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SURE YOU CAN®

Work on Electronic Ignition

A Simplified Guide to Finding and Fixing Problems

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Original Equipment Quality for
Original Equipment Performance

WELLS

Original Equipment Quality Since 1903

Since 1903, Wells Mfg. Corp. has been producing original-equipment quality ignition and engine performance components in Fond du Lac, Wisconsin. We got our start making parts for the original Model T Ford, and as cars and trucks have changed over the years, so have we.

Today, your vehicle has some pretty complicated electronic ignition components on it. We're building those parts in our own electronics plant that's as high-tech as they come. We've got all the state-of-the-art computer-operated robots that the automakers have, and then some. Maybe that's why they buy a fair number of their ignition components from us.

So, whether you need a point set for your '57 Chevy or an electronic ignition module for your brand-new vehicle, you can rest assured that each and every Wells component is an exact match to the original. We guarantee it.

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A Simplified Guide To Finding and Fixing Problems

This guide from Wells Manufacturing Corp. is designed to help you get over the technology shock of working on your late-model car. While new cars have become more sophisticated, there are still a lot of things you CAN do yourself, when you know how. No matter how complex modern computer-controlled electronics become, a few troubleshooting techniques and some basic equipment will allow you to diagnose and repair most common problems.

Since the early eighties, every new car and light truck is equipped with one or more on-board computers. The computers, called Electronic Control Modules, are used for a variety of purposes. Over the years, the operation of the engine ignition system has been turned over to complete computer control, mainly for emission control reasons. All new cars use some form of electronic ignition, but some systems are more comprehensive than others in what they control and how they do it.

The most modern of these computerized electronic ignition systems use a variety of engine sensors to allow the computer to constantly adjust the spark timing under all driving conditions. If one of these sensors fails, it could cause a loss of performance or a drop in fuel mileage. It could also cause more harmful emissions from the tailpipe and could result in catalytic converter damage.

These modern electronic components (with no moving parts) should theoretically last the life of the vehicle, but components do sometimes fail due to the harsh operating environment under the hood. Most automotive electrical systems have built-in aids to help you find the problem. They're designed to be easy to trouble-shoot. In fact, finding a failed electronic component is often easier than finding a fouled spark plug or a bad ignition wire.

⚠ **CAUTION:** All computer-based systems are extremely sensitive to electrical voltages and cannot tolerate careless or haphazard testing or service procedures. Be careful not to connect or disconnect test leads or connectors with the ignition switch ON. Make sure the manufacturer's instructions for the test equipment you use states that the tester will work with the type of electronic ignition you're troubleshooting. Read all operating instructions carefully before making any test connections.

There are only a few diagnostic techniques you need to know when dealing with any computerized automotive control system. Read the basic information before attempting any testing to provide the background of information necessary to avoid the most common and obvious mistakes which can cost you both time and money. Most replacement and testing procedures are simple. A basic understanding of the typical electronic ignition components and their function is all you need.

Although the test procedures in this booklet have been written for domestic GM, Ford, and Chrysler vehicles, many imported vehicles can also be tested using similar procedures. Be sure to consult the service manual for the vehicle on which you are working.

Minor component malfunctions can make a big difference in performance, so it helps to know how each component affects the operation of the overall electronic ignition system. Once you understand how everything works together, it's easier to find the ultimate cause of a problem without replacing good components unnecessarily. A wise old mechanic once said, "It's not enough to use the proper test equipment; you must use the test equipment properly!"

Following is a list of equipment you will need to perform all of the testing and troubleshooting procedures and "Two-Minute Tests" listed in this guide. Although test equipment and manuals cost money, you will find that the price of test equipment required to solve a problem will generally be much less than you would pay to have someone do the work for you. Therefore, the purchase of test equipment for the do-it-yourselfer is most often a good value; and the value continues to increase each time you use the equipment in the future.

- Digital voltmeter, any high-impedance (10 megohm) type—for testing Oxygen Sensors and General Motors and Chrysler Manifold Absolute Pressure (MAP) Sensors.

