

State of California
AIR RESOURCES BOARD

EXECUTIVE ORDER D-40-1
Relating to Exemptions under Section 27156
of the Vehicle Code

AUTOTRONIC CONTROLS CORPORATION
"MSD-2"

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
39023 of the Health and Safety Code;

IT IS ORDERED AND RESOLVED: That the installation of "MSD-2"
electronic capacitive discharge ignition system manufactured
by Autotronic Controls Corporation, 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 1975 and older model-year
vehicles with the standard 12-volt, negative ground Kettering
system with either breaker points or breakerless switching.
The following are specifically excepted:

Any vehicles equipped with an emission control system utilizing
an electronic speed sensor such as the Dana Retronox system or
the Carter CER system.

The device consists of a DC-to-DC converter circuit, a storage
capacitor, an electronic timing circuit, and an electronic switch.

This Executive Order is valid provided that installation instructions
for this device will not recommend tuning the vehicle to specifica-
tions different than those listed by the vehicle manufacturer.

Changes made to the design or operating conditions of the device
as originally submitted to the Air Resources Board for evaluation
that adversely affect the performance of the vehicle's pollution
control devices 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 "MSD-2" 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 unlawful, untrue or misleading advertising and Section 17534 makes violation punishable as a misdemeanor.

Sections 39130 and 39184 of the Health and Safety Code provide as follows:

"39130. No person shall install, sell, offer for sale, or advertise or, except in an application to the board for certification of a device, represent, any device as a motor vehicle pollution control device unless that device has been certified by the 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 section is a misdemeanor."

"39184. (A) No person shall install, sell, offer for sale, or advertise, or, except in an application to the board for accreditation 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 accredited by the board. No person shall sell, offer for sale, advertise, or represent any motor vehicle pollution control device as an accredited device which, in fact, is not an accredited 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-40, dated October 3, 1974, is superceded and of no further force and effect.

Executed at Sacramento, California, this 14 day of January, 1975.

WILLIAM SIMMONS
Executive Officer

State of California
AIR RESOURCES BOARD

January 8, 1975

Staff Report

Evaluation of Autotronic Controls Corporation's
Application for an Exemption from the Prohibitions
of Vehicle Code Section 27156 for the "MSD-2"
Capacitive Discharge Ignition System for Vehicles
Equipped with Breakerless Ignition Systems

I. Introduction

Autotronics Controls Corporation, 6908 Commerce, El Paso, Texas 79915, has requested an exemption from the prohibitions of Vehicle Code Section 27156 for its "MSD-2" capacitive discharge ignition system. They have previously been granted an exemption (E. O. D-40, 10/3/74) for 1974 and older model-year vehicles with a 12-volt, standard Kettering ignition system. Vehicles originally equipped with electronic ignition systems (breakerless, capacitive discharge, or transistorized) or 1966-70 vehicles retrofitted with Dana or Carter speed sensors were specifically excepted. They are now requesting an exemption for their "MSD-2" device for installation on vehicles with breakerless ignition systems.

II. Device Description and Function

The "MSD-2" is a capacitive discharge type ignition with circuitry that allows repeated firings of spark plug after the initial firing in order to extend the time available for ignition. The

circuit description and function are described in detail in the Staff report of September 27, 1974, "Evaluation of Autotronic Controls Corporation's Application for an Exemption from the Prohibitions of Vehicle Code Section 27156 for the "MSD-2" Capacitive Discharge Ignition System".

III. Device Evaluation

The applicant did not submit any emission test data showing the effects of the device on the OEM emission control system. In order to evaluate the device, the electrical output characteristics of a Chrysler and a Ford breakerless ignition system with and without the "MSD-2" device installed were compared. The tests were conducted on the Air Resources Board's ignition system simulator which consists of a Sun distributor tester, Tektronix oscilloscope, Sun ignition analyzer, and associated auxiliaries. The ARB evaluation consisted of measuring the spark advance, spark duration, available secondary voltage, and secondary voltage rise time.

The results of this test showed that the installation of the "MSD-2" device significantly changed the output characteristics of the OEM ignition system. Centrifugal spark advance timing was increased one to three degrees from OEM and both the spark duration and available secondary voltage were significantly reduced. These reductions would greatly increase the chance of misfire under conditions of high speed and high load. Ignition misfire would cause significant increases in hydrocarbon emissions.

In order to evaluate the effect of these changes on a vehicle's emissions, a series of 3 hot-start CVS-1 and 55-mph steady-state, road load tests were run with the device installed and in the baseline condition. Emissions of hydrocarbons (HC), carbon monoxide (CO), oxides of nitrogen (NOx), carbon dioxide, and calculated fuel economy in miles per gallon (MPG) were recorded for all tests as well as repeating the tests of spark advance, spark duration, secondary voltage rise time, and available secondary voltage on the vehicle. The results from these tests are shown in Table II.

