of the device (discussed in Section 6.a.(4) of this evaluation).

c. Effects on Emissions and Fuel Economy:

(1) Unregulated Emissions:

The applicant did not submit any data with respect to unregulated exhaust emissions. Although data was not provided, it is EPA's engineering judgement that based on the design of the device, the Cyclone-Z is unlikely to adversely affect unregulated pollutants.

(2) Regulated Emissions and Fuel Economy:

The applicant did submit test data (Attachment E) in accordance with the Federal Test Procedure and the Highway Fuel Economy Test. These two test procedures are the primary ones recognized by EPA for evaluation of fuel economy and emissions for light duty vehicles.[1] EPA evaluated the data and noted the following concerns.

(a) The applicant deviated from the EPA recommended test plan by performing hot-start test. While that deviation may be acceptable for some devices, in this instance it was not in that the applicant's claims (e.g. quicker starts and warm-ups) could not be assessed.

(b) The test results were typical of most air bleed devices, i.e., carbon monoxide (CO) was greatly reduced, hydrocarbons (HC) and nitrogen oxide (NOx) may or may not have been reduced, and fuel economy was essentially unchanged.[2]

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[1]The requirement for test data following these procedures is stated in the policy documents that EPA sends to each potential applicant. EPA requires duplicate test sequences before and after installation of the device on a minimum of two vehicles. A test sequence consists of a cold start FTP plus a HFET or, as a simplified alternative, a hot start LA-4 plus a HFET. Other data which have been collected in accordance with other standardized procedures are acceptable as supplemental data in EPA's preliminary evaluation of a device.

[2]A few air-bleed devices have shown a small improvement in emissions or fuel economy by leaning out the richer air/fuel mixtures associated with vehicles prior to the onset of emission controls. Without using a device, the same effect could also be achieved on these vehicles by leaning out the idle mixture screws. However, with the leaner air/fuel ratios now used by the manufacturers to control emissions and improve fuel economy, even these few devices would not show improvements. On the most recent models with computerized emission control systems, any changes attributable to the device would automatically be negated by the controls.

(c) The test report compares the test results after 200 miles of driving to those results obtained prior to the 200 miles. Because baseline testing (without device) had not been performed after the 200 miles, one can not ascertain whether the change in emissions and fuel economy were attributable to the device or to the mileage accumulation.

The applicant contended both within the application and in telephone conversations with EPA that the reason the test results did not show significant benefits (except for CO) was possibly because of adverse effects of the air shipment on the mechanical parts of the device prior to testing.

The applicant was notified (Attachment F) of EPA's concerns regarding the test data and requested that he submit additional test data. The applicant subsequently notified EPA the device was being redesigned to correct a manufacturing problem. Because the design had not been finalized and considering the time yet required to test the new design, EPA was forced to complete its evaluation of the Cyclone-Z using all available information.

d. Testing by EPA:

EPA did not test the device for this evaluation for the following reasons. First, the test data submitted by the applicant did not adequately support the claims made for the device. Additionally, current ongoing design changes are not yet completed. Further, EPA's engineering judgment and its experience with other air-bleed devices suggest that significant changes attributable to the device are unlikely to be realized.

7. Conclusions

EPA fully considered all of the information submitted by the applicant. The evaluation of the Cyclone-Z device was based on that information, EPA's engineering judgment, and its experience with other air bleed devices. Although the device may significantly reduce CO emissions for some vehicles, it will probably not have a significant effect on HC, NOx, or fuel economy. Additionally, EPA has no reason to believe that the device can cause a noticeable difference in starting, warm-up, power, or piston ring blow-by as claimed. Further, it is possible that for some recent model vehicles which are designed and calibrated with lean air/fuel mixtures, further enleanment of the mixture may result in driveability problems (e.g., hesitation and stalling). For other recent models with feedback carburetors, any change attributable to the device would likely be automatically negated by the controls.

Thus, there is no technical basis for EPA to support the claims made for the device or to perform confirmatory testing.

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

List of Attachments

Attachment A	A copy of the Patent Application (provided with 511 Application).
Attachment B	A copy of an enclosure to a letter from Kana Corporation to EPA, April 2, 1982.
Attachment C	A copy of an enclosure to the application, titled, A Revolution in Combustion Engineering Theory, the Cyclone-Z.
Attachemnt D	A copy of an enclosure to a letter from Kana Corporation to EPA, April 2, 1982.
Attachment E	A copy of an enclosure to the application containing test results from Automotive Testing Laboratories, Inc., August 27, 1982.
Attachment F	A copy of letter from EPA to Kana Corporation, October 5, 1982.

PATENT COOPERATION TI

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NOTIFICATION OF RECEIPT OF RECORD COPY

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DATE OF MAILING by the International Bureau	19 February 1982 (19.02.82)
APPLICANT'S OR AGENT'S FILE REFERENCE	YM-0084

IDENTIFICATION OF THE INTERNATIONAL A.

International Application No.	International Filing Date
PCT/JP82/00036	08 February 1982 (08.02.82)

Applicant (Name)

1) HANAYA INC.,
2) USUI, Kyoji, et al.

NOTIFICATION

The applicant is hereby notified that the record copy of the above-identified ir
ved by the International Bureau on 18 February 1982 (18.
This date is within the prescribed time limit. (2) –

The International Bureau has notified each designated Office specified in the .
date of receipt of the record copy. The Annex to this notification also indicate
gnated Offices, there is an applicable time limit under Article 22 (3). (3)

The numbers -- if any -- used in the Annex to this notification against the n
by reference to corresponding numbers appearing above against the names o
been indicated as applicants in respect of which designated Offices.

The priority has been claimed of earlier application(s) having the following

None

A copy of this notification has been sent (1) to the receiving Office and the I

ANNEX

The designated Offices notified are those shown opposite the indications of the designations made in the international application.

Designations made in the international application: Contracting State and (where applicable) kind of patent		Designated Office notified
[X] Australia	(1)	Australian Patent Office * Δ
Austria		
a. [ ] National patent		Austrian Patent Office *
b. [ ] Regional (European) patent		European Patent Office †
[ ] Belgium		European Patent Office †
[X] Brazil	(1)	National Institute of Industrial Property, Rio de Janeiro
[ ] Cameroon		African Intellectual Property Organization *
[ ] Central African Republic		African Intellectual Property Organization *
[ ] Chad		African Intellectual Property Organization *
[ ] Congo		African Intellectual Property Organization *
[ ] Democratic People's Republic of Korea		Inventions Committee
[ ] Denmark		Danish Patent and Trademark Office
[ ] Finland		National Board of Patents and Registration
[X] France	(1)	European Patent Office †
[ ] Gabon		African Intellectual Property Organization *
Germany (Federal Republic of)		
a. [ ] National patent		German Patent Office *
b. [X] Regional (European) patent	(1)	European Patent Office †
[ ] Hungary		National Office of Inventions * Δ
[X] Japan	(1)	Japanese Patent Office
Liechtenstein (see Switzerland and Liechtenstein below)		
Luxembourg		
a. [ ] National patent		Ministry of National Economy, Patent Office, Luxembourg *

Annex, page 2

Designations made in the international application: Contracting State and (where applicable) kind of patent (Continued)		Designated Office notified (Continued)
[ ] Madagascar		Ministry of Industry and Commerce, Department of Industry and Mines
[ ] Malawi		Ministry of Justice, Department of the Registrar General
[ ] Monaco		Ministry of State, Patent Office •
Netherlands		
a. [ ] National Patent		Netherlands Patent Office
b. [ ] Regional (European) patent		European Patent Office †
[ ] Norway		Norwegian Patent Office
[ ] Romania		State Office for Inventions and Trademarks •
[ ] Senegal		African Intellectual Property Organization •
[X] Soviet Union	(1)	USSR State Committee for Inventions and Discoveries •
Sweden		
a. [ ] National patent		Swedish Patent Office
b. [ ] Regional (European) patent		European Patent Office †
Switzerland and Liechtenstein		
a. [ ] National patent		Swiss Intellectual Property Office•
b. [X] Regional (European) patent		European Patent Office †
[ ] Togo		African Intellectual Property Organization •
United Kingdom		
a. [ ] National patent		United Kingdom Patent Office
b. [X] Regional (European) patent	(1)	European Patent Office †
[X] United States of America	(2)	United States Patent and Trademark Office

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Footnotes ·

• The time limit under Article 22 (2) does not apply; instead, where the International Searching Authority makes a declaration under Article 17 (2) (a) that no international search report will be established, the time limit under Article 22 (1) applies.

† Payment to the European Patent Office of the national fee may be made up to one month after the time limit applicable under Article 22 (1) or (2) (note, however, that the extension does not apply to payment of the European examination fee).

Δ The time limit under Article 22 (1) is extended by one month.

Translation of - [illegible]

SPECIFICATION

TITLE OF INVENTION:

Air Supply Device for Internal Combustion Engine

FIELD OF INVENTION:

This invention pertains to air supply device for internal combustion engine which is designed to improve a fuel/air ratio of mixtured gas in internal combustion engine.

BACKGROUND OF TECHNIQUE:

The internal combustion engine operates on the principle that a carburetor atomizes fosil fuels to produce mixtured gas which is forwarded to a cylinder to be ignited. It is known that optimum condition of mixtured gas tends to suffer a change by the engine speed and the temperature of internal combustion engine, as well as by the altitude where internal combustion engine is located. The present inventor conducted the experiment in which the number of revolutions of internal combustion engine was set at a uniform rate (3000 rpm), while the altitude was altered. The following measurements are the results of said experiment which show the relationship between the altitude and the manifold boost pressure.

Altitude	Manifold boost pressure
2400 m	385 mmHg
1730	420
1590	440
1000	465

The results thus obtained leads to the conclusion that atmospheric pressure of the place where internal combustion engine is located alters the condition of mixtured gas in internal combustion engine.

According to the prior arts, the jet engines that use electronic fuels are provided with altitude compensating controller which operates on the basis of absolute pressure, and altitude compensating controller which adjusts air bleeder by vacuum bellows is incorporated into carburetor. However such altitude compensating controllers as mentioned above are expensive.

It is also uneconomical to improve internal combustion engine which is already in the form of a finished product by making use of the aforementioned method.

Also, for the method to decrease NO_x contained in the exhaust gas, it is reported that combustion which occurs in a high temperature generates a large amount of NOx; NOx is mainly generated in the center of combustion chamber where a high temperature permeates. Namely, combustion performed within engine where a high pressure exists causes following reaction:

$$N_2 + O_2 \longrightarrow 2NO - 43.2 \text{ Kcal}$$

This reaction frequents where a temperature is high. Aforementioned NO which undergoes a non-equilibrium condition to be caused by the stroke where combustion expands is exhausted to an atmosphere to react on O_2 so as to yield NO_2. As regards the aforementioned fact that NOx is generated in the center of a combustion chamber, it is reported that the concentration of NO to be produced at the first stage of combustion is extremely high and the following stages of combustion are not the decisive factor to generate NO ("The Principles on Engine Planning for Automobile" Tokyo: Sankaido Publishing Co.). Furthermore, a serial picture released by Research Institute of General Motors, Co., U.S.A. shows that NO which is ignited to begin combustion at BTDA 7° still retains a high temperature as well as a high pressure at ATDC 40° (Cohlin Campbell. "Sports Car: Its Theory and Design": 42 - 43. Translation by Yoshiaki Shinoda and Jiro Kashiwagi. Nikyosha Publishing Co.). In addition, the concentration of NOx to be exhausted from a rotary engine in which the position of combustion chamber is altered as compared with that to be exhausted from a reciprocating engine. The phenomenon mentioned above result from the characteristics of a rotary engine where combustion chamber rotates in a stroke of suction and compression to give rise to a turbulence which continues to exist during ignition as well as combustion, so that the flame is cooled down by means of cylinder and rotor.

The present inventor quotes the gist of the publication cited above as regards the generation of CO and HC contained in exhaust gas.

In an ordinary carburetor, fuels tend to float in the air in the form of an extremely fine spray which flows into cylinder with air flow. But in case where an engine load is small or an engine idles, fuels tend to run into an inlet manifold in the form of pure liquid. On the other hand, when an engine performs with a large amount of load or a full throttle, even a high temperature does not prevent a throttle plate from opening in full scale. Thus fuels to be supplied increase extremely. Sometimes, the amount of fuels to be supplied in the form of spray reaches as high as 60%. Consequently, the effect of a flush boiling that may occur as a liquid flows into a low-pressure inlet manifold does not prove itself substantially, resulting in unbalance of mixtured gas as well as incomplete combustion to generate a large amount of CO and HC. Furthermore, in the case of a reciprocating engine, the swirl effect caused by squash does not offer any noticeable result at an initial stage of combustion, whereas said effect brings about a noticeable result at a final stage of combustion ("The Principles on Engine Planning for Automobile").

DISCLOSURE OF INVENTION:

This invention intends to provide an air supply device for internal combustion engine which is designed to maintain constantly an efficient fuel/air ratio of mixtured gas regardless of a change in the altitude and give high output with minimum consumption of fuels, as well as to reduce the amount of NOx, CO, HC contained in the exhaust gas. The characteristics of this invention resides in that a first control valve to be controlled by atmospheric pressure and a second control valve to be controlled by the load of carburetor are placed in an air path in series, the downstream terminal of said air path being connected to an inlet pipe which is located downstream from a carburetor of internal combustion engine.

The structure of this invention mentioned above makes it possible to maintain constantly optimum fuel/air ratio in accordance with the number of revolutions of internal combustion engine regardless of a change in the altitude; this results in an increase in output as well as reduction of fuel consumption.

At the same time, in the structure of this invention, an inlet manifold generates a stroke of inhalation, compression and explosion to cause a swirl in mixtured gas which works to improve the evaporation and combustion of fuels, as well as to enhance a greater uniformity of mixtured gas. Thus, NOx, CO and HC contained in exhausted gas can be reduced.

Furthermore, since an air supply device provided by this invention uses PCV line of the conventional internal combustion engine to supply the air, it can be applied to almost all of the conventional internal combustion engine. In addition, PCV line can offer an appropriate angle at which secondary air is injected to the main mixtured gas, resulting in the generation of uniform mixtured gas. It should be noted that the injection of secondary air through a hole for boost measurement cannot set uniform mixtured gas.

BRIEF EXPLANATION OF ACCOMPANYING DRAWINGS:

Fig. 1 shows an exemplary embodiment of this invention;

Fig. 2 and Fig. 3 show the sectional drawings of a carburetor;

Fig. 4 shows an oblique drawing of an exemplary embodiment of this invention.

OPTIMUM FORM TO EMBODY INVENTION:

Hereinafter, an exemplary embodiment of this invention will be explained with accompanying drawings. Referring to Fig. 1, an exemplary embodiment of this invention identified as an air supply device 1 comprises air cleaner 2, atmosphere chamber 4, aneroid chamber 6, first air chamber 9 (this embodiment prepares two first air chambers as shown in Fig. 1), suction chamber 10 and second air chamber 12. The atmosphere chamber 4 to inhale a purified air through the air cleaner 2 is connected to the first air chamber 8 through the high-speed metering jet 16 which works as the first control valve to be controlled by the first diaphram 14 of the aneroid chamber 6. Aneroid chamber 6 is airtightly enclosed by the first diaphram 14. Atmosphere chamber 4 and first air chamber 8 are connected by the high-speed metering jet 16 and high-speed adjuster 17 which works as first manual control valve. The air passing area of the high-speed metering jet 16 for connection with the air chamber 8 is adjusted by high-speed metering rod 20 mounted on lifter 18 that is integral part of the operating body of first diaphram, and the area to be occupied by the high-speed adjuster 17 for connection with the first air chamber 8 is adjusted by first adjustment screw 21. Referring to Fig. 2 and Fig. 3, the suction chamber 10 is connected to vacuum advance port 152 of carburetor 150 through signal connector 22. The suction chamber 10 is stopped by second diaphram 24 to make up second control valve, and compression spring 28 is installed between the bottom 26 of the suction chamber 10 and the second diaphram 24. Since exhaust port 30 of the first air chamber 8 is substantially stopped by the second diaphram 24 and valve seat 25, decompression of the suction chamber 10 causes second diaphram 24 to travel toward the bottom 26 against the operation of compression spring 28, so that the exhaust port 30 begins to expand the air passing area thereof in proportion to the pressure in the suction chamber 10. Thus, the two of first air chamber 8 are connected to the second air chamber 12. The atmosphere chamber 4 is also connected to both the second air chamber 12 through slow metering jet 32 which works as third control valve and slow-speed adjuster 34 which works as second manual control valve. Slow-speed metering rod 36 mounted on lifter 18 adjusts the area to be stopped by the slow metering jet 34 for connection with the second air chamber 12 and second adjustment screw 37 adjusts the area to be stopped by the slow-speed adjuster 34 for connection with the second air chamber 12. Cover

39 is installed to adjust the first adjustment screw 21 and the second adjustment screw 36 from outside. The second air chamber 12 is connected to PCV (not shown in the accompanying drawings) through supply connecter 40. Referring to Fig. 1 and Fig. 3, said vacuum advance port 152 is placed in the path which locates itself slightly upstream from the center of rotation of butterfly 153. When the accelerator is stepped on to cause the butterfly 154 to rotate counterclockwise as shown in Fig. 3, the vacuum advance port 152 begins to locate itself down-stream from the butterfly 154.

Fig. 4 shows the structure of the atmosphere chamber 4 which is composed of the high-speed metering jet 16, the high-speed adjuster 17, the slow metering jet 32 and the slow-speed adjuster 34. As shown in Fig. 4, the lifter support 52 and the valve seat member 54 are mounted on partition member 50 to separate the first air chamber 8 from the second air chamber 12. The first diaphram 14 is placed within the bottom 56 of the lifter support 52, and the upper part of rising member 58 of the lifter support 52 has lifter rod 60 which is installed so as to project from the top of the rising member 58. Vertical lifter rod 60 and V-shaped lifter plate 62 are incorporated to make up the structure of the lifter 18, and the high-speed metering rod 20 and the slow-speed metering rod 36 are mounted on each terminus of V-shaped lifter plate 62. On the other hand, the valve seat member 54, which is furnished with the high-speed metering rod 20 and the slow-speed metering rod 36, is further provided with the first adjustment screw 21 and the second adjustment screw 37. The high-speed adjuster 17 consists of the first adjustment screw 21 and a first compression spring 70 which is adapted to prevent the first adjustment screw 21 from loosing. The low-speed adjuster 34 consists of the second adjustment screw 37 and a second compression spring 72 which is adapted to prevent the second adjustment screw 37 from loosing.

In the structure mentioned above, when an engine either idles or decelerates, the butterfly 154 of the carburetor 150, as shown in Fig. 2, operates to close the path where mixtured gas travels. Thus the pressure in the vacuum advance port 152, that is, the pressure in the suction chamber 10 tends to stand as high as atmopheric pressure, and the first air chamber 8 is cut off from the second air chamber 12 by the second diaphram 24. Consequently, the air which passes through the slow metering jet 32 that opens in accordance with the range of altitude, that is, atmospheric pressure and the slow-speed adjuster 34 that opens in accordance with a desired area to be occupied for connection, is forwarded to the intake manifold through the supply connecter and the PCV line.

On the other hand, when an engine is either accelerated or is operated at high speed, the butterfly 154 of the carburetor begins to move counterclockwise, as shown in Fig. 3, to locate itself upstream from the vacuum advance port 152. Thus the amount of pressure in the vacuum advance port 152, that is, the amount of pressure in the suction chamber 10 approaches the amount of boost pressure in the intake manifold. Thus the second diaphram 24 begins to lower against the operation of compression spring 28, resulting in the creation of a space between the second diaphram 24 and the valve seat 25 to connect the first air chamber 8 with the second air chamber 12. The air passes through the slow-speed metering jet 32 that opens in accordance with the range of altitude, namely atmospheric pressure, and the slow-speed adjuster 34 that opens in accordance with a desired area to be occupied for connection, and the air also passes through the high-speed metering jet 16 that opens in accordance with the range of altitude, namely atmospheric pressure, and the high-speed adjuster 17 that opens in accordance with a desired area to be occupied for connections and further the space between the second diaphram 24 and the valve seat 25, so that the air is forwarded to intake manifold through the supply connecter 40 and the

PCV line.

In the structure mentioned above, the high-speed metering jet 16 and the slow-speed metering jet 32 are designed in accordance with the following table so that they can supply the air which matches ranges of the sea level to be selected.

	High-speed metering jet (2000 rpm)		Low-speed metering jet (650 rpm)	
Sea level (m)	Area for connection (mm^2)	Air to be supplied (l/min)	Area for connection (mm^2)	Air to be supplied (l/min)
0	0	0	0	0
600	0.55	30.0	0.72	2.0
1,200	1.25	40.0	0.87	2.4
1,800	1.95	45.0	1.04	2.7
2,400	2.65	50.0	1.20	3.0

Next, in the structure mentioned above, an air supply device for internal combustion engine is adjusted as follows:

First of all, the air supply device 1 is placed in engine room almost in vertical position and the engine is heated. Then, a tachometer and an exhaust gas analyzer are employed to measure as well as to record the engine speed of idling and the concentration of exhaust gas.

