Rev 1.1
March 2011

# EFII Ignition System Installation Instructions
# And
# User Guide for part nos. EIGN-1 and EIGN-2

**Introduction**

This document is intended to serve as a guide for the installation and use of the EFII Electronic Ignition Systems for Lycoming engines.

Installation of this system requires modification to the electrical system and engine components of the aircraft.

The EFII ignition system is a high energy inductive ignition system similar to what can be found on most modern automobiles. The EFII ignition provides several times the spark energy of a typical aircraft ignition and will improve engine efficiency, horsepower output and starting characteristics.

**Description**

The EFII ignition system consists of an Electronic Control Unit (ECU), wiring harness, MAP sensor, ignition coils, Iridium spark plugs, spark plug adapters, spark plug wires and all mechanical adapters required for the Lycoming installation.

The EFII ignition system displaces a number of parts that would otherwise be used on a Lycoming engine. Parts no longer used are the magnetos, aircraft spark plugs and aircraft spark plug wires.

Flying with the EFII ignition system is very easy. If you are using the EIGN-1 single mag replacement system, you can start the engine off the EFII ignition alone and take advantage of a hot spark at top dead center during cranking. Then switch on your remaining mag after starting. If you wish, you can cycle power off on your EFII ignition during your runup to witness your mag operation on it's own.

With the EIGN-2 dual mag replacement system, of course you will be running off the EFII ignition on all plugs at all times. With the dual system, there is no need to do any ignition switching during runup as the EFII system is in control of all spark plugs.

The EFII system has proven to provide additional horsepower for your aircraft. This is due to the greater efficiency of having a high energy ignition and proper spark timing curve. The EFII ignition system can easily jump a 1” spark gap in free air. This is in stark contrast to the tiny anemic spark available from magnetos. As a consequence, we can run a much larger spark gap and burn more of the available fuel with the EFII system, again contributing to better power and efficiency. More complete combustion also helps minimize lead fouling and engine wear.

# Contents

# Limited Warranty and Liability Agreement

Though we at EFII will attempt to be as thorough and helpful as possible in educating customers about the safe installation and use of this system, the ultimate responsibility for proper installation, maintenance, and use of this system can only be provided by the person performing the installation of components and maintenance of the aircraft.

It is the responsibility of the aircraft owner and system installer to ensure that the components provided by EFII are applicable and safe for your application. It is also the responsibility of the aircraft owner and system installer to ensure that this system is operated and maintained in a safe fashion. EFII cannot guarantee any aspect of the installation, maintenance or safe use of this system.

EFII limits warranty solely to the replacement of components provided by us which may have been delivered with a factory defect. We in no way guarantee, warranty or assume any further liability for any other systems, components, aircraft or other property, or personal injury that may result after the installation of this system.

By installing this system, you are accepting the above terms.

# Electrical Supply System

When operating an aircraft that relies upon the continued operation of critical engine electronics such as the EFII system, we strongly recommend using a redundant essential bus power system to guarantee that a good source of +12v is available at all times to power the engine electronics. The simplest way to implement a protected essential bus is to use the Protek Bus Manager product which provides a triple redundant essential bus using two batteries. The Bus Manager also incorporates automatic backup fuel pump monitoring and activation as well as a number of other useful functions. Please read more about the Bus Manager at:
www.protekperformance.com