A 1974 Ford LTD, 400 CID, 2-bbl. carburetor, automatic transmission, with air injection and exhaust gas recirculation emission controls was provided by the applicant, with the staff's concurrence, to determine the device's effect on a vehicle.

Table II

Centrifugal Spark Advance in Crankshaft Degrees from TDC

<u>RPM</u>	<u>Baseline</u>	<u>Device</u>
750	12	12
1000	13	13
1500	18.5	18
2000	22	22
2500	25	25
3000	29	28

Spark Duration in Microseconds

<u>RPM</u>	<u>Baseline</u>	<u>Device</u>	<u>Number of Pulses</u>
750	1700	1200	6
1200	1400	800	4
2000	1300	400	2
3000	1100	400	2

Secondary Voltage Rise Time in Microseconds

<u>RPM</u>	<u>Baseline</u>	<u>Device</u>
2000	40	8

Available Secondary Voltage in Kilovolts @ 55-MPH Road Load Cruise

<u>Baseline</u>	<u>Device</u>
27	27

CVS-1 Hot Start Emissions (gm/mi)

<u>Test Condition</u>	<u>HC</u>	<u>CO</u>	<u>NOx</u>	<u>Fuel Economy (MPG)</u>
Average Baseline 3-tests	1.217	25.596	1.671	11.203
Average Device 3-tests	1.124	27.463	1.694	10.792
<u>Percent Change from Baseline</u>	-7.6%	7.3%	+1.4%	-3.7%

Data from the 55-MPH steady-state emissions test was inconclusive due to excessive variability of the emissions. The results of the Hot Start CVS-1 were statistically analyzed and no difference between the baseline and the device results were found at the 80% confidence level or higher. Thus, the data shows no significant increases in emissions.

The applicant included installation instructions (Exhibit I) for the "MSD-2" device on vehicles originally equipped with Delco's HEI Electronic Unitized Ignition System; the other systems' installation is identical to that of the standard Kettering system. By following the applicant's revised instructions for installation of the "MSD-2" device on the Delco HEI system

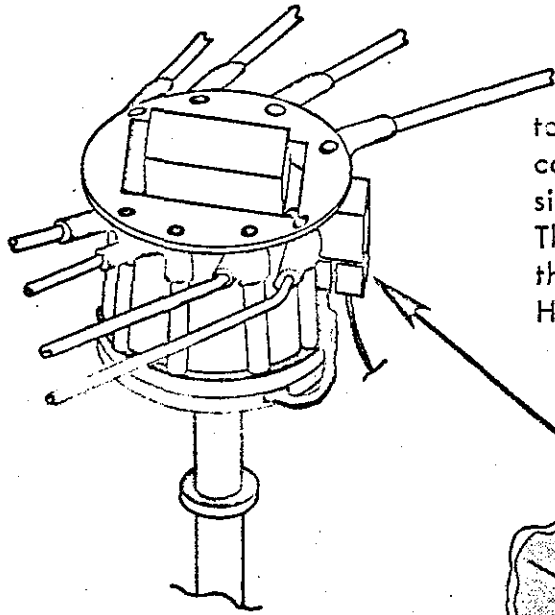
the OEM system's connecting plugs are no longer directly connected to each other. Instead, they are connected by a "jumper" connection between the common coil frame ground connection. This installation leaves the HEI plugs dangling and no longer constrained. This installation does not maintain the sealed interconnection of the OEM system. The coil frame, however, is grounded by the "jumper" and the staff has no knowledge of adverse emission effects caused by the failure of this ground.

IV. Conclusions and Recommendations

It is the opinion of the staff that the "MSD-2" device does not reduce the effectiveness of required emission control systems.

Therefore, it is recommended that Autotronic Controls Corporation be granted an exemption from the prohibitions of Vehicle Code Section 27156 for its "MSD-2" capacitive discharge ignition device to be used with 1975 and older model-year vehicles equipped with a 12-volt, standard Kettering ignition system but utilizing some electronic system to replace the breaker points.

