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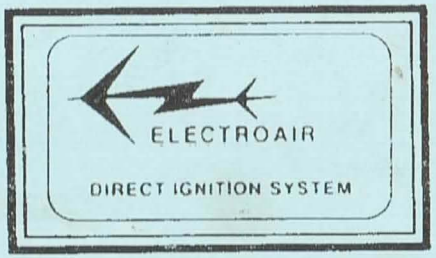

Electroair Ignition System
EIS-1

Instruction Manual

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Note

Electroair Electronic Ignition System was designed to be used as an experiment on combustion engines and is in no way certified for use on any type of aircraft. This device should be used in compliance with all F.A.A. Federal Regulations. The purchaser by placing this order with Electroair agrees that all parts purchased will be used solely at purchaser's risk.

Table of Content

Introduction

The Electroair Ignition System (EIS) is the result of years of development and represents a major breakthrough in engine control technology. The system is a single, easy to use, easy to install package that contains everything to control engine ignition.

The EIS has several advantages over the standard systems and some very impressive benefits:

1. No mechanical parts to wear
2. No spark distribution losses
3. High-energy spark
4. Longer spark durat
5. Automatic dwell adjustment
6. Fully adjustable timing
7. High Accuracy of Timing

The EIS uses two coils. Each coil fires two cylinders simultaneously. One cylinder is on its compression stroke and the other on its exhaust stroke. This is called a "waste spark system" because one of the sparks is "wasted" on the exhaust stroke cylinder. The EIS eliminates the need to distribute the spark to one plug at a time, doing away with the distributor and all the other energy robbing components of a traditional Kettering ignition system.

The coils fire directly into the spark plugs, delivering all the energy they have generated. The delivered spark is of longer duration than other system giving you the following benefits:

1. Hotter spark
2. Cleaner plugs
3. Less chance of plug fouling
4. Better engine efficiency
   -Smoother running
   -Better fuel economy
5. Higher resolution timing

The heart of the EIS is a digital integrated circuit chip. A timing housing replaces the magneto. The chip receives electrical impulses from the timing housing and fires the coils in the proper sequence. A calibration circuit works with the chip to determine the RPM and compute the spark advance. Controls are provided allowing you to optimize the timing.

Theory Of Operation

Dual Magneto System

On a traditional dual magneto system both magnetos are timed to fire at 25° before Top Dead Center (TDC). When starting the engine, the ignition switch grounds the "P" lead to the right magneto stopping it from firing. Meanwhile the left magneto with the impulse coupler still can fire. The impulse coupler causes the magneto to fire at TDC, and will continue to fire at TDC until the engine reaches about 200 RPM. At this time the impulse coupler disengages and the magneto falls back to 25° before TDC. Once the ignition switch is released the right magneto also begins to fire. From now on no matter what the RPM or the power setting the engine timing will remain at 25° before TDC.

At lower altitudes, a cylinder on the intake stroke draws in fuel and air. On the compression stroke (as the piston moves up) 25° before the piston reaches the top TDC the spark plug fires lighting the fuel. The objective is to have the peak pressure built up by the time the piston reaches 11 degrees past TDC.

As altitude increases, thinner air reduces the oxygen available for the proper fuel-air mixture creating more space between molecules. When the spark plug fires at 25° before TDC the thinner fuel-air mixture burns slower. Therefore the peak pressure point occurs much later than 11 degrees after TDC hence a loss in power. By advancing the timing, the peak pressure point can be maintained much closer to 11 degrees after TDC.

