



CPL Theory Aircraft Systems (CSYA)

CSYA 4 – Ignition System



1. Document Identification

Document Identification	
Document Category	Training Material
Document Revision Number	1.0 (uncontrolled when printed)
Document Issue Date	11/04/2019
Document Status	Active
Document Title	CSYA 4 – Ignition Systems
Document Identification	MBWTRG-TRM-1448

2. Amendment Record

Amendments made to this document since the previous version are listed below. All amendments to this document have been made in accordance with CAE OAA document management procedures.

Original Author		Date of Publication (DD/MM/YY)	
Slide	Changes	Editor	Date (DD/MM/YY)

3. Disclaimer

This presentation is for CAE training purposes only. Nothing in this presentation supersedes any legal or operational documents issued by the Civil Aviation Safety Authority (Australia) or its equivalent in any country, the aircraft, engine and avionics manufacturers or the operators of aircraft or systems and rules throughout the world..

IGNITION SYSTEM

Ignition System

➤ The purpose of the ignition system is to:

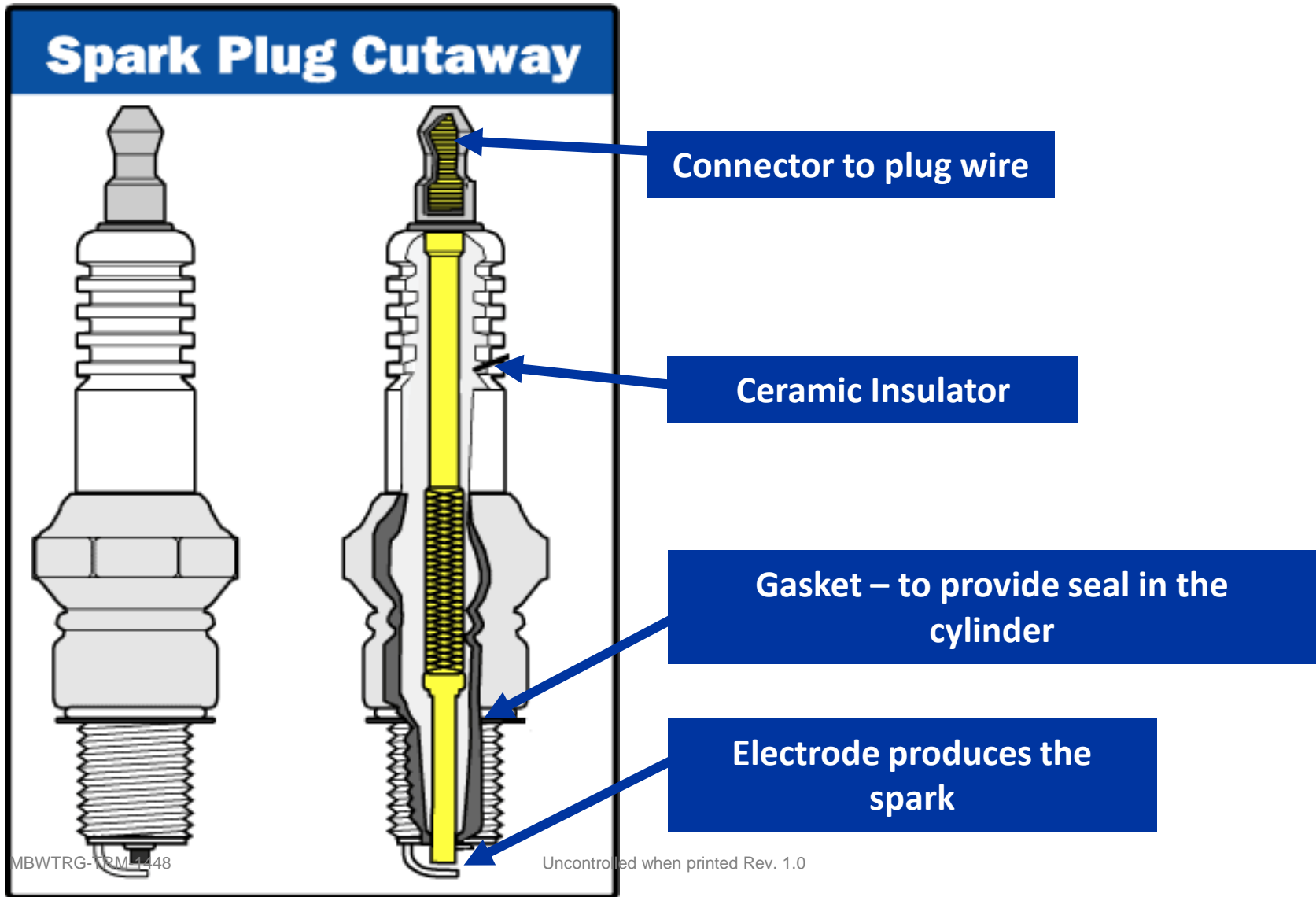
1. Provide the means for engine starting