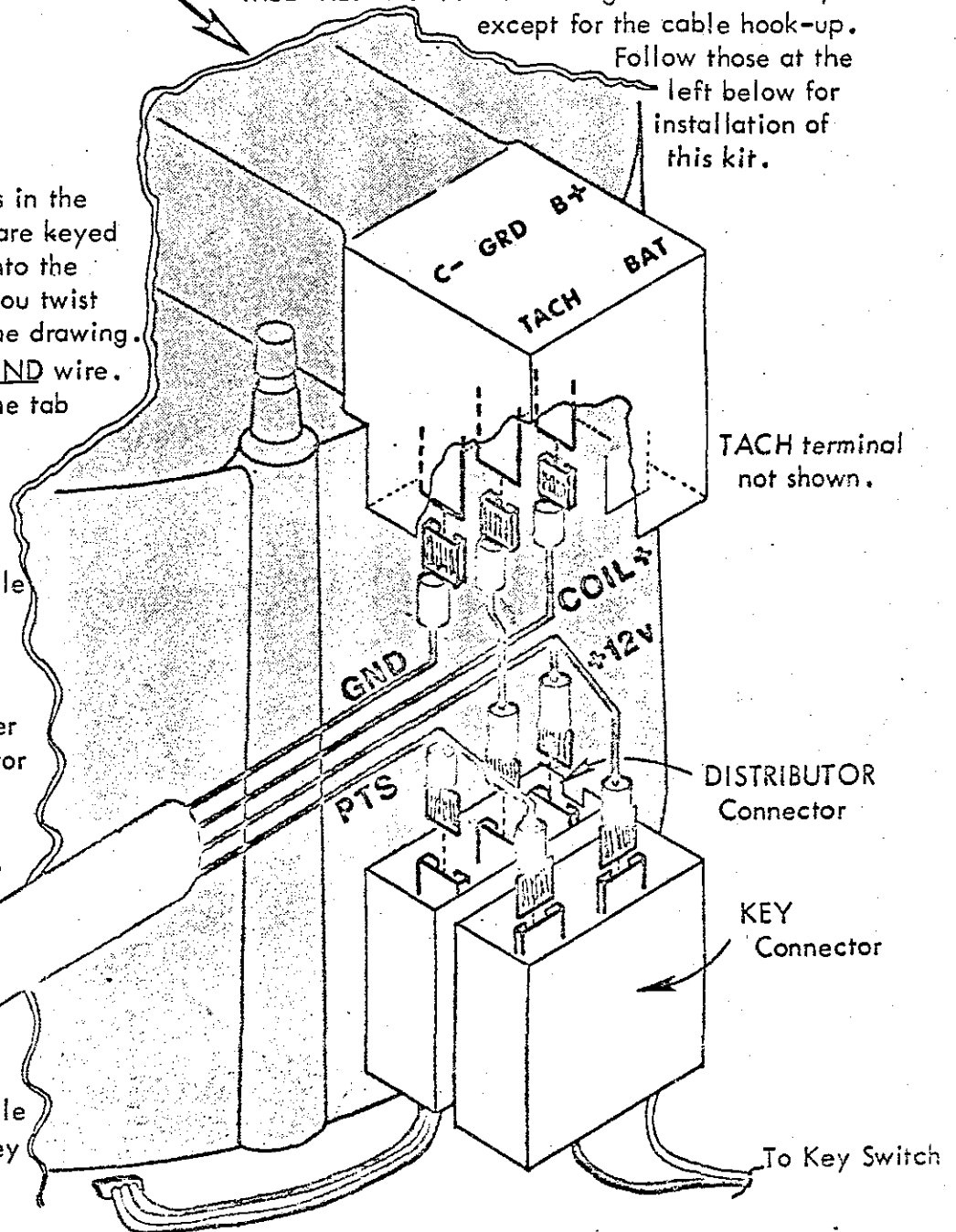
Installation of the MSD-2 on GM cars using the HEI unitized electronic ignition.



The new General Motors HEI ignition system is totally contained in the distributor housing. All of the connections are made with a pair of connectors on the side of the distributor as shown in the sketch at the left. They make installation of the MSD-2 very easy. Adding the MULTI-FIRING of the MSD-2 to the breakerless HEI really makes good sense.

This installation requires the special MSD-2 cable and a short jumper wire as supplied in the MSD-HEI kit. Follow the regular instructions, except for the cable hook-up. Follow those at the left below for installation of this kit.

1. Separate the connectors as in the detail on the right. They are keyed so you can't insert them into the distributor wrong, but if you twist them, they won't match the drawing.
2. Start by connecting the GND wire. Its receptacle slips onto the tab marked C-.
3. Next install the COIL + wire. Its receptacle slips onto the tab marked B+.
4. Now, attach the receptacle end of the jumper wire to the tab marked GRD.
5. Insert the tab end of the jumper wire into the center receptacle of the distributor connector.
6. Notice that the +12v wire has two tabs. Insert a tab into the right side receptacle of both the distributor and key connectors.
7. The PTS wire also has two tabs. Insert a tab into the left side receptacle both the distributor and key connectors.



State of California
AIR RESOURCES BOARD

September 27, 1974

Staff Report

Evaluation of Autotronic Controls
Corporation's Application for an
Exemption from the Prohibitions of Vehicle Code
Section 27156 for the "MSD-2" Capacitive Discharge
Ignition System

I. Introduction

Autotronic Controls Corporation, El Paso, Texas, has requested a finding relative to the requirements of Vehicle Code Section 27156 for its "MSD-2" capacitive discharge ignition system. Autotronic Controls Corporation intends to market this device for use with 1974 and older model-year vehicles with 12 volt negative ground.

