State of California
AIR RESOURCES BOARD

EXECUTIVE ORDER D-70-4
Relating to Exemptions under Section 27156
of the Vehicle Code

MALLORY ELECTRIC COMPANY
"UNIMAG" BREAKERLESS IGNITION SYSTEM
MODEL 540

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 Section 39515 of the Health and Safety Code and Executive Order G-30A;

IT IS ORDERED AND RESOLVED: That the installation of the "Mallory Unimag Breakerless Ignition System Model 540" manufactured by Mallory Electric Company, Division of W. R. Grace & Co., 1801 Oregon Street, Carson City, Nevada 89701 has been found to not 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 1974 and older model year 6 and 8 cylinder vehicles equipped with distributors with a concentric breaker plate except for the following applications:

1. Vehicles originally equipped with transistorized, breakerless, and capacitive discharge ignition systems.
2. Vehicles equipped with dual point distributors where one of the points is used for emission control.
3. 1966-1970 vehicles with NOx retrofit devices with a 4° retard in basic ignition timing (i.e, Carter, Echlin, STP Air Computer, Pure Power-Electro-NOx).

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

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 "MALLORY UNIMAG BREAKERLESS IGNITION SYSTEM MODEL 540" 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.

Executive Order D-70-2 is hereby rescinded.

Executed at Sacramento, California, this 20th day of April, 1978.

Thomas C. Austin
Deputy Executive Officer

State of California
AIR RESOURCES BOARD

April 11, 1978

Staff Report

Evaluation of Mallory Electric Co. "Unimag" Model 540 and 550 for Compliance with the Requirements of Section 27156 of the Vehicle Code

I. Introduction

On June 28, 1977, the Air Resources Board (ARB) received an application from Mallory Electric Co., a division of W. R. Grace & Co., 1801 Oregon Street, Carson City, NV 89701, requesting an exemption from the prohibitions of Vehicle Code Section 27156 for the "Unimag" Breakerless Ignition System Models 540 and 550 The applicant requested that exemption be granted on Model 540 for 1974 and older 6 and 8 cylinder vehicles (except Chrysler) and Model 550 for 1976 and older 4 cylinder vehicles.

The applicant claimed "Unimag" Model 540 and 550 were identical to KV-E300 and E-400 breakerless ignition systems, respectively, which were manufactured by Fairchild Semiconductor. The latter retrofit ignition systems were exempted by the ARB from the prohibitions of Vehicle Code Section 27156 by Executive Orders D-44-2 and D-44-3. The ARB thereupon issued Executive Order D-70-2 and D-70-3, dated August 9, 1977, granting "Unimag" Model 540 and 550, respectively, exemptions based on the claim of identical systems.

Pursuant to Section 2224 (b) of Title 13, of the California Administrative Code, the ARB conducted surveillance tests on the above exempted "Unimag" Model 540 and 550 devices to determine compliance with the requirements of Section 27156 of the Vehicle Code. This staff report discusses the results of these test evaluations.

II. Systems Description

The "Unimag" Model 540 and 550 breakerless ignition systems are designed to replace the breaker points within the distributor. Each kit consists of an amplifier, magnetic pick-up unit, adapter, solderless connectors, feeler gauge and installation instructions. The "Unimag" Model 550 has an additional compensator spring which is slipped over the distributor cam of 4 cylinder distributors. This compensator spring functions as a symmetrical, peaked cam, causing the magnetic sensor to generate the correct wave form, regardless of the original equipment cam profile.

For more detailed descriptions of the two systems, refer to the staff reports "Evaluation of the Fairchild Semiconductor Breakerless Ignition System Model KV-E300", dated October 7, 1975, and "Evaluation of the Fairchild Semiconductor Breakerless System Model E-400", dated April 16, 1976.

III. Systems Evaluation

The Air Resources Board conducted surveillance tests on the "Unimag" Model 540 and Model 550 in accordance with ARB Criteria for Aftermarket Ignition System Modifications adopted November 4, 1977. For tests on the "Unimag" Model 540, the distributors that have non-concentric breaker plates design were selected since any timing change attributable to mechanical modifications would be most pronounced on this type of design. The distributors chosen were (1) 1967 Ford 8 cylinder distributor (2) 1970 Chevrolet 6 cylinder distributor, and (3) 1973 Ford 8 cylinder distributor. Since the "Unimag" Model 550 is limited to 4 cylinder applications, a 1974 Toyota 4 cylinder distributor was selected.

The results of the above tests are summarized in Table I through IV. The ignition test data indicates that the "Unimag" Model 550 meets the ARB criteria for ignition system modifications and "Unimag" Model 540 did not, for the following reasons:

(1) The spark energy decreased by more than 50% on the 1967 Ford 8 cylinder distributor and 25% on the 1970 Chevrolet 6 cylinder distributor at cruise conditions. (ARB criteria allows no more than 20% degradation in spark energy).

(2) Available secondary voltage with load decreased by more than 15% on the 1967 Ford and 1970 Chevrolet distributors (ARB criteria allows no more than ±10% secondary voltage variation from the original equipment).