2. Provide correctly timed sparks to ignite the fuel/air mixture inside the cylinders

➤ The high voltage spark inside each cylinder comes from the spark plugs



Ignition System



Ignition System

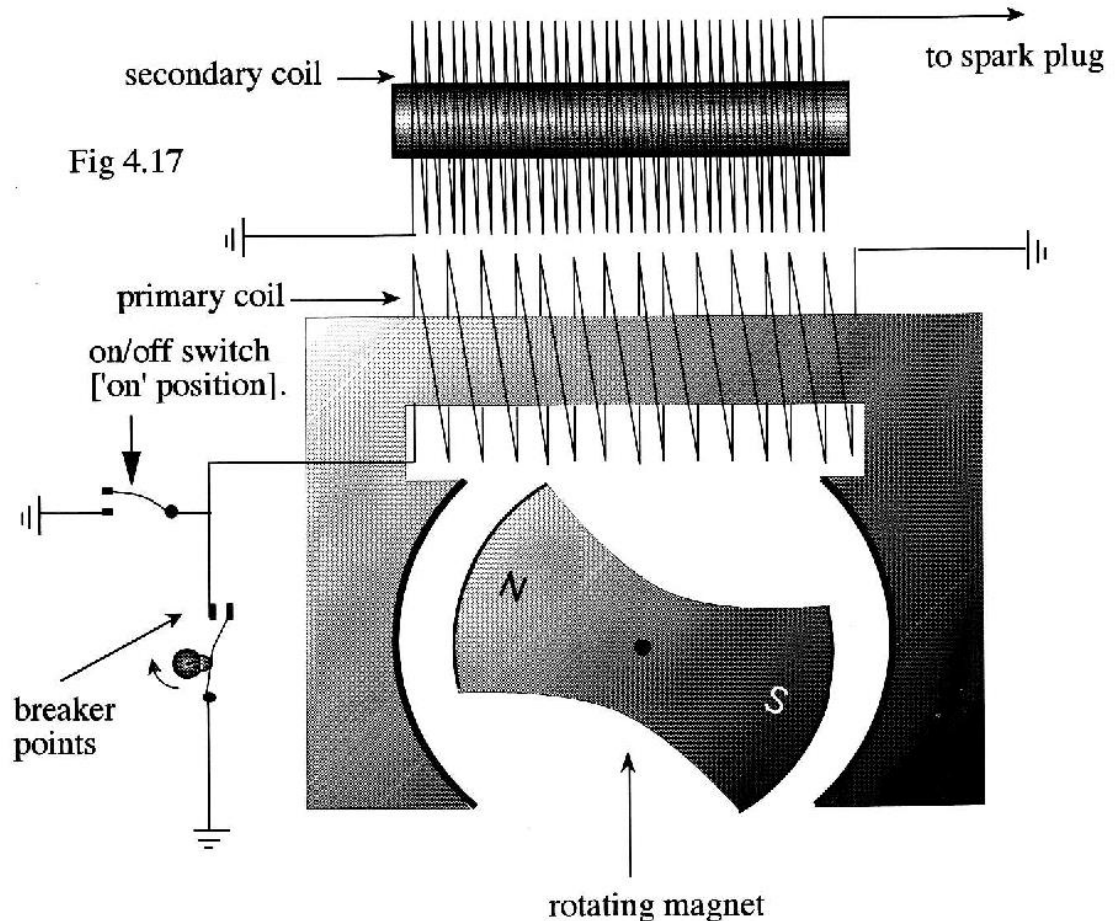
- The spark plugs receive the necessary electrical energy to generate a spark from a **Magneto**. There are two magnetos in light aircraft



