

State of California
AIR RESOURCES BOARD

EXECUTIVE ORDER D-106
Relating to Exemptions under Section 27156
of the Vehicle Code

ZEMCO, INC.

Fuel Saver

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 Fuel Saver device manufactured by Zemco, Inc. 12907 Alcosta Blvd. San Ramon, CA 94583 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 1980 and older model-year vehicles except for the following:

1. Diesel powered vehicles.
2. Vehicles which do not utilize electric engine starters.

This Executive Order is valid provided that installation instructions for this device will not recommend tuning the vehicle to specifications different from those submitted by the device manufacturer.

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 FUEL SAVER DEVICE.

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 2nd day of December, 1980.

K. D. Drachand
K. D. Drachand, Chief
Mobile Source Control Division

State of California
AIR RESOURCES BOARD

Staff Report

September 17, 1980

Evaluation of Zemco, Inc. "Fuel Saver" Device

I. Introduction

Zemco, Inc. 12907 Alcosta Blvd, San Ramon, CA. 94583, has submitted an application requesting an exemption from the prohibitions of Section 27156 of the California Vehicle Code for their "Fuel Saver" device. The device is designed for installation on all 1980 and older model-year vehicles except for the following:

1. Diesel powered vehicles
2. Vehicles which do not utilize electric engine starters
(i.e. motorcycles and manual starters).

II. System Description and Operation

The Fuel Saver is an electronically controlled device which automatically stops and restarts the engine. This is accomplished by means of an electronic control unit and various sensors.

The device does not function, by design, for approximately two minutes after initial engine starting. This allows the engine to warm-up. The control unit requires signals from two sensors for its operation. The first signal is received from the vehicle's brake system. When the operator applies the foot brakes, an electrical signal from the brake light switch is routed to the Fuel Saver control unit. A second sensor, which is included in the device kit, detects the speed of the vehicle. This sensor is installed at the vehicle's drive shaft (see Figure 1).

Approximately two seconds after receiving signals from the brake light switch and the movement sensor, the control unit opens the ignition circuit to the coil, thus stopping the engine. In restarting the engine, the operator simply presses the accelerator, which has been fitted with a micro switch. The micro switch signals the control unit to close the ignition relay and to activate the relay for the engine starting system. After the engine is restarted the device will not stop the engine again until the vehicle is moved several feet. This is to prevent multiple restarts.

The control unit is mounted in the passenger compartment (see Figure 2). It incorporates the following features:

1. On-Off switch. This allows the operator to activate or deactivate the unit by simply pressing the corresponding button.
2. A digital display informing the operator of the quantity of fuel saved when the engine is turned off.
3. Five rocker switches on the back of the unit allow it to be matched to various vehicle applications. Switches 1 and 2 determine the number of cylinders and the engine size. Switch 3 determines if the digital display will register in gallons or liters. Switch 4 signals the unit whether or not to automatically disable when the engine is shut off. The applicant considered this a safety feature but it only provides a way for the unit to remember the mode before the engine was shut off. Switch 5 determines how the engine will be restarted, either by the micro switch on the accelerator or by the absence of the signal when the brakes are released. The manufacturer recommends use of the accelerator restarting method. Switch 5 was added for certain manual transmission applications.

III. System Evaluation

The applicant submitted CVS test data prepared by Olson Engineering in Huntington Beach, California to demonstrate that the device does not have an adverse effect on emissions. The test vehicle is described in Table 1 and its emission results are given in Table 2. The percentage change from the baseline emissions are given in parenthesis.

Table 1 Vehicle Description

<u>Make</u>	<u>Model</u>	<u>Year</u>	<u>Engine Size, Trans</u>	<u>Emission Control Systems</u>	<u>Engine Family</u>
Toyota	Supra	1979	T56.4 CID, A/T	Three Way Catalyst, EGR, Elect F.I.	4ME

Table 2 CVS-75 Emission Test Data

<u>Test</u>	<u>Exhaust Emissions in grams/mile</u>			<u>Fuel Economy in MPG</u>
	<u>HC</u>	<u>CO</u>	<u>NOx</u>	
Baseline	0.3	4.7	0.8	16.9
Device	0.2(-33%)	3.0(-36%)	0.7(-13%)	18.2(+8%)
1979 Emission Standard	0.41	9.0	1.5	-

Confirmatory testing of the Fuel Saver device was also performed at the ARB's laboratory. The test vehicle is described in Table 3 and its exhaust emission results are given in Table 4. The percentage change from the average baseline results are given in parenthesis.