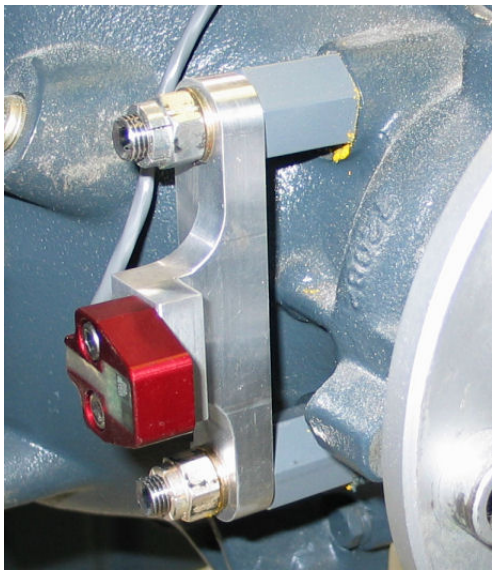
**Grounding the vehicle systems**
**(Refer to DRAWING 1)**
Proper operation of modern vehicle systems demands a good electrical grounding system. The airframe should never be considered to be an electrical path.
The airframe should be grounded at ONLY one point to the vehicle ground system, typically at the firewall. All other vehicle systems should ***not*** rely on a connection to the airframe as a method of completing the ground circuit. All vehicle systems should have ground returns to a ground bus which is in turn connected to the battery ground with an appropriate gauge return wire. The engine needs to have a large gauge ground wire connected to a secure bolt on the engine case or block. Never use a motor mount bolt as a ground cable connection point to the engine. Motor mount bolts experience a great deal of stress and movement and can be the source of a grounding problem if the engine ground is connected to them. The engine ground cable should be the same gauge wire that connects the main +12V power feed to the starter motor.

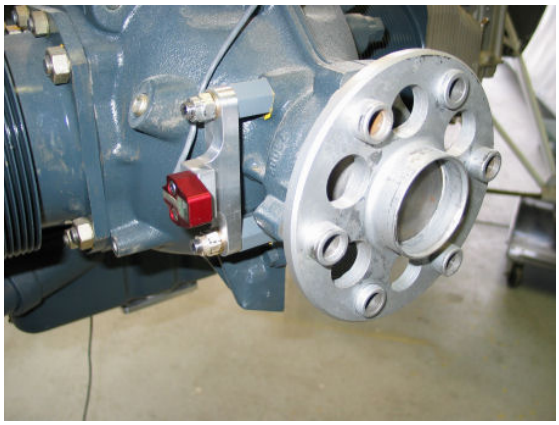
If a ground bolt is used as a main ground pass through on the firewall, this is also a convenient place to tie in the ground bus which all vehicle systems will be grounded to. The ground bus can be electrically connected to the firewall ground bolt with a number 8GA wire.

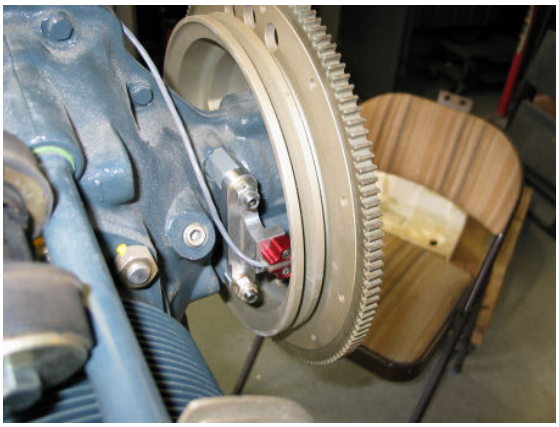
The EFII system will require three +12V circuits and associated circuit breakers. For panel planning purposes, please provide one 10A breaker for ignition power, one 5A breaker for the ECU power, and one 10A breaker for the fuel pump power. If you plan on using a Protek Bus Manager, you may also need panel space for a Fuel Pump Mode Switch, and Start Mode Switch.

# Engine Component Installation
## Crank Trigger

Your EFII kit includes a billet aluminum, Hall effect crank trigger assembly as shown below:







The crank trigger mounts onto the front two engine case bolts that are above and below the crankshaft. Remove the nuts and washers from the right side of these two bolts. Locate the two one inch long threaded hex standoffs in your crank trigger kit. Screw the standoffs onto the case bolt ends and make sure the bolts go no more than ½" into the standoff when assembled. If the bolts are too long, shorten them or add washers as necessary under the bolt head. Using red loctite, install the threaded hex standoffs onto the end of each case bolt. Torque the standoffs to 300 in. lbs.