- A magneto is a rotating magnet inside a coil (this produces an electrical current)
- The voltage is then amplified and the magneto current **distributor** sends the current to the correct spark plug at the correct time
- A magneto has a set of “**breaker points**” which collapse the magnetic field and generate a spark

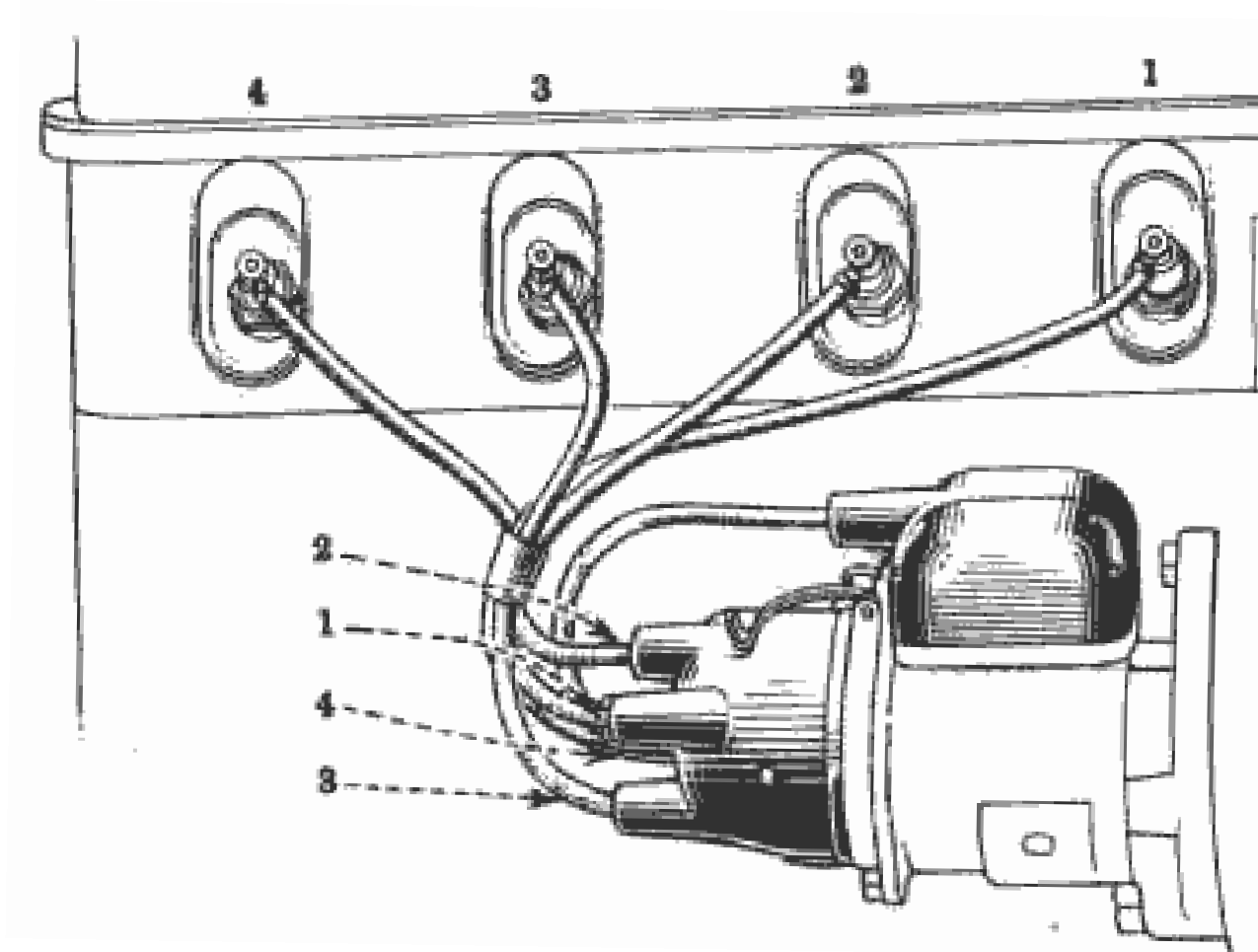
Ignition System

- When the breaker points separate, a spark is produced
- When the breaker points are connected, the current is earthed and no spark is produced
- A **condenser** (capacitor) is connected across the breaker points – this stores the current so that a spark is not produced at the breaker points when they separate as this may burn and damage the breaker points