- Engine tachometer—for testing Ford MAP Sensors and Mass Air Flow (MAF) Sensors.

- Ohmmeter—for testing Ignition Coils, Spark Plug Wires, magnetic-type Pick-up Coils, Ignition Resistors, Temperature Sensors, etc.

  NOTE: Multimeters are also available. This type of tester contains a voltmeter, ohmmeter, and tachometer. Some meters may even have other functions. The multimeter is usually less expensive and more convenient to use than separate pieces of test equipment.

- Pair of jumper wires with alligator clips for testing MAP Sensors.
- Vacuum gauge or hand vacuum pump for testing MAP Sensors.
- Small propane torch for testing Oxygen Sensors.
- Hall Effect Tester kit with the necessary adapters and feeler gauge for testing Hall Effect Sensors.
- Magnetic Sensor (variable reluctance) Tester for testing Knock Sensors and Crankshaft Position Sensors.
- Manifold Absolute Pressure (MAP) Sensor Tester.
- Mass Air Flow (MAF) Sensor Tester.
- "No-start" type Electronic Ignition Module Tester.
- "Indicator light" type Sensor Tester for testing Throttle Position Sensors (TPS) and Idle Speed Control (ISC) Motors.
- Nine-volt battery (the type used in transistor radios) for testing Idle Speed Control (ISC) Motors.
- A service manual that will supply specifications and guidelines for the vehicle on which you are working. This manual contains the electrical wiring diagrams and service information needed for some of the tests. This manual also includes the trouble code charts that are necessary when working on late model computer-controlled vehicles. These types of manuals are available from publishers such as Chilton, Haynes, Mitchell, Motor, etc.

Be sure to check with your auto parts supplier if you are not certain of the type of equipment to buy for the vehicle on which you are working.

Safety Guidelines

TO PREVENT ACCIDENTS THAT COULD RESULT IN SERIOUS INJURY AND/OR DAMAGE TO YOUR VEHICLE OR TEST EQUIPMENT, CAREFULLY FOLLOW THESE SAFETY RULES AND TEST PROCEDURES:

SAFETY EQUIPMENT

- Fire Extinguisher

  Never work on your car without having a suitable extinguisher handy. A 5-lb. or larger CO^2 or dry chemical unit specified for gasoline/chemical/electrical fires is recommended.

- Fireproof Container

  Rags and flammable liquids should be stored only in fireproof, closed metal containers. A gasoline-soaked rag should be allowed to dry thoroughly outdoors before being discarded.

- Safety Goggles

  We recommend wearing safety goggles when working on your car to protect your eyes from battery acid, gasoline, and dust and dirt flying off moving engine parts.

  NOTE: Never look directly into the carburetor throat while the engine is cranking or running, as sudden backfire can cause burns.

LOOSE CLOTHING AND LONG HAIR

Be very careful not to get your hands, hair, or clothes near any moving parts such as fan blades, belts and pulleys, or throttle and transmission linkages. Never wear neckties or loose clothing when working on your car.

JEWELRY

Never wear wrist watches, rings, or other jewelry when working on your car. You'll avoid the possibility of catching on moving parts or causing an electrical short circuit which could shock or burn you.

VENTILATION

The carbon monoxide in exhaust gas is highly toxic. To avoid asphyxiation, always operate your vehicle in a well-ventilated area. If the vehicle is in an enclosed area, exhaust should be routed directly to the outside via leakproof exhaust hose.

SETTING THE BRAKE

Make sure that your car is in **park** or **neutral** and that the **parking brake is firmly set**.

HOT SURFACES

Avoid contact with hot surfaces such as exhaust manifolds and pipes, mufflers (catalytic convertors), the radiator, and hoses. Never remove the radiator cap while the engine is hot, as escaping coolant under pressure may cause serious burns.

SMOKING AND OPEN FLAMES

Never smoke while working on your car. Gasoline vapor is highly flammable, and the gas formed in a charging battery is explosive.

