State of California
AIR RESOURCES BOARD

EXECUTIVE ORDER D-121-1
Relating to Exemptions under Section 27156
of the Vehicle Code

LINDBERG INTERNATIONAL CORP.
LINDBERG COMBUSTION CONTROL SYSTEM

Pursuant to the authority vested in the Air Resources Board by Section 27156 of the Vehicle Code; and

Pursuant to the authority vested in the undersigned by Sections 39515 and 39516 of the Health and Safety Code and Executive Order G-45-5;

IT IS ORDERED AND RESOLVED: That the installation of the Lindberg Combustion Control System manufactured by the Lindberg International Corp., Berkeley, California has been found not to reduce the effectiveness of required motor vehicle pollution control devices and, therefore, is exempt from the prohibitions of Section 27156 of the Vehicle Code for 1983 and older model-year gasoline fueled motor vehicles.

This Executive Order is valid provided that installation instructions for this device on all 1983 and older model-year vehicles will not allow tuning the engine to specifications different from those of the original engine/vehicle manufacturers.

Changes made to the design or operating conditions of the device, as exempted by the Air Resources Board, that adversely affect the performance of a vehicle's pollution control system shall invalidate this Executive Order.

Marketing of this device using an identification other than that shown in this Executive Order or marketing of this device for an application other than those listed in this Executive Order shall be prohibited unless prior approval is obtained from the Air Resources Board. Exemption of a kit shall not be construed as an exemption to sell, offer for sale, or advertise any component of a kit as an individual device.

This Executive Order does not constitute any opinion as to the effect that the use of this device may have on any warranty either expressed or implied by the vehicle manufacturer.

THIS EXECUTIVE ORDER DOES NOT CONSTITUTE A CERTIFICATION, ACCREDITATION, APPROVAL, OR ANY OTHER TYPE OF ENDORSEMENT BY THE AIR RESOURCES BOARD OF ANY CLAIMS OF THE APPLICANT CONCERNING ANTI-POLLUTION BENEFITS OR ANY ALLEGED BENEFITS OF THE LINDBERG COMBUSTION CONTROL SYSTEM.

No claim of any kind, such as "Approved by Air Resources Board" may be made with respect to the action taken herein in any advertising or other oral or written communication.

Section 17500 of the Business and Professions Code makes untrue or misleading advertising unlawful, and Section 17534 makes violation punishable as a misdemeanor.

Section 43644 of the Health and Safety Code provides as follows:

> "43644. (a) No person shall install, sell, offer for sale, or advertise, or, except in an application to the state board for certification of a device, represent, any device as a motor vehicle pollution control device for use on any used motor vehicle unless that device has been certified by the state board. No person shall sell, offer for sale, advertise, or represent any motor vehicle pollution control device as a certified device which, in fact, is not a certified device. Any violation of this subdivision is a misdemeanor."

Any apparent violation of the conditions of this Executive Order will be submitted to the Attorney General of California for such action as he deems advisable.

Executed at El Monte, California, this 14th day of October, 1983.

K. D. Drachand, Chief
Mobile Source Division

State of California
AIR RESOURCES BOARD

EVALUATION OF THE LINDBERG INTERNATIONAL CORPORATION'S LINDBERG COMBUSTION CONTROL SYSTEM DEVICE IN COMPLIANCE WITH THE REQUIREMENTS OF SECTION 27156 OF THE CALIFORNIA VEHICLE CODE

September, 1983

Date: September, 1983

EVALUATION OF THE LINDBERG INTERNATIONAL CORPORATION'S LINDBERG COMBUSTION CONTROL SYSTEM DEVICE IN COMPLIANCE WITH THE REQUIREMENTS OF SECTION 27156 OF THE CALIFORNIA VEHICLE CODE

by

Mobile Source Division

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Air Resources Board
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SUMMARY

Lindberg International Corp., Berkeley, California, requested that the Air Resources Board (ARB) update Executive Order D-121 for exemption from the prohibitions in Section 27156 of the California Vehicle Code for their "Lindberg Combustion Control System" (LCSS) device. The applicant has requested that the exemption be granted for the installation of this device on all 1983 and earlier model-year gasoline-fueled vehicles.

A 1983 Chevrolet Chevette (Vehicle No. 1) with a four-cylinder 98 CID, three-speed automatic transmission and a 1983 Ford LTD (Vehicle No. 2) with a V-8, 302 CID, four-speed automatic transmission, both equipped with California certified emission control systems, were used for the evaluation of this device. The vehicles were tested using back-to-back (baseline and with device) CVS-75 and Highway Fuel Economy Test (HFET) procedures.