Locate the two stainless 3/8"-24 x 1 1/2" set screws included with the crank trigger. Ensure that there is approx ½" of available thread depth in the hex standoffs installed in the last step. Install the two set screws into the ends of the threaded standoffs using red loctite and torque them to 200 in. lbs.

Position the crank trigger assembly onto the installed set screws and secure with the included all metal lock nuts (never use Nylock nuts on the engine). Torque the lock nuts to 200 in. lbs.

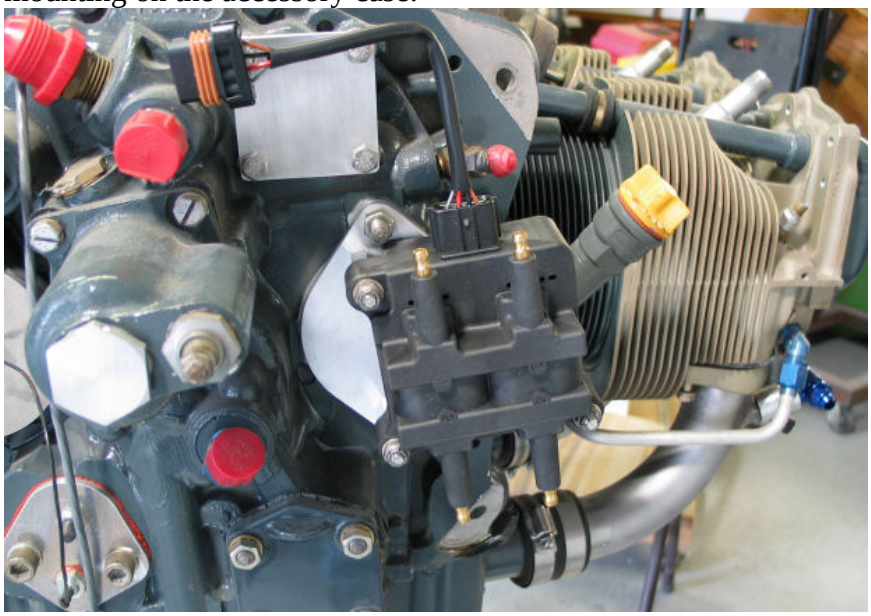
Check the #10-32 stainless screws that hold the crank trigger sensor (red component in the picture). Make sure these screws are tightened against their included lock washers.

Carefully test fit your flywheel onto the engine. Make note of the indexing (larger) prop dowel position on the prop flange and the flywheel. The flywheel will go on only one way. With the flywheel properly clocked to the crankshaft, carefully slide it onto the end of the crankshaft and watch for any interference with the crank trigger assembly. With the flywheel fully seated, there should be an air gap between the flywheel and the crank trigger of approx .030” to .050”. A drill bit makes a good gauge to measure the airgap. If the airgap is too small, material must be machined off the threaded hex standoffs to increase the airgap.

Once the crank trigger is installed, route the crank trigger cable over the center of the top of the engine. Support the crank trigger cable using adel clamps attached to the top case bolts. (retorque ¼” case bolts to 75 in. lbs.)

## Ignition Coils and Magneto Block Plates

Typically, the ignition coils are mounted to magneto block off plates which serve to cover up the magneto holes in the accessory case. In some cases, it may be more convenient to mount the ignition coils to the firewall. EFII can provide magneto block off plates that do not include the coil mounting features if this suits your installation. Below is a picture of typical ignition coil mounting on the accessory case:



