

# Troubleshooting Outboard Motor Magneto Ignitions

## Application Note

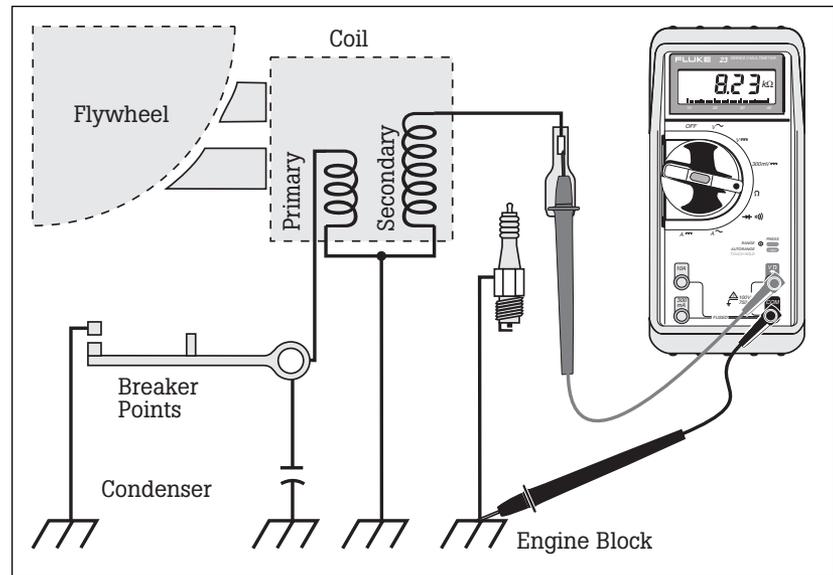
### Introduction

Your outboard motor won't start. Yes, it's been in storage for awhile but it was running well when you left it. Should it go to the repair shop? The shop will do a good job but they're always busy and the repair will probably take two weeks—remember your out of town guests want to go fishing tomorrow.

Isn't it time you learned how to fix it yourself? You suspect the ignition since that's what went bad last time. Will you need the special test equipment called out in the repair manual? NO! This application note will show you, in a few simple steps, how to pinpoint magneto ignition troubles quickly. All you will need is a few mechanics' tools and a good quality digital multimeter.

You can justify the multimeter because it will do double duty for your other electrical troubleshooting tasks, including the battery and charging system, trailer lights, corrosion protection system, and other electrical systems in either your house or boat.

The ignition troubleshooting procedure that follows can be used for any small one or two cylinder gasoline engine that employs a breakerpoint magneto ignition; for example your lawn mower, chainsaw, generator, pressure washer etc.



### Won't start scenario

Now let's get down to cases with the dead engine. In order to start, the engine needs three critical items: a) proper amount of fuel/air mixture, b) properly timed spark and c) some compression. If it won't start, chances are that one or more of these is missing. The troubleshooting logic is straightforward: find out which critical items are missing and why.

Before getting into the actual procedure, verify that the fuel tank has sufficient quantity of fresh fuel mixture and if your engine has an electric starter, use the dc volts function on your multimeter to check the battery voltage and the ohms function to check the cables for loose or corroded connections.

With reference to the ignition system, here is a list of the critical components listed in the order of their likelihood of failing: Spark Plug, Breaker Points, Coil, HV Wire, Condenser and Flywheel Magnet

### Troubleshooting procedure

We will assume you have already tried the normal starting procedure, i.e., turned the engine over a number of times, first with choke closed and then open.

#### Spark plug check

Remove the cowling (if necessary) to gain access to the spark plugs. For a twin cylinder engine, label the spark plug wires so that they can be replaced in the correct order. Pop the wires off and unscrew the spark plug(s). Keep track of which plug came out of each cylinder.

Now, examine each plug carefully. This is like palm reading; the condition of the plug tip can tell a story about what is going on in each cylinder. If the plugs are wet with gasoline, fuel is undoubtedly reaching the cylinders.

If the plugs are dry, the opposite is true. Look for a blockage in the fuel system or a bad fuel pump in a remote tank configuration.