Example:

Engine speed	650 rpm
Concentration of CO	4.0 %
Concentration of HC	800 ppm

Next, the engine speed is set at 2000 rpm to measure the concentration of exhaust gas.

Example:

Engine speed	2,000 rpm
Concentration of CO	0.6 %
Concentration of HC	150 ppm

Afterwards, a supply connecter of air supply device 1 is connected to the PCV line through a three-way pipe, and the second adjustment screw 37 of the slow-speed adjuster 34 is revolved so as to get minimum measurements of CO and HC to be exhausted by putting the engine in the idling position. In the operation mentioned above, the engine speed is adjusted by an idle adjuster. Since the adjustment of the idle adjuster results in different measurements of CO and HC to be exhausted, it is required to repeat the adjustment by the use of the second adjustment screw 37 after the engine speed in the idling position is adjusted. Next, the signal connector 22 is connected to the vacuum advance port 152 and the number of revolutions of first adjustment screw 21 of high-speed adjuster 17 is adjusted to get minimum measurements of CO and HC to be exhausted with the engine speed being set at 2,000 rpm.

Example:

Engine speed	2,000 rpm
Concentration of CO	0.2 %
Concentration of HC	100 ppm

The following table shows the result of the experiment where an air supply device provided by this invention is applied to a 4-cycle, 8-cylindered engine with gross engine displacement of 7539 cc. The comparative measurements of the table are based on 10 mode.

	Without an air supply device	With an air supply device	Ratio of increase and decrease
CO	107.65 g/bn	45.27 g/bn	-57.9%
HC	3.72 g/bn	1.56 g/bn	-58.0%
NOx	4.72 g/bn	3.38 g/bn	-28.3%
CO_2	653.9 g/bn	651.8 g/bn	- 0.3%
Ratio of fuels to be consumed	2.8 bn/l	3.3 bn/l	17.8%

The following table shows the comparative measurements resulted from the experiment where an air supply device provided by this invention is placed at various range of sea level.

Sea Level m	Engine Speed rpm	Without an air supply device CO(%)	Without an air supply device HC(ppm)	With an air supply device CO(%)	With an air supply device HC(ppm)
0	650	2.2	80		
	2,000	1.2	30		
850	650	2.9	120	2.2	130
	2,000	2.0	65	1.35	55
1,300	650	2.9	130	2.2	140
	2,000	2.8	80	1.4	55
1,600	650	3.1	140	2.2	155
	2,000	3.0	95	1.2	70
2,000	650	3.1	160	2.2	170
	2,000	3.2	100	1.35	70
2,300	650	3.2	180	2.3	180
	2,000	3.6	110	1.4	80

CLAIMS:

1. An air supply device for internal combustion engine comprising a first control valve to be controlled by atmospheric pressure and a second control valve to be controlled by load of an engine; said two valves being placed in an air path in series and the downstream terminal of said air path being connected to an inlet pipe located downstream from a carburetor of internal combustion engine.

2. An air supply device for internal combustion engine as specified in claim 1, said first manual control valve is placed in parallel with said first control valve in said air path.

3. An air supply device for internal combustion engine as specified in claim 1, in which the downstream terminal of said air path are connected to an inlet pipe located downstream from a carburetor of internal combustion engine through a PCV line.

4. An air supply device for internal combustion engine as specified in claim 1, in which a third control valve to be controlled by atmospheric pressure is placed in parallel with said first control valve and said second control valve in said air path.

5. An air supply device for internal combustion

engine as specified in claim 1, in which a second manual control valve is placed in parallel with said first control valve and said second control valve in said air path.

ABSTRACT

This invention intends to provide an air supply device for internal combustion engine the characteristics of which resides in that a first control valve to be controlled by atmospheric pressure and a second control valve to be controlled by the load of engine are placed in series in air path, the down-stream terminal of said air path being connected to an inlet pipe located down-stream from a carburetor of internal combustion engine, resulting in the improvement of fuel/air ratio of mixtured gas of internal combustion engine to reduce the amount of fuels to be consumed as well as to decrease the amount of NOx, CO and HC contained in exhaust gas.

FIG. 1

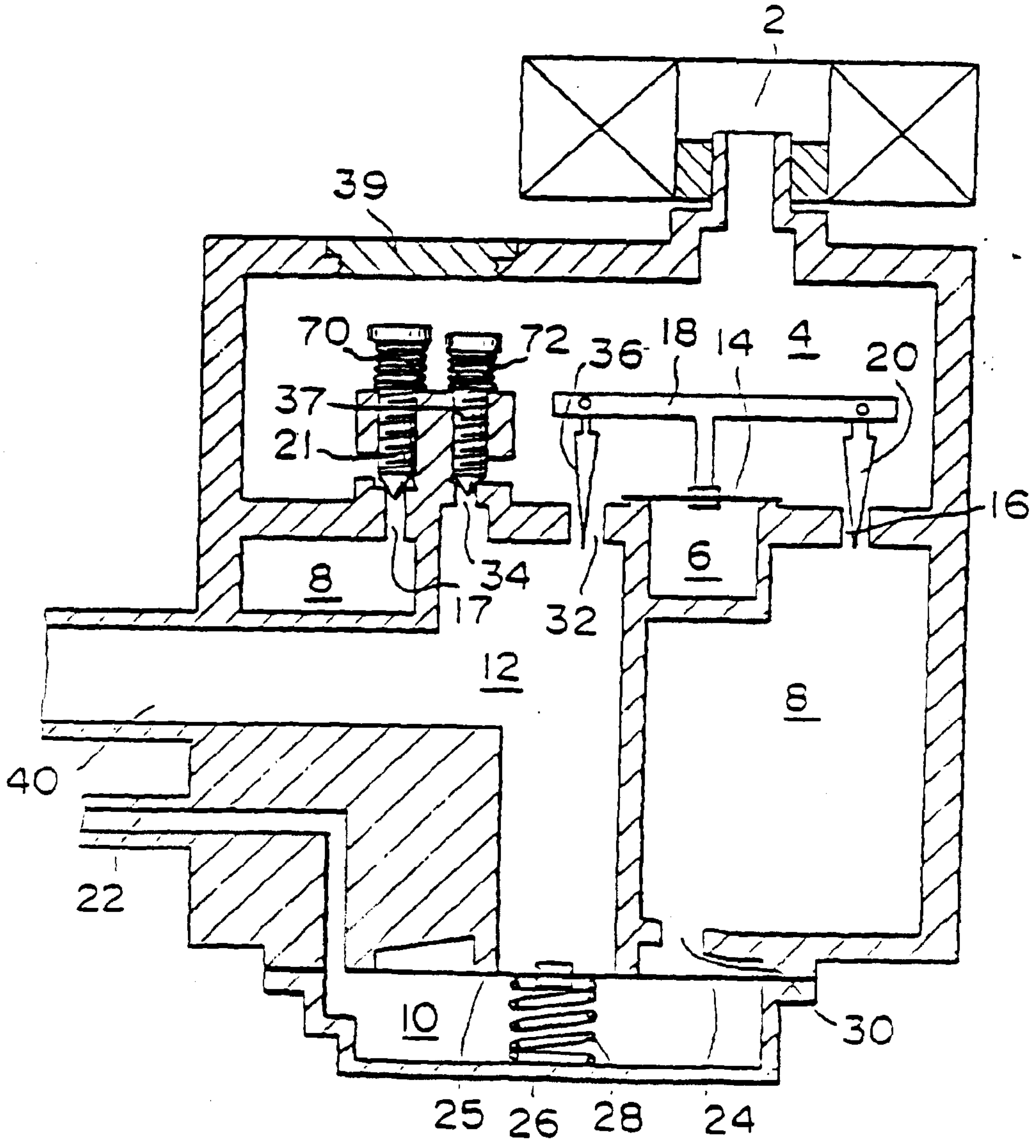


FIG.2

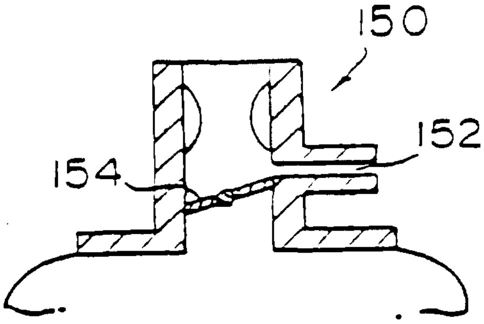


FIG.3

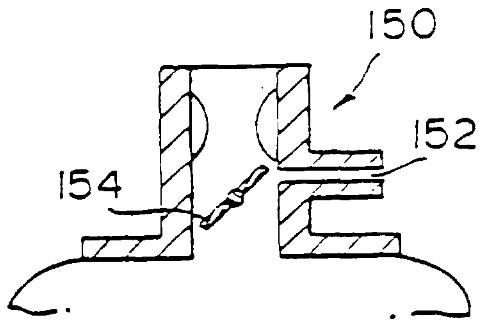
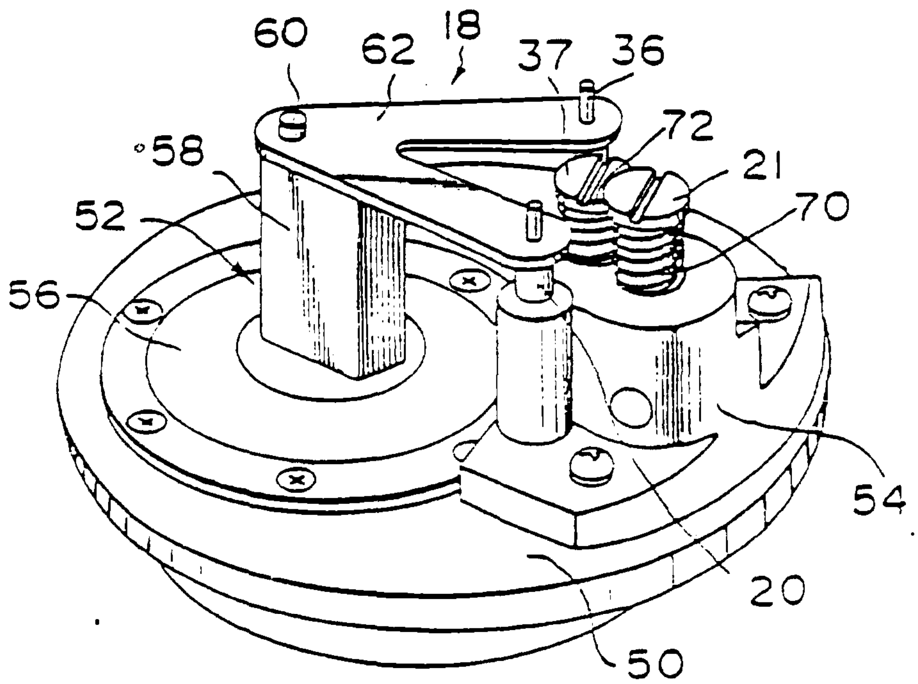


FIG.4



A CHALLENGE TO THE STARTING POINT IN THE COMBUSTION ENGINEERING THEORY!!

A COMBUSTION EFFICIENCY IMPROVEMENT DEVICE PERFECTED THROUGH THE TURBULENCE EFFECT

THE BIRTH OF THE "UZUMAKI"

A Start to a Clean Future Without Any Auto Exhaust Pollution

Auto owners throughout the world have waited for a long time for the development of this gasoline savings and auto exhaust emission reduction device which takes a drastic lead in this energy saving era.

- We shall name this, the "UZUMAKI"-

The Hanaya Group has established corporations in both America and Japan, has also challenged the starting point in the combustion engineering theory and was instrumental in perfecting the so-called "UZUMAKI." The Hanaya Group's engineering staff, in ordert to experiment and develop the fossil fuel for internal combustion engine to reduce the poisonous exhaust gases and also save fuel based their studies and work in Denver, Colorado, U.S.A. Our endeavors have come to fruition for the perfection of a super machine which surpasses the common knowledge of the combustion engineering theory.

This devise, the "UZUMAKI" not only drastically reduced poisonous gas from auto exhaust emissions, but also extends the gasoline mileage, and helps save fuel expenditures, making it an epoch-making new product whose development was awaited by all car owners throughout the world.

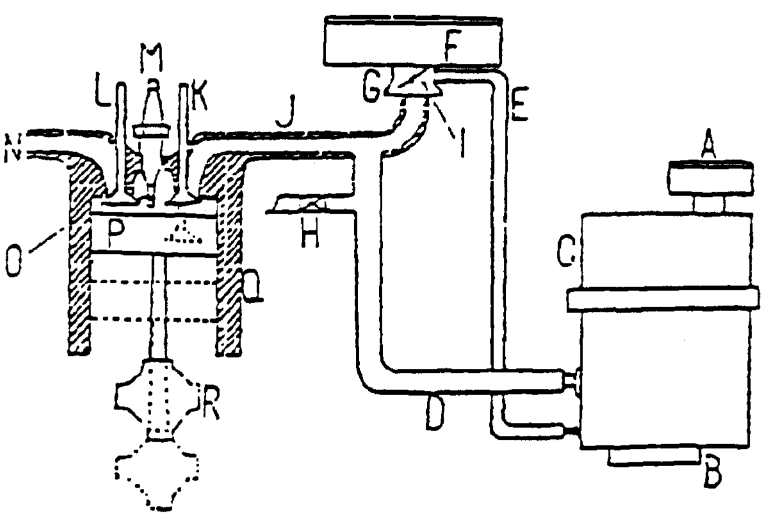
Starting with Japan and the U.S.A., the Hanava Group has officially applied for patent registration in 56 main industrial countries. Having completed these registrations, we are now disclosing our news throughout the world and advertising the true value of our device.

Usually auto engines are designed to burn vaporized gas either by a carburetor or jet injected fuel system. This uneven air fuel vaporized gas (either in a foggy mist or in a liquid form) is sent to its various cylinder which mixture tends to stick to the piston walls and cylinder walls thereby, the burning efficiency rate is only 60%-70%. The remaining gasoline is burned of which the majority is unburned gasoline polluting the air with poisonous gas such as the hydrocarbons (HC). This is a very serious problem from environmental protection and energy-saving views. With this in mind, the Hanaya Group by controlling its excellent engineering staff, developed the ideal, complete gasoline burning device. So to speak, we have made a challenge to the starting point in the combustion engineering theory. And, we have finally completed this device for practical use.

The basic system of this combustion efficiency improvement device "UZUMAKI," sends additional supply of secondary air into the fuel/air mixture produced by the carburetor, which generates a turbulence, and with the boost pressure in the intake manifold a multiplying effect occurs to vaporize the fuel activity, activating a flash boiling effect which in turn helps to make a steady flow of air and fuel and raises the uality of the mixture for a more effective burn in the cylinder.

The supply of the secondary air which raises the combustion efficiency is composed of 3 major parts. Namely, it is the low speed controller, high speed controller and the high altitude compensator (atmospheric pressure sensor). While the car is in operation, being under control with the above 3 parts, the correct amount of the secondary air is let in through the P.C.V. line after the engine revolution, engine load, and the altitude at which the car is running is calculated. At the same time, the secondary air to make the turbulence is let in through the P.C.V. line. The making of the turbulence effect helps to completely burn the fuel/air mixture which is in a comparatively low temperature around the piston head, around the cylinder wall and around the metal portion of the combustion chamber. With "the wave motion of combustion propagation" in the chamber, it has enabled making a faster combustion which in turn produced a high combustion pressure. This raised the combustion effect to almost 100%.

An effective combustion, raises the engine's revolution, the power also greatly increases, and it also decreases the fuel cost. Poisonous exhaust gases like CO (carbon monoxide), HC (hydro-carbons) and NOX (nitroxcide) are very hard to eliminate--gas can be stopped in advance.

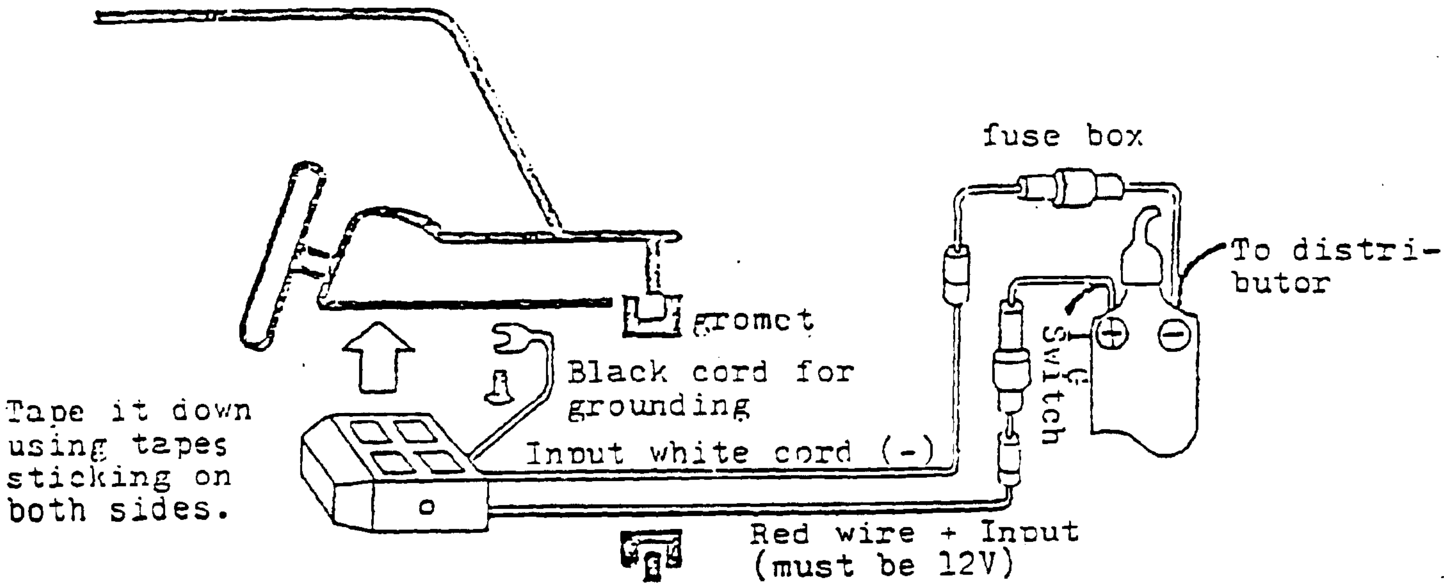


A. Air Cleaner.
B. Engine Condition Sensor.
C. RANRYU Main Body.
D. Supply line for turbulance.
E. Signal pipe.
F. Air cleaner for engine.
G. Carburator.
H. P. C. V.
I. Carburator butterfly.
J. Intake Manifold.
K. Intake Valve.
L. Exhaust valve.
M. Spark plug.
N. Exhaust Manifold.
O. Combustion chamber.
P. Piston.
Q. Cylinder.
R. Crank Shaft

Therefore, by raising the power in the vehicle, and depending on the types of vehicle, additional gasoline will be saved, and you will still be able to enjoy a marvelous ride. Our "UZUMAKI" is also equipped with a mini-computer sensor.

This sensor has the capability of a testor, and also incorporates a memory unit which connects directly to the ignition line, the gasoline or propane line. This always leaves your car in the best ignition condition. Even if the driver does not notice the time lag in the ignition, the sensor will catch it. Therefore, you will witness no loss in the fuel. Engine trouble especially in the electrical system with which you are not familiar will be checked by the sensor which will let you know in advance. Before driving, the driver can always press a certain sensor button which shows whether the ignition line, ignition timing, overheating, engine stop, engine starting is in good condition or not. With this sensor, you will be able to know your engine condition immediately before it gets uncontrollable or into a major disaster.

By catching the engine trouble beforehand to prevent any major problems, it means that you are having a normal condition, no fuel loss, and a maximum decrease in auto exhaust gas emission. Through these favorable conditions, our "UZUMAKI" will be able to give you almost a 100% combustion effect, which leads to the maximum decrease in the exhaust gas emission and savings on the gasoline expenditure.



With the installation of the "UZUMAKI," the following merits will be witnessed.

1. The turbulence effect on the combustion improvement system "UZUMAKI" produces a high speed combustion which in effect generates a high pressure combustion power. Through this we have fuel savings of 15% up to 35%. Also, a great reduction in auto exhaust emission of CO (carbon monoxide) HC (hydro-carbon) and NOX (nitroxide) are witnessed.

2. The combustion improvement device "UZUMAKI," detects the altitude difference while driving, also depending on the altitude, the altitude compensator feeds the necessary secondary air for the turbulence effect to match the air density. Therefore, you shall witness a perfect fuel/air mixture, and with the wave motion of combustion propagation, the combustion in the combustion chamber is instantly and completely burned.

Therefore, power loss by lack of oxygen, and large fuel loss can be detected before hand.

3. The turbulence effect from the combustion improvement device "UZUMAKI," eliminates the carbon deposits in the various parts of the combustion chamber (combustion chamber, piston head, intake valve, exhaust valve, piston ring, etc.)