"The Air Resources Board Criteria for Determining Compliance with Section 27156 of the Vehicle Code" was used to evaluate the device.

II. Device Description and Function

The "MSD-2" device is a capacitive discharge ignition system connected to the OEM coil and distributor. The device consists of a DC-to-DC converter circuit, a storage capacitor, an electronic switch and an electronic timing circuit. See

"MSD-2"

Appendix A for the circuit diagram. The installation instructions and engine setting revisions are in Appendix B.

In operation, the converter circuit is in series with the battery and ignition switch. The battery voltage, 12 volts DC, is converted by this circuit to 350 volts DC and stored in a tank capacitor. The 350 volts are available on demand for exciting the coil of the OEM ignition system.

When the points open, the electronic timing function becomes operative for a definite period of time unless mechanically interrupted by the distributor. During this period of operation, the timing circuit will turn the electronic switch (SCR) on and off at fixed intervals. Each time the SCR is turned on the 350 volts in the storage capacitor are discharged into the primary of the ignition coil with the resultant spark occurring at the spark plug. These voltage discharges or pulses for each engine firing will vary in number with engine speed. More pulses will occur at the lower engine speeds. See Figure 1 for typical spark lines of the OEM and "MSD-2" devices.

The concept of multiple sparks is to extend the spark duration by producing a number of shorter duration sparks. The total time to fire the cylinder is then the sum of the

shorter duration sparks. The advantage claimed for this concept is that if the air/fuel mixture is too lean to fire on the first spark, a richer air/fuel mixture will shortly be swept by the spark plug and be fired by a succeeding spark.

III. Evaluation Tests

A. Applicant Tests

The applicant submitted emission data of tests performed at the Edelbrock Emission Laboratory. Baseline and device tests were performed on a 1973 Chevrolet Nova, 350 CID, automatic transmission. These tests were performed to determine emission trends produced by the device with an unacceptable test procedure followed during the tests. Therefore, the submitted data is considered inconclusive.

B. ARB Laboratory Tests

A 1974 Ambassador, 360 CID, 4-bbl carburetor, AIR emission control system and automatic transmission was selected to determine the device's electronic characteristics and effects on emissions.

The following is a comparison of the baseline and device electronic characteristics:

Centrifugal Spark Advance

<u>Engine Speed RPM</u>	<u>Standard Ignition Crankshaft Degrees</u>	<u>MSD-2 Device Crankshaft Degrees</u>
750 (Idle)	6	6
1000	14	14
1500	18	18
2000	20	20
2500	22	23
3000	26	27

Spark Duration

<u>Engine Speed - RPM</u>	<u>Standard Ignition Microseconds (us)</u>	<u>No. Sparks</u>	<u>MSD-2 Device us/Spark</u>	<u>Tot. us</u>
750 (Idle)	1700	7	643	4500
2000	1400	3	567	1700

Secondary Voltage Rise Time

<u>Engine Speed RPM</u>	<u>Standard Ignition Microseconds</u>	<u>MSD-2 Device Microseconds</u>
750 (Idle)	10	10

Secondary Voltage

<u>Engine Speed RPM</u>	<u>Standard Ignition Volts</u>	<u>MSD-2 Device Volts</u>
750 (Idle)	30,000	32,000
2200	26,000	31,000

The "MSD-2" device exhibited electrical characteristics for spark advance and voltage rise time similar to the OEM ignition system. Typical for capacitive discharge ignition systems, the device also provides greater available voltage at the higher engine speeds in comparison to the OEM system.

The multiple spark feature of the "MSD" device is apparent when comparing the device and OEM spark duration data. The OEM system generates a single spark of a duration dependent upon engine speed and secondary ignition system. The "MSD-2" device produces a series of sparks for each cylinder firing. The duration of each spark is less than the OEM duration while the duration of the sum of the series of sparks is greater than the OEM duration.

The duration of the spark is an important factor in controlling lean misfires. An increase in hydrocarbon emissions will occur with lean misfires. To determine if this effect exists with the "MSD-2" device, 50 mph steady state emission tests were performed on the 1974 American Motors vehicle. The following are the results of these tests:

50 MPH Steady State Test

	<u>Grams/Mile</u>		
	<u>HC</u>	<u>CO</u>	<u>NOx</u>
Baseline	0.91	3.96	2.72
Device	0.93	4.02	2.67
Percent Change	2.2	1.5	-1.8

No significant increases in emissions were noted in these tests.