Table 3 - Test Vehicle Description

<u>Make</u>	<u>Model</u>	<u>Year</u>	<u>Engine Size, Carbs, Trans</u>	<u>Emission Control Systems</u>
AMC	Ambassador	1974	360 CID, 2V, A/T	EGR, AIR

Table 4 - CVS-75 Emission Test Data

<u>Test</u>	<u>HC</u>	<u>Exhaust Emission in grams/mile CO</u>	<u>NOx</u>	<u>Fuel Economy MPG</u>
Baseline	1.85	20.26	1.94	11.6
Baseline ⁽¹⁾	1.65	19.07	1.89	12.1
Device	1.86(+8%)	23.47(+22%)	1.71(-8%)	12.7(+7%)
Baseline ⁽²⁾	1.65	18.46	1.77	12.1
Avg. Baseline	1.72	19.26	1.86	11.9

(1) and (2), additional baseline tests were performed to demonstrate that the vehicle is suitable and that the emission results are repeatable.

The applicant submitted additional test data prepared by Southern California Automobile Club (SCAC). The vehicle is described in Table 5 and its exhaust emission results are given in Table 6. The percentage change from the baseline(s) are given in parenthesis.

Table 5 - Test Vehicle Description

<u>Make</u>	<u>Model</u>	<u>Year</u>	<u>Engine Size Carb, Trans</u>	<u>Emission Control Systems</u>	<u>Odometer Mileage</u>
Ford	LTD	1978	351 CID, 2V, A/T	AIR, EGR OC	+30K

Table 6 - CVS-75 Emission Test Data

<u>Test</u>	Exhaust Emissions in grams/mile			<u>Fuel Economy MPG</u>
	<u>HC</u>	<u>CO</u>	<u>NOx</u>	
Baseline (1)	1.6	50.1	0.89	10.0
Device (1)	1.5(-6%)	39.3(-22%)	0.86(-3%)	10.8(+8%)
Baseline (2)	1.3	8.2	1.47	10.5
Device (2)	0.7(-46)	9.0(+10%)	1.44(-2%)	11.5(+9%)
1978 Ca. Emis. Stds.	0.41	9.0	1.5	

(1) before repairs

(2) after repairs

IV. Discussion

The applicant's submitted data, represented in Table 2, is generally acceptable. All three of the measured emissions were reduced and the fuel economy increased 8% with the device. The staff concluded that since the engine was shut-off during portions of the test cycle, fuel was not consumed and there were no exhaust emissions. It should be noted that this test vehicle uses electronic controlled fuel injection which could be less susceptible to throttle position on restarts. The staff, therefore, requested the applicant to submit a device for confirmatory testing at the ARB's laboratory.

When installing the device on the ARB's test vehicle, considerable problems were encountered. The device had design problems which resulted in failure of several modules. In order to save test time, temporary

modifications to the device were made to test its concept on a vehicle with a carburetor and standard points type ignition system. The emission results are listed in Table 4. The device emission results indicated little change in HC and NOx emissions. Although CO emissions increased 22%, the staff did not consider this type of emission increase significant due to the limits of test variability.

During the ARB's confirmatory testing, the engine stoppage time was determined and is recorded in Table 7. This data revealed that the device stopped the engine 232.6 seconds or 9.4% of the total test time.

The amount of time required to restart the engine was noted during the test cycle. All restarts, except the first one at 130 seconds, required less than one second. The first restart took approximately 3 seconds because the vehicle was not completely warmed-up.

The test for determining fuel economy, the Highway Fuel Economy Test, was not used because it does not have stop and go driving portions.