   By taking away the carbon deposits, the following merits shall be seen.

   a) The engine oil will last longer due to carbon not mixing in the engine oil.

   b) The carbon mixed oil acts as a polishing agent on sliding parts (piston, piston ring, crank metal, conrod metal, crank journal and conrod journal), however, as our device eliminates the carbon in the engine, the engine itself lasts longer.

   c) Since the carbon on the spark plug electrodes are always cleaned, there will be no burning or becoming sooty.

4. The turbulence effect from the combustion improvement device "UZUMAKI" increased the combustion speed and produces a high combustion pressure. This increases the crank shaft torque and also gives a better response on the engine revolutions, which in turn give a better erformance in the acceleration and driving hills.

5. Through the turbulence effect from the combustion improvement device, "UZUMAKI," it increases the flash boiling giving each cylinder an even fuel/air mixture which eliminates unpleasant engine vibration.

Further, "UZUMAKI" has the following 5 specialities.

1. While in operation, this device detects engine revolutions, its load conditions and the necessary quantity for the secondary air for the making of the turbulence is supplied by the flow meter controller.

2. For low or high altitude difference (atmospheric pressure difference) our device incorporates an altitude compensator which detects, operates and automatically supplies the necessary secondary air for the turbulence.

3. This device is applicable on small, medium, large and special cars of all makes.

4. An engine condition sensor with special wiring is incorporated in this device, which automatically supplies and controls the flow of the secondary air for turbulence at low or high speeds.

5. After the complete installation of the device, the only necessary maintenance required is to replace the air cleaner.

As noted above, the "UZUMAKI" is an epoch-making device that supersedes the theory in the combustion engineering principles, and we strongly believe that we can be of worldwide help in this auto field.

The perfection of the "UZUMAKI" was made at the end of last year (1981), and our final test with prototype samples was performed in Colorado, U.S.A. (Highland), E.T.C. Environmental Testing Corp., at California U.S.A. (low land), S.C.I. Systems Control Inc., covering large, medium, and small size vehicles. LA-4 mode at high speeds and long distance drive tests at highway mode and 10-mode tests at town speeds and also emission tests were performed. Splendid test results have been obtained.

The following vehicles were tested:

1. Large-Size Vehicles, over 2,000 cc:
   Lincoln, Cadillac, Thunderbird, TransAm, Gallaxy, LTD, Mercury Cougar,Corvette, Monarch, Camaro, Monte Carlo, Valiant, etc.

2. Medium-Size Vehicles, 1,500 cc to 2,000 cc:
   Toyota Crown, Nissan Cedric, Matsuda, etc.

3. Small-Size Vehicles, 1,000 to 1,500 cc:
   Volkswagon, Subaru, etc.

As a result, all personnel at the testing grounds were amazed with the excellent test data the"UZUMAKI" showed.

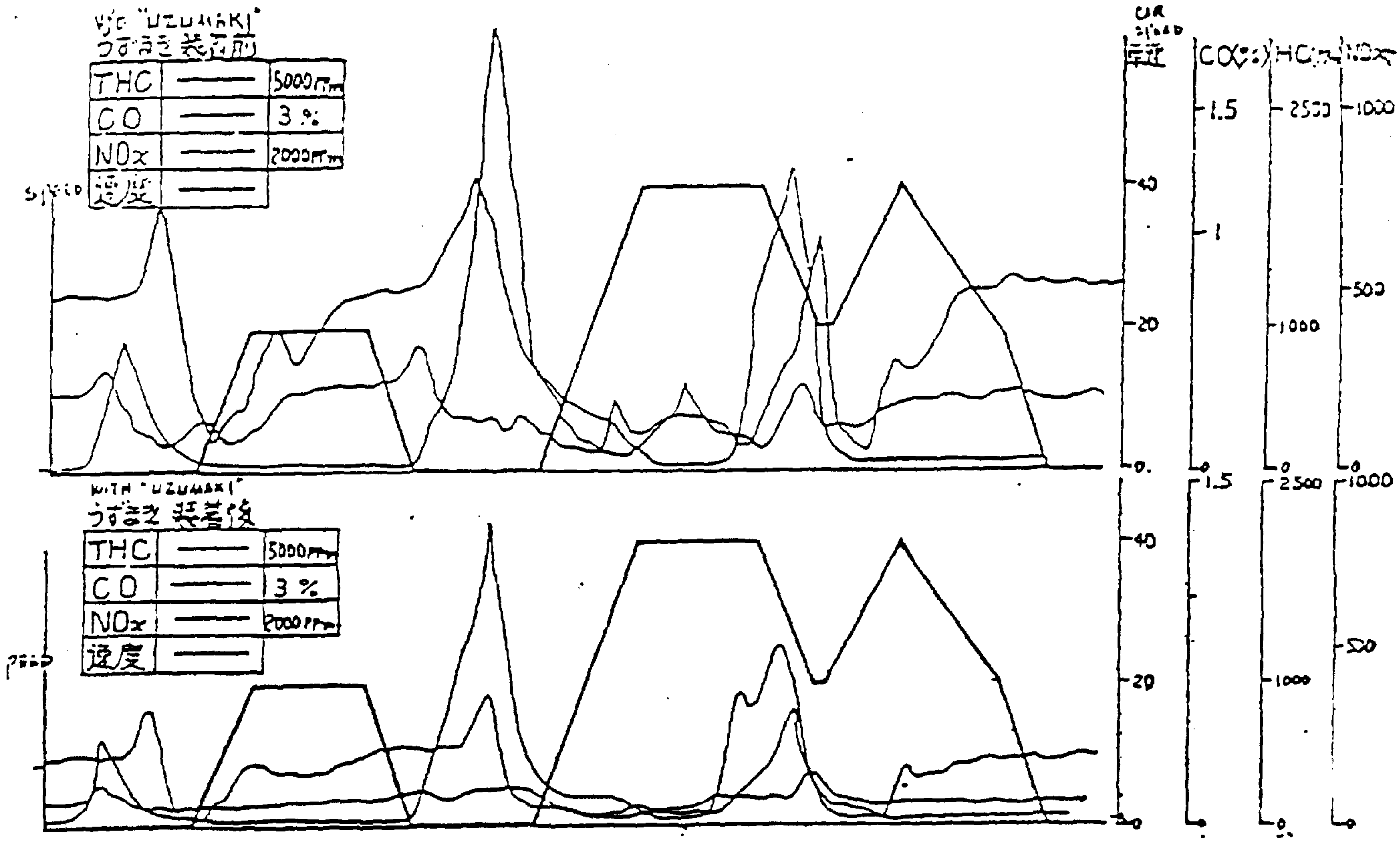
Test Data Supplied by the Japanese Vehicle Testing Associations

Performed by the Authorative Foundational Juridicial Person

A 10-Mode Test Data

Vehicle Name: Lincoln, Continental 4-door, 1975, 7.53?ee

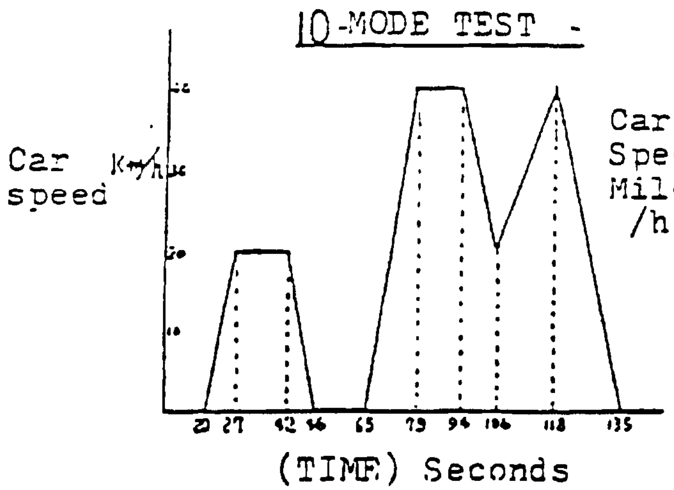
	CO (g/km)	HC (g/km)	NO_x (g/km)	CO_2 (g/km)	FUEL CONSUMPTION RATE 燃料消費率
W/O DEVICE 装置取付前	107.65	3.72	4.72	653.9	2.8 (km/ℓ)
WITH DEVICE 装置取付後	45.27	1.56	3.38	651.8	3.5 (km/ℓ)
排気ガス減少及び走行距離増加率	57.9% (減) DECREASE	58.1% (減) DECREASE	28.4% (減) DECREASE	0.3% (減) DECREASE	25% (増) INCREASE

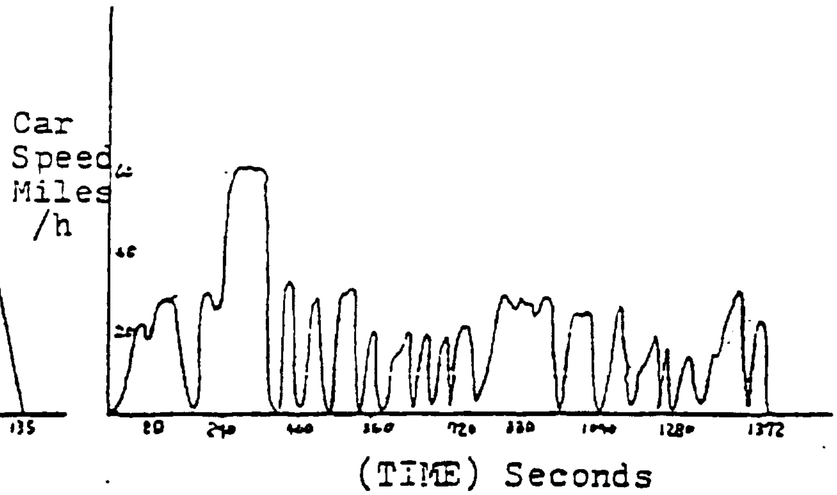


We are particularly proud to announce our test data performed by the authoritative Foundational Juridicial Person, the Japanese Vehicle Testing Association and the equally authoritative laboratory with equipment similar to the above Japanese Vehicle Testing Association known as the A.D.I. Auto Exhaust Gas Testing Laboratory. The type of test performed at both laboratories was the 10-mode test which is required by Japanese law and known throughout the world as one of the most severe auto tests with regards to auto emission and fuel savings. Being such, we are proud to inform you that the test data we have obtained is a very valuable and authoritative document. Via separate cover, we have taken the pleasure of displaying the results for a better understanding of our "UZUMAKI."

What is the 10-mode Test?

This is a test pattern basing the driving on an average speed in large cities of Japan. And, this driving pattern starts from 0 Km/h (0-mile/h) up to 40 Km/h (24.9 mile/h) within a time of 135 seconds and this is repeated 5 times. The mileage per gallon is then calculated from the exhaust gas obtained from this test mode.





What is the LA-4 Mode Test?

This is a test pattern performed in the state of California, U.S.A. at a given driving speed starting from 0 Km/h (0 mile/h) and up to 81.23 Km/h (56.7 mile/h) for a period of 1.372 seconds and driven at a standard pattern in the town and highways of California. The mileage per gallon is then calculated from the exhaust gas obtained from this test mode.

We have finally arrived to our decreased best figures of CO (carbon monoxide) 20% to 40%, and a gain in gas mileage of 5% to 35%. Through our endless endeavor in this project, such as repeated tests performed on the road as well as tests with chassis dynamometer, we gradually revised our unit to its best.

With reference to the test on "UZUMAKI," the representative of Hanaya Group has for many years tested large American cars as well as medium-sized Japanese cars in altitudes of 0 meters in Japan through altitudes of 5,000 feet at Mt. Fuji. Tests were also performed in Mexico City, one of the highest cities in the world, and in Colorado, U.S.A. and throughout California for tests in low and high altitudes to check its performance against pressure change and loss of oxygen. Also, during the summer months, tests under intense heat in the states of Utah, New Mexico, Arizona, etc. were performed.

Severe cold weather tests were also performed throughout the states of Colorado, Wyoming, Montana, etc. Tests were also performed in the Rocky Mountains under freezing and snowing conditions to check its durability and performance. Under the above conditions, the "UZUMAKI" has been perfected by traveling a total of 800,000 Km (500,000 miles).

Other than the above, tests were performed at Mexico City in June 1981 on new vehicles, but the older cars with more carbon in the engine were tested. Depending on the engine of the car, there was an unbelievable 30% gain and above in mileage which surprised the personnel witnessing the test. Vehicles without chemical catalysts showed CO decrease over 90%, and HC showed a decrease of above 70%.

There was a remarkable change especially in American large-type vehicles together with vehicles without the chemical catalyst units and we are proud to announce that this is the first epoch-making device developed which would solve the rumored gasoline shortage in the near future. The following are the data obtained during that period.

ROAD TEST DATA OBTAINED DURING OUR PRODUCT DEVELOPMENT IN THE USA (55/h)

VEHICLE NAME	YEAR	H.P. or DIS-PLACEMENT	WITHOUT UNIT	WITH UNIT	PERCENT INCREASE
Pontiac	1972	350 Hp	13.5 mile/gal. 5.6 Km/l	16.9 mile/gal. 7.1 Km/l	25.2%
Cadillac 4 Door	1975	350 HP	15.5 mile/gal. 6.5 Km/l	19.5 mile/gal. 8.3 Km/l	25.8%
Chevrolet 4 Door	1976	350 Hp	13.6 mile/gal. 3.38 Km/l	16.8 mile/gal. 5.41 Km/l	23.8%
Plymouth Sta. Wagon	1975	400 Hp	14.7 mile/gal. 6.2 Km/l	17.9 mile/gal. 7.6 Km/l	21.7%
Pontiac Lyman	1977	350 HP	14.5 mile/gal. 6.12Km/l	19.5 mile/gal. 8.24 Km/l	34.5%
Cadillac Eldorado	1977	450 HP	15.3 mile/gal. 5.93 Km/l	20.8 mile/gal. 13.0 Km/l	35.9%
Chrysler New Port	1973	440 HP	12.0 mile/gal. 5.1 Km/l	17.4 mile/gal. 7.4 Km/l	45%
Lincoln 4 Door	1978	350 HP	16.5 mile/gal. 6.9 Km/l	21.5 mile/gal. 9.1 Km/l	30.3%
Pontiac Leman	1977	350 HP	13.3 mile/gal. 5.6 Km/l	16.5 mile/gal. 6.9 Km/l	24.6%
Pontiac Leman	1977	350 HP	14.2 mile/gal 6.0 Km/l	18.3 mile/gal. 7.7 Km/l	28.9%
Pontiac Leman	1977	350 Hp	13.9 mile/gal. 5.9 Km/l	18.8 mile/gal. 7.9 Km/l	35.3%
Pontiac Leman	1977	350 HP	14.1 mile/gal. 5.9 Km/l	18.5 mile/gal. 7.8 Km/l	31.2%
Lincoln Mark 5	1979	350 HP	16.9 mile/gal. 7.1 Km/l	20.5 mile/gal. 8.7 Km/l	21.3%
Olds-mobile	1977	460 HP	16.3 mile/gal. 6.8 Km/l	21.9 mile/gal. 9.2 Km /l	34.4%
Toyota Celica	1978	2,180 cc	25.6 mile/gal. 10.8 Km/l	34.0 mile/gal. 15.2 Km/l	32.8 %
Subaru St. Wagon	1977	1,600 cc	31.5 mile/gal. 13.3 Km/l	39.5 mile/gal. 16.7 Km/l	25.4%

ROAD TEST DATA OBTAINED DURING OUR PRODUCT DEVELOPMENT IN JAPAN (80 Km/h)

VEHICLE NAME	YEAR	H.P or DIS- PLACEMENT	WITHOUT UNIT	WITH UNIT	PERCENT INCREASE
Toyota 51	1973	2,000 cc	8.1 Km/l 19.2 mi/gal	10.7 Km/l 25.3 mi/gal	31.8%
Nissan K	1972	2,000 cc	8.7 Km/l 20.6 mi/gal	11.2 Km/l 26.5 mi/gal	28.6%
Toyota MS	1978	2,000 cc	8.3 Km/l 19.6 mi/gal	10.9 Km/l 25.8 mi/gal	31.6%
Matsuda E-SA	1979	573x2	7.5 Km/l 17.7 mi/gal	9.3 Km/l 22.1 mi/gal	24.9%
Toyota	1978	1,600 cc	16.2 Km/l 38.3 mil/gal	19.8 Km/l 46.8 mi/gal	22.2%
Toyota Century	1975	3,300 cc	7.6 Km/l 17.9 mi/gal	9.3 Km/l 22.0 mi/gal	22.9%

EXAMPLE OF EXHAUST GAS AND MILEAGE TEST IN MEXICO CITY

AUTO EXHAUST TEST AT IDLING AND HIGH SPEED

	I D L I N G		2,500 P P M	
	HC	CO	HC	CO
Vehicle Name: Grand Marquis Year: 1982 Mileage: 1,059 Km				
Without Unit	175ppm	2.4%	65ppm	0.65%
With Unit	100ppm	0.35%	30ppm	0.09%
Exhaust Gas Reduced Rate	42.9% reduced	85.4% reduced	53.8% reduced	86.2% reduced
Vehicle Name: Dodge Dart Year: 1981 Mileage: 28,211 Km				
Without Unit	90ppm	1.2%	50ppm	0.35%
With Unit	30ppm	0.12%	25ppm	0.03%
Exhaust Gas Reduced Rate	66.7% reduced	90% reduced	50% reduced	91.4% reduced
Vehicle Name: Chrysler LeBaron Year: 1981 Mileage: 15,217 Km				
Without Unit	240ppm	4.7%	130ppm	3.3%
With Unit	120ppm	1.25%	60ppm	0.5%
Exhaust Gas Reduced Rate	50% reduced	73.4% reduced	53.9% reduced	84.8% reduced
Vehicle Name: Chrysler Town & Country, Y: 1981 M: 51,179 Km				
Without Unit	280ppm	4.0%	160ppm	3.6%
With Unit	120ppm	0.9%	90ppm	0.6%
Exhaust Gas Reduced Rate	57.1% reduced	77.5% reduced	43.8% reduced	83.3% reduced
Vehicle Name: Chrysler LeBaron Y: 1981 M: 50,000 Km				
Without Unit	150ppm	3.0%	50ppm	0.45%
With Unit	70ppm	1.1%	25ppm	0.07%
Exhaust Gas Reduced Rate	53.3% reduced	63.3% reduced	50% reduced	84.4% reduced

MEXICO CITY MODE TEST

	HC (g/Km)	CO (g/Km)	Fuel Consumption Rate
Vehicle Name: Chrysler Town & Country, Y: 1981 M: 51,179 Km			
Without Unit	2.93	70.01	6.04
With Unit	1.97	27.35	6.81
Reduction in gas & gain in Km rate	32.75% reduction	60.93% reduction	12.75% gain
Vehicle Name: Dodge Dart Year: 1980 Mileage: 68,923 Km			
Without Unit	3.65	98.05	5.63
With Unit	1.88	25.53	6.98
Reduction in gas & gain in Km rate	48.49% reduction	73.96% reduction	23.97% gain

As noted in the above test data, the "UZUMAKI" is a splendid product which saves gasoline, and depending on the car, it shows a very high savings. Moreover, our unit reduces auto gas emissions which are not found in other products.

