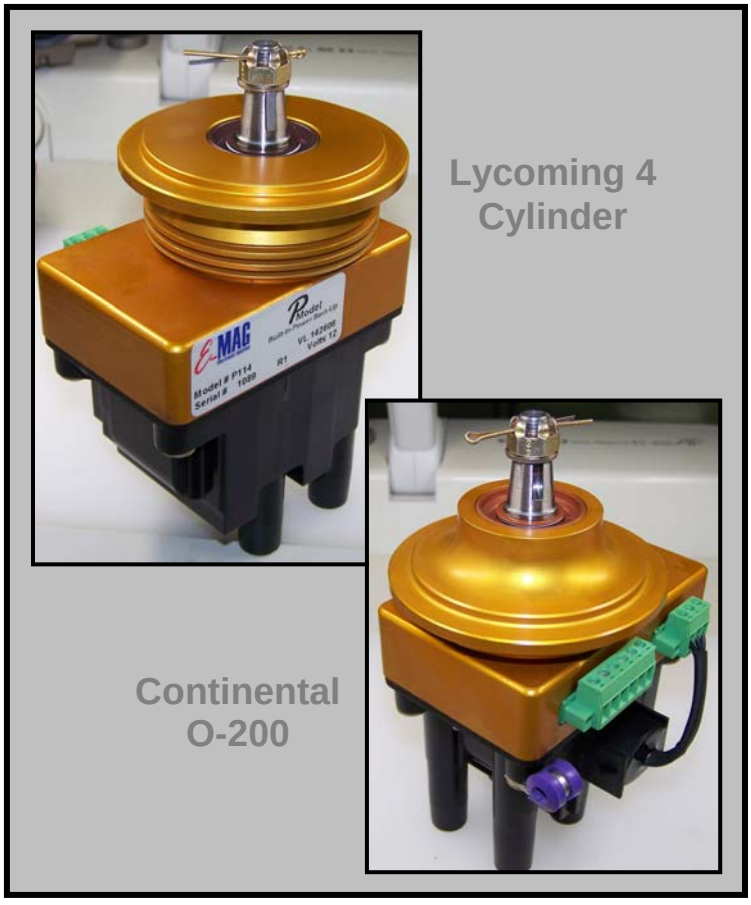
E-MAG Electronic Ignition

Product Documentation



Troubleshooting Tips

LC114.02

Applicable to E-MAG 4 Cylinder Ignitions

(NOTE: Ignition models and firmware sets vary. Not all suggestions are applicable to all models. E-MAG reserves the right to make changes without notice.)

Experimental Aircraft Only

E-Mag ignitions are not (currently) certified and are not approved for installation on certified aircraft.

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Troubleshooting

The following troubleshooting suggestions are predicated on the operator already knowing and using proper safety precautions. Proceed with caution.

Note: Strategies are not listed in any particular order.

Strategies to Verify Overall Ignition Operation

Pull-Thru Test

A good starting point for troubleshooting is the Pull-Thru test. It will confirm a number of operating requirements at once:

- Plug wire assignments.
- Both ignition firing circuits.
- Ignition timing.
- Plug wires and the plugs themselves.
- Drive gear engagement.
- 12 volt and ground connection.
- P-lead wiring and p-lead switch.

1. Remove all the spark plugs from the engine and reconnect them to the plug leads.

2. Rest each plug on the engine case, or any convenient location, making sure the plug is grounded to the engine.

3. Unground the p-lead and then rotate the prop by hand to confirm the plugs fire as follows:

4. The PAIR of plugs:

    - [Lycoming Only] Closest to the prop will fire at TDC.

    - [Continental Only] Furthest from the prop will fire at TDC.

5. The other PAIR of plugs will fire 180 degrees later. Note: Certain firmware versions will cause the second pair (at slow “Pull-Thru” speeds) to spark at positions well before or well after 180 degrees. The firing position will be correct when the engine is turning at normal speeds. Just make sure the second pair fires and use the first pair to verify they fire at TDC.

If you don’t see firing in this pattern, you will have some clues as to where to start looking.

1. Plugs that don’t fire in correct pairs – check for plug leads not connected to proper coil terminals.

2. Individual plugs not firing – check plugs or plug leads (see ohm check below).

3. Plugs don’t fire at TDC – Timing is not set correctly.

4. Plugs don't fire at all

    a. Is the LED lit Red or Green? If so, you are still in set-up mode, so the p-lead is still grounded (check switch or possible short to ground).

    b. Is the LED Yellow? – Indicates sensor magnet is out of alignment – see LED Signals below.

    c. Is the 3 pin (coil) plug attached and are the wires securely connected?