IV. Conclusions and Recommendations

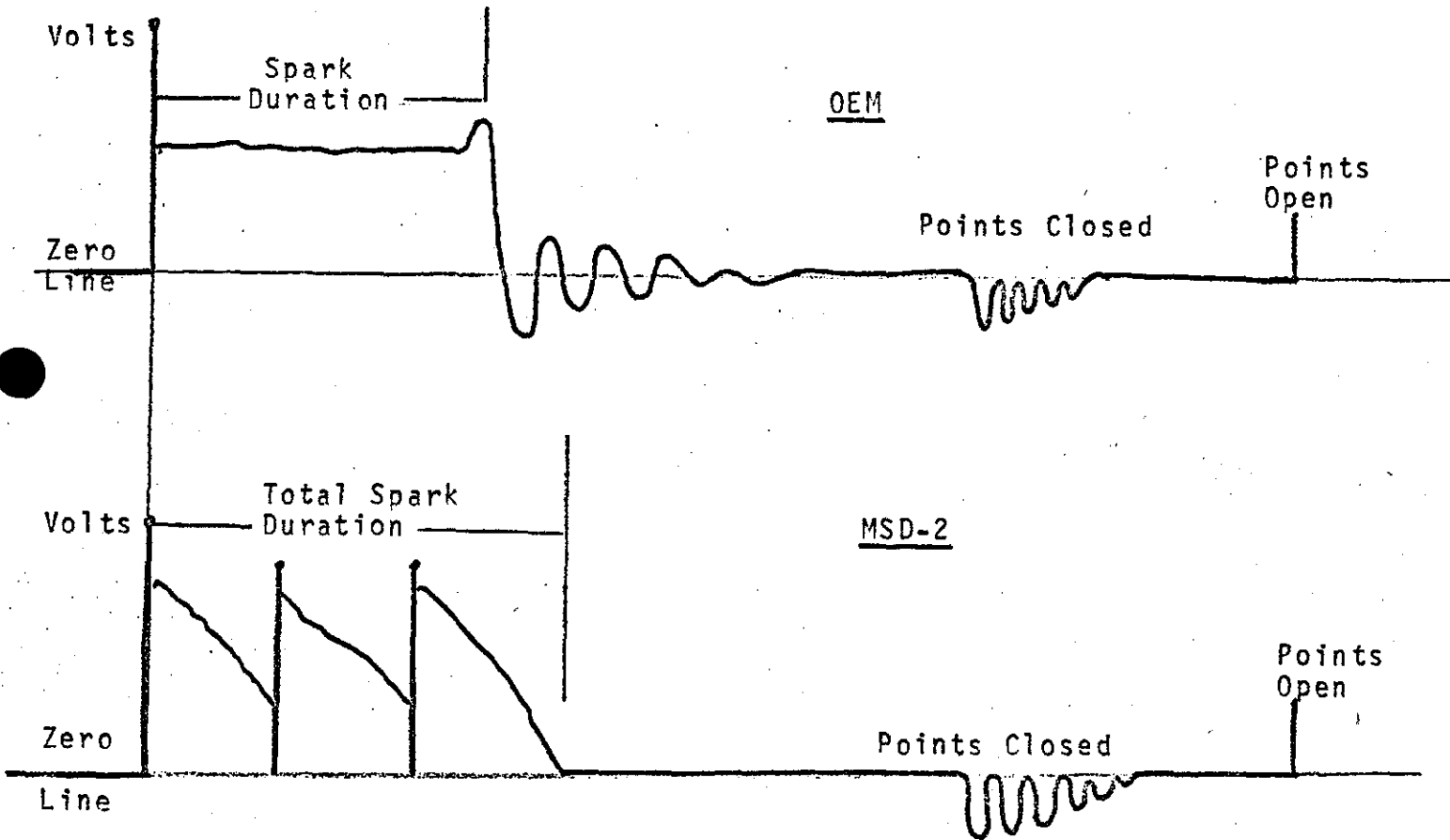
It is the opinion of the staff that the "MSD-2" device does not reduce the effectiveness of required emission control systems.