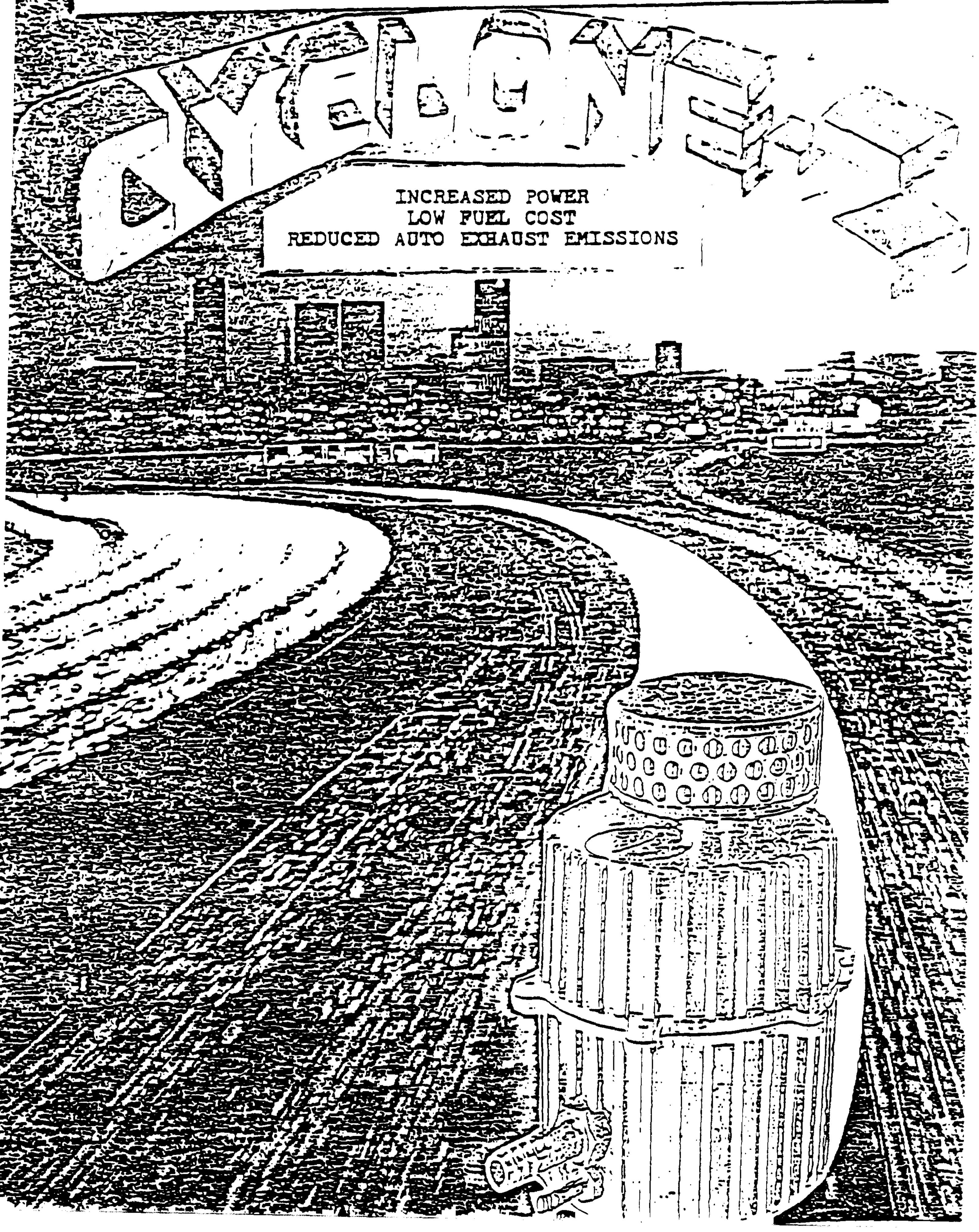
Until the completion of the "UZUMAKI," it has gone through many difficulties and unheard of episodes. The efforts and patience to perfect this unit in terms of energy and spiritual endurance has surpassed our imagination, but we are happy now that it has been perfected.

President Usui, the representative of this development, cold heartedly, has said "no" many times with gains of 5% to 10% in gasoline mileage and decrease in auto exhaust emissions. The backbone of this success was due to President Usui's violent passion for the completion of its objective, and rejecting any compromises. Not mentioning the merits of the inventor, and our President's supervision, we can proudly say that the success of this venture lies in Hanaya Group's excellent cooperation of its staff members.

This is as if, the human race is facing the sun, taking a deep breath. This also seems, as someone telling us not to waste the important energy, so it will last in our ever-lasting universe.

THE FIRST COMBUSTION EFFICIENT UNIT
IN THE WORLD

ATTACHMENT C



A REVOLUTION IN COMBUSTION ENGINEERING THEORY

THE "CYCLONE-Z®"

INCOMPLETE COMBUSTION LEADS TO DECREASED POWER, FUEL LOSS AND POLLUTION

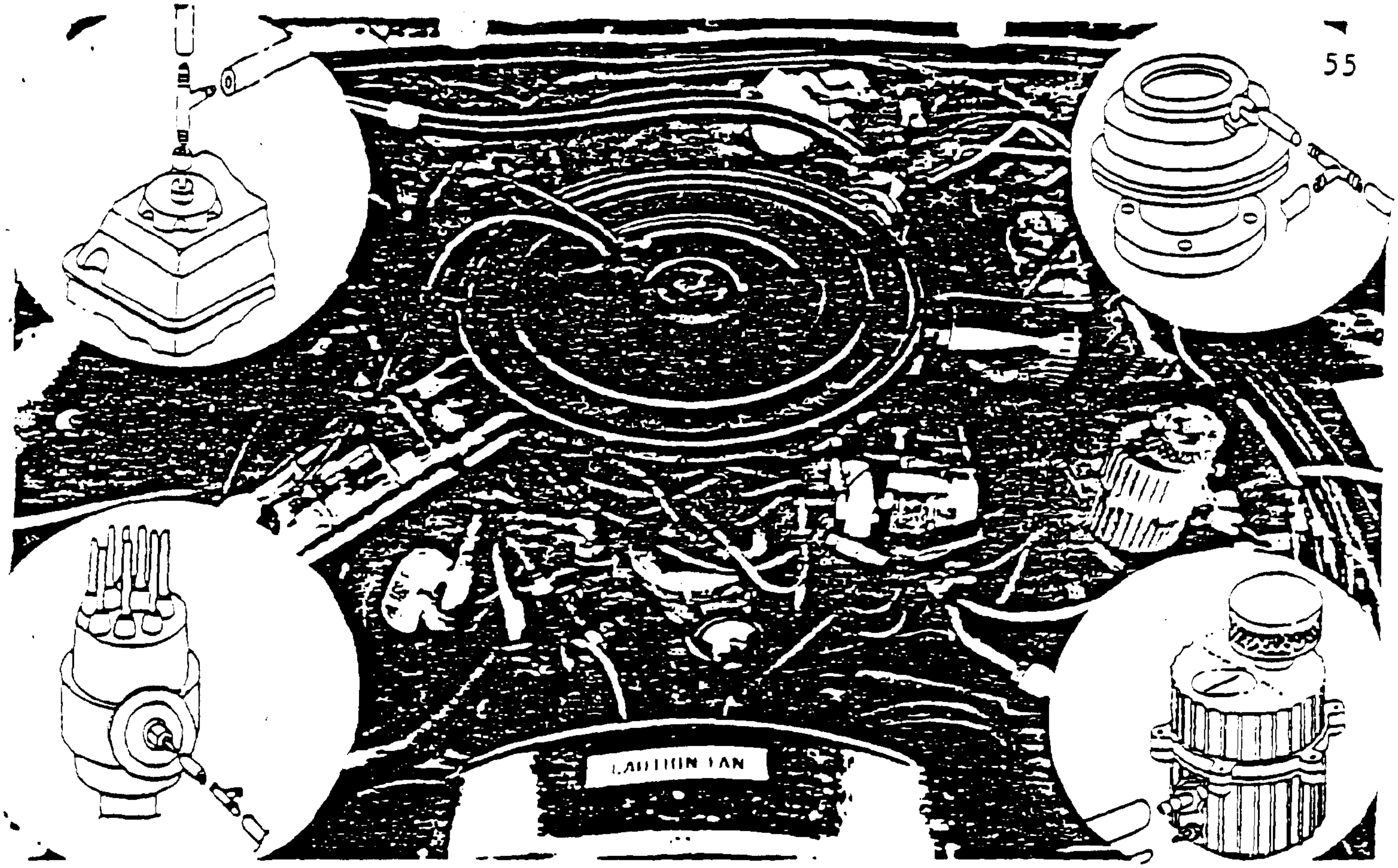
Vehicles are designed to operate when air and fuel are mixed in the carburetor and fed into the cylinder chamber for combustion. However, when the air and fuel are not completely mixed, raw gasoline remaining in the relatively cool combustion chamber adheres to the piston head and cylinder wall. As a result, an oxygen shortage occurs leaving unburned fuel and resulting in harmful emissions such as CO (carbon monoxide), HC (hydrocarbon) and NOx (nitrous oxide). High gasoline consumption, or poor mileage, and unnecessary engine wear also result from incomplete combustion.

Further, conventional engines do not have an altitude control compensator unit. This device automatically adjusts for the correct air/fuel mixture at various altitudes. Without it a problem arises with a change in air density when travelling from a high altitude to a low altitude or vice versa. This problem results in power and fuel losses, as well as emission increases.

THE CYCLONE-Z® HAS BEEN DEVELOPED BASED ON THE COMBUSTION ENGINEERING THEORY FOR BETTER AND HIGHER COMBUSTION EFFICIENCY. IT INCREASES POWER, IS ECONOMICAL AND VERY EFFICIENT IN REDUCING AUTO EMISSIONS.

WHAT IS THE TRUE CHARACTER OF THE CYCLONE-Z®?

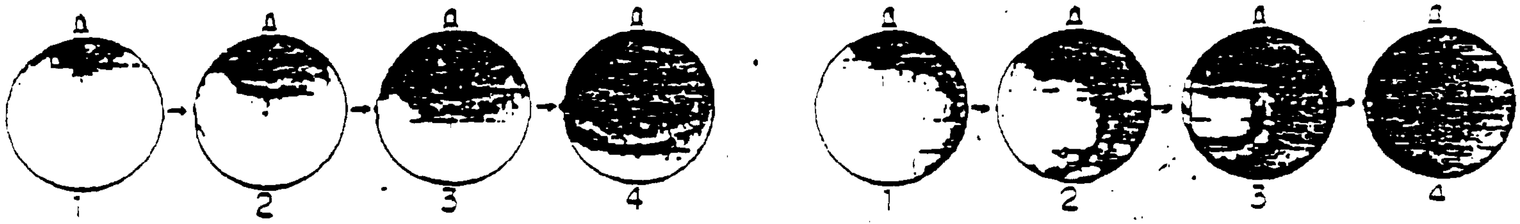
While an automobile is being driven, the engine revolutions and load condition normally will change according to circumstances. Cyclone-Z® immediately catches these engine conditions with three (3) special adjusting mechanisms incorporated into the device. These mechanisms are the low speed controller, high speed controller and the altitude control compensator. As a result of automatic changes in these mechanisms, a controlled amount of secondary air is fed into the P.C.V. line and further to the intake manifold, where it is mixed with the existing air/fuel mixture. A circulating flow is caused producing a turbulence in the air/fuel mixture in the combustion chamber. This turbulence results in a much more complete combustion, thereby reducing the dangerous exhaust emissions and increasing power.



WITH THE TURBULENCE EFFECT CAUSING AN AGITATED COMBUSTION, THE CYCLONE-Z® FURTHER INCREASES COMBUSTION EFFICIENCY.

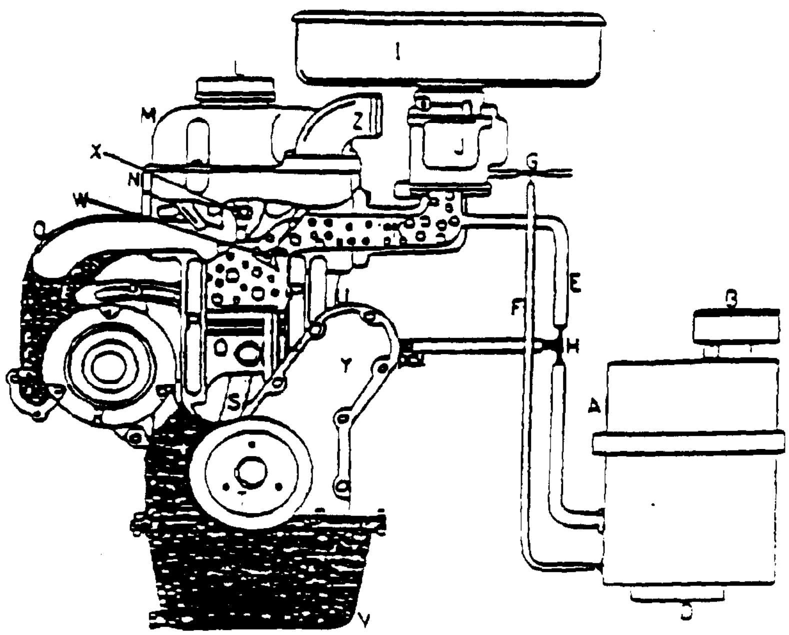
THE COMBUSTION SYSTEM OF THE CYCLONE-Z®

The turbulence created by the supplying of secondary air, together with the intake manifold boost in pressure, speeds up the gasification of gasoline. This effect increases the flash boiling effect of the droplet sized air/fuel mixture that was not vaporized at the carburetor and converts it to an even air/fuel mixture. The turbulence effect further leads to more complete combustion at the piston head, cylinder wall, and at other metal portions of the combustion chamber where the air/fuel mixture is relatively cool and hard to burn. In other words, the induction of a secondary air supply causes a circulation flow in the cylinder leading to an agitated combustion throughout the combustion chamber. Combustion speed and combustion pressure are increased leading to improved combustion. As a result, the driver gets better response from the engine, increased power, fuel savings, and considerable reduction in CO, HC and NOx emissions.



Until now, the engineering theory with regard to combustion was that, whenever the combustion efficiency is good, the CO and HC emissions were reduced but the troublesome NOx emissions were increased. However, the Cyclone-Z® has broken this theory. The NOx also has been decreased. During combustion, because of the increased combustion speed and high combustion pressure, combustion time is reduced. The actual time required to complete combustion is less than the time required to produce NOx, and combustion is completed before the NOx can be formed. Additionally, the cooler flame resulting from the mixed air/fuel allows the piston head, cylinder walls, and other metal parts of the combustion chamber to remain cooler, thus further inhibiting the production of NOx. This effect was instrumental in solving a most difficult problem. Cyclone-Z® has revolutionized the combustion engineering theory.

THE OPERATING PRINCIPLES OF "CYCLONE-Z®"



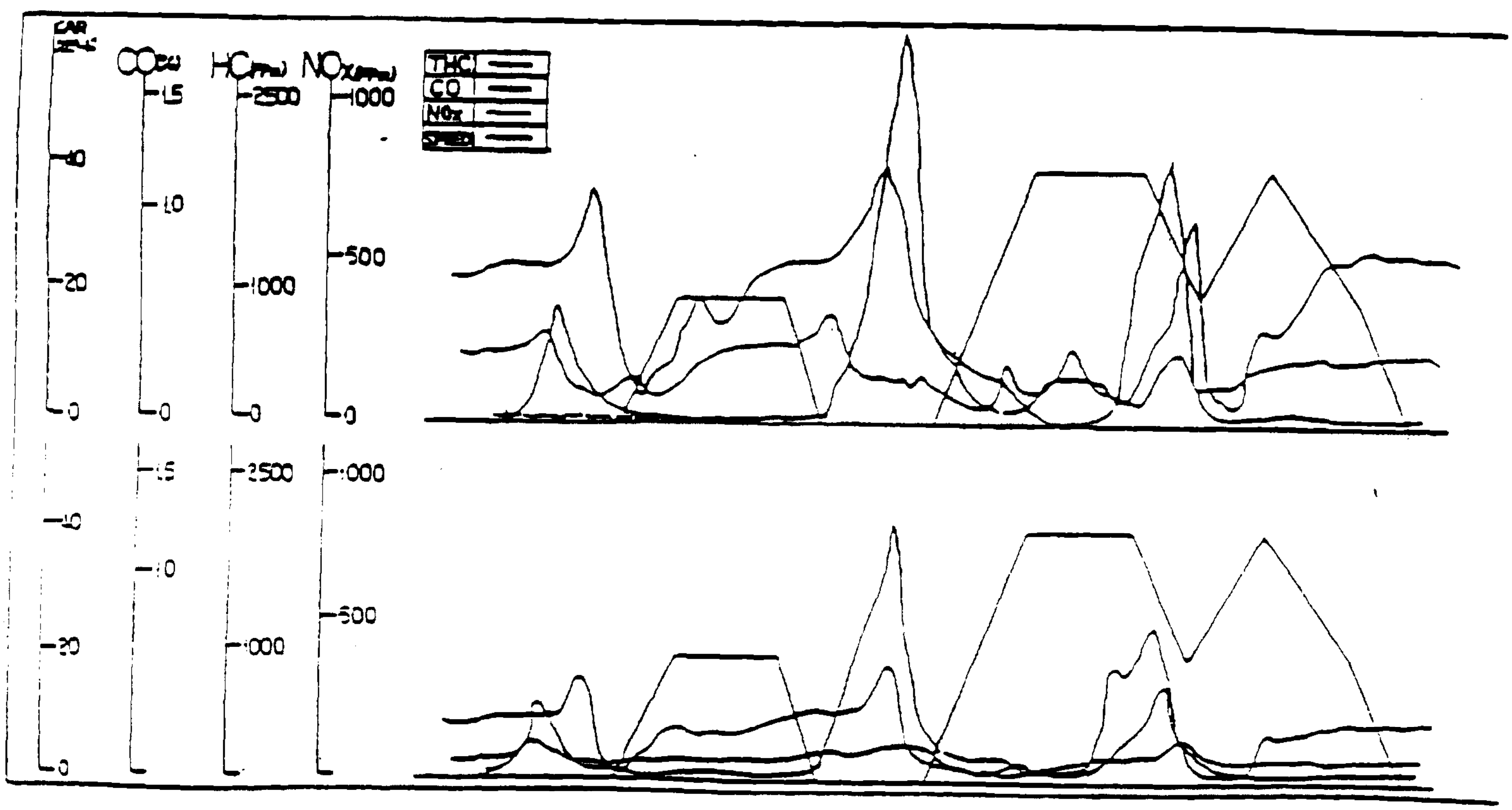
A. "CYCLONE-Z®" main body
B. Air cleaner
C. Air adjuster
D. Engine conditions censor
E. Sub line for turbulence
F. Signal pipe
G. 3/way for signal vacuum
H. 3/way for air
I. Engine air cleaner
J. Carburetor
K. Intake manifold
L. Oil cap
M. Locker cover
N. Engine cylinder head
O. Exhaust Mainfold
P. Water jacket
Q. Piston
R. Alternator
S. Connecting rod
T. Crank pully
U. Cylinder
V. Oil pan
W. Intake Value
X. Spark plug
Y. Timing Chain case
Z. Water outlet

WHAT IS A 10-MODE TEST?

This is a test pattern based on driving at an average speed in large cities of Japan (Tokyo and Osaka). This 10 mode driving pattern of running and stopping goes from 0 km/h (0 m.p.h.) up to 40 km/h (24.9 m.p.h.) in a time period of 135 seconds and is repeated 5 times. The mileage per gallon is then calculated from the exhaust gases obtained during this test mode. This fuel test is based on city driving and is most accurate in giving true mileage. Also, this test is required by the Japanese Government Transportation Ministry and is reputed to be the most accurate, yet severe, test of mileage and emissions.

A TREMENDOUS FUEL SAVINGS AND REDUCTION IN EMISSIONS

The following chart shows the results of a 10 mode test on a 1979 Lincoln Continental (7,539 cc engine), without the use of the "Cyclone-Z® " and with the use of the "Cyclone-Z®". The tests were performed at the Japanese Vehicle Testing Association, a Japanese Government Department on December 17, 1981.



The above analyzed results based on exhaust gas weight and fuel savings are as noted below. The exhaust gases at idling without the Cyclone-Z® were CO - 4% and HC - 700 p.p.m. Engine revolutions were 650 r.p.m. With the unit, these emissions were reduced to CO - 0.8% and HC - 100 p.p.m. Engine revolutions increased to 850 r.p.m.

	CO (g/km)	HC (g/km)	NOx (g/km)	CO_2 (g/km)	Fuel Consumption
Without Unit	107.65	3.72	4.72	653.9	2.8 (km/ℓ)
With Unit	45.27	1.56	3.38	651.8	3.5 (km/ℓ)
Emissions Decr / Mileage Incr	57.9 % ↓	58.1 % ↓	28.4 % ↓	0.3 % ↓	25 % ↑

RESULTS - NOT TALK! THE TRUE VALUE OF THE

CYCLONE-Z HAS BEEN ESTABLISHED IN LABORATORY TESTS

10 MODE FUEL CONSUMPTION TEST DATA FOR JAPANESE CARS (TESTS PERFORMED AT JAPAN VEHICLE TESTING ORGANIZATION AND A.D.I. EXHAUST GAS LABORATORY)

	Exhaust Weight w/o unit	Exhaust Weight w/unit	Change
CO	26.3 g/k	14.8 g/km	43.6 % ↓
HC	3.2 g/k	2.8 g/km	8.0 % ↓
Fuel Consump.	7.1 km/ℓ 16.9 mile/gal	9.1 km/ℓ 21.5 mile/gal	28.1 % ↑

	Exhaust Weight w/o unit	Exhaust Weight w/unit	Change
CO	64.1 g/km	6.7 g/km	89.5 % ↓
HC	2.9 g/km	1.2 g/km	58.5 % ↓
Fuel Consump.	6.5 km/ℓ 15.4 mile/gal	8.8 km/ℓ 20.8 mile/gal	33.7 % ↑

HIGHWAY FUEL ECONOMY TEST RESULTS

VEHICLE	YEAR	ENGINE		ACTUAL FUEL CONSUMPTION RATE	INCR.
Toyota Celica	1978	2000cc	w/o unit	10.85 km/ℓ (25.68 mile/gal)	30.88 %
			w/unit	14.20 km/ℓ (33.59 mile/gal)	
Nissan Lowrel	1978	2000cc	w/o unit	9.15 km/ℓ (14.64 mile/gal)	31.69 %
			w/unit	12.05 km/ℓ (19.28 mile/gal)	
Pontiac LeMans	1977	350hp	w/o unit	6.13 km/ℓ (14.5 mile/gal)	33.1 %
			w/unit	8.16 km/ℓ (19.3 mile/gal)	
Oldsmobile Toronado	1977	455hp	w/o unit	6.89 km/ℓ (16.3 mile/gal)	24.53 %
			w/unit	3.58 km/ℓ (20.3 mile/gal)	

ADVANTAGES OBTAINED AFTER INSTALLING THE "CYCLONE-Z®"

1. QUICK STARTS.

With the more complete combustion at all times resulting from the turbulence effect (causing an agitated combustion), less carbon remains on the spark plug electrode. Therefore, the engine starts more quickly even in severe cold and only a short time is required to warm up the engine.