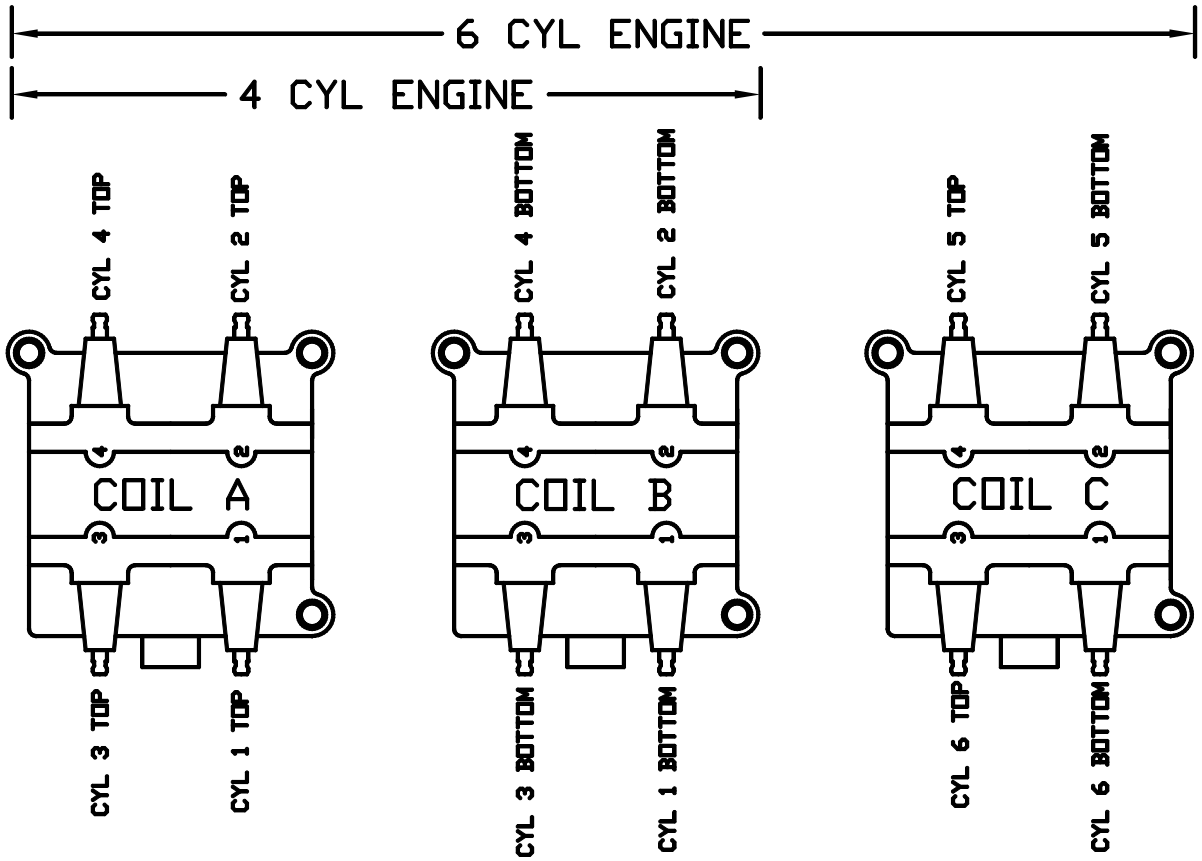
It is important to make sure there is clearance between the motor mount and the coils.
It is highly recommended to hang the motor mount onto the engine when fitting the coils.
In some cases, the impulse coupling spacer that typically sits under the left mag can be used to space one of the coils out about .8” away from the motor to improve clearances. When mounting the coils with the magneto block off plates, the left coil will mount with its connector pointing down and the right coil will mount with its connector pointing up (as seen in the picture above). After you have test fitted the coils and motor mount, apply Ultra Black Silicone Gasket Maker between the magneto block off plate and the accessory case and permanently mount the coils.

## Spark Plugs and Adapters

Your kit comes complete with Iridium spark plugs and spark plug adapters for all plug locations. Your plugs should be gapped at .032” to .035”. If you adjust the gaps, be very careful not to damage the thin center electrode (don’t pry against it). Install the adapters and plugs in all spark plug locations. If you are using the EIGN-1 kit which replaces only one magneto, you may want to install the EFII spark plugs in the bottom spark plug holes. The high spark energy of the EFII system will help keep the bottom plugs clean.