The test data showed the following:

1. Test results from vehicle No. 1 showed an increase in NOx emissions, and an increase in fuel economy with the use of the device. However, these increases (NOx and fuel economy) were due to the alteration of the original engine manufacturer's tune-up specifications (ignition timing).

2. Vehicle No. 2 test results indicate no adverse effect on emissions by the use of the device. The comparative fuel economy test data show that the figures are within laboratory test variability limits, indicating that the device has no effect on fuel economy of the test vehicle.

The installation instructions were strictly followed for both test vehicles, however, the applicant decided not to alter the ignition timing on the No. 2 vehicle. He explained that since the test vehicle is equipped with a computer control system, a 5° timing advance is not necessary.

The staff, therefore, recommends the issuance of ARB Executive Order D-121-1, allowing the installation of the LCCS device on all 1983 and older model-year gasoline-fueled motor vehicles provided that the installation instructions for this device will not allow tuning the engine to specifications different from those of the original engine/vehicle manufacturer.

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EVALUATION OF THE LINDBERG INTERNATIONAL CORPORATION'S LINDBERG COMBUSTION CONTROL SYSTEM DEVICE IN COMPLIANCE WITH THE REQUIREMENTS OF SECTION 27156 OF THE CALIFORNIA VEHICLE CODE

I. INTRODUCTION

Lindberg International Corporation of 1052 Dwight Way, Berkeley, California 94710, submitted an application for exemption from the prohibitions in Section 27156 of the California Vehicle Code for the company's "Lindberg Combustion Control System" (LCCS) device. Vehicle Code Section 27156 prohibits the installation of any device or mechanism which reduces the effectiveness of the required emission control system. This code also authorizes the Air Resources Board (ARB) to exempt a device from this prohibition if it can be demonstrated that the device, upon installation on the engine, will not adversely affect the performance of the existing emissions control system. The applicant has requested that the exemption be granted for the installation of this device on 1983 and older model-year gasoline fueled vehicles.

II. CONCLUSION

The staff evaluated the device and found that the LCCS device will have a significant adverse effect on emissions (high NOx level) from motor vehicles as shown by the test results on vehicle No. 1. The applicant explained that this emission increase was due to the alteration of the original engine manufacturer's (OEM) ignition timing by applying a 5^{o} timing advance on the No. 1 test vehicle. The applicant deferred this timing advance on No. 2 test vehicle. The test results on the second vehicle did not show any emissions effect; the test results did not show any appreciable fuel economy gain either.

III. RECOMMENDATION

Based on test data and the submitted information, the staff recommends that the ARB exempt the LCCS device from the prohibitions in Vehicle Code Section 27156. The staff, therefore, recommends the adoption of ARB Executive Order D-121-1, allowing the installation of LCCS device on all 1983 and older model-year gasoline-fueled motor vehicles provided that the installation instructions for this device will not allow tuning the engine to specifications different from those of the original engine/vehicle manufacturer.

IV. SYSTEM DESCRIPTION AND OPERATION

The LCCS device (Figure 1 of Appendix) is connected to the engine intake manifold through the hose line between the Positive Crankcase Ventilation (PCV) valve and the carburetor. The device consists of: a) water reservoir made of special plastic material, b) a metering valve (magtrol) that controls the amount of water flow under all operating conditions, c) a reactor, which mixes and proportions exhaust gas, water and air in varying forms of steam or hot water droplets, d) a tornado control, which induced turbulent flow and distributes a mixture of air, exhaust gas, fuel, steam and hot water droplets to the cylinders, and e) high temperature resistance hoses, to conduct the fluid to each component of the system, and finally to the intake manifold inlet port on the base of carburetor.

The LCCS device responds to the engine's power requirements providing the metered amount of air, hot exhaust gas, crankcase gas, fuel, water and enhance turbulent flow, depending upon the engine operating conditions at all times.

This response is activated by the engine's changing needs at varying dynamic operating and power conditions, causing changes of water pressure at the reservoir aft-located water outlet, increasing pressure during acceleration and decreasing pressure in deceleration as applied to the magtrol inlet and supported by a water section created by exhaust gas flowing through the reactor and applied to the magtrol outlet.

During low temperatures such as cold soak and cold starting conditions, the magtrol body, having a greater coefficient of expansion than the 440 stainless steel ball shrinks, locking the ball and closes off all water flow until the engine warms the magtrol body to open the valve. As soon as enough heat is conducted to the magtrol and the other components of the system, fluidic conditions arise to counteract the force of the magnet thus moving the ball away from the magnet and the ball seat allowing a metered amount of water to enter the reactor.