If the plug(s) are fouled with carbon and/or oil, several things could be wrong: The spark to the plug(s) is weak or nonexistent, the spark plug heat range is too cold, or the engine has been run for long periods of time at low speeds possibly with an incorrect fuel or fuel/oil mixture. In the case of multi-cylinder engines, if only one plug shows difficulties, the problem is likely to be a weak spark from the ignition system.

In any event, the next step is to check actual spark plug operation. If new plugs are available, use them for the next test. If not, clean the old ones as follows: using a sharp object such as the point of a safety pin or a straightened fish hook, scrape off the deposits on the insulator that surrounds the center electrode. Dig down between the insulation and sidewall and remove as much carbon as possible. Now, wash out any remaining oil or carbon particles with a nonconductive solvent such as paint thinner or unmixed gasoline. Allow the plug to air dry; blow on it if necessary.

Next, gap each plug by tapping or bending the outer electrode. If you don't know what the recommended gap is, use 0.025" (a bank credit card is typically .030"). Test each plug and HV wire combination by connecting the wire to the plug and laying the plug on the engine block where the gap can be seen. The plug outer body needs to make electrical contact to the engine block as it does when it is screwed in place.

Now, turn the engine over at normal cranking speed and watch for a spark. If you are in bright sun, you may have to shade the plug to see the spark. If this test shows no spark or a weak spark, troubles with the breaker points or coil inside the magneto are likely.

### Coil and HV wire resistance/continuity test for one-cylinder engines

The next test checks for a continuous path for the spark through the HV wire and the ignition coil. Refer to the electrical diagram in Figure 1. Note that for a one cylinder engine there is a direct electrical path from the plug cap through the HV wire,

and coil to the engine block. This can be checked without taking apart the magneto as follows: Set the multimeter into the ohms ( $\Omega$ ) function. Use the range button to manually select the 40 k $\Omega$  range. (Auto ranging may not work here due the inductance of the coil).

Now, touch one probe tip to the engine block and the other to the metal connector inside the plug wire cap. The meter should read the resistance of the coil and HV wire in series. Good readings will range from 3 k $\Omega$  to 15 k $\Omega$ . Higher readings mean a poor connection, which typically occurs either where the HV wire connects to the coil or at the other end where the HV wire connects to the spark plug clip inside the cap. A reading of OL means an open circuit or break in the electrical path. If a bad reading is indicated, double check to make sure you are making a good connection with both test leads.

### Coil and HV wire continuity test for two-cylinder engines

If you are testing a 2-Cylinder, 2-Cycle engine (mixed fuel) then perform the test as above for each cylinder individually. Look for a correlation between a bad reading (OL) and a fouled spark plug on the same cylinder.

If the engine is a 4-Cycle model (unmixed fuel) such as a Honda or Onan, the test is performed slightly differently as shown in Figure 2. Here we will be looking for continuity from one spark plug clip to the other since there is only one secondary coil which is not connected to the engine block. An open spark path will kill the spark to both cylinders.

### HV circuit repairs

A break in the HV circuit can occur in several places as shown in Figure 3.

If the poor connection or open circuit occurs at the spark plug clip, you may be able to repair it without taking anything else apart. If the problem is located inside the magneto, it will probably be necessary to remove the flywheel.