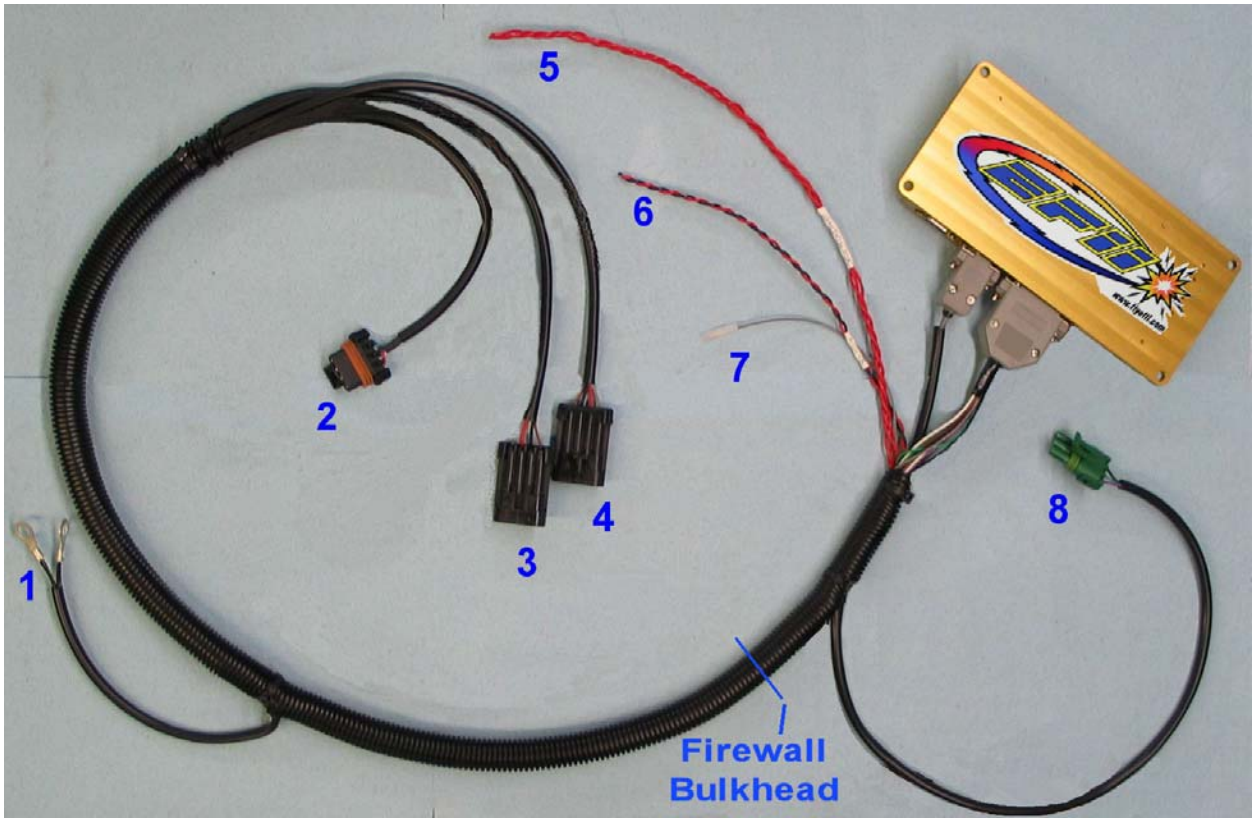
## Spark Plug Wires

It is best to wait on spark plug wire assembly until the motor is on the motor mount and all engine accessories are mounted. This will ensure when you establish wire lengths and routing that everything fits well. When you are ready to prepare the spark plug wires, follow the instructions that come with the included spark plug wire set. A pair of spark plug wire crimpers are handy to have available. If you don’t have access to proper crimpers, you can get them from summitracing.com pn TAY-43390. Below is a diagram showing which coil outputs should be connected to which spark plug: (note – there are numbers molded into the ignition coils below the spark plug towers that correspond to the correct cylinder number for each spark wire connection for four cylinder engines. For six cylinder engines, follow the diagram below for the remaining cylinders).