Most Frequent Installation Errors:

1. Plug leads connect to incorrect coil posts.
2. Plug lead assembly damages (nicks) the center conductor core. See Ohm Check below.
3. Getting the control plug terminal numbering system backwards. (Hint – Terminal #1 is the ground wire and is the one closest to the LED and MAP connection).
4. Setting timing with the 25 degree mark on flywheel instead of the TDC mark.
5. Not having a proper ground connection.
6. Impacting the nose (inward) when installing the drive gear (or other handling).
7. Not installing blast tube cooling or not orienting it to the proper area on the ignition.

Most Frequent Operating Errors:

Hard starting or pop/stumble at startup – then smoothes out. May result from starting too rich or over priming. Fuel injected engines in particular are prone to this problem. [Excerpt from E-MAG Operating Manual]

A starting routine for fuel injected engines (suggested by E-MAG customers) is as follows:

1. Master ON.
2. Open throttle ¼"
3. Mixture
    a. Cold Engine:
        i. Mixture full rich.
        ii. Boost pump ON until pressure rises then OFF.
        iii. Return mixture to lean.
    b. Hot Engine:
        i. Leave mixture lean.
        ii. No boost.
4. Crank until first fire (typically 3 to 4 blades).
5. Feed in mixture gradually.

Strategies to Isolate a Symptom

Isolate the ignition - If you suspect unusual ignition behavior:

1. Try switching (p-lead) OFF one ignition and then the other to see if you can associate the symptom with a single ignition. If the condition appears with both ignitions independently, the problem may not be with the ignition at all.

2. Try swapping ignitions left to right to see if the symptom follows the ignition. If the symptom persists in the same way, the issue may be with the plugs, plug wires, fuel supply, or the cylinders themselves.

Isolate accessory hardware

1. Try swapping the harness left to right to see if the symptom follows the harness.

2. Try swapping the plugs (or installing new plugs) to see if the symptom follows the plugs.

Isolate the cylinder

Look for temperature drops between the cylinders. EGT will respond quicker than CHT and may be a better indicator. A cold cylinder (or momentary temperature drops) may indicate the plug is not firing, or is not firing consistently.

Isolate the issue inside/outside the ignition

Background - Wasted spark systems fire plugs in pairs (front pair and then the rear pair). So if you can associate a symptom with a single (1) cylinder (example: one cylinder temp is cold – plug not firing), the cause is not likely to be inside the ignition box itself. It may be in the plug wire, the plug, the cylinder, or fuel to that cylinder – i.e. outside the ignition. The ignition control cannot tell one plug to fire different from its companion plug. Alternatively, if you detect a pattern that affects two paired cylinders simultaneously (1 and 2 or 3 and 4), then the issue is more likely to be inside the ignition control itself. There is one exception to this rule that you can double- check. Make sure that one of the coil wires on the three pin plug located on the side of the ignition is not loose. If it is, it can affect the firing of two paired cylinders.

Isolate by pattern of occurrence

Does the condition appear?

1. All the time?

2. At hot/cold starts?

3. At particular engine speeds?

4. At particular power settings?

5. At high altitude and not at low altitude or vice versa? A nicked spark plug wire may not present a problem initially. Over time, however, it can erode back, and commonly first appears as roughness at higher altitudes - and then smooth out at lower altitudes. See Ohm Check below.

6. Is this a new or long term symptom?

7. Have you made any other changes to your wiring/fuel/controls/baffling near the time the issue first appeared?

Plug Lead – Ohm Check

You can verify that your plug leads are assembled correctly by a simple ohm check. Each lead should produce approximately 180 ohms of resistance per running foot of plug wire.

1. Disconnect the leads from the ignition and the spark plugs.

2. Connect an ohmmeter to the terminals on each end. Check the ohmmeter reading while you alternately exercise each plug ends (twist, bend, tug) to see if the reading jumps significantly (to several times the normal reading). If it does, you likely have a nicked conductor core.

3. To repair a terminal, simply snip off the bad end (assuming you have an inch or so to spare) and replace with a new terminal. Our wire kits ship with two extra terminals in every set, so you should have the hardware on hand. When trimming the insulation for the new end, take care to stay clear of the center core. See instructions in the current manual regarding wire assembly.

Lead Check (for aviation style plugs)

At the aviation plug end, the conductor core is pinched between the spirals of a spring that, in turn, contact with the spark plug. We've seen a couple of examples of this spring (pinch) acting like a wire stripper and pulling the spiral wound conductor core off of its fiber center.

What Can the System Tell You?