The reactor is the heart of this system. This is where the water, air and exhaust gas is properly mixed. The metered water is converted into steam during low to part-throttle, and to warm water droplets at full-throttle, by the heat from the exhaust gas and the induction of hot fresh air into the reactor. Under high manifold vacuum conditions, such as part throttle (deceleration)mode, more hot fresh air and less water is induced into the reactor. This mixture combined with a predetermined amount of exhaust gas to produce "high quality" steam. Under low manifold vacuum conditions, such as full-throttle (acceleration) mode, larger amount of water is directed into the reactor due to the increased aspiration effect induced by the entering exhaust gas at a higher velocity. The resulting mixture produces a steam of "lower quality".

The mixture from the reactor is then conveyed to a high velocity tornado-like mixer called the tornado control which is plumbed into the PCV line very close to the manifold below the carburetor. This high-velocity mixture is introduced into the manifold under the butterfly valve. It then combines with the fuel charge and enters directly into the cylinders through the intake manifold. The vaporization process of the wet steam contained in the mixture tends to cool down the fuel charge temperature this in turn may result in lower cylinder (combustion) temperature thus minimizing the pre-ignition tendency and the formation of NOx emissions.

The water reservoir acts as a heat storage device and due to its location keeps the intake manifold warm for a long time after shutting off the engine. This condition enhances the engine start up in cold weather.

V. EMISSION AND FUEL ECONOMY TEST

The test vehicles were procured and driven by the applicant to the Haagen-Smit Laboratory. Upon arrival of the test vehicle, it was inspected to assure that it is in good operating condition for emission testing.

The comparative emissions and fuel economy tests (baseline versus with-device tests) were conducted in accordance with the cold-start CVS-75 and Highway Fuel Economy Test (HFET) procedures. The baseline test was run with vehicle engine set to vehicle manufacturer's specifications. The with-device test was run with the device installed and adjusted according to the device manufacturer's written instructions.

VI. TEST RESULTS

The Air Resources Board first subjected this device to CVS-75 and HFET procedures using a 1983 Chevrolet Chevette (No. 1) with a four-cylinder, 98 CID,three-speed automatic transmission, feed-back carburetor, closed loop, exhaust gas recirculation, and equipped with a three-way catalytic converter. The test results are shown as follows:

Cold-Start CVS-75 Test

Test Condition	Exhaust Emissions, gm/mi HC	CO	NOx	Fuel Economy MPG
Baseline	0.15	2.79	0.39	23.16
Device Test	0.13	1.34	0.56	26.60

Hot-Start HFET Test

Test Condition	Exhaust Emissions, gm/mi HC	CO	NOx	Fuel Economy MPG
Baseline	0.01	0.79	0.14	29.2
Device Test	0.13	0.04	0.25	34.6

A second test vehicle, a 1983 Ford LTD (No.2), with a V-8, 302 CID engine, four-speed automatic transmission, feed-back carburetor, closed loop, exhaust gas recirculation, and equipped with a three-way catalytic converter. The test results are shown below:

Cold-Start HFET Test

Test Condition	Exhaust Emissions, gm/mi HC	CO	NOx	Fuel Economy MPG
Baseline	0.33	4.95	0.58	16.20
Device Test	0.39	4.83	0.44	15.40

Hot-Start HFET Test

Test Condition	Exhaust Emissions, gm/mi HC	CO	NOx	Fuel Economy MPG
Baseline	0.17	4.10	0.30	25.20
Device Test	0.08	2.50	0.33	25.30

VIII. DISCUSSION OF TEST RESULTS

The applicant submitted several customer testimonials, Olson Engineering Inc., test report, and the Lindberg International Corporation test report on a 1983 Ford Ranger.

The ARB did not accept any of the above document for the following reasons: customer testimonials are considered to be very subjective, and uncontrollable test variables are always present along the test routes. Olson Engineering, Inc., test data and report, although dated January 19, 1981, were done and obtained on a 1965 Dodge Dart, 225 CID, automatic transmission; this is not acceptable for the model-year coverage Lindberg is seeking for exemption coverage. Even though the applicant submitted test data on a 1983 Ford Ranger, 2.3 liter engine, the ARB did not accept

them because they were not derived from the CVS-75 test procedures. The ARB will only accept the CVS-75 test results as the official emission test from the properly selected test vehicles, and Highway Fuel Economy Test (HFET) results for fuel economy evaluation.

Two 1983 test vehicles were selected and each of them was given an emissions and fuel economy comparative tests.