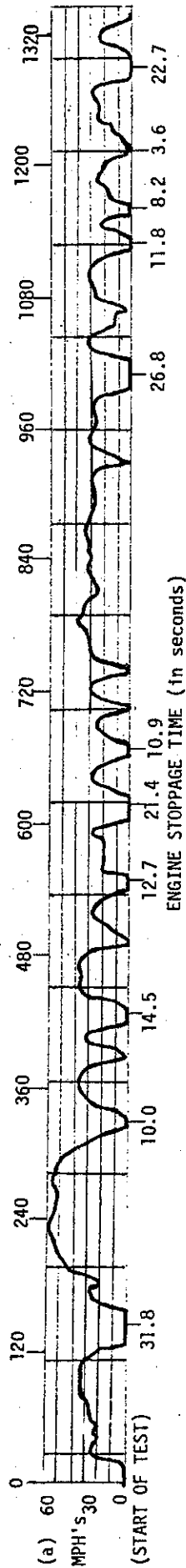
The design problems associated with the device resulted in changes to it. The relays for both the ignition and start solenoids were removed from the module and re-installed in the engine compartment and improved designed wire connectors were used. These changes solved the design problems.

The applicant, to demonstrate that the design changes solved the problems, conducted additional testing on a third vehicle. The emission results are listed in Table 6. The test vehicle demonstrated extremely high CO and HC emissions for the first series of tests (before repairs). A second series of tests (after repairs) was conducted but the HC emissions still exceeded the emission standard. Although the vehicle still showed signs that further repairs were needed the device emission results did demonstrate no significant emission increases when compared to the baseline test.

TABLE 7

Engine Stoppage Time
Zemco Device
CVS-75 Test Cycle*

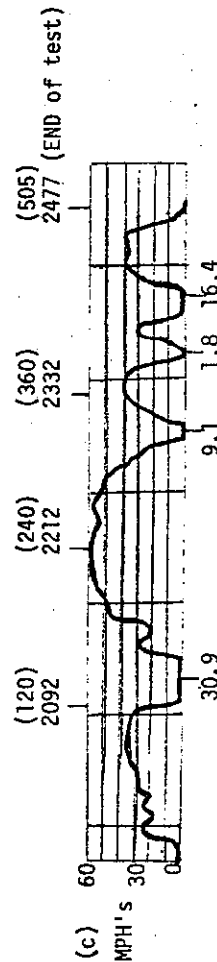
TEST TIME (in Seconds)



(a)
MPH's
0 30 60
(START OF TEST)

(b)
MPH's
0 30 60
10 min. soak (engine off)
(600)
1972

31.8	Accumulated
10.0	Engine
14.5	Stoppage
12.7	Time
21.4	For
10.9	Zemco
26.8	Device
11.8	
8.2	
3.6	
22.7	
30.9	
9.1	
1.8	
+ 16.4	
232.6	seconds = 9.4% of total test time



(c)
MPH's
0 30 60
(END OF TEST)

*The CVS-75 test cycle is 2477 seconds in duration.
The first portion, (a) is 1372 seconds with emission measurements.
The second portion, (b) is 600 seconds without emission measurements
The third portion, (c) is a repeat of the first 505 seconds of (a) with emission measurements

V. Conclusions and Recommendations

The device was tested in three different designs. The concept proved that stopping and restarting the engine would not cause a significant emission increase and that fuel economy would benefit. Even though less fuel would be consumed, the device would cause additional wear on the engine's starting circuit. Individuals have been performing the same task without the use of the device by manually stopping and restarting the engine during stop and go traffic.

Since the use of the device does not have adverse effect on emissions, the staff recommends that the Board grant Zemco, Inc. an exemption from the prohibitions of Section 27156 of the California Vehicle Code for their "Fuel Saver" device.