LED Signals

1. A YELLOW LED – (series 113 and after) Indicates the position sensor is positioned too close or too far away from the sensor chip. If the nose of the ignition is pressed or bumped sharply (inward) the shaft can move and cause such a misalignment. Proper alignment can be restored by removing the ignition and using two flat blade screw drivers to pry outward against the heel of the drive gear. You might detect (feel or hear) a small outward shift in the position of the shaft. The expected movement is rather small - 0.030" or less.

    a. Up to and including firmware version 26 - A YELLOW LED (solid) will appear in run mode ONLY, and will not intervene with regard to engine timing or operation.

    b. Beginning with Firmware version 27 – A YELLOW LED (flashing) will appear in both setup mode as well as run mode at power-up, and will intervene (prohibit) further operation until proper alignment is restored. If the condition is detected while the engine is running, the LED will light (solid) Yellow but will not prohibit operation.

    c. Firmware versions 25 and before – predates the sensor magnet position alert feature.

2. No LED at power up - Indicates the power or ground is not connected.

3. After setting timing the LED stays green when you move the prop - Indicates the magneto impulse spacer is still in place and the drive gear is not engaging the accessory drive gear.

4. After timing the ignition, the LED turns green at a position other than the flywheel TDC mark. The ignition is not holding timing – call E-MAG.

EICAD Information (version 4) (Series 114 Ignitions)

1. Current ignition (circuit board) temperature.
2. Maximum recorded (circuit board) temperature.
    a. Properly installed blast tube cooling should keep the maximum temperatures in the 175 to 185 degree (F) range. If you see temps above 190, check your cooling tubes and/or your accessory case air flow. Higher temps run the risk of thermal shutdown.
3. Spark Plug Alerts – Series 114 units have components that report the ignition coil discharge rate.
    a. A rapid discharge rate indicates a spark plug or plug lead is fouled (shorted).
    b. A slow discharge rate indicates a spark plug or plug lead is open (broken).

Strategies for Dealing with High Engine Temps:

1. Double check engine timing.
2. Set the ignition for less advance.
    a. Temporarily - Put the control plug jumper IN and remove the MAP tube. This will reduce your max advance to roughly 26 degrees (similar to most magnetos). This is easy to do in the field, and is just as easy to undo if you don't see results.
    b. Use EICAD to:
        i. Move the Advance Shift downward (Note: Advance Shift is ignored when you have the control plug jumper IN).
        ii. Move the Max Advance ceiling down.
3. Improve engine baffling.
4. Improve accessory compartment exit air path. Exit air is just as important as inlet air.
5. Carbureted engines – make sure you have properly sized jets.

Common tach errors:

1. Failure to configure ignition for 5 vs 12 volts
2. Failure to configure ignition for correct pulse per rev.
3. Instruments that are designed to pick up a signal from the magneto p-lead are looking for a much stronger pulse (hundreds of volts) than our tach signal will generate.

Ignition Temperatures / Blast Tube Cooling

Late series 113 ignitions (and after) have a feature that records the maximum temperature seen at the ignition circuit board. The large majority of ignitions we've serviced in our shop have a recorded "Max Temp" in the range of 175 to 185 degrees (F). This is within our recommended limit of 190 (the same limit specified for some, if not all, magnetos). This shop reading will not tell us when the Max Temp was recorded (heat soak after shut-down, early break-in procedures, etc.), so we don't know if the reading reflects the current operating environment. Also please note: Our temperature signal has NOT been calibrated, and serves as a general temperature indicator ONLY.

Ignitions operating at exceptionally high temperatures can experience thermal shut down. Such instances can be aided by the addition of (or improvements to) blast tube cooling, as is required by the current manual. Experience has also shown the mere presence of blast-tubes does not guarantee they are operable and/or effective. So we encourage builders (soon after installation) to verify the ignitions are operating within acceptable temperature limits. E-MAG's built-in temperature signal can be displayed by one or more of the free configuration and control programs that are available on our web site (see our "Downloads" page at www.emagair.com). Other, more accurate, readings can be made with thermal reactive labels or with a thermal probe secured in a manner to measure ignition case temperature.

The most frequent cause of inhibited blast tube cooling (we suspect) relates to exit air restrictions. Blast tube air "blasts" because of the pressure differential across the baffle partition. If accessory side exit-air is restricted, pressure on the back side can rise, and the pressure differential is reduced. We don't claim to be authorities in this area, but we have enough reports from customers who were able to significantly reduce ignition temperatures (as well as oil temperatures and accessory case temps overall) by improving exit-air flow, that we are confident this is, at a minimum, one of the primary causes.