Electroair Ignition System (EIS)

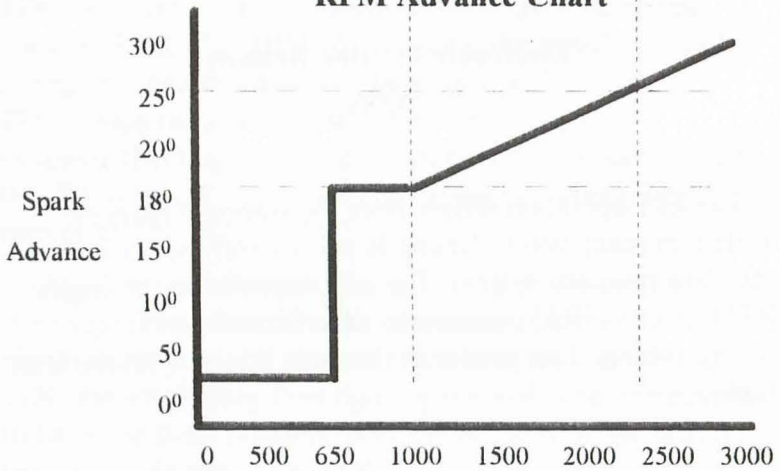
The EIS operation differs from the standard magneto system in many ways. Timing is permanently set in a standard magneto system. The EIS depends on the engine RPM and manifold pressure to determine the optimum timing setting. This produces the most power with the least fuel.

Spark Advance = Mechanical Advance + RPM Advance + Vacuum Advance

Mechanical advance is set during the installation of the EIS timing housing. This is usually 0^0 TDC.

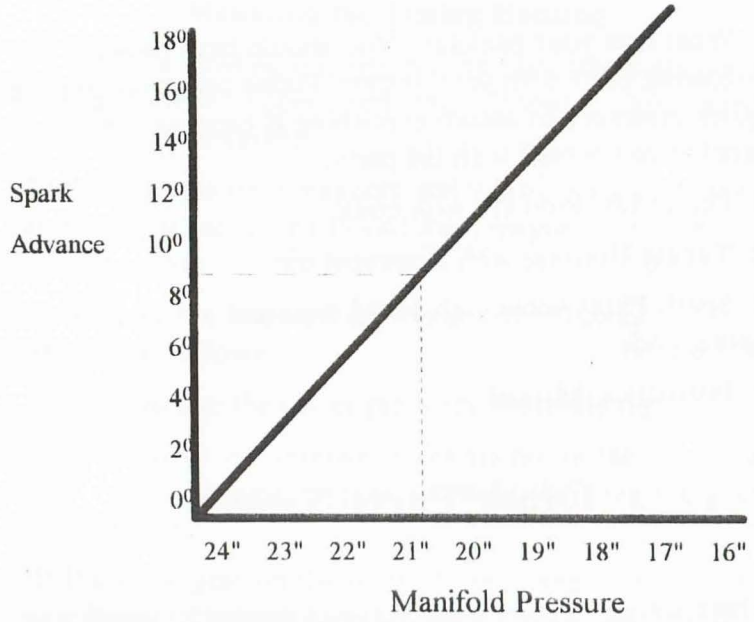
As the engine is started, the unit is set to fire the spark plugs at Top Dead Center (TDC). After reaching 650 RPM the EIS will advance the timing to 18^0 and stays at 18^0 until it reaches 1000 RPM, and then continue to advance approximately $1/4^0$ per each additional 100 RPM. Refer to the RPM Advance Curve Chart.

RPM Advance Chart



While the timing is advanced for RPM, the manifold pressure is sensed and calculated into the total spark advance. These two measurements are used together to figure the most efficient timing setting for the engine. See the Vacuum Advance Curve chart.

Vacuum Advance Curve Chart



If the vacuum sensor option in not installed, then the vacuum advance value in the above equation will be zero.

With no vacuum sensor, the advance remains zero up to 650 RPM. At 650 RPM, it immediately advances to the inital RPM advance setting. The advance remains at the initial RPM advance setting until 1000 RPM when it will advance in a straight line to the maximum RPM advance setting. If a vacuum sensor is used, then the advance will be the same as just described plus an additional 0 to 18 degrees depending on the manifold pressure.

Parts and Inventory

What is in your package? You should have received the following parts with your system. Please take time to do a quick inventory to assure everything is there and to familiarize yourself with the parts.

1. Direct Ignition Unit with coils
2. Timing Housing with alignment pin
3. Spark Plugs wires with screw caps and spring ends
4. Instruction Manual

Other Parts Needed

There are some other parts you will needed to install your system listed below.