# Wire Harness

Your EFII ignition kit includes a prewired  Tefzel wire harness. All necessary connectors are preinstalled. Below is a picture of the harness with the connectors referenced by number:




**Harness Connectors**

1. Ignition coil ground wires (engine side of firewall).
2. Crank trigger.
3. Ignition coil.
4. Ignition coil.
5. Ignition power (these wires stay bundled and fed from a 10A IGNITION breaker).
6. ECU power (black to ground bus, red to 5A ECU PWR breaker).
7. Tach output (connects to your engine monitor or tachometer).
8. MAP sensor (in cabin).

## Wire Harness (cont)

The Ignition Coil Ground wires should be bolted to your large gauge engine ground wire where it passes through the firewall.

Your harness includes connectors for two ignition coils. If you are using the EIGN-1 single mag replacement kit, you will only use one of these connectors for your coil connection (either connector can be used with your single coil). The second coil connector has been included in case you decide to add the second mag replacement components in the future. If you are using the EIGN-2 dual mag replacement ignition, it doesn't matter which connector you plug into each coil.

The Ignition Power wires provide +12V power to the ignition coils. Provide +12V power to these wires through a single 10A circuit breaker.

The red ECU power wire needs to be connected to a source or +12V through a 5A circuit breaker. The black ECU power wire should be connected to your ground bus using a reliable crimped or soldered connection method.

The TACH output wire provides a +12V square wave output signal that can drive the tach input of your engine monitor or tachometer. The TACH signal provides two pulses per revolution on four cylinder installations and three pulses per revolution on six cylinder installations.

The MAP sensor connector simply plugs into your included MAP sensor which is typically mounted on the cabin side of the firewall or under the instrument panel in a convenient location.

## ECU

The EFII system uses the popular SDS ECU. This engine computer has been used in countless vehicles and is well known to be very reliable and easy to use. With this ECU, the ignition timing can be modified by the end user to tailor the operation of your EFII system to the specific requirements of your vehicle. We have preprogrammed a conservative ignition timing curve into your system that will enhance engine operation as well as keep your engine running in a safe area of ignition timing.

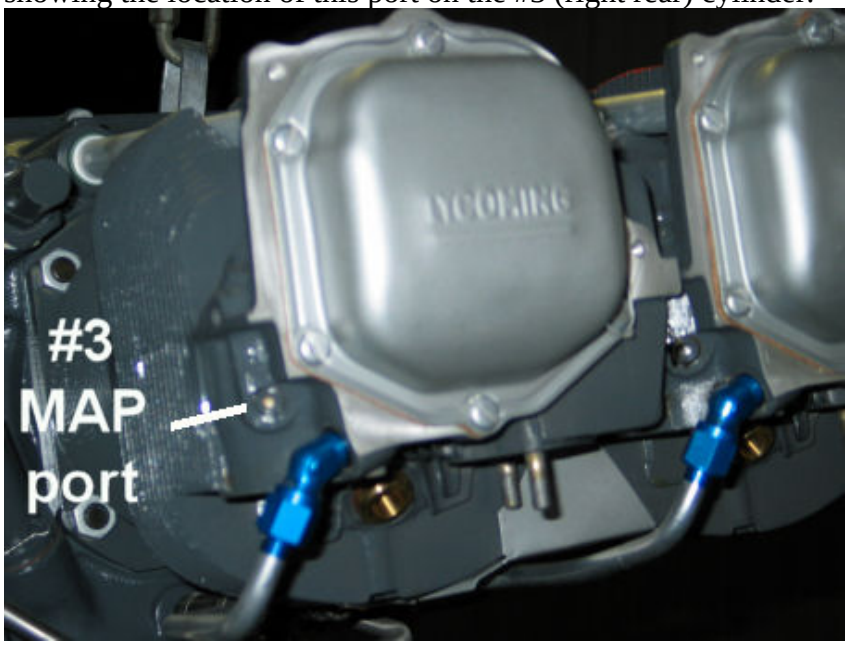
The ECU is typically mounted under the instrument panel, not far from the firewall. It is best to mount the ECU such that the connectors can easily be accessed for the sake of attaching the wire harness. The ECU should be mounted such that moisture cannot find it’s way into the ECU enclosure – the enclosure is not waterproof.