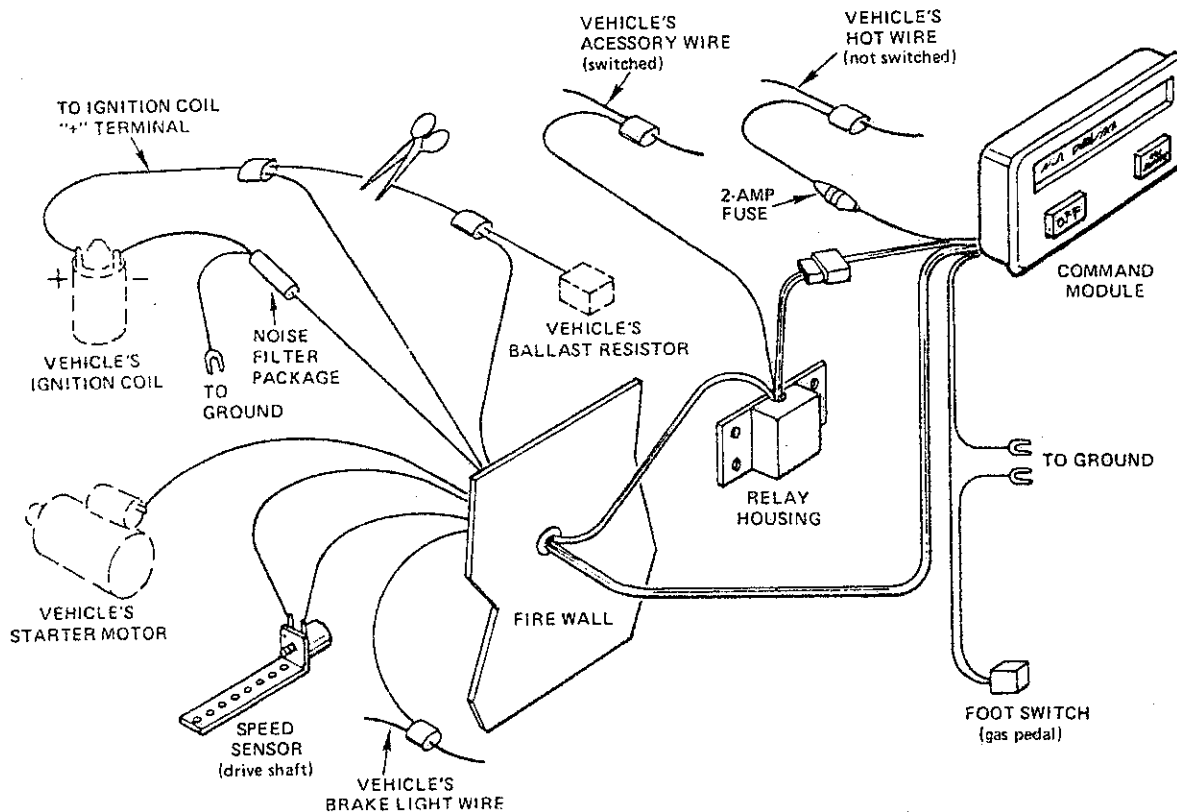


Zemco

FIGURE 1

FUELSAVER

HOW IT WORKS:



SAVES FUEL — United States Government approved Environmental Protection Agency testing shows in city driving you can expect to save 7% of fuel consumed *.

STRETCHES DISTANCE BETWEEN REFUELING — Less trips to service station. Less time waiting for fuel.

DISPLAYS COMPUTER ESTIMATE OF SAVINGS — Actual savings varies according to driving habits and traffic conditions. However FUELSAVER displays estimate of actual savings based on your driving.

EASY TO INSTALL: Clear well diagrammed instructions allow the do it yourself to install in a couple hours.

EVERYTHING IN ONE PACKAGE:

3 pound shippable package includes:

1. Command module with digital display
2. Relay housing
3. Color coded wiring harness with plug in connectors
4. Accelerator switch
5. Speed sensor
6. Mounting hardware
7. Installation and operating manuals with 90 day limited warrantee.

ZET

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FIGURE 2

Zemco **FUELSAVER**

**NUMBER ONE IN AUTOMOTIVE
MICROPROCESSORS**

ZEMCO FUELSAVER —

an automatic engine stop/restart system

The microcomputer detects vehicle movement, brake operation,
to shut down engine operation when not needed . . . **SAVING FUEL.**

By sensing accelerator motion, microcomputer smoothly and
automatically restarts engine. You hardly notice its operation.

For automobiles, vans and light trucks.



*** COPY OF TESTING DETAILS AVAILABLE UPON REQUEST**

HELP REDUCE OUR DEPENDENCY ON OIL IMPORTS WITH FUELSAVER

ZEMCO MANUFACTURES DRIVING COMPUTERS, FUEL SAVING DEVICES, CRUISE CONTROLS, ANTITHEFT DEVICES.