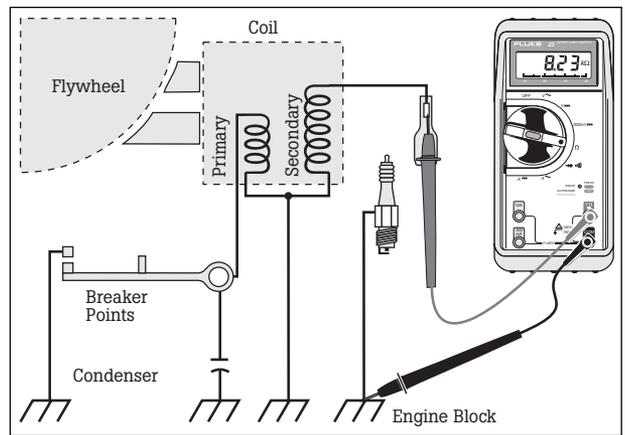


Figure 1: HV wire resistance/continuity test

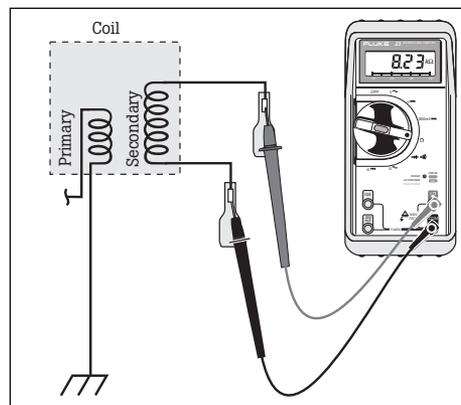


Figure 2: Resistance/continuity test for 2-cylinder, 4-cycle engines

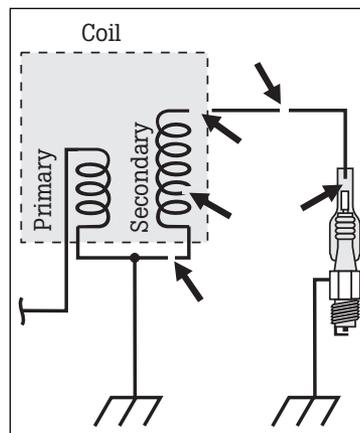
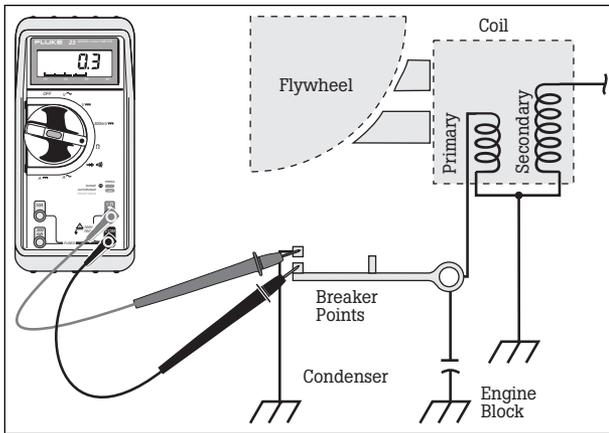


Figure 3: Possible locations of breaks in secondary HV circuit



**Figure 4:** Breaker point contact resistance test

### Breaker point test

The breaker points on a magneto ignition are often located under the flywheel. Remove any parts that might interfere with the flywheel removal. Hold the flywheel in a stationary position with a strap wrench and remove the large nut that holds the flywheel to the crankshaft.

Use a puller to loosen the flywheel and lift it off the crankshaft. Locate the breaker points and examine the contact surfaces. (Caution here: when rotating the crankshaft, turn it in the forward direction only to prevent damage to the water pump impeller).

For proper operation the breaker point contact surfaces should be clean and shining. Make an electrical resistance test with your digital multimeter before attempting to clean the contact surfaces. This will allow a before and after indication. Refer to the diagram in Figure 4. Note that the points are in parallel with the primary coil. When the points are open the resistance across the coil and points in parallel will be about 1.0Ω (the coil's wire resistance). When the points (with clean contacts) are closed the resistance will fall to a value of 0.1 to 0.2Ω. Any oil or corrosion on the point contact surfaces will raise the resistance and reduce the primary coil current, which subsequently weakens or kills the spark.

Measure the contact resistance as follows: place the multimeter in the Ω function and hold the probe tips tightly together to obtain a reference reading with the tips shorted. The reading should show between 0.0 and 0.3 ohms, note the value. This is the reference reading.

Now place the probe tips on opposite sides of the point contacts when the points are in the closed position. The meter should now read no more the 0.1Ω greater than the reference reading. Higher readings indicate contamination on the contact surfaces. If the contact surfaces are pitted, the best choice would be to replace the points. If you can't install new ones, then carefully clean the ones you've got. The object here is to remove all contamination without damaging the underlying metal.