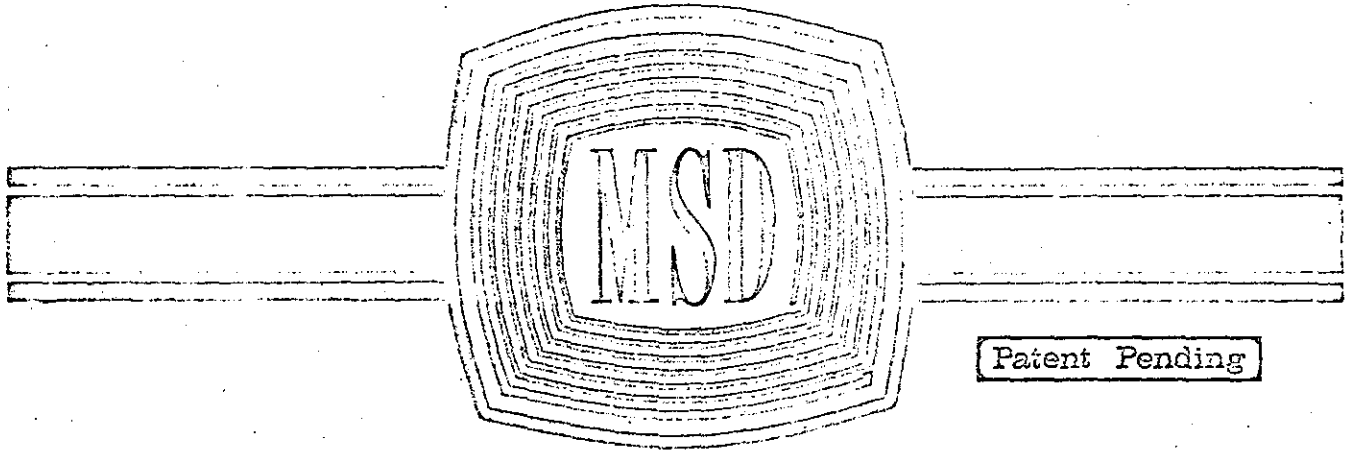
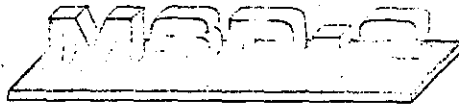
Therefore, it is recommended that Autotronic Controls Corporation be granted an exemption from the prohibitions of Vehicle Code Section 27156 for its "MSD-2" capacitive discharge ignition device to be used with 1974 and older model-year vehicles except the following:

1. All vehicles equipped with an electronic ignition system.
2. All 1966-70 model-year vehicles equipped with a Dana or Carter NOx retrofit device using an electronic speed sensor.

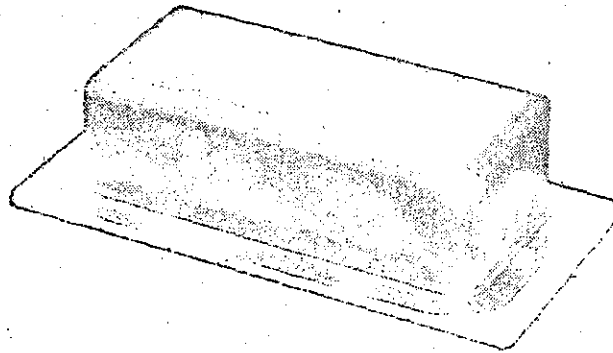
Figure 1

Comparison of Coil Secondary
Output Voltages of a Typical
OEM Ignition System and the "MSD-2" Device





INSTALLATION MANUAL



BY CAREFULLY FOLLOWING THESE BRIEF STEPS, YOU WILL ASSURE A CORRECT, RELIABLE INSTALLATION. SHORT-CUTS WILL PROBABLY COST YOU TIME AND EVEN IF THE ENGINE DOES RUN, YOU MIGHT NOT GET ALL OF THE BENEFITS THAT THE MSD IGNITION SYSTEM CAN PROVIDE. READ COMPLETELY THROUGH THESE INSTRUCTIONS BEFORE YOU START. CHECK EACH CIRCLE AS YOU COMPLETE THAT STEP.

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○ STEP-1 MOUNT THE MSD IGNITION UNIT

Good places are flat surfaces on the firewall, the engine side of the wheel well cover, and beside the radiator. Use the case as a template for locating the holes. Fasten the unit securely with bolts or sheet metal screws. This must be a firm connection because it supplies ground to the circuit. If the unit is mounted on a plastic body part (NOT ADVISED), you MUST add a ground wire of 10 gauge or larger.

DO NOT INSTALL in front of the radiator or near the exhaust system or the radio antenna.

○ STEP-2 LOCATE THE COIL

-----BE CERTAIN THAT THE IGNITION SWITCH IS OFF. It is always a good idea when working on a car's electrical system to disconnect the positive lead of the battery for added safety.

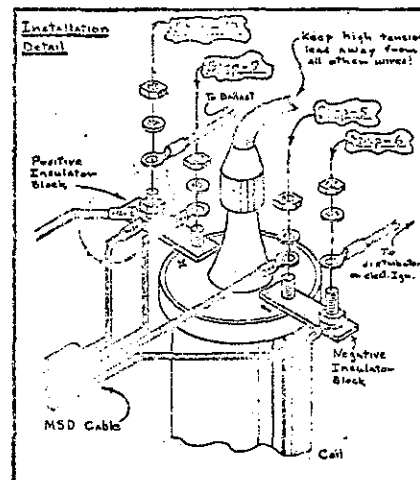
○ STEP-3 DISCONNECT ALL LEADS FROM THE NEGATIVE (-) COIL STUD.