If you wish to tune the ignition timing that is programmed into your ECU. You will need our aviation programmer kit. We do not recommend changing the ignition timing curve unless you are an engine builder, dyno tester, or otherwise knowledgeable engine tuner. Incorrect ignition timing can cause engine damage.

## MAP Sensor

Manifold Absolute Pressure Sensor (MAP) – importance ESSENTIAL – The MAP sensor is a three wire sensor that is typically mounted aft of the firewall. The MAP sensor tells the ECU how much air pressure is in the engine intake manifold. The combination of the MAP sensor and the rpm information from the Crank Trigger are the most critical inputs to your ECU. So please mount and hook up both of these sensors with care. A manifold pressure source must be routed to the MAP sensor.

The MAP sensor requires a pressure signal from your cylinder head. Lycoming cylinders have a 1/8" NPT pipe plug in the cylinder near the intake pipe entrance into the cylinder. Below is a pic showing the location of this port on the #3 (right rear) cylinder.




Locate the 3/16" brass barb fitting and 6 feet of thick wall vacuum hose included in your kit. Use these components to make a pressure hose connection from the MAP port on the cylinder to your MAP sensor. Make sure to use pipe dope on the NPT threads of the barb fitting when you install it into the cylinder. Also note that the included barb fitting has a restrictor orifice inside to damp the intake pulses of the engine and give a smoother pressure signal to the MAP sensor. After you have installed the barb fitting, hose, and MAP sensor, use a length of safety wire to secure the vacuum hose to the fittings at each end. At each fitting, wrap the safety wire around the hose ends about three times and then twist and tighten the ends of the wire.

# EFII Pre Start System Checks

All elements of your EFII system should be checked for proper operation before starting your engine. Below is a checklist to aid in this process.

ECU

- Verify power and ground
- Verify coil power if necessary (red wires should have +12V when ignition power is on)
- Check spark plug wires installed correctly
- Verify spark plugs are tight

Batteries

- Check battery voltages, charge or replace if necessary.

Starter

- Check starter and starter solenoid wiring for proper operation

## Using the EFII Ignition System

The EFII system is very easy to use. After you have carefully verified that all components are properly installed and working, it is time to start the engine. If ignition power and fuel are present, the engine should start fairly easily.

After you get your engine running and all portions of your system are working correctly, it is time to make ground power runs to test your system. You should always check all aspects of your system without leaving the ground. This will require making full power test runs of the engine. If you can't safely do this using the aircraft brakes to hold the vehicle, then tie the aircraft to a secure anchor point for this testing. Flight testing should only be done after all systems have been tested and verified through ground running.

While on the ground, test your aircraft at all different power levels.

After making your ground runs and satisfying yourself that all systems are working correctly, it is time to make a test flight. Never fly an aircraft with engine systems that are not working 100 percent correctly – systems will not fix themselves in the air if they don't work on the ground. That may sound obvious, but too many people in the experimental world have decided to make test flights on incomplete aircraft – this isn't good for anyone.

## FLYING

Flying behind the EFII system couldn't be easier

Perform your normal runup, if you have a remaining mag, you can switch off the EFII system to test the mag and vice versa. If you have replaced both mags and the engine is running smoothly, you can be assured that your entire EFII system is working properly.

CHT monitoring is always the best way to be certain that your engine isn't running too lean or running with too much ignition advance. You should never see CHTs above 450 degrees. If so you may have too lean a fuel mixture or inadequate cooling air over your cylinders. If present, these issues should corrected before any further flight.

We hope you enjoy your new EFII system as much as we do.

If you have comments or suggestions, we are always open to customer feedback.

Blue skies,
EFII

# DRAWING 1

## TYPICAL STARTER AND GROUND WIRING WITH TWO BATTERIES