1. If you are replacing a Bendix Mag, you will need the mag holders used for a Slick Mag. These are used to hold the timing housing on.
2. Off/On switch and a circuit breaker
3. Parts to hook into a maniford pressure line. If you do not have a maniford presure line, you will need to install one. The connection to the manifold pressure system must end in an 1/8" tube that will connect to the DIS unit.

Basic Installation

Mounting the Timing Housing

(1) With the cowling off, remove the right lower spark plugs and the left upper spark plugs. These are associated with the right magneto.

(2) Remove the right magneto and wiring harness. Make sure you disconnect the P-lead from magneto and the ignition switch.

(3) Remove the magneto drive gear from the right magneto as follows:

- remove the cotter pin from the castle nut.
- loosen and remove the castle nut in the center of the gear. This may require carefully clamping the gear in a vise.

(4) Place the gear on the shaft of the timing housing. Be sure to align the half moon key on the shaft. Apply the washer and castle nut and tighten. Install the cotter pin with the long end, away from the nut. Bend the cotter pin slightly to get it in place. Bend the long end of the cotter pin over the end of the shaft. The short end of the cotter pin bends down over the side of the nut. If the hole does not line up properly with the castles on the nut, file a little off the washer surface or the bottom of the nut until the hole aligns.

(5) Install the gasket on the timing housing. If the magneto gasket is not torn up, it can be reused. It will probably fit better than the one supplied with the kit. If the gasket must be replaced, be sure the pad is clean.

(6) Rotate the engine to set it at Top Dead Center (TDC). This is done by holding a finger over the #1 cylinder plug hole while rotating the engine until you feel compression. Then look in the plug hole to see the piston rising. Stop rotating the engine when the piston reaches the top (just before it starts down). At TDC, the impulse coupler on the left magneto should click. In addition, there are two sets of timing marks. One set of marks are found on the fly wheel and starter. The second set is a mark on the fly wheel that should match the engine case half seam. These should now be lined up. If all of these indications are correct, the engine is now at TDC and the installation may continue. If any of these indications are not correct, repeat this step until they are. Always rotate the engine in the direction that is turns.

(7) Holding the timing housing, insert the alignment pin in the first hole. Slowly turn the drive gear until the pin drops into the second hole. The timing unit is now set at 0^0. Leave the alignment pin in the unit. Install the timing housing in the right magneto hole. Secure the timing housing using the hold down tabs commonly used with Slick mags. Tighten them to engine specifications. This sets the mechanical advance.

REMOVE THE ALIGNMENT PIN!!

The timing housing is now installed and timed.

Mounting the Direct Ignition Unit (DIU)

(1) The firewall is the most common place to mount the DIU. Try to locate the unit in a position to keep the spark plug wires as short as possible and not interfere with other maintenance. Also, make sure the hole to be drilled will not interfere with components on the other side of the fire wall. The DIU should be on a flat surface that is grounded. If the unit cannot be attached to a grounded surface, run a ground wire to the black wire on the base of the DIU. The black wire on the DIU is ground.

(2) Drill the four mounting holes and secure the DIU with four 1/4" bolts.

(3) The red and white wire is 12 volt power. Attach it with a circuit breaker to a toggle switch on the instrument panel. This toggle switch will to turn the unit on and off. The plus 12 volts must be shielded 20 gauge wire, connected at the battery not the bus bar. The size of the circuit breaker should be about 5 to 10 AMPS. **WARNING** - Make sure the toggle is turned off. DO NOT RUN the unit without the spark plug wires attached.

Install Manifold Pressure Hose

(1) If you already have a vacuum line for a manifold pressure gauge, cut the line and install a "T". Run a vacuum hose to the Manifold Absolute Pressure (MAP) sensor on the end of the DIU unit. If you do not have a vacuum line installed, you must install one to take

advantage of the vacuum advance feature. The manifold pressure line is attached to the intake of one of the cylinders. Remove the plug that is in the cylinder, attach an AN fitting and an 1/8" line that will be run to the MAP sensor. For the best results, use AN fittings for all connections.