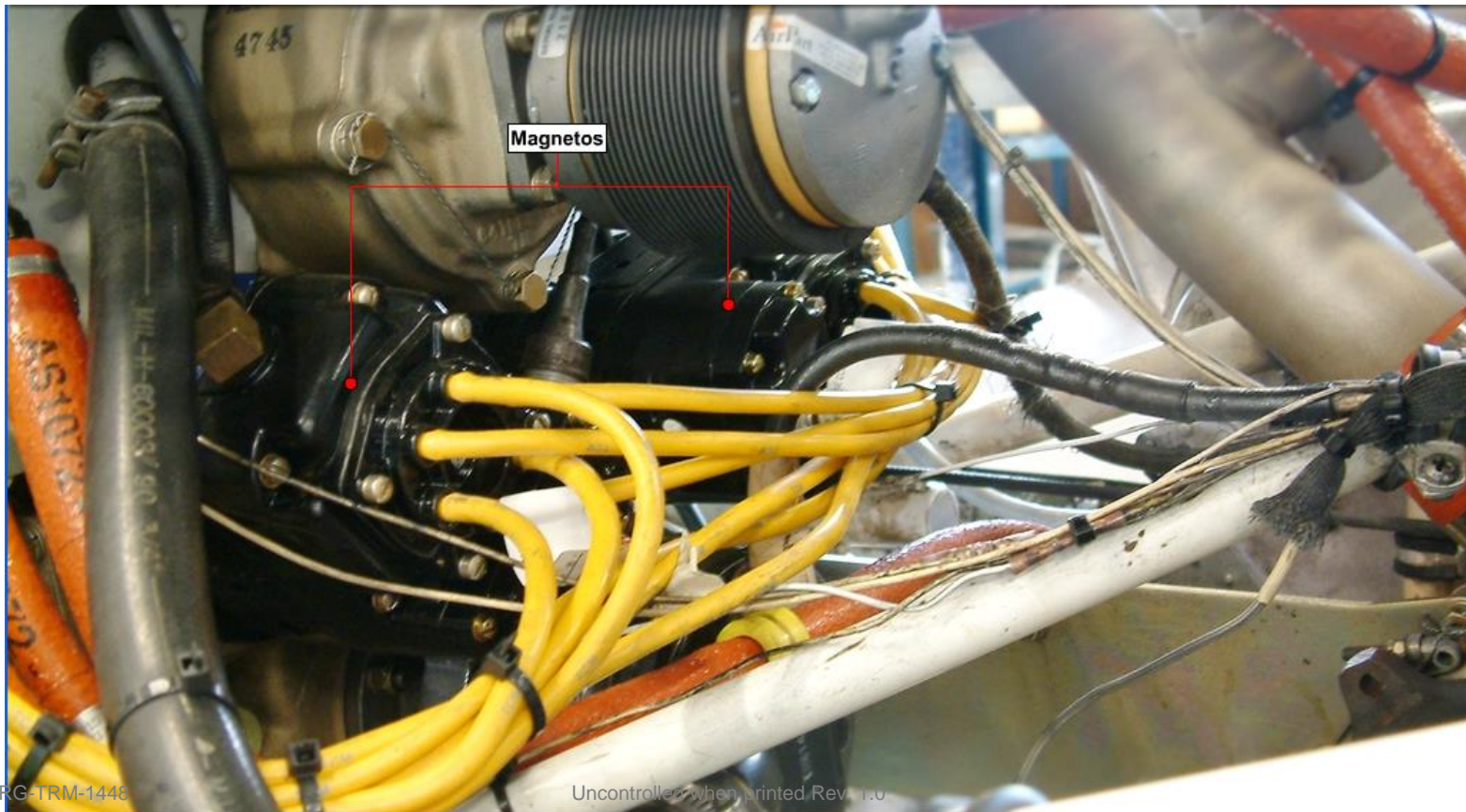
Ignition System

- Each magneto has 4 leads that connect to a spark plug in each of the 4 cylinders