2. INCREASED POWER.

With the more complete combustion, the crankshaft torque strenghtens, response quickens, climbing power increases, and engine noise is reduced. Since this unit is equipped with an altitude compensator, secondary air is automatically fed to keep the air/fuel ratio steady. Therefore, there is less power decrease resulting from a high altitude lack of oxygen.

3. DECREASED HAZARDOUS EXHAUST GASES.

With the turbulence effect causing an agitated combustion, the highest degree of combustion efficiency is obtained. Therefore, the blow-by gas, CO, HC, NOx and other emissions are drastically reduced.

4. FUEL ECONOMY.

Through the more complete combustion in the various parts of the combustion chamber (piston head, intake valve, exhaust valve, piston ring, etc.), more carbon is removed from these parts, and gasoline is more completely burned that would otherwise have been passed out as emissions. As a result, mileage will increase greatly. Further, this more efficient combustion eliminates carbon build-up on the spark plugs, which, in turn, lengthens the life of the spark plug. With the reduction of carbon deposits, sliding parts (piston, piston ring, crank metal, conrod metal, crank journal and conrod journal) will not be worn down by carbon in the engine oil; and therefore both the oil and the engine itself will last longer.

5. OTHER ADVANTAGES.

Because air passes through the "Cyclone-Z®" and because it contains few moving parts, the "Cyclone-Z®" has a great life expentancy. The only maintenance required is a periodic changes ot its air filter.

"CYCLONE-Z®" SAVES GASOLINE AND REDUCES AIR POLLUTION

As most people know, after the recent oil crises, many similiar devises were developed and publicized; but every one of them had its drawbacks. For example, when one increased power, the NOx decreased, but the CO and HC's, together with fuel consumption, increased. Other devices decreased the CO and HC gases, but the NOx greatly increased, and no fuel savings were achieved. When adjustments were made for saving fuel, the CO and HC decreased but the NOx increased and power decreased. These phenomena occurred because the conventional combustion engineering theory was used as the basis for all these devices. Cyclone-Z® is the result of a return to the basics in the combustion engineering theory and a revision in that theory.

MANY EXPERIMENTS AND ACTUAL RESULTS THROUGHOUT THE WORLD HAVE PROVEN THE CYCLONE-Z®

The experiments were performed on large sized American cars, medium sized Japanese cars, and small sized European cars. In Japan, testing was performed in Tokyo, at zero meters altitude, and on Mt. Fuji, at an altitude of 2,300 meters. In the United States, testing was done at sea level in California, and at high altitudes in Colorado. Tests were also performed in Mexico, both in Mexico City at high altitude, and then driving from there to the coastal regions. These tests measured the efficiency of the Cyclone-Z® with variations in pressure and air density. Tests were made in Utah and New Mexico for efficiency of the Cyclone-Z® in hot weather and in the Rocky Mountains for the efficiency in cold weather. The resulting Cyclone-Z® has been determined to be efficient at any altitude and under any weather conditions. Testing took place over a 5 year period and over 500,000 miles. The resulting unit has been tested and approved at sea level laboratories such as the Japanese Vehicle Testing Laboratory and at high altitudes by the Mexican Government Environmental Agençy-Auto Department. The resulting unit is the revolutionary Cyclone-Z®.

9-15 Akasaka 1-chome, Minato-ku, Tokyo TEL. TOKYO (585)3395

Order No. 00387-81 Date February 5, 1982

REPORT NO. 600036

EMISSION TEST RESULTS OF " CYCLONE-Z "
TO REDUCE FUEL CONSUMPTION AND EMISSIONS

RENDERED TO
HANAYA OF JAPAN LTD.

INTRODUCTION

This test report contains the results of examination and test of the vehicle with the device reducing fuel consumption and emissions to demonstrate compliance with the applicable requirements of Article 31 of Japanese Safety Standards for Motor Vehicles.

AUTHORIZATION

Letter of request dated December 17, 1981 from Mr. T. Omori.

DESCRIPTION OF THE TEST DEVICE

Name: CYCLONE - Z

The main functions:

Feed the secondary air through a part of P.C.V. line into the inlet manifold to generate the turbulence in the main mixed gas, to elevate the combustion rate and promote the reduction of the amount of harmful exhaust gases and save fuel expenses. Furthermore, by the sea level sensor's operation, the amount of the secondary air into the inlet manifold feed which varies depending on the sea level, and operates automatically so as to decrease or increase the secondary air in its suitable amount.

See Photograph 1.

Report No. 600036

TEST AND TEST METHODS

Tests - The tests perform two terms. One of them is the vehicle without CYCLONE - Z, other term is vehicle used for CYCLONE - Z.

Test method conform to Article 31 of Japanese Safety Standards for Motor Vehicles. The salient points are briefly described in the notes below.

STANDARD NOTES

(1) Dynamometer driving cycle: 10-mode cycle to be repeated 6 times
See fig. 1

(2) Test vehicle weights (Reference weights): Curb. weight plus 110 Kg

(3) Inertia weight class: See fig. 2

(4) Exhaust gas sampling: Constant-volume sampling

(5) Exhaust gas analysers

HC .... Flame-ionization detector

CO, CO_2 .... Non-dispersive infrated analyser (NDIR)

NOx .... Chemiluminescence detector (CLD)

TEST CONDITION

Date: December 17, 1981

Location of test: Japan Vehicle Inspection Association
Vehicle Testing Lab. Tokyo, Japan

	Without device	With device
Barometric pressure	770.0 mmhg	770.0 mmhg
Test room temperature	28.0°C	28.0°C
Humidity	32.9 %	32.9 %

Checked by. K.M

Report No. 600036

VEHICLE USED FOR TEST

Name and type: Lincoln - 81A

Vehicle No.: (41) 5334

Odometer reading: 112827 Km

Unladen vehicle weight: 2350 Kg

Dynamometer inertia: 2500 Kg

Engine model: G180

a) Type of cooling; Water
b) Cylinder arrangement; 8
c) Combustion cycle; Otto cycle
d) Swept. volume; 7539 cc

Transmission: Automatic, 3 speed

Axle ratio: 2.750

Test fuel: Gasoline of Japanese specification

TEST EQUIPMENT

a) Type of dynamometer: BANZAI, BCD-1000E

b) Exhaust gas analysers:
Type of analysers; HORIVA, MEXA-8320

EMISSION TEST RESULTS

Test data obtained from the above test of the submitted test vehicle is presented in the next table page.

Checked by.

Report No. 600036

EMISSION TEST RESULTS (cont'd)

1. Emission levels at idling test

Content	Gear position	Without device	Used " CYCLONE-Z "
Engine Revolution (rpm)	N	700	700
Emission			
CO (%)	N	5.21	2.66
HC (ppm)	N	51	26
CO2 (%)	N	11.6	12.3

2. Emission levels at 10-mode test

Content	Without device	Used " CYCLONE - Z "
Emission levels		
CO (g/Km)	107.65	45.27
HC (g/Km)	3.72	1.56
NOx (g/Km)	4.72	3.38
CO_2 (g/Km)	653.9	651.8
Fuel Consumption rate (Km/l)	2.8	3.5

Report Approved by:

Kazuo Miyoshi

K. Miyoshi, Director
Vehicle Testing Laboratory

N. Saito

Engineer In Charge of Test

Checked by. Km

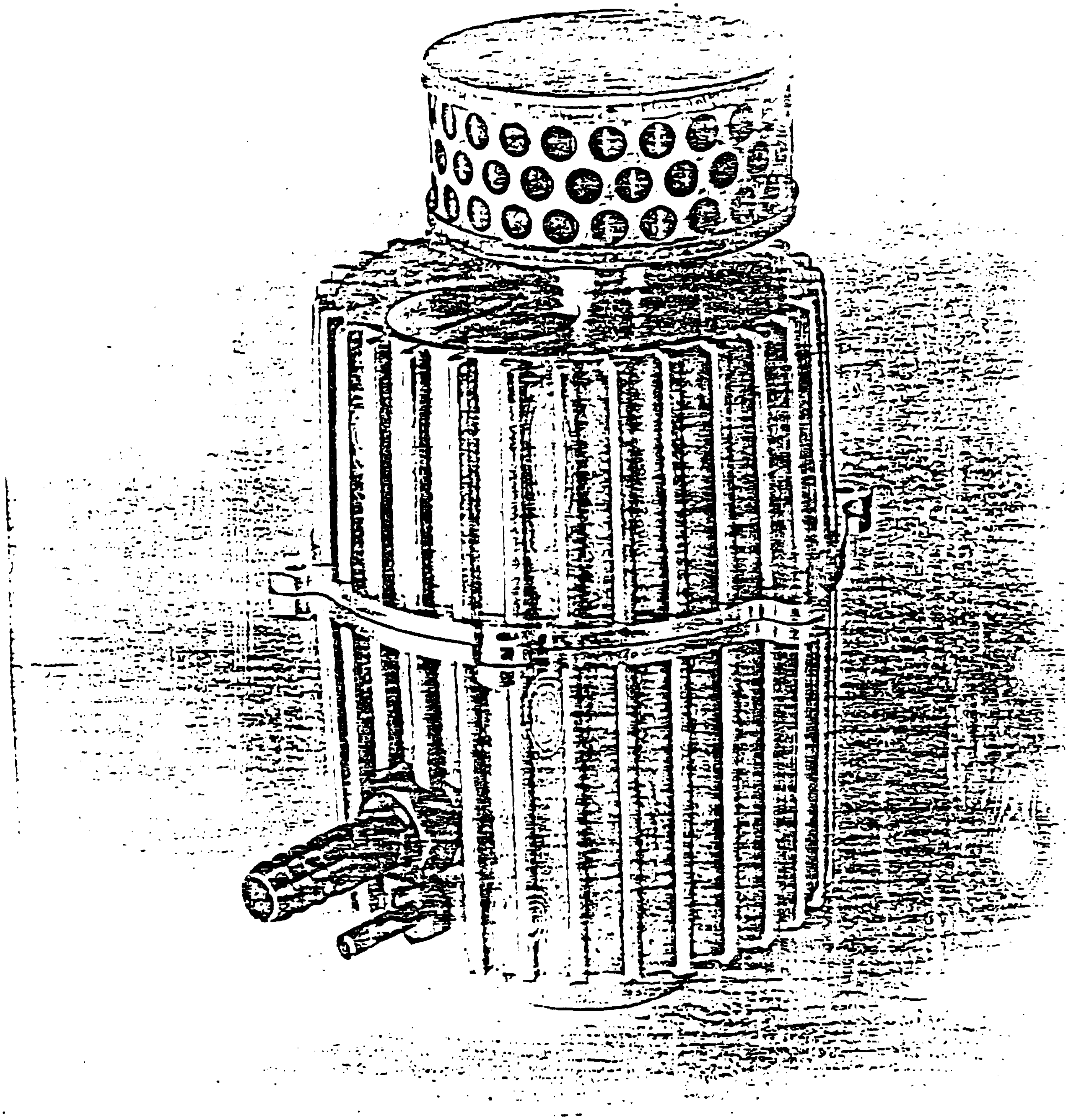


FIG. 1 10 MODE DYNAMOMETER DRIVING SCHEDULE

( ) .... 4 Speed Trans.

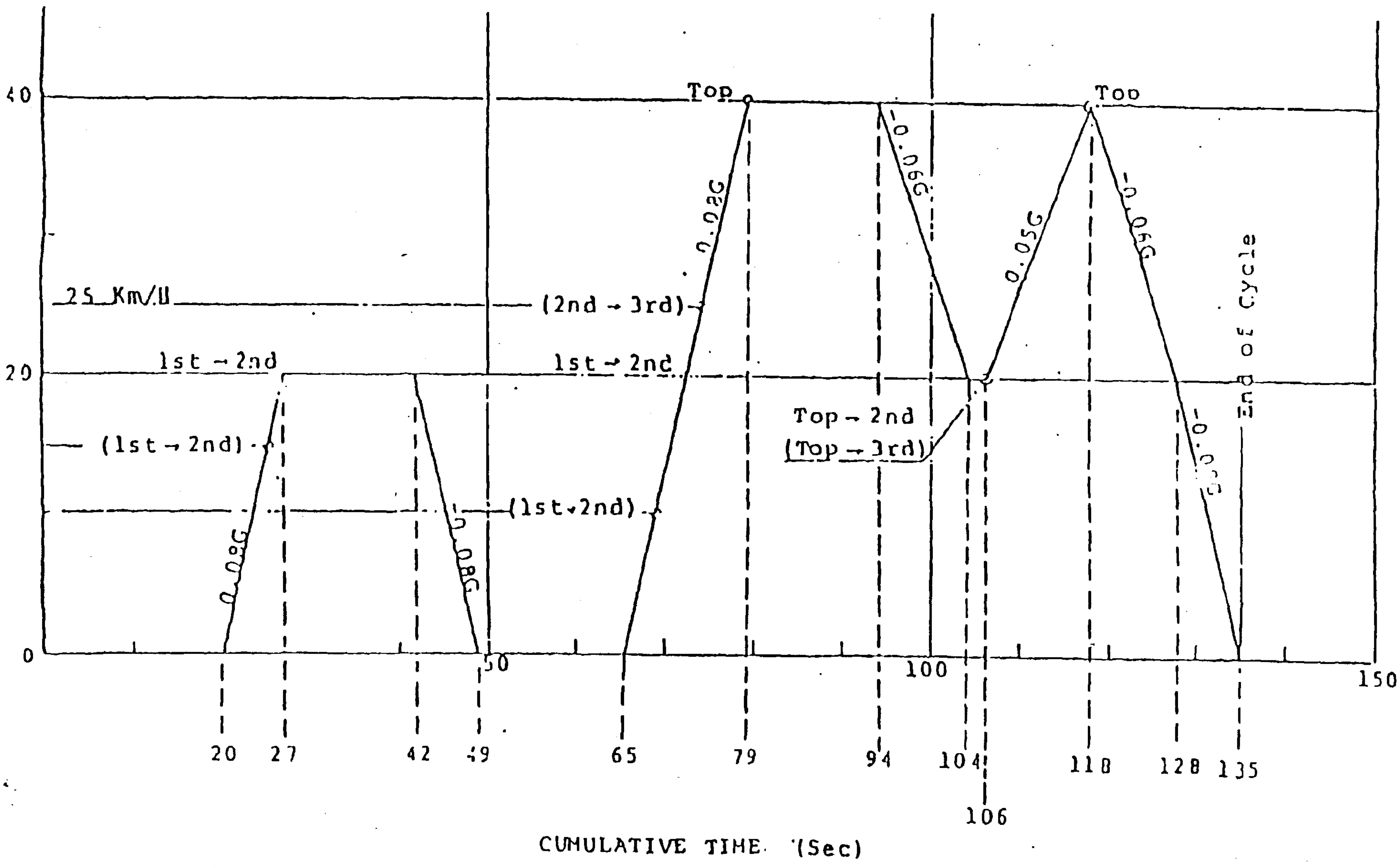


Fig. 2

INERTIA WEIGHT CLASS

Japanese 10-mode cycle test	
Test vehicle Wt. (Kg)	Equivalent inertia Wt. (Kg)
- 562	500
563 - 687	625
688 - 812	750
813 - 937	875
938 - 1125	1000
1126 - 1375	1250
1376 - 1625	1500
1626 - 1875	1750
1876 - 2125	2000
2126 - 2375	2250
2376 - 2625	2500
2626 - 2875	2750
2876 - 3250	3000
500 Kg increment	500 Kg increment

ORIGINAL

FINAL REPORT

EPA 511 PROGRAM
(Retrofit Devices & Additives)
EVALUATION OF "CYCLONE Z"

ITS EFFECT ON
FUEL ECONOMY AND EMISSIONS

Conducted For

KANA CORPORATION
1653 Vine Street
Denver, Colorado
80206

By

AUTOMOTIVE TESTING LABORATORIES, INC.
East Liberty, Ohio 43319

August 27, 1982

Gary Neyman
Manager of
Technical Communications

TABLE OF CONTENTS

INTRODUCTION

This report covers an evaluation program to determine the effects on fuel economy and emissions of a retrofit device known as "Cyclone Z", presented for testing by Kana Corporation, Denver, Colorado. The program was conducted by Automotive Testing Laboratories, Inc., an independent laboratory which is recognized by the EPA as being capable of performing emissions tests on motor vehicles.

The test sequence used is specifically outlined by EPA for a retrofit device which:

1. Does not require any parameter adjustment (major tuning changes) on the vehicle.
2. Does not require mileage accumulation before evaluation.
3. Is effective during both city and highway driving.
4. Has no effect on the cold start operation of the vehicle.

This sequence is referred to as 511 Procedure A-1 by EPA. Also, Kana Corporation requested additional testing to be performed on one test vehicle after 200 miles were accumulated with the retrofit device in operation.

ENDORSEMENT POLICY

EPA 511 tests are routinely run by Automotive Testing Laboratories, Inc., in accordance with guidelines set forth by the Environmental Protection Agency in Part 610 - "Fuel Economy Retrofit Devices, Final Test Procedures and Evaluation Criteria". By requesting and accepting these test results, the customer agrees that the information contained in this report is in no way intended to serve as an endorsement by Automotive Testing Laboratories, Inc., of the product(s) tested. The use of Automotive Testing Laboratories, Inc.'s name or logo in any advertising or promotion of the product(s) tested is strictly prohibited unless written permission has been obtained.

RESULTS

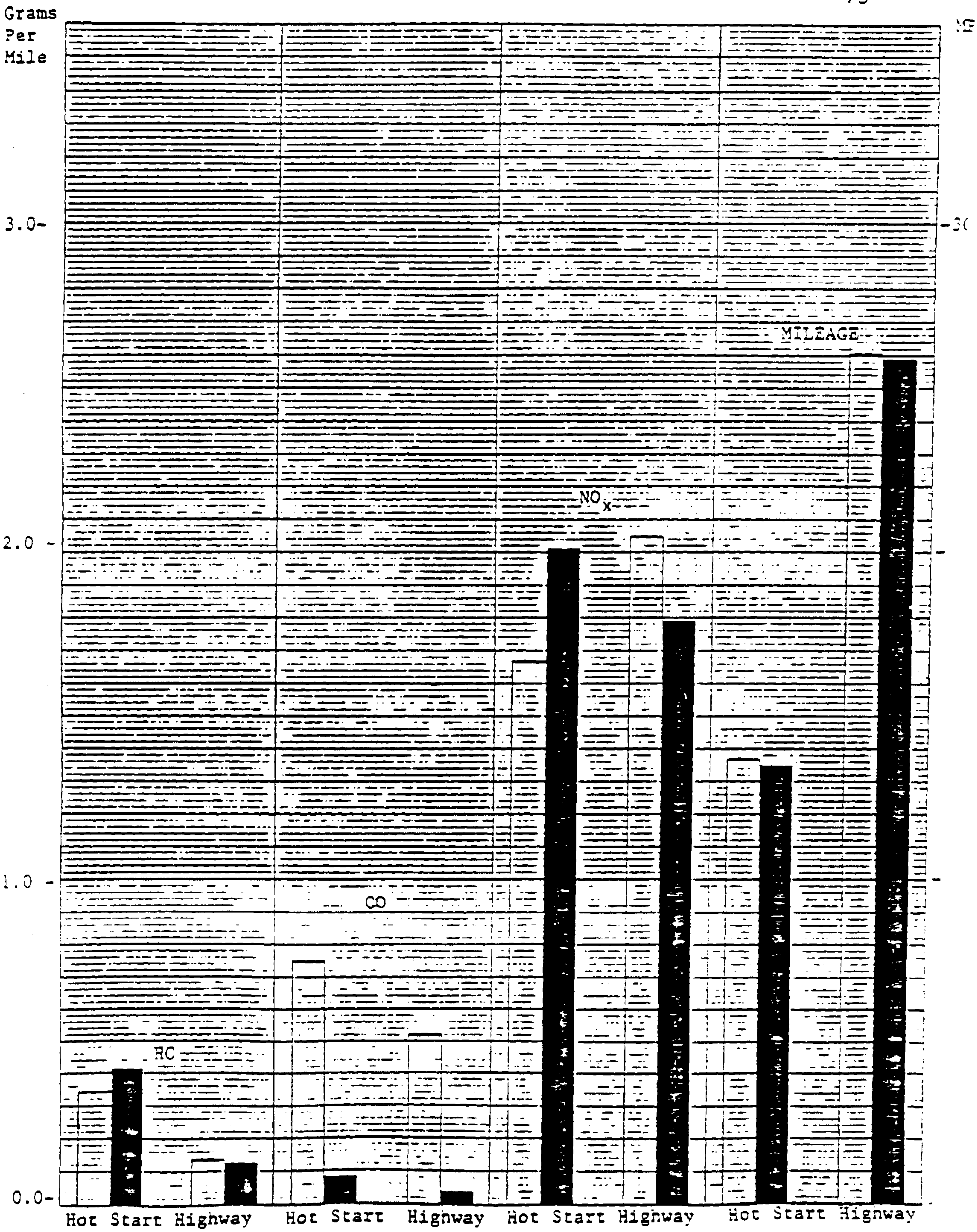
The following table presents fuel economy (mileage) data which was compiled during this testing program. Based on this information, the retrofit device "Cyclone Z" does not produce a significant improvement in fuel economy. (Per EPA Guidelines, a 6% or greater improvement in fuel economy is required for significance in a two-vehicle fleet.)