BATTERY

Do not lay tools or equipment on the battery. Accidentally grounding the "HOT" battery terminal can cause shock or burn and may damage the wiring, battery, or your tools and testers. The battery might even explode! Be careful of contact with battery acid. It can burn holes in your clothing and burn your skin or eyes.

When operating any test instrument from an auxiliary battery, connect a jumper wire between the negative terminal of the auxiliary battery and ground on the vehicle under test. When working in a garage or other enclosed area, an auxiliary battery should be located at least 18 inches above the floor to minimize the possibility of igniting gasoline vapors.

HIGH VOLTAGE

High voltage—30,000-50,000 volts—is present in the Ignition Coil, Distributor Cap, ignition wires, and spark plugs. When handling ignition wires while the engine is running, use insulated pliers to avoid shock. While not lethal, a shock may cause you to jerk involuntarily and hurt yourself.

JACK

The jack supplied with the vehicle should be used only for changing wheels. Never crawl under the car or run the engine while your vehicle is on a jack. Be sure to use an approved jack stand or hoist when working under a vehicle.

TOOLS

Don't use loose fitting wrenches or other tools which may slip and cause injury.

Don't push on wrenches when loosening or tightening nuts or bolts. Always try to pull the wrench toward you. If the situation calls for pushing the wrench away, push with an open hand to avoid scraped knuckles if the wrench should slip.

Don't attempt to lift a heavy component alone—get someone to help you.

OTHER

Don't rush or take unsafe shortcuts to finish a job.

Don't allow children or animals in or around the vehicle while you are working on it.

Get someone to check on you periodically when working alone on a vehicle.

Remember that your vehicle's safety affects that of yourself and others. If in doubt on any point, get professional advice.

OWNER'S MANUAL

Consult the vehicle owner's manual and an up-to-date service manual for any additional safety guidelines that you may be required to follow.

Organized Troubleshooting Procedures

It is often said that when working on a 15-20 year old car, it takes 15 minutes to find the problem and 2 hours to fix it. But when working on late model cars, it takes 2 hours to find the problem and only 15 minutes to fix it!

An organized troubleshooting routine is a must to correctly identify the problem. Approach any ignition system problem in a logical, organized manner. Following are some standard trouble-shooting techniques:

1. **Find out exactly when the problem occurs.** Does it appear only under certain conditions? Were there any obvious symptoms, such as a cold or hot engine, wet or dry conditions, high or low RPM, heavy or light engine load, etc.?

2. **Pull diagnostic codes.** Vehicles with self-diagnosing computer systems can provide trouble codes that can be used to locate the system or electrical circuit that has the problem.

3. **Test for problems systematically.** Are all the components functioning properly? Is power going to electrical components? Is there vacuum at the vacuum switches and/or actuators? Doing careful, systematic checks will often turn up most causes on the first inspection without wasting time checking unrelated components.

4. **Isolate the problem area within the ignition system.** Make some simple tests and observations, then eliminate things which are working properly. Check for broken wires, dirty connections, or split or disconnected vacuum hoses. *Always check for the obvious before assuming something complicated is the cause.*

5. **Test all repairs after the work is done to make sure that the problem is fixed.** Some ignition system problems can be traced to more than one component, so a careful verification of repair work is important to pick up additional malfunctions.

Electronic ignition parts can be easily tested using the procedures outlined in this guide. If you are not familiar with the proper use of any of the tools used to do these tests, refer to the COMMON TROUBLESHOOTING TOOLS section in the Appendix of this guide.

Safety Precautions

Computerized control systems, such as modern electronic ignition, require some special precautions to prevent the possibility of personal injury or damage to electronic components during service or test procedures. These include the following:

⚠ **CAUTION:** Make sure the ignition is switched OFF before connecting or disconnecting battery cables, component connectors, or test leads.

⚠ **CAUTION:** Exercise care when inserting test probes into connectors to insure good connections without damaging the connector or spreading the pins. Whenever possible, probe connectors from the rear (wire) side, NOT the pin side, to avoid accidentally shorting terminals together. Straight pins can make handy probes for terminals, but don't pierce any wires in the process.