(3) The ignition timing decreased by a maximum of 8 crankshaft degrees on the 1967 Ford distributor, and 5 crankshaft degrees on the 1970 Chevrolet distributor (ARB criteria allows no more than 4 crankshaft degrees retard).

Mallory Electric Co. was notified of the above results by letter dated December 14, 1977. In response, by letter dated December 23, 1977, the applicant stated that the design of the "Unimag" systems were identical to Fairchild Semiconductor breakerless ignition systems, which the ARB had previously found to meet our ignition system modifications criteria, and therefore, should have the same ignition characteristics. The applicant also raised some questions regarding the test procedures used and the repeatability of the test data.

The ARB staff reviewed the evaluation of the Fairchild Semiconductors ignition systems and found that the company submitted ignition test data that met the ARB ignition modifications criteria on similar distributors as tested above. However, the ARB Laboratory did not conduct confirmatory tests during the evaluation of Fairchild KV-E300 for Section 27156 exemption to verify the data submitted. (The Laboratory may waive confirmatory testing if it finds good correlation of test data with the applicant on previous tests).

To resolve the concerns raised by the applicant, the ARB Laboratory conducted retests of the "Unimag" Model 540 on the same distributors that exhibited degradation of ignition parameters; i.e., 1967 Ford 8 cylinder distributor and 1970 Chevrolet 6 cylinder distributor, using the same ignition bench test procedures. The baseline distributors centrifugal and vacuum advance curves were also verified to be within the OEM calibration.

Table V and VI summarize the test data. No significant degradation of spark energy and available voltage with load were detected. However, on both distributors, the allowable timing retard exceeded the ARB criteria as experienced in the previous tests. The 1967 Ford 8 cylinder distributor showed a combined maximum retard of 13 crankshaft degres and the 1970 Chevrolet distributor, 7 crankshaft degrees retard at typical high cruise conditions.

Conclusions and Recommendations

The ARB Laboratory surveillance tests on the "Unimag" Model 550 showed that the retrofit ignition system would not adversely affect the O.E.M. ignition system performance. However, installation of the "Unimag" Model 540 on distributors equipped with a non-concentric breaker plate would cause significant retard of ignition timing. Excessive retard could cause engine overheating which would adversely affect exhaust emssion control system.

Therefore, the staff recommends that Executive Order D-70-2 granting Mallory Electric Co. exemption for the "Unimag" Model 540 be rescinded and a new Executive Order D-70-4 be issued limiting the "Unimag" Model 540 exemption to 1974 and older 6 and 8 cylinder vehicles equipped with distributors with a concentric breaker plate. In addition, the staff recommends that Mallory Electric Co. be required to take appropriate steps to correct the installation applications of "Unimag" Model 540 already in the market to conform with the new Executive Order.

Table I "Unimag" Model 540 Breakerless Ignition System Data Summary for 1967 Ford 8 Cylinder Distributor, Part No. C7AF12127AD (Initial Test)

A. Centrifugal Spark Advance in Crankshaft Degrees

Engine RPM	Baseline	Device
600	0	0
1600	4	3
2000	6	4
2400	8	6
3200	12	10

B. Vacuum Spark Advance in Crankshaft Degrees

Vacuum in. Hg.	Baseline	Device
3	0	0
6	2	0
9	11	8
15	26	20
20	30	26

C. Spark Duration in Microseconds

Engine RPM	Baseline	Device
600	1200	1300
3000	1100	700

D. Secondary Voltage Rise Time in Microseconds

Engine RPM	Baseline	Device
600	100	50
3000	100	50

E. Spark Energy in Millijoules

Engine RPM	Baseline	Device
600	25.9	30.4
3000	21.4	9.8

F. Available Secondary Voltage in Kilovolts (simulating fouled spark plug)

Engine RPM	Baseline	Device
600	16	12
3000	15	10

G. Available Secondary Voltage in Kilovolts (with load)

Engine RPM	Baseline	Device
600	22	19
3000	19	16

Table II "Unimag" Model 540 Breakerless Ignition System Data Summary for 1970 Chevrolet 6 Cylinder Distributor, Part No. 1110466 (Initial Test)

A. Centrifugal Spark Advance in Crankshaft Degrees

Engine RPM	Baseline	Device
600	0	0
1400	8	7
2000	16	15
2600	20	18
3200	22	20

B. Vacuum Spark Advance in Crankshaft Degrees

Vacuum in. Hg.	Baseline	Device
3	0	0
6	0	0
9	6	6
15	25	22
20	26	24

C. Spark Duration in Microseconds

Engine RPM	Baseline	Device
600	1800	1500
2500	1100	900

D. Secondary Voltage Rise Time in Microseconds

Engine RPM	Baseline	Device
600	150	100
3500	150	100

E. Spark Energy in Millijoules

Engine RPM	Baseline	Device
600	39.8	29.3
3500	21.4	16.2

F. Available Secondary Voltage in Kilovolts (simulating fouled spark plug)

Engine RPM	Baseline	Device
600	18	14
3500	11	11

G. Available Secondary Voltage in Kilovolts (with load)

Engine RPM	Baseline	Device
600	26	22
3500	17	16

Table III "Unimag" Model 540 Breakerless Ignition System Data Summary for 1973 Ford 8 Cylinder Distributor, Part No. D3AZ (Initial Test)