Test Vehicle	MPG, HOT-START			MPG, HIGHWAY		
	Without Device	With Device	% Imp.	Without Device	With Device	% Imp.
2.3 L Ford	21.85	21.76	-0.4%	28.02	27.95	-0.2%
5.0 L Chev	16.94	16.93	-	23.51	23.72	0.9%
Average	19.40	19.34	-0.3%	25.76	25.84	0.3%

This table presents additional fuel economy (mileage) data which was generated after the standard EPA Evaluation by operating the Chevrolet for 200 miles with the "Cyclone Z" device operating.

5.0L Chev after 200 miles with "Cyclone Z' in operation	MPG, HOT-START			MPG, HIGHWAY		
	Without Device	With Device	% Imp.	Without Device	With Device	% Imp.
	16.94	17.32	2.2%	23.51	24.32	3.4%

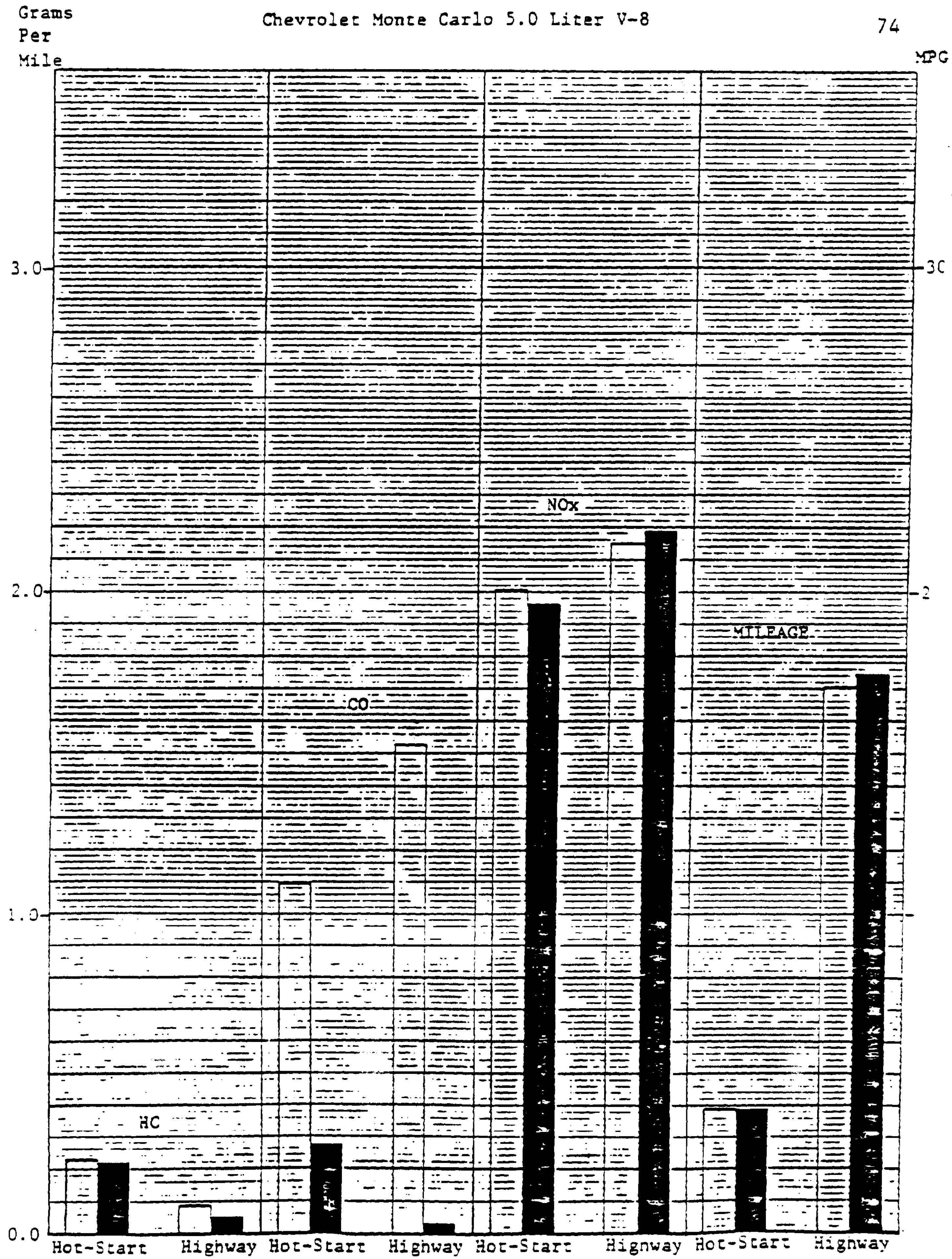
Ford Fairmont 23. liter L-4



The open (unshaded) bars represent baseline or reference data (no device).

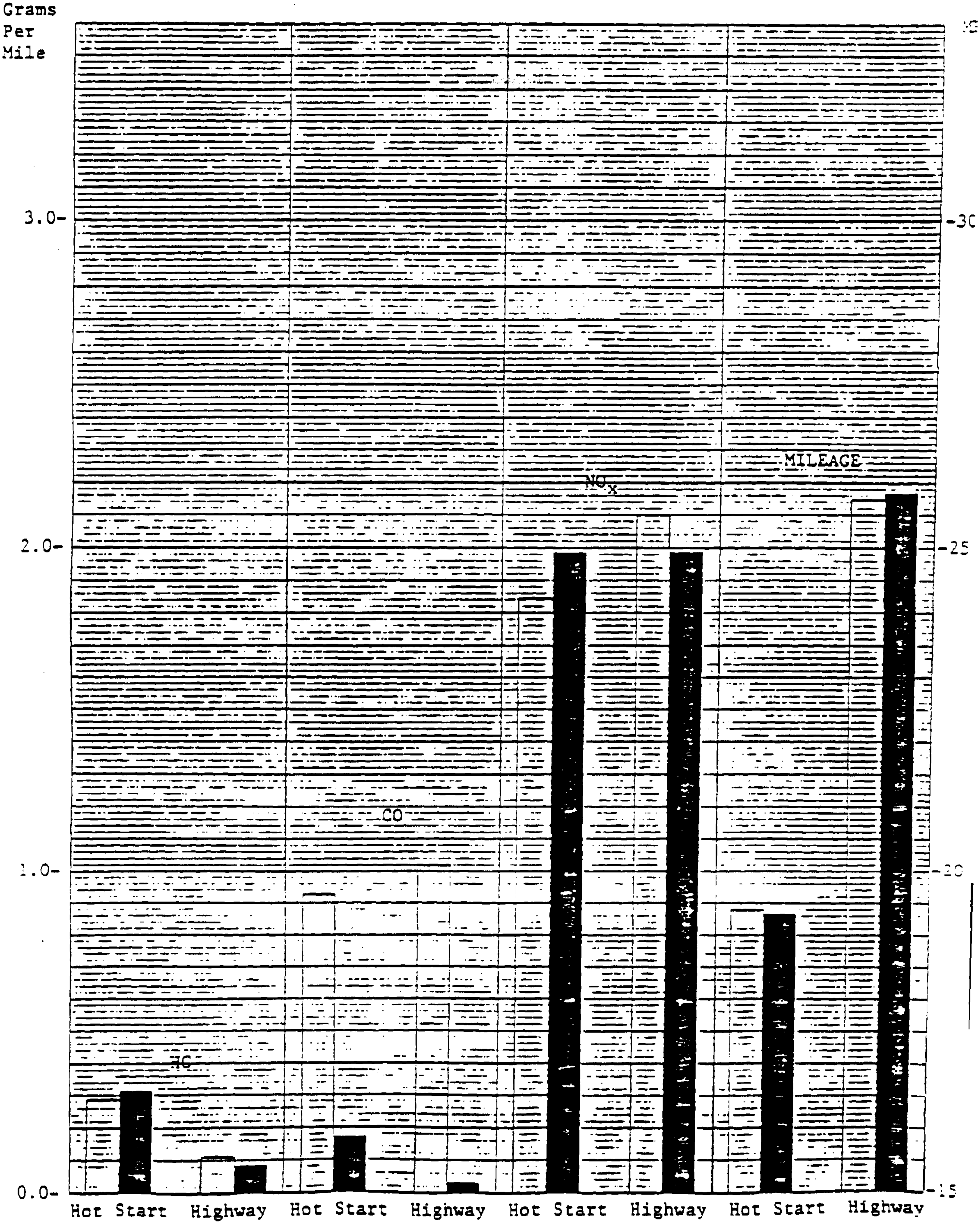
device installed

Chevrolet Monte Carlo 5.0 Liter V-8



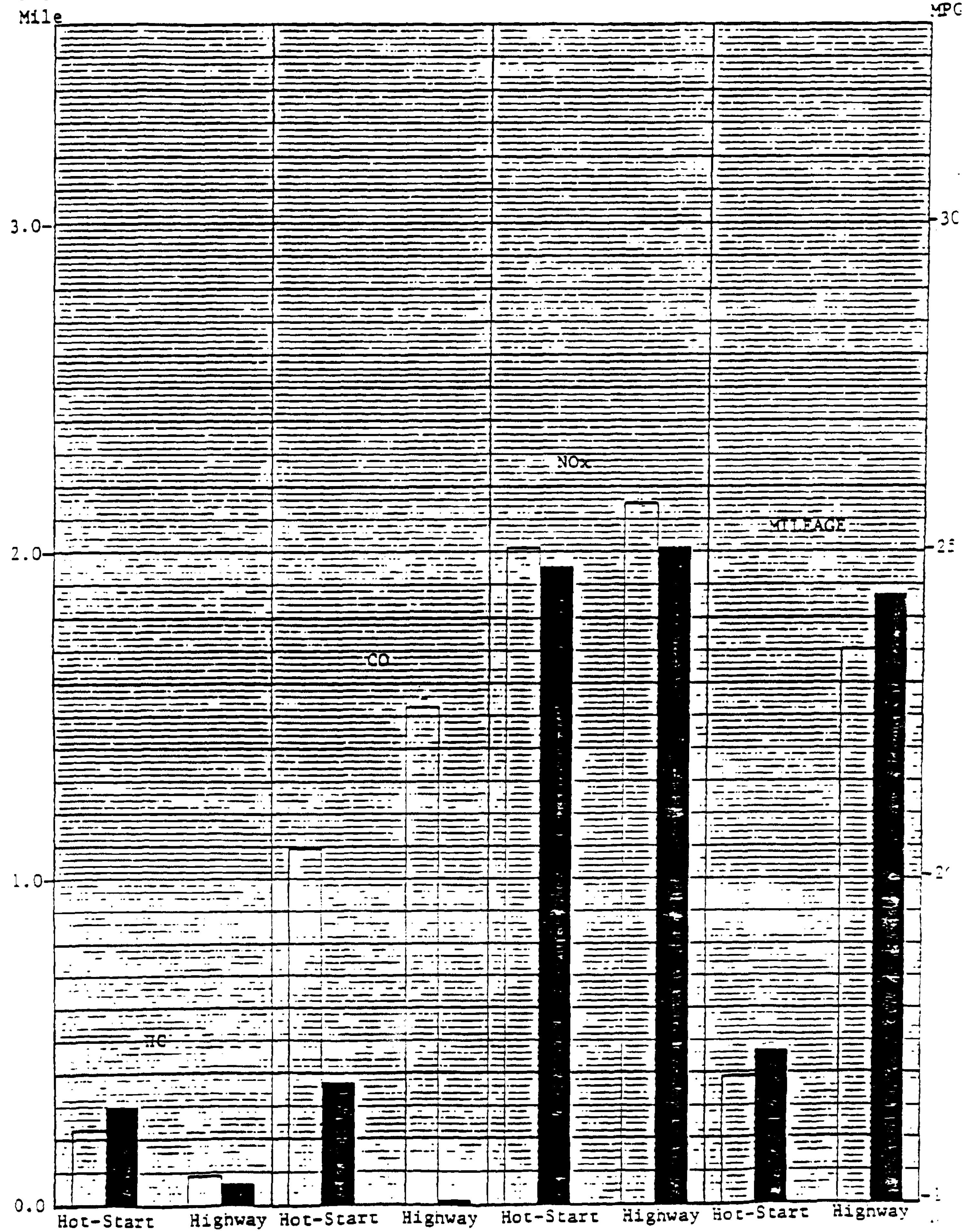
reference data (no device).

Two-Car Fleet Average



Chevrolet Monte Carlo, 5.0 Liter V-8

After Accumulating 200 Miles with Device Operating



... line or reference data (no device).

<u>SUMMARY OF TESTS</u>

Vehicle	Date	Odo.	Retrofit	Test Description
9981	7/29/82	27120	No Device	Baseline Hot Start
9981	7/29/82	27138	No Device	Baseline Highway
9981	7/29/82	27149	No Device	Baseline Hot Start
9981	7/29/82	27168	No Device	Baseline Highway
9981	7/29/82	27199	Device Added	Retrofitted Hot Start
9981	7/29/82	27207	Device Added	Retrofitted Highway
9981	7/29/82	27228	Device Added	Retrofitted Hot Start
9981	7/29/82	27236	Device Added	Retrofitted Highway
4620	8/02/82	60629	No Device	Baseline Hot Start
4620	8/02/82	60642	No Device	Baseline Highway
4620	8/02/82	60663	No Device	Baseline Hot Start
4620	8/02/82	60671	No Device	Baseline Highway
4620	8/03/82	60712	Device Added	Retrofitted Hot Start
4620	8/03/82	60720	Device Added	Retrofitted Highway
4620	8/04/82	60741	Device Added	Retrofitted Hot Start
4620	8/04/82	60749	Device Added	Retrofitted Highway
ACCUMULATION OF 200 MILES WITH "CYCLONE Z" OPERATING				
4620	8/06/82	60995	Device Added	Retrofitted Hot Start
4620	8/06/82	61003	Device Added	Retrofitted Highway
4620	8/06/82	61024	Device Added	Retrofitted Hot Start
4620	8/06/82	61032	Device Added	Retrofitted Highway

SUMMARY OF TEST RESULTS

Date	Vehicle	Retro-Fit	Odo.	Grams per Mile HC	Grams per Mile CO	Grams per Mile NOx	MPG	Test
7/29/82	9981	No	27120	.333	.675	1.661	21.91	LA-4
7/29/82	9981	No	27138	.139	.540	2.049	28.00	HFET
7/29/82	9981	No	27149	.350	.838	1.678	21.79	LA-4
7/29/82	9981	No	27168	.135	.505	2.056	28.03	HFET
7/29/82	9981	Yes	27199	.426	.105	2.000	21.80	LA-4
7/29/82	9981	Yes	27207	.124	.049	1.791	27.90	HFET
7/29/82	9981	Yes	27228	.398	.058	2.034	21.71	LA-4
7/29/82	9981	Yes	27236	.124	.042	1.791	28.00	HFET
8/02/82	4620	No	60629	.249	1.320	2.039	17.07	LA-4
8/02/82	4620	No	60642	.091	1.722	2.107	23.41	HFET
8/02/82	4620	No	60663	.208	.876	1.980	16.81	LA-4
8/02/82	4620	No	60671	.082	1.334	2.196	23.61	HFET
8/03/82	4620	Yes	60712	.193	.294	1.942	16.87	LA-4
8/03/82	4620	Yes	60720	.051	.046	2.170	23.73	HFET
8/04/82	4620	Yes	60741	.248	.249	1.984	16.99	LA-4
8/04/82	4620	Yes	60749	.051	.016	2.207	23.72	HFET
THE FOLLOWING TESTS WERE RUN AFTER ACCUMULATING 200 MILES WITH THE "CYCLONE 2" OPERATING								
8/06/82	4620	Yes	60995	.356	.529	1.965	17.21*	LA-4
8/06/82	4620	Yes	61003	.062	.020	1.992	24.38*	HFET
8/06/82	4620	Yes	61024	.236	.215	1.950	17.43*	LA-4
8/06/82	4620	Yes	61032	.062	.018	2.028	24.26*	HFET

* At Kana's request, Fluidyne data was collected to verify the mileage figures obtained using the carbon balance method. The values obtained from Fluidyne procedures are 17.59 and 24.60 for "city" and "highway", respectively.

TEST PROCEDURES

This program was conducted in accordance with Title 40, Part 610 - "Fuel Economy Retrofit Devices, Final Test Procedures and Evaluation Criteria" of The Code of Federal Regulations, dated March 14, 1979. The specific sequence of tests was selected from EPA's "Basic Test Plans for 511 Evaluations", dated November, 1981.

The urban chassis dynamometer driving schedule was driven in accordance with Title 40, Part 86, Paragraph 86.115-78 of The Code of Federal Regulations. The highway chassis dynamometer driving schedule was driven in accordance with Title 40, Part 600, Paragraph 600.109-78 of The Code of Federal Regulations.

TEST EQUIPMENT AND INSTRUMENTATION

A single set of equipment was used for all tests in this program. It was selected, calibrated and operated to meet or exceed the standards presented in the foregoing procedures. It includes the following:

1. Emissions Sampling and Analysing Equipment (C-Cell).

   a. AESi, Model 1000, Positive Displacement Pump, Constant Volume Sampler.

   b. Beckman, Model 400, Flame Ionization Detector, Total Hydrocarbon Analyser.

   c. Bendix, Model 8501-5C, Nondispersive Infrared, Carbon Monoxide Analyser.

   d. Beckman, Model 864, Nondispersive Infrared, Carbon Dioxide Analyser.

   e. Thermo Electron, Model 10AR, Chemiluminescence, Oxides of Nitrogen Analyser.

2. Dynamometer (C-Cell).

   a. Clayton, Model ECE-50, Direct Drive Variable Inertia, Dual Roller Chassis Dynamometer (equipped with automatic load control).

   b. The test vehicle's speed and driven distance were measured from the rear (idler) roll.

3. Dynamometer Driving Schedule Recording (C-Cell).

   a. Esterline Angus, Model L1102S, 10" Strip Chart, Dual-Crossover Pen Recorder was used to record the driver's performance and the computer-generated driving schedules.

TEST EQUIPMENT AND INSTRUMENTATION - continued

b. Data General, Model NOVA 1220/8154, Data Processing System, Minicomputer was used to monitor several variables during the test. These include: Actual test driven distance, CVS temperature, Test Cell wet and dry bulb temperature, and the four dilute exhaust gas analyser's output. The Data General Minicomputer generated the required dynamometer driving schedules, which were fed to one channel of the Esterline Angus Recorder.

4. The Test Cell (C-Cell) temperature and humidity were carefully controlled at the auxiliary engine compartment cooling fan inlet.

In addition, every effort was made to minimize test-to-test variability. The same driver performed all the dynamometer tests on the same dynamometer. Vehicle position of the dynamometer rolls was carefully duplicated each time as was the positioning of cooling fans and air conditioning ducts.

VEHICLE SPECIFICATIONS

Vehicle Test No:	9981
Year, Make, Model:	1980 Ford Fairmont
Vehicle Identification No:	0X92A209981
Engine Size:	2.3 Liter L-4
Initial Odo Reading:	27120
Inertia Weight:	3000
Actual H.P:	10.8

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Vehicle Test No:	4620
Year, Make, Model:	1978 Chevrolet Monte Carlo
Vehicle Identification No:	1Z37U81464620
Engine Size:	5.0 Liter V-8
Initial Odo Reading:	60554
Inertia Weight:	3500
Actual H.P:	10.7

Maintenance

Prior to initiating this evaluation program, the vehicles were given a safety inspection and tuned to the manufacturer's specifications. The Monte Carlo was tuned again after its first round of testing produced unacceptably high levels of emissions. Otherwise, no unusual maintenance was performed on either unit.

Fuel Specifications

Indolene Motor Fuel HO III was used for all dynamometer testing. This fuel was obtained from AMOCO, River Rouge, Michigan.

Dynamometer Test Fuel Analysis

Research Octane	96.6
Lead, grams/U.S.gallon	0.001
Distillation Range:	
Initial Boiling Point, °F	99
10% Point, °F	122
50% Point, °F	223
90% Point, °F	341
End Point, °F	420
Sulfur, weight %	< 0.01
Phosphorus, grams/U.S.gallon	< 0.005
RVP, 23 pounds	7.4
Hydrocarbon Composition:	
Olefins, % Max.	3.0
Aromatics, % Max.	34.2
Saturates, %	62.8

TESTING SEQUENCE/DISCUSSION

The procedure used to evaluate the effects of Kana Corporation's "Cyclone Z" on emissions and fuel economy was selected from EPA's "Basic Test Plans for 511 Evaluations", dated November, 1981, per the criteria mentioned in the Introduction, p. 1, of this report. 511 Evaluation Procedure A-1 was run. The following flow chart details the steps in this procedure, beginning with (1).