-----NOTE: On some coils the negative stud is marked PTS. and the positive stud is marked BATT.

○ STEP-4 PLACE THE INSULATOR BLOCK WITH THE PTS. (Yellow Sleeve) CABLE TERMINAL ON THE NEGATIVE (-) COIL STUD.

○ STEP-5 PLACE THE WIRE TERMINAL MARKED GND. (White Sleeve) OVER THE NEGATIVE COIL STUD ON TOP OF THE INSULATOR BLOCK. Secure with a nut and lock washer. TIGHTEN.

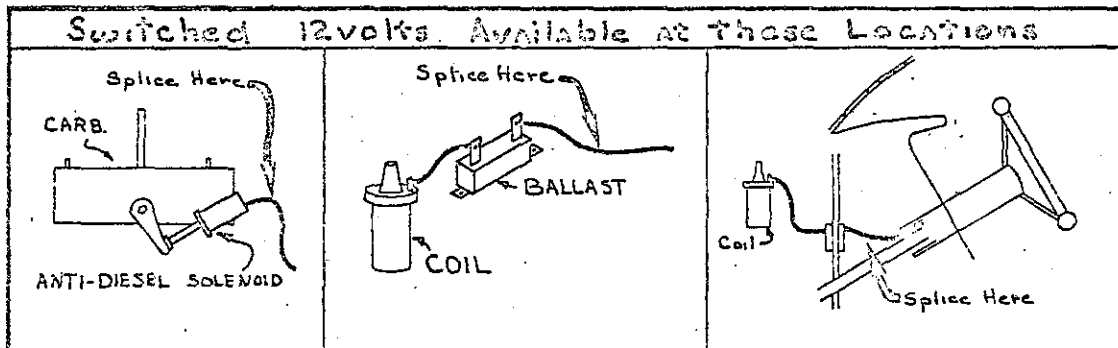
○ STEP-6 PLACE THE WIRE TERMINAL THAT DID GO TO THE NEGATIVE COIL STUD (Make certain that this wire goes to either the distributor (points) or to the stock factory electronic ignition unit.) ON THE SAME BOLT THAT THE PTS. WIRE (Yellow Sleeve) IS ATTACHED TO. Secure with a lock washer and nut. TIGHTEN.



○ STEP-7 REMOVE THE TERMINALS, NUTS, WASHERS, CONDENSER, ETC. FROM THE POSITIVE (+) COIL STUD.

○ STEP-8 PLACE THE INSULATOR BLOCK WITH THE +12v. (Red Sleeve) TERMINAL ON THE POSITIVE COIL STUD.

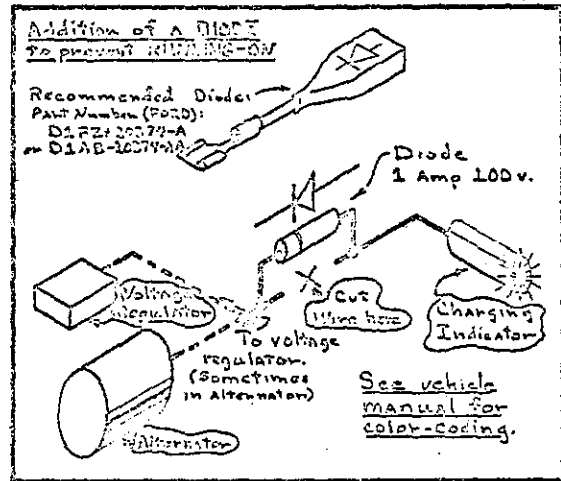
- STEP-9 PLACE THE WIRE TERMINAL MARKED COIL (Blue Sleeve) OVER THE POSITIVE COIL STUD ON TOP OF THE INSULATOR BLOCK. Secure with a lock washer and nut. TIGHTEN.
- STEP-10 PLACE ALL THE WIRE TERMINALS THAT DID GO TO THE POSITIVE COIL STUD ON THE BOLT WITH THE CABLE TERMINAL MARKED +12v. (Red Sleeve). ALSO BE SURE THAT THE TERMINAL ATTACHED TO THE SINGLE WIRE IS ON THIS BOLT. Secure with a lock washer and a nut. TIGHTEN.
- STEP-11 BY-PASS THE BALLAST RESISTOR. --- THE SINGLE WIRE THAT WAS JUST ATTACHED TO THE +12v. BOLT MUST BE CONNECTED TO THE KEY SWITCH SIDE OF THE BALLAST RESISTOR. SOME CARS, NOTABLY GM, DO NOT HAVE A BALLAST RESISTOR, BUT INSTEAD, HAVE A RESISTANCE WIRE FROM THE COIL TO NEAR THE KEY SWITCH. THE SINGLE WIRE MUST BE ATTACHED AT THIS POINT,



OR ON MANY LATER MODEL CARS, IT CAN BE SPLICED TO THE WIRE GOING TO THE ANTI-DIESELING SOLENOID ON THE CARBURETOR. THE RECOMMENDED METHOD OF SPLICING IS THE USE OF AN ETC Co. Vibrakrimp TAP SPLICE OR A 3M Co. Scotchlok. SEE THE SKETCH ON PAGE 4. In an emergency, the wire can be carefully stripped (DO NOT NICK THE WIRE), the end of the single wire wrapped around the first wire, and the connection carefully soldered with ROSIN CORE solder. Carefully wrap the splice with electrical tape.