Install Spark Plugs

(1) The spark plugs that will be connected to the DIS must be replaced with resistor spark plugs. The plug gap should be between .030 and .035. The REM37 BY plug is an example of an acceptable plug in most 4 cylinder Lycoming engines. The REM40E is a common spark plug which is very difficult to gap to .035. However they have been gapped at .025 and used successfully. If you have any problems with spark plug selection give us a call.

Install Spark Plug Wires

(1) It is essential to use a resistive spark plug wire. In the automotive world these wires are known as noise suppression wires. Also, the new spiral core wrap wires work well with the EIS. Route the spark plug wires from the DIU to the proper cylinder. See the chart for the connections. Keep the spark plug wires away from the exhaust pipes and try not to run two wires in parallel without some kind of separation. Cut the wires leaving enough length to go three inches beyond the spark plug.

(2) Slide the brass nut on the wire. Next, slide the rubber washer on the wire about one inch. A small amount of RTV or silicon will help the washer slide on and keep the end of the wire from pushing out after it drys. If you are using carbon core wire insert the spring in the center of the wire. If you are using the spiral core wire, the center is non-conductive, so insert the spring to the side of the center core.

(3) Attach the wire to the spark plug by sliding the brass nut down with the rubber washer inside of it. If you connect the spark plug end first, before you route the wire to the coils, this will allow the spark plug wire to twist while tightening the nut. **DO NOT** over-tighten the nut as this may cause separation in the core of the wire. Hand tighten and then turn an additional one-half turn with a wrench.

Spark Plug Wire Hookup Chart

Coil

Engine:	A	B	C	D
4 Cyl.				
Continental	1&2	3&4		
Lycoming	1&2	3&4		
Rotorway	1&2	3&4		
VW	1&2	3&4		
6 Cyl.				
Chevy 2.8	1&4	2&5	3&6	
Continental	1&2	5&6	3&4	
Buick 3.0/3.8	1&4	3&6	2&5	
Ford 2.8	1&5	3&4	2&6	
Franklin	1&2	3&4	5&6	
Lycoming	1&2	3&4	5&6	
8 Cyl.				
Lycoming	1&2	7&8	5&6	3&4
Mosy GM Chrysler and AMC	1&6	4&7	5&8	2&3

WARNING:

On some engines such as Lycoming 540's the magneto drive gear is not attach to the magneto and <u>MUST BE REMOVED</u> from the Accessory Housing or it will damage the engine.

Final Installation Steps

(1) Connect the wire from the timing housing (magnetic pickup) to the wire on the DIU with the connectors supplied and installed by the factory.

(2) Reattach and reinstall any connections or parts removed or loosened during this installation.

(3) Secure all new wires, connections and lines to prevent excessive vibration failures.

(4) The Timing Housing is new and should be monitored. Watch for signs of looseness and wear. If any problems are noted, please contact the factory immediately.

Calibration

The Direct Ignition Unit has two adjustments which can be set by you, the user. These adjustments are controlled with two knobs found under a protective cover and labelled:

* INIT - initial advance adjusting idle control
* 3000 - additional advance up to 3000 RPM

The INIT and 3000 knobs have been set to standrad settings at the factory as described below.

For most Lycoming and Continental engines, the 3000 knob is set at the lowest setting, labelled 6. At this setting 6 to 8 degrees will be added to the initial advance setting while the engine is between 1000 and 3000 RPM.

The INIT knob is set between 16 and 19. This setting results in a timing of 25 degress at 2500 RPM.

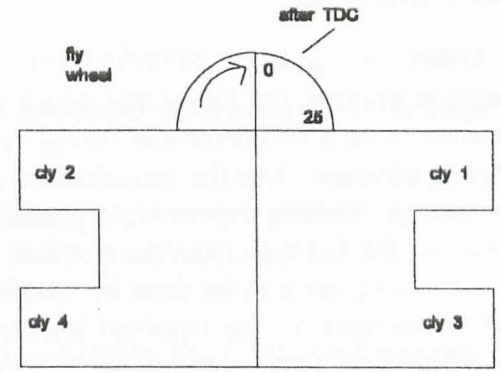
When replacing the cover, take care not to hit or rotate the knobs. There is foam rubber in the cover to keep the knobs at their settings and prevent vibration.