Evaluation Procedure "A"

1. Obtain and prepare vehicle.
2. Run Test Sequence "1", beginning at a.
3. Install device.
4. Run Test Sequence "1", beginning at a.
5. Remove device.
6. De-prep vehicles.
7. Assemble data.

Test Sequence "1"

a. Check basic parameters.
b. HFET precondition.
c. Run Hot-Start LA-4.
d. Run HFET.
e. Run Hot-Start LA-4
f. Run HFET
g. Check basic parameters.
h. Proceed to next step in Evaluation Procedure "A".

The Chevrolet Monte Carlo had gone through the first four steps of Evaluation Procedure "A" when Automotive Testing Laboratories, Inc., was requested by Kana Corporation to drive it 200 miles with the "Cyclone Z" operating and then run Test Sequence "1" again. This was to evaluate what effect, if any, mileage accumulation would have on the "Cyclone Z".

TEST NUMBER: 0-0670 VEHICLE: 7761
DATE: 07-29-82 TEST CELL: C

ODO (27120) BASELINE #1

THIS TEST DATA WAS PROCESSED ON 07-29-82 AT 08:24

CVS V(0) : .3109 PUMP INLET PRESSURE :14.4 IN.H2O / 1.06 IN.HG

		BLOW REVS	BAG DF	BARO. IN HG	DRY BULB TEMP	WET BULB TEMP	CVS TEMP	MILES	REL. HUM%	ABS. HUM. GRAINS	NOX C.F.
HOT	TRAN	9476	12.22	28.88	70.7	61.7	111.0	3.61	60.5	70.17	.9778
HOT	STABI	16294	17.34	28.88	70.5	61.8	111.0	3.88	61.6	70.98	.9814

	CONCENTRATION HC(PPM)	CO(PPM)	NOX(PPM)	CO2(%)
HOT TRANSIENT SAMPLE	29.9	41.0	57.4	1.090
HOT TRANSIENT BKGRND	3.6	1.5	.1	.046
HOT STABILIZED SAMPLE	23.0	13.6	20.6	.769
HOT STABILIZED BKGRND	3.7	1.5	.1	.044

	TOTAL GRAMS HC	CO	NOX	CO2
HOT TRANSIENT BAG	1.10	3.31	7.68	1374.1
HOT STABILIZED BAG	1.39	1.75	4.75	1641.2

		GRAMS PER MILE HC	CO	NOX	CO2	MPG
HOT TRANSIENT	PHASE	.305	.917	2.128	380.527	23.1[illegible]
HOT STABILIZED	PHASE	.359	.450	1.225	423.211	20.8[illegible]
HOT TRANSIENT	COMP	.147	.442	1.026	183.480	
HOT STABILIZED	COMP	.186	.233	.635	219.150	
HOT 1974 COMPOSITE		.333	.675	1.661	40[illegible].630	21.[illegible]1

AUTOMOTIVE TESTING LABORATORIES, INC.
PO BOX 289, EAST LIBERTY, OH. 43319

TEST NUMBER: 0-0671
DATE: 07-29-82

ODO (27138) BASELINE #2

THIS TEST DATA WAS PROCESSED ON 0?

CVS V(0) : .3109 PUMP INLET PRESSURE

	BLOW REVS	BAG DF	BARO. IN HG	DRY BULB TEMP	WET BULB TEMP	CV TE
HW FUEL EC	14344	8.03	28.88	70.9	62.3	11?

	HC(PPM)	CC
HW FUEL ECONOMY SAMPLE	25.7	
HW FUEL ECONOMY BKGRND	3.5	

	HC	TOTAL CO
HW FUEL ECONOMY BAG	1.42	5.52

	HC	GRAMS CO
HW FUEL ECONOMY	.139	.540

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HOT START 1974 EMISSION TEST
(GASOLINE)

TEST NUMBER: C-0672
DATE: 07-29-82

VEHICLE: 9981
TEST CELL: C

ODO (27149) BASELINE #3

THIS TEST DATA WAS PROCESSED ON 07-29-82 AT 08:34

CVS V(0) : .3109 PUMP INLET PRESSURE :14.4 IN.H2O / 1.06 IN.HG

		BLOW REVS	BAG DF	BARO. IN HG	DRY BULB TEMP	WET BULB TEMP	CVS TEMP	MILES	REL. HUM%	ABS. HUM. GRAINS	NOX C.F.
HOT	TRAN	9480	12.31	28.88	70.7	61.3	111.0	3.58	58.9	68.30	.9694
HOT	STABI	16294	17.35	28.88	70.6	61.7	111.0	3.85	60.9	70.34	.9786

	CONCENTRATION			
	HC(PPM)	CO(PPM)	NOX(PPM)	CO2(%)
HOT TRANSIENT SAMPLE	34.0	59.5	57.5	1.080
HOT TRANSIENT BKGRND	3.4	1.1	.0	.042
HOT STABILIZED SAMPLE	21.8	10.2	20.9	.769
HOT STABILIZED BKGRND	3.5	.9	.0	.044

	TOTAL GRAMS			
	HC	CO	NOX	CO2
HOT TRANSIENT BAG	1.28	4.89	7.65	1366.3
HOT STABILIZED BAG	1.32	1.34	4.83	1641.2

		GRAMS PER MILE				
		HC	CO	NOX	CO2	MPG
HOT TRANSIENT	PHASE	.357	1.363	2.134	381.321	23.06
HOT STABILIZED	PHASE	.343	.348	1.254	406.177	20.73
HOT TRANSIENT	COMP	.172	.657	1.029	183.787	
HOT STABILIZED	COMP	.177	.180	.650	220.771	
HOT 1974 COMPOSITE		.350	.839	1.679	404.558	21.79

AUTOMOTIVE TESTING LABORATORIES, INC.
PO BOX 289, EAST LIBERTY, OH. 43319

HIGHWAY FUEL ECONOMY TEST
(GASOLINE)

TEST NUMBER: 0-0673
DATE: 07-29-82

VEHICLE: 9981
TEST CELL: C

ODO (27168) BASELINE #4

THIS TEST DATA WAS PROCESSED ON 07-29-82 AT 08:39

CVS V(0) : .3109 PUMP INLET PRESSURE :14.4 IN.H2O / 1.06 IN.HG

	BLOW REVS	BAG DF	BARO. IN HG	DRY BULB TEMP	WET BULB TEMP	CVS TEMP	MILES	REL. HUM%	ABS. HUM. GRAINS	NOX C.F.
HW FUEL EC	14344	8.06	28.88	70.9	62.5	111.0	10.20	63.0	73.64	.9936

	CONCENTRATION HC(PPM)	CO(PPM)	NOX(PPM)	CO2(%)
HW FUEL ECONOMY SAMPLE	24.9	41.3	101.7	1.656
HW FUEL ECONOMY BKGRND	3.2	.6	.0	.042

	TOTAL GRAMS HC	CO	NOX	CO2
HW FUEL ECONOMY BAG	1.38	5.15	20.98	3216.1

	GRAMS PER MILE HC	CO	NOX	CO2	MPG
HW FUEL ECONOMY	.135	.505	2.056	315.209	28.03

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(GASOLINE)

TEST NUMBER: 0-0677 VEHICLE: 9981 89
DATE: 07-29-82 TEST CELL: C

ODO (27199) DEVICE INSTALLED #1

THIS TEST DATA WAS PROCESSED ON 07-29-82 AT 08:48

CVS V(0) : .3109 PUMP INLET PRESSURE :14.4 IN.H20 / 1.06 IN.HG

		BLOW REVS	BAG DF	BARO. IN HG	DRY BULB TEMP	WET BULB TEMP	CVS TEMP	MILES	REL. HUM%	ABS. HUM. GRAINS	NOX C.F.
HOT	TRAN	9474	12.27	28.88	70.7	61.9	111.0	3.57	61.3	71.12	.9821
HOT	STABI	16294	17.47	28.88	70.6	62.3	111.0	3.83	63.3	73.18	.9915

	CONCENTRATION			
	HC(PPM)	CO(PPM)	NOX(PPM)	CO2(%)
HOT TRANSIENT SAMPLE	38.6	8.7	61.9	1.087
HOT TRANSIENT BKGRND	3.8	.5	.1	.042
HOT STABILIZED SAMPLE	27.4	.7	28.0	.764
HOT STABILIZED BKGRND	3.7	.1	.3	.046

	TOTAL GRAMS			
	HC	CO	NOX	CO2
HOT TRANSIENT BAG	1.45	.68	8.33	1375.2
HOT STABILIZED BAG	1.70	.09	6.48	1626.5

		GRAMS PER MILE				
		HC	CO	NOX	CO2	MPG
HOT TRANSIENT	PHASE	.406	.191	2.331	384.777	22.95
HOT STABILIZED	PHASE	.444	.024	1.691	424.455	20.82
HOT TRANSIENT	COMP	.196	.092	1.125	185.686	
HOT STABILIZED	COMP	.230	.013	.875	219.621	
HOT 1974 COMPOSITE		.426	.105	2.000	405.307	21.80

AUTOMOTIVE TESTING LABORATORIES,INC.
PO BOX 289, EAST LIBERTY, OH. 43319

HIGHWAY FUEL ECONOMY TEST
(GASOLINE)

TEST NUMBER: 0-0678
DATE: 07-29-82

VEHICLE: 9981
TEST CELL: C

ODO (27207) DEVICE INSTALLED #2

THIS TEST DATA WAS PROCESSED ON 07-29-82 AT 08:58

CVS V(0) : .3109 PUMP INLET PRESSURE :14.4 IN.H2O / 1.06 IN.HG

	BLOW REVS	BAG DF	BARO. IN HG	DRY BULB TEMP	WET BULB TEMP	CVS TEMP	MILES	REL. HUM%	ABS. HUM. GRAINS	NOX C.F.
HW FUEL EC	14346	7.99	28.88	70.9	63.0	111.0	10.20	65.1	76.05	1.0050

	CONCENTRATION HC(PPM)	CO(PPM)	NOX(PPM)	CO2(%)
HW FUEL ECONOMY SAMPLE	23.3	4.2	88.2	1.675
HW FUEL ECONOMY BKGRND	3.5	.3	.7	.052

	TOTAL GRAMS HC	CO	NOX	CO2
HW FUEL ECONOMY BAG	1.27	.50	18.27	3237.8

	GRAMS PER MILE HC	CO	NOX	CO2	MPG
HW FUEL ECONOMY	.124	.049	1.791	317.371	27.90

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HOT START 1974 EMISSION TEST
(GASOLINE)

TEST NUMBER: D-0679 VEHICLE: 9981
DATE: 07-29-82 TEST CELL: C

ODO (27228) DEVICE INSTALLED #3

THIS TEST DATA WAS PROCESSED ON 07-29-82 AT 09:03

CVS V(0) : .3109 PUMP INLET PRESSURE :14.4 IN.H2O / 1.06 IN.HG

		BLOW REVS	BAG DF	BARO. IN HG	DRY BULB TEMP	WET BULB TEMP	CVS TEMP	MILES	REL. HUM%	ABS. HUM. GRAINS	NOX C.F.
HOT	TRAN	9476	12.03	28.88	70.7	61.9	110.0	3.57	61.3	71.12	.9821
HOT	STABI	16294	17.42	28.88	70.7	62.4	111.0	3.84	63.4	73.49	.9930

	CONCENTRATION HC(PPM)	CO(PPM)	NOX(PPM)	CO2(%)
HOT TRANSIENT SAMPLE	35.5	5.0	62.1	1.109
HOT TRANSIENT BKGRND	4.0	.3	.7	.054
HOT STABILIZED SAMPLE	26.3	.5	29.1	.767
HOT STABILIZED BKGRND	3.6	.4	.2	.050

	TOTAL GRAMS HC	CO	NOX	CO2
HOT TRANSIENT BAG	1.32	.40	8.30	1393.4
HOT STABILIZED BAG	1.63	.03	6.77	1623.5

		GRAMS PER MILE HC	CO	NOX	CO2	MPG
HOT TRANSIENT	PHASE	.368	.112	2.323	389.866	22.67
HOT STABILIZED	PHASE	.425	.008	1.764	423.231	20.89
HOT TRANSIENT	COMP	.178	.054	1.120	188.040	
HOT STABILIZED	COMP	.220	.004	.913	219.098	
HOT 1974 COMPOSITE		.398	.058	2.034	407.138	21.71

HIGHWAY FUEL ECONOMY TEST
(GASOLINE)

TEST NUMBER: 0-0680 VEHICLE: 9981
DATE: 07-29-82 TEST CELL: C

ODO (27236) DEVICE INSTALLED #4

THIS TEST DATA WAS PROCESSED ON 07-29-82 AT 09:09

CVS V(0) : .3109 PUMP INLET PRESSURE :14.4 IN.H2O / 1.06 IN.HG

	BLOW REVS	BAG DF	BARO. IN HG	DRY BULB TEMP	WET BULB TEMP	CVS TEMP	MILES	REL. HUM%	ABS. HUM. GRAINS	NOX C.F.
HW FUEL EC	14340	8.00	28.88	70.7	62.9	111.0	10.22	65.4	75.90	1.0042

	CONCENTRATION HC(PPM)	CO(PPM)	NOX(PPM)	CO2(%)
HW FUEL ECONOMY SAMPLE	23.1	3.8	88.2	1.672
HW FUEL ECONOMY BKGRND	3.4	.5	.5	.052

	TOTAL GRAMS HC	CO	NOX	CO2
HW FUEL ECONOMY BAG	1.26	.43	18.30	3231.0

	GRAMS PER MILE HC	CO	NOX	CO2	MPG
HW FUEL ECONOMY	.124	.042	1.791	316.238	28.00

HOT START 1974 EMISSION TEST
(GASOLINE)

TEST NUMBER: 0-0734 VEHICLE: 4620
DATE: 08-02-82 TEST CELL: C

ODO (60629) BASELINE#1

THIS TEST DATA WAS PROCESSED ON 1 AT 09:09

CVS V(O) : .3109 PUMP INLET PRESSURE :14.4 IN.H2O / 1.06 IN.HG

		BLOW REVS	BAG DF	BARO. IN HG	DRY BULB TEMP	WET BULB TEMP	CVS TEMP	MILES	REL. HUM%	ABS. HUM. GRAINS	NOX C.F.
HOT	TRAN	9489	9.83	28.83	71.7	64.9	109.0	3.60	69.9	84.28	1.0456
HOT	STABI	16294	13.74	28.83	71.6	64.9	111.0	3.85	70.3	84.45	1.0465

	CONCENTRATION			
	HC(PPM)	CO(PPM)	NOX(PPM)	CO2(%)
HOT TRANSIENT SAMPLE	35.4	109.3	63.0	1.349
HOT TRANSIENT BKGRND	3.9	.0	.2	.039
HOT STABILIZED SAMPLE	10.7	4.7	25.0	.974
HOT STABILIZED BKGRND	3.4	.0	.1	.037

	TOTAL GRAMS			
	HC	CO	NOX	CO2
HOT TRANSIENT BAG	1.32	9.16	9.05	1730.4
HOT STABILIZED BAG	.53	.67	6.14	2117.5

		GRAMS PER MILE				
		HC	CO	NOX	CO2	MPG
HOT TRANSIENT	PHASE	.367	2.545	2.514	480.799	18.25
HOT STABILIZED	PHASE	.138	.174	1.595	550.143	16.1[illegible]
HOT TRANSIENT	COMP	.177	1.230	1.215	232.330	
HOT STABILIZED	COMP	.071	.090	.824	284.304	
HOT 1974 COMPOSITE		.249	1.320	2.039	516.635	17.0[illegible]

AUTOMOTIVE TESTING LABORATORIES, INC.

HIGHWAY FUEL ECONOMY TEST
(GASOLINE)

TEST NUMBER: 0-0743 VEHICLE: 4620
DATE: 08-02-82 TEST CELL: C

ODO (60642) BASELINE#2

THIS TEST DATA WAS PROCESSED ON 1 AT 09:13

CVS V(0) : .3109 PUMP INLET PRESSURE :14.4 IN.H2O / 1.06 IN.HG

	BLOW REVS	BAG DF	BARO. IN HG	DRY BULB TEMP	WET BULB TEMP	CVS TEMP	MILES	REL. HUM%	ABS. HUM. GRAINS	NOX C.F.
HW FUEL EC	14344	6.69	28.82	71.5	65.4	111.0	10.30	72.8	87.20	1.0608

	CONCENTRATION HC(PPM)	CO(PPM)	NOX(PPM)	CO2(%)
HW FUEL ECONOMY SAMPLE	18.2	140.7	99.2	1.987
HW FUEL ECONOMY BKGRND	3.6	.0	.5	.039

	TOTAL GRAMS HC	CO	NOX	CO2
HW FUEL ECONOMY BAG	.94	17.75	21.71	3873.6

	GRAMS PER MILE HC	CO	NOX	CO2	MPG
HW FUEL ECONOMY	.091	1.722	2.107	375.893	23.41

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HOT START 1974 EMISSION TEST
(GASOLINE)

TEST NUMBER: 0-0745 VEHICLE: 4620
DATE: 08-02-82 TEST CELL: C

ODO (60663) BASELINE#3

THIS TEST DATA WAS PROCESSED ON 1 AT 09:16

CVS V(0) : .3109 PUMP INLET PRESSURE :14.4 IN.H2O / 1.06 IN.HG

	BLOW REVS	BAG DF	BARO. IN HG	DRY BULB TEMP	WET BULB TEMP	CVS TEMP	MILES	REL. HUM%	ABS. HUM. GRAINS	NOX C.F.
HOT TRAN	9472	9.73	28.82	71.3	64.6	111.0	3.61	70.2	83.47	1.0415
HOT STABI	16294	13.30	28.82	71.3	64.9	111.0	3.87	71.5	84.99	1.0493

	CONCENTRATION HC(PPM)	CO(PPM)	NOX(PPM)	CO2(%)
HOT TRANSIENT SAMPLE	29.3	72.6	61.0	1.367
HOT TRANSIENT BKGRND	4.7	.5	.1	.039
HOT STABILIZED SAMPLE	11.9	3.7	24.9	1.006
HOT STABILIZED BKGRND	4.9	.0	.1	.037

	TOTAL GRAMS HC	CO	NOX	CO2
HOT TRANSIENT BAG	1.04	6.02	8.69	1744.6
HOT STABILIZED BAG	.52	.54	6.13	2188.3

	GRAMS PER MILE HC	CO	NOX	CO2	MPG
HOT TRANSIENT PHASE	.287	1.666	2.405	482.992	18.33
HOT STABILIZED PHASE	.135	.139	1.583	565.462	15.66
HOT TRANSIENT COMP	.138	.804	1.161	233.169	
HOT STABILIZED COMP	.070	.072	.819	292.480	
HOT 1974 COMPOSITE	.208	.876	1.980	525.649	16.81

HIGHWAY FUEL ECONOMY TEST
(GASOLINE)

TEST NUMBER: 0-0746
DATE: 08-02-82

VEHICLE: 4620
TEST CELL: C

ODO (60671)BASELINE#4

THIS TEST DATA WAS PROCESSED ON 1 AT 09:19

CVS V(0) : .3109 PUMP INLET PRESSURE :14.4 IN.H20 / 1.06 IN.HG

	BLOW REVS	BAG DF	BARO. IN HG	DRY BULB TEMP	WET BULB TEMP	CVS TEMP	MILES	REL. HUM%	ABS. HUM. GRAINS	NOX C.F.
HW FUEL EC	14344	6.76	28.82	71.6	63.2	111.0	10.29	71.6	86.01	1.0546

	CONCENTRATION HC(PPM)	CO(PPM)	NOX(PPM)	CO2(%)
HW FUEL ECONOMY SAMPLE	16.9	106.8	103.4	1.970
HW FUEL ECONOMY BKGRND	4.0	.0	.0	.037

	TOTAL GRAMS HC	CO	NOX	CO2
HW FUEL ECONOMY BAG	.84	13.73	22.60	3842.6

	GRAMS PER MILE HC	CO	NOX	CO2	MPG
HW FUEL ECONOMY	.082	1.334	2.196	373.324	23.6

HOT START 1974 EMISSION TEST
(GASOLINE)

TEST NUMBER: 0-0763
DATE: 06-03-82

VEHICLE: 4620
TEST CELL: C

ODO (60712) DEVICE INSTALLED #1

THIS TEST DATA WAS PROCESSED ON 08-03-82 AT 09:01

CVS V(0) : .3109   PUMP INLET PRESSURE :14.4 IN.H2O / 1.06 IN.HG

	BLOW REVS	BAG DF	BARO. IN HG	DRY BULB TEMP	WET BULB TEMP	CVS TEMP	MILES	REL. HUM%	ABS. HUM. GRAINS	NOX C.F.
HOT TRAN	9469	9.80	28.83	71.6	65.3	111.0	3.58	72.0	86.48	1.0571
HOT STABI	16294	13.40	28.83	71.5	65.4	111.0	3.82	72.8	87.16	1.0606