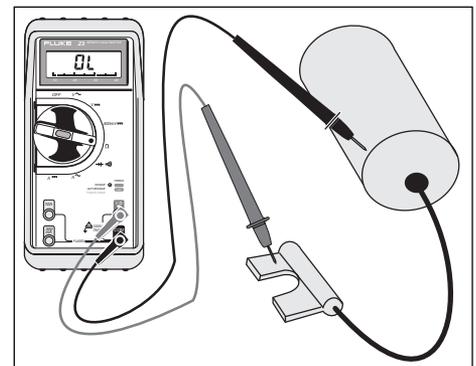
The preferred cleaning method is to scrape the contact surfaces with a sharp carpet-layer's knife, followed by a wiping with solvent on a clean cloth. Filing will sometimes work but there is a risk of damaging the underlying metal which will shorten the life of the contacts. In any event do not use sandpaper. The grit will imbed itself in the contact metal, rendering the points useless.

If you want a quick fix to get the engine running, try the "old-timers point cleaning trick" as follows: With the crank shaft positioned so that the points are closed, pry the breaker arm open and insert a clean business card between the contact surfaces. Release the breaker arm so that the points grip the end of the card and then drag the card through its width, wiping the contacts in the process. The card has two properties which make it work. It is absorbent enough to remove oil and gently abrasive enough to remove surface contamination.

When you think the cleaning is complete, verify the results by repeating the electrical resistance test. Before leaving the points, make a visual inspection of the gap in the open position. A typical specification would be 0.020 inches.

### Condenser test

Next check the condenser as follows: Disconnect the condenser lead, then place the multimeter in the capacitance function and hold one test lead to the capacitor case and the other to the terminal. (See Figure 5).



**Figure 5: Checking condenser leakage**

Check for leaking condensers with the Ohms function. As the condenser charges up, the resistance should increase to infinity. Any other reading indicates that you should replace the condenser.

Do not touch both leads simultaneously with your fingers because the resistance through your body will cause reading errors. A typical range of good readings would be .015  $\mu\text{F}$  to .030  $\mu\text{F}$ . A reading of OL (overload) in the capacitance function means the capacitor is shorted.

A very low capacitance reading probably means the capacitor is open. Capacitors are not normally repairable so a bad reading will likely mean a trip to the parts store.

If your multimeter does not have the capacitance function, use ohms instead. This test is best performed with the capacitor removed from the engine. Start by shorting the capacitor by touching the lead to the case. Now, touch one probe to the lead and one to the case without touching the probe tips or exposed capacitor parts with your

fingers. Watch the meter reading as the capacitor charges up. A reading of OL in the ohms function means the capacitor is not leaking or shorted, i.e., it's probably good.

Now reverse the test leads and repeat the test. The results should be the same.

### Flywheel magnet test

Flywheel magnet failures are rare but sometimes do occur. You can verify the strength of the magnet with a simple test. Locate the inside surface of the flywheel that travels near the pole pieces of the coil. You will find some magnetic material (typically laminated steel) in two places separated by a gap of non-magnetic material (typically aluminum). Lay a hacksaw blade on the laminations near the gap. If the magnet is good it will exhibit a strong pull on the hacksaw blade.

### Reassembly and final check

Once you've checked out and repaired the ignition system, reassemble the engine and repeat the spark plug test. If the spark looks good, install the plug(s) and try again to start the engine. If troubles persist, look to the fuel system. Carburetor cleaning may be required. Remember that most engine manufacturers recommend the addition of fuel stabilizer for long periods of storage.

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#### Put basic tests on automatic

- VCheck™ automatically switches from measuring ohms/continuity to ac or dc volts
- Capacitance, to 10k microfarads
- Continuity capture locates intermittent opens and shorts
- Min/Max recording with relative time stamp



### Fluke 73 Series III

- Touch Hold® captures stable readings
- Auto and manual ranging
- Holster with Flex-Stand™ included
- Volts ac and dc
- Resistance
- Diode test/continuity beeper
- AC/DC current with ranges from 32 mA to 10A



### Fluke 26 Series III

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- Tough, electrical test lead set with silicone insulation and alligator clip
- True-rms ac voltage
- AC/DC current with ranges from 4.0 mA to 10A
- Lo Ohms



### Fluke 27

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- Touch Hold® captures stable readings
- Volts, ohms, amps, continuity, diode test
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### Fluke 36 ClampMeter

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