The test results from the test vehicle No. 1, a 1983 Chevrolet Chevette, showed an increase in NOx emissions, and an increase in fuel economy with the use of the device. However, these increases (NOx and fuel economy), were found to be due to the alteration of the OEM tune-up specifications (a 5° timing advance).

The results from the test vehicle No. 2, a 1983 Ford LTD, tested without alteration to the OEM timing, indicates no adverse effect on emissions by the use of the device. The comparative fuel economy test data show that the figures are within the variability limits of laboratory test, indicating that the device has no effect on fuel economy of the test vehicle.

APPENDIX

LINDBERG DEVICE

INSTALLATION DIAGRAM

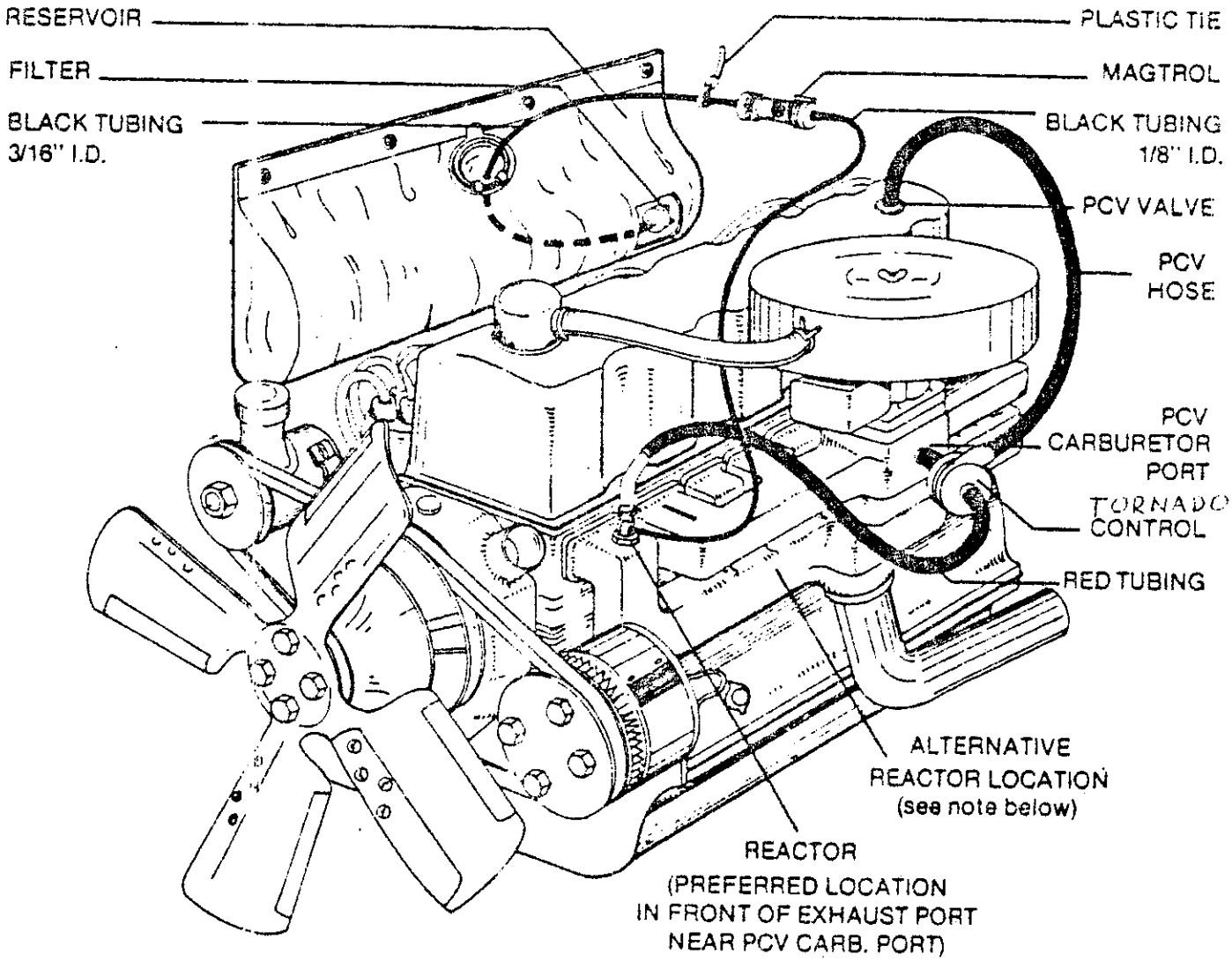

FIGURE 1