CONCENTRATION	HC(PPM)	CO(PPM)	NOX(PPM)	CO2(%)
HOT TRANSIENT SAMPLE	22.8	27.1	61.4	1.362
HOT TRANSIENT BKGRND	4.9	1.2	.5	.046
HOT STABILIZED SAMPLE	13.4	.4	22.5	.9 [illegible]
HOT STABILIZED BKGRND	4.3	.4	.3	.044

TOTAL GRAMS	HC	CO	NOX	CO2
HOT TRANSIENT BAG	.76	2.17	8.82	1728.6
HOT STABILIZED BAG	.67	.00	5.55	2156.4

GRAMS PER MILE		HC	CO	NOX	CO2	MPG
HOT TRANSIENT	PHASE	.212	.606	2.465	482.861	18.3[illegible]
HOT STABILIZED	PHASE	.174	.001	1.452	563.906	15.7[illegible]
HOT TRANSIENT	COMP	.102	.293	1.192	233.474	
HOT STABILIZED	COMP	.090	.001	.750	291.245	
HOT 1974 COMPOSITE		.193	.294	1.942	524.719	16.8

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HIGHWAY FUEL ECONOMY TEST
(GASOLINE)

TEST NUMBER: 0-0764
DATE: 08-03-82

VEHICLE: 4620
TEST CELL: C

ODO (60720) DEVICE INSTALLED #2

THIS TEST DATA WAS PROCESSED ON 08-03-82 AT 09:06

CVS V(0) : .3109 PUMP INLET PRESSURE :14.4 IN.H2O / 1.06 IN.HG

	BLOW REVS	BAG DF	BARO. IN HG	DRY BULB TEMP	WET BULB TEMP	CVS TEMP	MILES	REL. HUM%	ABS. HUM. GRAINS	NOX C.F.
HW FUEL EC	14344	6.77	28.83	71.8	66.0	111.0	10.22	74.1	89.75	1.0745

	CONCENTRATION HC(PPM)	CO(PPM)	NOX(PPM)	CO2(%)
HW FUEL ECONOMY SAMPLE	11.8	4.1	100.7	1.978
HW FUEL ECONOMY BKGRND	4.0	.4	1.2	.062

	TOTAL GRAMS HC	CO	NOX	CO2
HW FUEL ECONOMY BAG	.52	.47	22.19	3818.3

	GRAMS PER MILE HC	CO	NOX	CO2	MPG
HW FUEL ECONOMY	.051	.046	2.170	373.464	23.[illegible]

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HOT START 1974 EMISSION TEST
(GASOLINE)

TEST NUMBER: 0-0765
DATE: 08-04-82

VEHICLE: 4620
TEST CELL: C

ODO (60741) DEVICE INSTALLED #3

THIS TEST DATA WAS PROCESSED ON 08-03-82 AT 09:12

CVS V(0) : .3109   PUMP INLET PRESSURE :14.4 IN.H2O / 1.06 IN.HG

		BLOW REVS	BAG DF	BARO. IN HG	DRY BULB TEMP	WET BULB TEMP	CVS TEMP	MILES	REL. HUM%	ABS. HUM. GRAINS	NOX C.F.
HOT	TRAN	9493	9.91	28.84	71.6	65.6	111.0	3.57	73.2	87.99	1.0650
HOT	STABI	16294	13.40	28.84	71.6	65.6	111.0	3.84	73.2	87.99	1.0650

CONCENTRATION	HC(PPM)	CO(PPM)	NOX(PPM)	CO2(%)
HOT TRANSIENT SAMPLE	32.4	22.5	62.4	1.346
HOT TRANSIENT BKGRND	4.2	.5	.8	.052
HOT STABILIZED SAMPLE	12.8	.4	22.9	.998
HOT STABILIZED BKGRND	3.9	.4	.3	.046

TOTAL GRAMS	HC	CO	NOX	CO2
HOT TRANSIENT BAG	1.18	1.84	9.02	1706.2
HOT STABILIZED BAG	.65	.00	5.68	2153.1

GRAMS PER MILE		HC	CO	NOX	CO2	MPG
HOT TRANSIENT	PHASE	.331	.516	2.525	477.382	18.5[illegible]
HOT STABILIZED	PHASE	.170	.001	1.480	561.141	15.7[illegible]
HOT TRANSIENT	COMP	.160	.249	1.217	230.221	
HOT STABILIZED	COMP	.088	.001	.766	290.527	
HOT 1974 COMPOSITE		.248	.249	1.984	520.748	16.[illegible]

AUTOMOTIVE TESTING LABORATORIES,INC.
PO BOX 289, EAST LIBERTY, OH. 43319

HIGHWAY FUEL ECONOMY TEST
(GASOLINE)

TEST NUMBER: 0-0766
DATE: 08-04-82

VEHICLE: 4620
TEST CELL: C

ODO (60749) DEVICE INSTALLED #4

THIS TEST DATA WAS PROCESSED ON 08-03-82 AT 09:16

CVS V(0) : .3109 PUMP INLET PRESSURE :14.4 IN.H2O / 1.06 IN.HG

	BLOW REVS	BAG DF	BARO. IN HG	DRY BULB TEMP	WET BULB TEMP	CVS TEMP	MILES	REL. HUM%	ABS. HUM. GRAINS	NOX C.F.
HW FUEL EC	14344	6.83	28.84	71.8	66.0	111.0	10.22	74.1	89.72	1.0743

	CONCENTRATION HC(PPM)	CO(PPM)	NOX(PPM)	CO2(%)
HW FUEL ECONOMY SAMPLE	12.0	1.3	101.7	1.961
HW FUEL ECONOMY BKGRND	4.3	.0	.5	.042

	TOTAL GRAMS HC	CO	NOX	CO2
HW FUEL ECONOMY BAG	.52	.16	22.56	3818.4

	GRAMS PER MILE HC	CO	NOX	CO2	MPG
HW FUEL ECONOMY	.051	.016	2.207	373.656	23.72

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HOT START 1974 EMISSION TEST
(GASOLINE)

TEST NUMBER: 0-0839
DATE: 08-06-82

VEHICLE: 4620
TEST CELL: C

ODO (60995) WITH DEVICE (200) MI.

THIS TEST DATA WAS PROCESSED ON 1 AT 09:25

CVS V(0) : .3109 PUMP INLET PRESSURE :14.4 IN.H2O / 1.06 IN.HG

	BLOW REVS	BAG DF	BARO. IN HG	DRY BULB TEMP	WET BULB TEMP	CVS TEMP	MILES	REL. HUM%	ABS. HUM. GRAINS	NOX C.F.
HOT TRAN	9476	10.09	28.89	71.7	64.7	111.0	3.57	69.1	83.07	1.0394
HOT STABI	16294	13.77	28.89	71.7	64.8	111.0	3.83	69.5	83.58	1.0420

	CONCENTRATION HC(PPM)	CO(PPM)	NOX(PPM)	CO2(%)
HOT TRANSIENT SAMPLE	48.5	45.7	64.0	1.321
HOT TRANSIENT BKGRND	6.4	.4	.2	.040
HOT STABILIZED SAMPLE	16.9	1.8	22.2	.972
HOT STABILIZED BKGRND	5.2	1.0	.2	.040

	TOTAL GRAMS HC	CO	NOX	CO2
HOT TRANSIENT BAG	1.77	3.78	9.11	1685.8
HOT STABILIZED BAG	.86	.13	5.42	2108.4

		GRAMS PER MILE HC	CO	NOX	CO2	MPG
HOT TRANSIENT	PHASE	.496	1.061	2.555	473.734	18.63
HOT STABILIZED	PHASE	.225	.034	1.416	551.085	15.07
HOT TRANSIENT	COMP	.239	.512	1.232	228.053	
HOT STABILIZED	COMP	.117	.017	.733	285.234	
HOT 1974 COMPOSITE		.356	.529	1.963	513.287	17.[illegible]

FUEL ECONOMY TEST SUMMARY

VEHICLE NO:	4620	DATE:	08-06-8[illegible]
TEST NO:	0-0839	TEST CELL:	C
INITIAL ODO:	60995	END ODO:	6102[illegible]
OIL:	WEATHER	REPLICATE:	1
DRIVER:	RS	BAROMETER:	28.89

OBSERVED API GRAVITY: 59.5 @ 71 F
API GRAVITY CORRECTED TO 60F: 58.25

	CC FUEL	FUEL TEMP	GALLONS USED	DISTANCE (MILES)	MPG	GALLONS 100 MI
COLD TRANSIENT	709.9	24.4	0.1890	3.566	18.864	5.30
COLD STABLE	881.5	24.2	0.2348	3.826	16.296	6.13
HOT TRANSIENT	0	0	0.0000	0	0.000	0.00
CITY COMPOSITE					0.000	0.00
HFET 1	1563.3	24.0	0.4165	10.184	24.453	4.08
HFET 2	1538.5	24.1	0.4098	10.191	24.867	4.02
CITY AND HFET 2 COMPOSITE					0.000	0.00

	ENGINE TEMPERATURES OIL	WATER
END OF SOAK	00	0
BEFORE HFET 1	0	0
FINAL	0	0

	CELL TEMPERATURE DRY BULB	WET BULB
COLD TRANSIENT	71.7	64.[illegible]
COLD STABLE	71.7	64.[illegible]
HOT TRANSIENT	0	[illegible]
HFET1	71.7	64.[illegible]
HFET2	72.1	65.[illegible]

AVERAGE COASTDOWN TIME: 0.000

AUTOMOTIVE TESTING LABORATORIES, INC.
EAST LIBERTY, OHIO

HIGHWAY FUEL ECONOMY TEST
(GASOLINE)

ST NUMBER: 0-0840 VEHICLE: 4620 103
TE: 08-06-82 TEST CELL: C

DO (61003) WITH DEVICE (200)MI.

THIS TEST DATA WAS PROCESSED ON 1 AT 09:34

CVS V(0) : .3109 PUMP INLET PRESSURE :14.4 IN.H2O / 1.06 IN.HG

	BLOW REVS	BAG DF	BARO. IN HG	DRY BULB TEMP	WET BULB TEMP	CVS TEMP	MILES	REL. HUM%	ABS. HUM. GRAINS	NOX C.F.
HW FUEL EC	14381	7.07	28.89	72.1	65.4	111.0	10.19	70.5	85.95	1.0543

	CONCENTRATION			
	HC(PPM)	CO(PPM)	NOX(PPM)	CO2(%)
HW FUEL ECONOMY SAMPLE	13.9	2.2	92.7	1.893
HW FUEL ECONOMY BKGRND	4.4	.6	.2	.039

	TOTAL GRAMS			
	HC	CO	NOX	CO2
HW FUEL ECONOMY BAG	.63	.21	20.30	3705.2

	GRAMS PER MILE				
	HC	CO	NOX	CO2	MPG
HW FUEL ECONOMY	.062	.020	1.992	363.575	24.3[illegible]

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HOT START 1974 EMISSION TEST
(GASOLINE)

TEST NUMBER: D-0841 VEHICLE: 4620
DATE: 08-06-82 TEST CELL: C

ODO (61024) WITH DEVICE (200)MI.

THIS TEST DATA WAS PROCESSED ON 08-09-82 AT 09:40

CVS V(0) : .3109 PUMP INLET PRESSURE :14.4 IN.H2O / 1.06 IN.HG

		BLOW REVS	BAG DF	BARO. IN HG	DRY BULB TEMP	WET BULB TEMP	CVS TEMP	MILES	REL. HUM%	ABS. HUM. GRAINS	NOX C.F.
HOT	TRAN	9480	10.17	28.89	71.8	65.0	111.0	3.57	70.0	84.42	1.0463
HOT	STABI	16294	13.91	28.89	71.8	65.1	111.0	3.63	70.4	84.93	1.0489

	CONCENTRATION			
	HC(PPM)	CO(PPM)	NOX(PPM)	CO2(%)
HOT TRANSIENT SAMPLE	25.4	17.4	63.7	1.313
HOT TRANSIENT BKGRND	4.8	.4	.2	.040
HOT STABILIZED SAMPLE	16.1	1.6	21.6	.962
HOT STABILIZED BKGRND	4.2	.4	.2	.042

	TOTAL GRAMS			
	HC	CO	NOX	CO2
HOT TRANSIENT BAG	.88	1.42	9.13	1676.2
HOT STABILIZED BAG	.87	.18	5.30	2082.4

		GRAMS PER MILE				
		HC	CO	NOX	CO2	MPG
HOT TRANSIENT	PHASE	.245	.398	2.559	469.795	18.82
HOT STABILIZED	PHASE	.226	.046	1.383	542.996	16.31
HOT TRANSIENT	COMP	.118	.192	1.233	226.426	
HOT STABILIZED	COMP	.117	.024	.716	281.290	
HOT 1974 COMPOSITE		.236	.215	1.950	507.716	17.43

FUEL ECONOMY TEST SUMMARY

VEHICLE NO:	4620	DATE:	08-06-8
TEST NO:	0-0841	TEST CELL:	(
INITIAL ODO:	61024	END ODO:	6104(
OIL:	WEATHER	REPLICATE:	:
DRIVER:	RS	BAROMETER:	28.8

OBSERVED API GRAVITY: 59.6 @ 76 F
API GRAVITY CORRECTED TO 60F: 57.8

	CC FUEL	FUEL TEMP	GALLONS USED	DISTANCE (MILES)	MPG	GALLONS 100 MIL
COLD TRANSIENT	706.7	24.2	0.1887	3.568	18.911	5.28
COLD STABLE	882.7	24.2	0.2357	3.835	16.273	6.14
HOT TRANSIENT	0	0	0.0000	0	0.000	0.00(
CITY COMPOSITE					0.000	0.00(
HFET 1	1570.4	24.0	0.4194	10.183	24.282	4.11
HFET 2	1541.4	24.1	0.4116	10.203	24.790	4.03
CITY AND HFET 2 COMPOSITE					0.000	0.00(

	ENGINE TEMPERATURES OIL	WATER
END OF SOAK	0	0
BEFORE HFET 1	0	0
FINAL	0	0

	CELL TEMPERATURE DRY BULB	WET BULB
COLD TRANSIENT	71.8	65.0
COLD STABLE	71.8	65.1
HOT TRANSIENT	0	0
HFET1	71.8	64.5
HFET2	72.1	65.2

AVERAGE COASTDOWN TIME: 0.000

AUTOMOTIVE TESTING LABORATORIES, INC.
EAST LIBERTY, OHIO

HIGHWAY FUEL ECONOMY TEST
(GASOLINE)

TEST NUMBER: 0-0842
DATE: 08-06-82

VEHICLE: 4620
TEST CELL: C

ODO (61032) WITH DEVICE (200)MI.

THIS TEST DATA WAS PROCESSED ON 08-09-82 AT 09:44

CVS V(O) : .3109   PUMP INLET PRESSURE :14.4 IN.H2O / 1.06 IN.HG

	BLOW REVS	BAG DF	BARO. IN HG	DRY BULB TEMP	WET BULB TEMP	CVS TEMP	MILES	REL. HUM%	ABS. HUM. GRAINS	NOX C.F.
HW FUEL EC	14381	7.02	28.89	72.1	65.2	111.0	10.20	69.7	84.93	1.0490

	CONCENTRATION			
	HC(PPM)	CO(PPM)	NOX(PPM)	CO2(%)
HW FUEL ECONOMY SAMPLE	13.9	1.9	94.9	1.907
HW FUEL ECONOMY BKGRND	4.5	.5	.2	.042

	TOTAL GRAMS			
	HC	CO	NOX	CO2
HW FUEL ECONOMY BAG	.63	.18	20.69	3726.9

	GRAMS PER MILE				
	HC	CO	NOX	CO2	MPG
HW FUEL ECONOMY	.062	.018	2.028	365.375	24.[illegible]

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
ANN ARBOR, MICHIGAN 48105

October 5, 1982

OFFICE OF
AIR, NOISE AND RADIATION

Mr. Louis A. Bluestein, Vice President
Kana Corporation
1653 Vine Street
Denver, CO 80206

Dear Mr. Bluestein:

We have received your September 10, 1982 application for an EPA evaluation of the "Cyclone-Z", a fuel economy retrofit device. We have made a preliminary review of your application. Because it states the Cyclone-Z and Uzumaki are the same, we have also considered all information regarding Uzumaki which you have previously submitted. We will complete our review after we receive all the required information. Our preliminary comments are as follows:

1. Your patent application shows the device as consisting of only a mechanical component which is intended to supply additional air into the PCV line. In the attachment to your April 20 letter titled: "A Challenge to the Starting Point in the Combustion Engineering Theory" (page 4) it states, "our Uzumaki is also equipped with a mini-computer sensor". It further states the sensor connects directly to the ignition line, the gasoline line, or propane line. Is your present application applicable to the electrical sensor, too? If so, please provide more details as to the theory of operation, maintenance, construction, etc.

2. Your application states the Cyclone-Z controls air/fuel (A/F) ratios to a constant level regardless of change in altitude. Please provide data which substantiates this statement and explain how the device maintains a constant air/fuel ratio.

3. An attachment to your application states, "a controlled amount of secondary air is fed into the PCV line and further to the intake manifold, where it is mixed with the existing air/fuel mixture. A circulating flow is caused producing a turbulence in the air/fuel mixture in the combustion chamber". It is not clear as to how the connecting air hoses and three-way pipe connector can induce a "circulating flow" and "turbulence" different enough from other commonly-available air hoses/connectors so that the effect is noticed all the way through the intake manifold and into the combustion chamber. Please provide more details to help in our understanding of the device.

4. Another attachment to your application states that the device causes the idle speed to increase. It has been our experience that the idle speed on many of today's automobiles (even without any retrofit device) can be increased merely by disconnecting the PCV line from the PCV valve. The speed increase is due to a leaner mixture (for rich A/F ratios only) and to a reduction in engine pumping losses. These changes are, in turn, due to the circumventing of the PCV valve and its throttling effect. As we understand the device now, the increased idle speed causes an increase in turbulence. The increased turbulence (due to the device) does not cause the idle speed to increase.

5. What materials are used in the construction of the device?

6. The application did not include a copy of those installation instructions intended to be given to purchasers of the device. Please provide a copy. Further, you did not list the tools and equipment needed to install the device.

7. Regarding maintenance, you state the only additional maintenance required is the replacement of the air filter every six months. How will replacement filters be available and how much will they cost? Further, you state engine idle speed may increase with time and therefore it may need to be adjusted. At those times, will the device have to be adjusted for minimum emission levels, as done during initial installation of the device?

8. Is one model of the device appropriate for all vehicles?

9. The application states, "it appears not to assist cars using other non-gasoline fuels". Yet, the attachment to your April 20 letter (addressed in item 1 above) suggests the device may also be applicable to propane-fueled vehicles. Please clarify this apparent inconsistency.

10. The attachment (page 6) to your application states the device reduces the warm-up time of the engine. Further, it states the "blow-by gas" is drastically reduced. Both of these benefits are claimed to be the result of improved combustion efficiency. Please submit additional information explaining how improved combustion efficiency can cause these benefits.

11. The attachment to your April 20 letter states the device eliminates carbon deposits in the various parts of the combustion chamber. Have you disassembled engines before and after using the device to verify this? Have you photographs of the disassembled engines? If so, please provide them.

12. With respect to the ATL data submitted to support the claims made for the device, the following was noted:

a. The tests were run according to Procedure A-1 instead of A-4 (as recommended in our letter of April 29). Please explain the deviation from the recommended test plans.

b. Because Procedure A-1 consists of hot-start testing, the tests did not show any benefits attributable to the claimed quicker warm-up period.

c. The test results are typical of those realized with other air bleed devices we have evaluated, i.e.,CO was greatly reduced, HC and NOx may or may not have been reduced, and fuel economy was essentially unchanged. You suggest the results may be due to Indolene fuel and the "adverse effects" of air shipment. Please explain the basis for your statements.

d. The test results contained in the ATL report compare the "with device" results after 200 miles to the "without device" results before the 200 miles. No "without device" tests were run after 200 miles and therefore it is possible that the mileage accumulation alone may have caused the "with device" results to also shift.

In summary, we need additional information to clarify certain portions of your application. Additionally, because the ATL data does not support the claims made for the device, and also considering your concerns about Indolene fuel and air shipment, we suggest you have additional tests performed by ATL (or any other EPA recognized facility) using a representative device and commercial pump fuel and following Procedure A-4. Without additional data we can only conclude the device does not achieve all of the claimed benefits, and therefore does not justify EPA testing of the device.

In order that we may evaluate your device in a timely manner, we ask that you respond to this letter by November 1 and submit the test results by November 29. If you have questions regarding this matter, please contact me.

Sincerely,

Merrill W. Korth
Device Evaluation Coordinator
Test and Evaluation Branch

Enclosure