Setting Timing

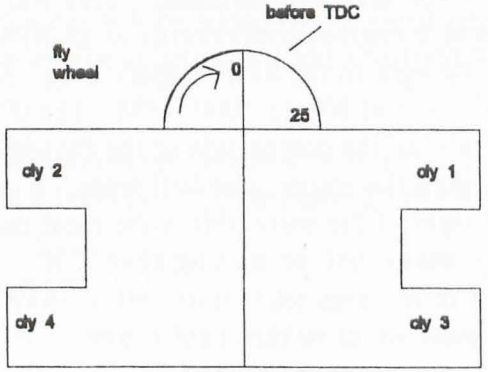
The best way to check the timing is to use a voltmeter and do a static run up between 2300 and 2600 RPM. Your timing should be 25 degrees before TDC for most Lycomings and Continentals.

Due to variation in printing, the knobs may be up to 3 degrees inaccurate. Use a voltmeter and timing light to verify your timing advance. Use the manufacturer's recommended timing. Disable the manifold pressure sensor by removing the red wire from the terminal marked +5 volts. (This can also be done by installing the optional MAP sensor switch. See Optional Installations.) To determine mechanical error, place a jumper wire between the +5 volt and RTD terminals. This will cause the unit to fire at 0 degrees continuously at all RPM. Connect a timing light to the #1 EIS spark plug. Start the engine and run it at 800 to 1000 RPM. The 0^0 or TDC timing mark on the engine side of the fly wheel should line up with the engine case half seam. If your 0^0 mark is to the right of the seam, this is the most desirable situation as the engine will be starting after TDC. If the 0^0 timing

mark is to the left of the seam, the engine is firing before TDC. On most Lycoming flywheels, 1/10 of an inch is equal to 1 degree of timing. **Refer to the following examples:**



0 deg. timing mark to the right , engine firing after TDC



0 deg. timing mark to the left , engine firing before TDC

OPTIONAL INSTALLATIONS

Manifold Absolute Pressure (MAP) Sensor:

The MAP sensor is located on one end of the DIU unit. A switch may be added to control power to the MAP sensor. This allows testing of the sensor. When the sensor is turned off, the engine should run rougher and rpms may drop. It also allows the sensor to be disabled in the event it malfunctions.

Remove the red wire from the +5 volt terminal and attach it to one side of the switch. Attach the other side of the switch to the MAP terminal where the red wire was attached. Install and label the switch in the instrument panel.

Electric Tachometer:

The terminal on the DIU marked TAC may be connected to an electric tachometer. Check with the manufacture of the tachometer before connecting. Be cautious attaching then EIS tach output to the electronic tach and magneto P lead. The P lead has 300 volts on it and can back feed and damage the EIS. To prevent this, isolate the EIS tach lead with a diode.

Tach output 4 cyl 2 pulses per revolution 12VDC

6 cyl 3 pulses per revolution 12VDC

Panel Mounted Advance Meter

The terminal marked ADV can be used to read timing advance when it is connected to the panel advance meter or a digital volt meter (DC volts). This may be used to indicate the spark advance with .01 volt equal to 1 degree of timing. If you are not installing a panel advance meter it is a good idea to run a wire from the ADV terminal to your panel so you can clip on a multi-meter to check your timing occassionally.

Operation in flight

Once the EIS is installed and properly adjusted it is fully automatic.

The EIS switch and optional MAP sensor may be turned off and on in flight as needed for troubleshooting.

Troubleshooting

Engine kicks back while starting -

This is due to one or more of the following reasons:

1. Weak battery
2. Weak starter
3. Bad starter cables
4. Timing set before TDC

Engine cranks but won't start -

With the ignition switch on, check voltage of the red and black wire with respect to ground. Red wire should be 12 to 18 volts. Black wire should be zero volts.

Engine fires but runs poorly -

Check spark plug wires and firing order.