⚠ **CAUTION:** Don't remove or attach wiring harness connectors with the ignition switch ON. The correct procedure is to turn the switch OFF, disconnect or connect the coupling, then turn the switch back ON if the test calls for it.

⚠ **CAUTION:** Be careful not to drop any components during service procedures and don't apply 12 volts directly to any component (such as a solenoid or relay) unless instructed specifically to do so in the test procedures. Most computerized components have electrical windings which are designed to only safely handle 4 or 5 volts and can be damaged if direct battery voltage is applied to the connector.

⚠ **CAUTION:** Accidents and serious injury could result if basic safety rules and test procedures are not carefully followed.

For a general list of guidelines that should be followed when working on and around automobiles, refer to the SAFETY GUIDELINES section of this guide.

Distributor Caps and Rotors

Distributor Caps and Rotors distribute high-voltage energy from the Ignition Coil to each of the individual spark plugs by way of the Spark Plug Wires. Damaged or worn out Distributor Caps and Rotors can cause hard starting (especially in cold or wet weather), lack of power, rough idle, hesitation, high exhaust emissions, poor fuel economy, and generally poor performance.

Distributor Caps and Rotors can be damaged in several ways. The terminals where electrical arcing occurs may erode over time, and the high-voltage resistance can be significantly reduced by contamination from grease, oil, or dirt.

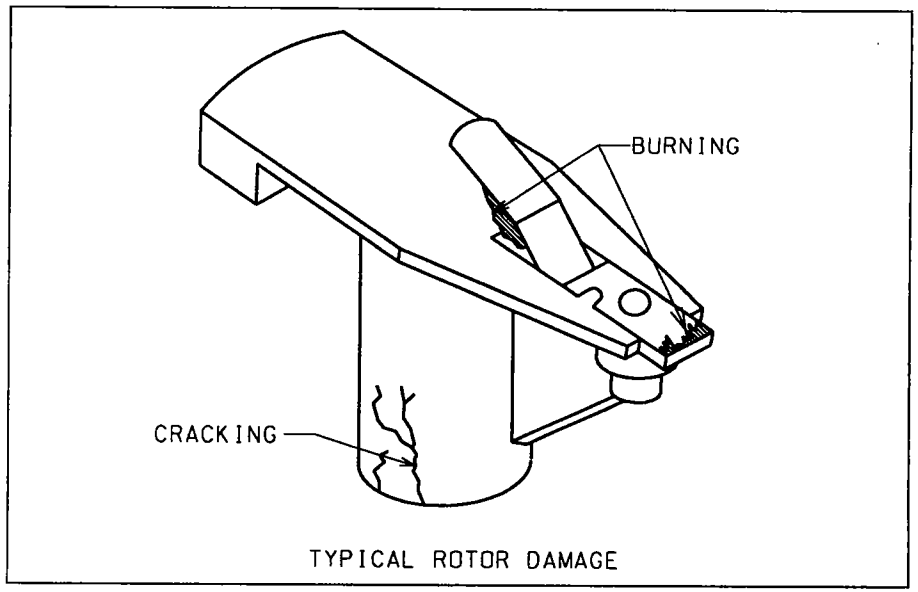

Fig. 1

When high voltage arcs across the surface of a Distributor Cap or Rotor, it burns the material (Fig. 1 and Fig. 2), leaving a powdery black trail called carbon tracking. Replace any component that shows this type of damage. Look for any fine cracks in the Distributor Cap or Rotor (Fig. 1 and Fig. 2). Cracks may allow moisture to enter and may cause a crossfire situation where the voltage arcs uncontrollably around the inside of the Distributor Cap. Again, replace any cracked Distributor Cap. Finally, check the carbon button in the top center of the Distributor Cap. Replace any Distributor Cap with a worn or damaged carbon button.

The same rules for damage apply to the Rotor, with one addition. If the Rotor electrode is burned or pitted, or if carbon tracking is evident, replace the Rotor.