A. Centrifugal Spark Advance in Crankshaft Degrees

Engine RPM	Baseline	Device
600	0	0
1400	2	2
2000	11	10
2600	14	12
3200	17	14

B. Vacuum Spark Advance in Crankshaft Degrees

Vacuum in. Hg.	Baseline	Device
3	0	0
6	0	0
9	8	6
15	18	18
18	22	22

C. Spark Duration in Microseconds

Engine RPM	Baseline	Device
600	1280	1100
3000	1100	850

D. Secondary Voltage Rise Time in Microseconds

Engine RPM	Baseline	Device
600	120	120
3000	120	120

E. Spark Energy in Millijoules

Engine RPM	Baseline	Device
600	24.6	22.9
3000	18.5	19.9

F. Available Secondary Voltage in Kilovolts (simulating fouled spark plug)

Engine RPM	Baseline	Device
600	16	14
3000	13	12

G. Available Secondary Voltage in Kilovolts (with load)

Engine RPM	Baseline	Device
600	22	20
3000	20	18

Table IV "Unimag" Model 550 Breakerless Ignition System Data Summary for 1974 Toyota 4 Cylinder Distributor, Part No. 29100-2942

A. Centrifugal Spark Advance in Crankshaft Degrees

Engine RPM	Baseline	Device
600	0	0
1000	0	0
2000	8	8
3000	16	16
4000	21	21

B. Vacuum Spark Advance in Crankshaft Degrees

Vacuum in. Hg.	Baseline	Device
3	0	0
6	0	0
9	2	2
15	10	10
20	14	14

C. Spark Duration in Microseconds

Engine RPM	Baseline	Device
600	1200	1300
4000	1200	1100

D. Secondary Voltage Rise Time in Microseconds

Engine RPM	Baseline	Device
600	100	100
4000	100	100

E. Spark Energy in Millijoules

Engine RPM	Baseline	Device
600	25.9	29.6
4000	25.9	22.9

F. Available Secondary Voltage in Kilovolts (simulating fouled spark plug)

Engine RPM	Baseline	Device
600	16	16
4000	15	14

G. Available Secondary Voltage in Kilovolts (with load)

Engine RPM	Baseline	Device
600	23	20
4000	22	19

Table V "Unimag Model" 540 Breakerless Ignition System Data Summary for 1970 Chevrolet 6 Cylinder Distributor, Part No. 1110466 (Retest)

A. Centrifugal Spark Advance in Crankshaft Degrees

Engine RPM	Baseline	Device	Retard
1000	3	2	0
1800	14	14	0
3200	22	21	1
3400	24	21	3
3600	26	22	4
4000	26	23	3

B. Vacuum Spark Advance in Crankshaft Degrees

Vacuum in. Hg.	Baseline	Device	Retard
3	0	0	0
6	0	0	0
9	6	6	0
15	25	22	3
20	27	24	3

C. Spark Duration in Microseconds

Engine RPM	Baseline	Device
600	2000	1800
3500	1000	950

D. Secondary Voltage Rise Time in Microseconds

Engine RPM	Baseline	Device
600	90	90
3500	90	90

E. Spark Energy in Millijoules

Engine RPM	Baseline	Device
600	36.0	32.4
3500	15.6	19.4

F. Available Secondary Voltage in Kilovolts (simulating fouled spark plug)

Engine RPM	Baseline	Device
600	17.5	15.5
3500	11.0	14.0

G. Available Secondary Voltage in Kilovolts (with load)

Engine RPM	Baseline	Device
600	25.5	23.5
3500	17.0	21.0

Table VI "Unimag" Model 540 Breakerless Ignition System Data Summary for 1967 Ford 8 Cylinder Distributor, Part No. C7AF1217AD (Retest)

A. Centrifugal Spark Advance in Crankshaft Degrees

Engine RPM	Baseline	Device	Retard
1000	4	2	1
1800	8	5	3
3200	17	12	5
3600	19	14	5
4000	20	18	2

B. Vacuum Spark Advance in Crankshaft Degrees

Vacuum in. Hg.	Baseline	Device	Retard
3	0	0	0
6	4	3	1
9	13	9	4
15	25	17	8
20	25	18	7

C. Spark Duration in Microseconds

Engine RPM	Baseline	Device
600	1600	1800
3000	1000	900

D. Secondary Voltage Rise Time in Microseconds

Engine RPM	Baseline	Device
600	120	120
3000	120	120

E. Spark Energy in Millijoules

Engine RPM	Baseline	Device
600	31.7	35.6
3000	18.2	17.6

F. Available Secondary Voltage in Kilovolts (simulating fouled spark plug)

Engine RPM	Baseline	Device
600	19	16
3000	13	14

G. Available Secondary Voltage in Kilovolts (with load)

Engine RPM	Baseline	Device
600	27.0	21.5
3000	19.5	19.5