- STEP-12 RECHECK ALL CONNECTIONS. You must install the system correctly to get the full benefit of MSD and to protect your WARRANTY.
- STEP-13 SPRAY THE COIL AREA (all terminals and top of the coil) WITH A SILICONE IGNITION SPRAY. THIS HELPS TO WATERPROOF THE INSTALLATION.
- STEP-14 START THE ENGINE. Reconnect the battery.

NOTE: On some cars the power that the alternator supplies to the charging light is sufficient to operate the MSD Ignition. This means that the engine will not stop when the key is turned off. (STOP by pulling high tension wire out of coil or shorting PTS. terminal to GND. terminal on coil.) The drawing on the right shows how to install the diode to prevent this. The Ford part shown will work on most cars. YOU must be sure that this is the problem. The engine can also continue to run if you have made a mistake in wiring. Check it again before installing the diode.

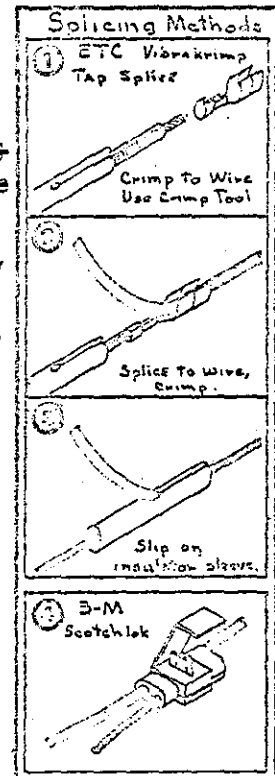


FOR EVEN BETTER OPERATION: The MSD Ignition System is not temperamental, it will give smooth engine operation even under adverse conditions. However, there are some things that you can do to help. All of your plugs, high tension wires, distributor rotor and cap, and points must be in good condition to get the full benefit of the MSD. Clean the top of the coil before you install the system and clean the inside of the distributor cap while inspecting it. Then spray the inside of the cap with silicone spray. ~~The timing setting is especially important. The MSD will work with most of the better timing lights. Start with the factory setting, but anticipate that you can advance the timing several degrees, getting even better mileage. You can also increase the spark plug gap to as much as .055" for better mileage yet. Non-resistor spark plugs, tightly wound solid wires, and sometimes colder plugs will maximize MSD performance.~~

Revised per attached ACC letter dated 9/18/74

ELECTRONIC TACHOMETER OPERATION: Some electronic tach installations may have to be modified for proper operation. Contact factory for information and include self-addressed, stamped envelope. State car model and tach model.

IN CASE OF FAILURE: No matter how thoroughly an electronic instrument is tested, a failure will sometimes occur. Your warranty will help, but you also need to operate your car. To disable the MSD Ignition, simply reverse Steps 11 thru 3 to reconnect the standard ignition system.



AUTOTRONIC CONTROLS CORPORATION
6908 COMMERCE, EL PASO, TEXAS 79915 — (915) 772-7431

September 18, 1974
Ref. No. 5-517

Mr. Joseph Calhoun
Chief of Motor Vehicle Testing
Air Resources Laboratory
9528 Telstar Ave.
El Monte, CA 91731

Dear Mr. Calhoun:

In reference to the Multiple Spark Discharge (MSD) Ignition System, MSD-2 of Autotronic Controls Corporation currently being tested for approval by your agency, I am enclosing a revised copy of the "Installation Manual" together with a copy of the old instructions.

On Page 4 of the manual the hints under "For Even Better Operation" concerning the advancing of the ignition timing beyond the manufacturer's specifications has been deleted. The revised version recommends "factory specified settings" and a caution that in some states it is mandatory.

All future printings of the Installation Manual will contain this revision on ignition timing. Any MSD-2 units shipped into California subsequent to approval by the Air Resources Board will carry the revised ignition timing recommendation.

Please contact our agent, Robert Lockhart, or Jack Priegel or myself if further action or information is required.

Sincerely yours,



J. Frank Casey
Marketing Manager

JFC/pf

cc: Mr. Dick Kinney
✓ Mr. Bob Weis
Air Resources Laboratory
9528 Telstar Avenue
El Monte, CA 91731

Enclosure