Ignition System

- When the leads are bound together, they are called an **ignition harness**
- If there is any break in the leads there will be current leakage which will lead to rough running



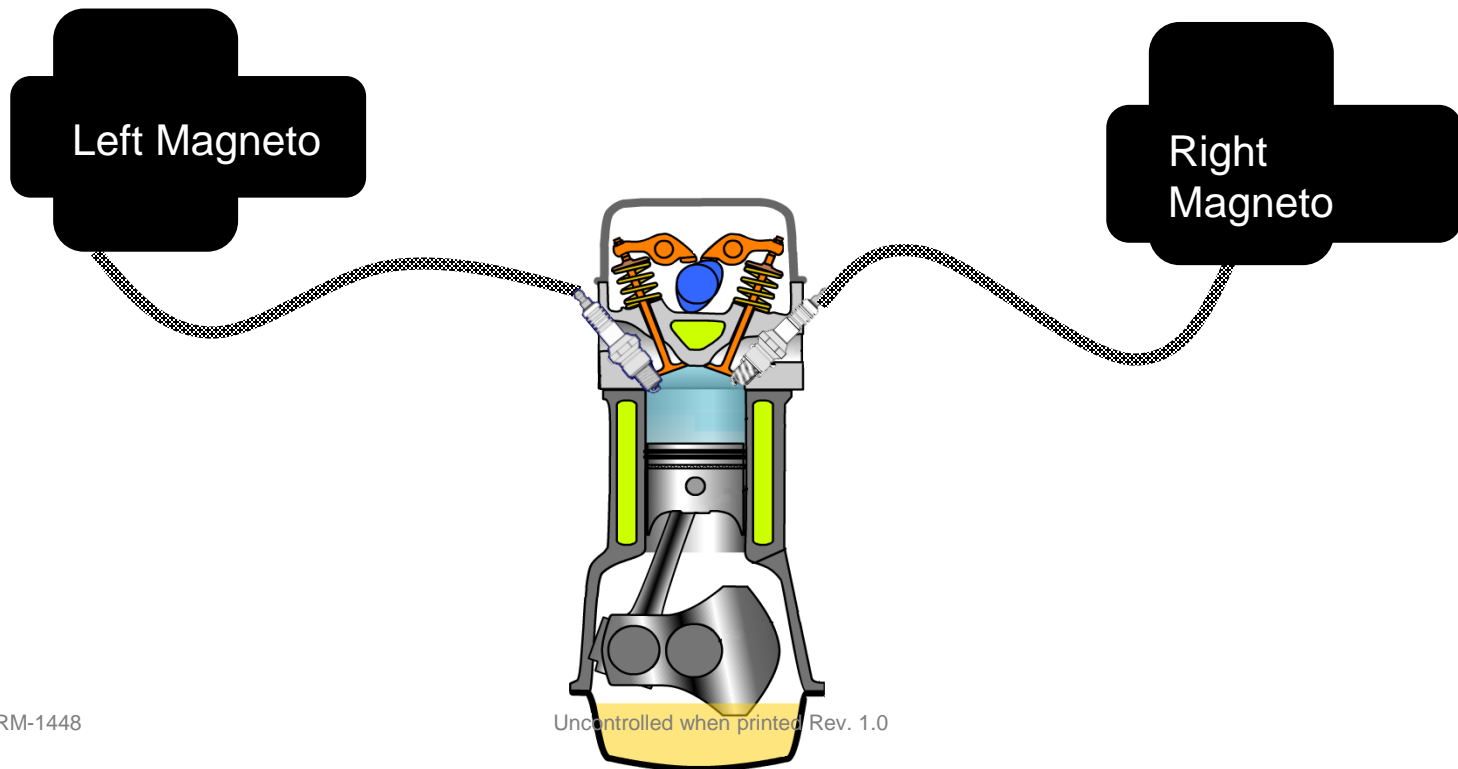
Ignition Lead Shielding

- To produce a spark, the voltage in the magneto leads must be very high
- These pulses of high-voltage current generate radio waves which can interfere with the aircraft radio equipment
- Ignition leads are often enclosed in a metallic shield to prevent these radio waves causing static in the radio – a clicking sound in the headset

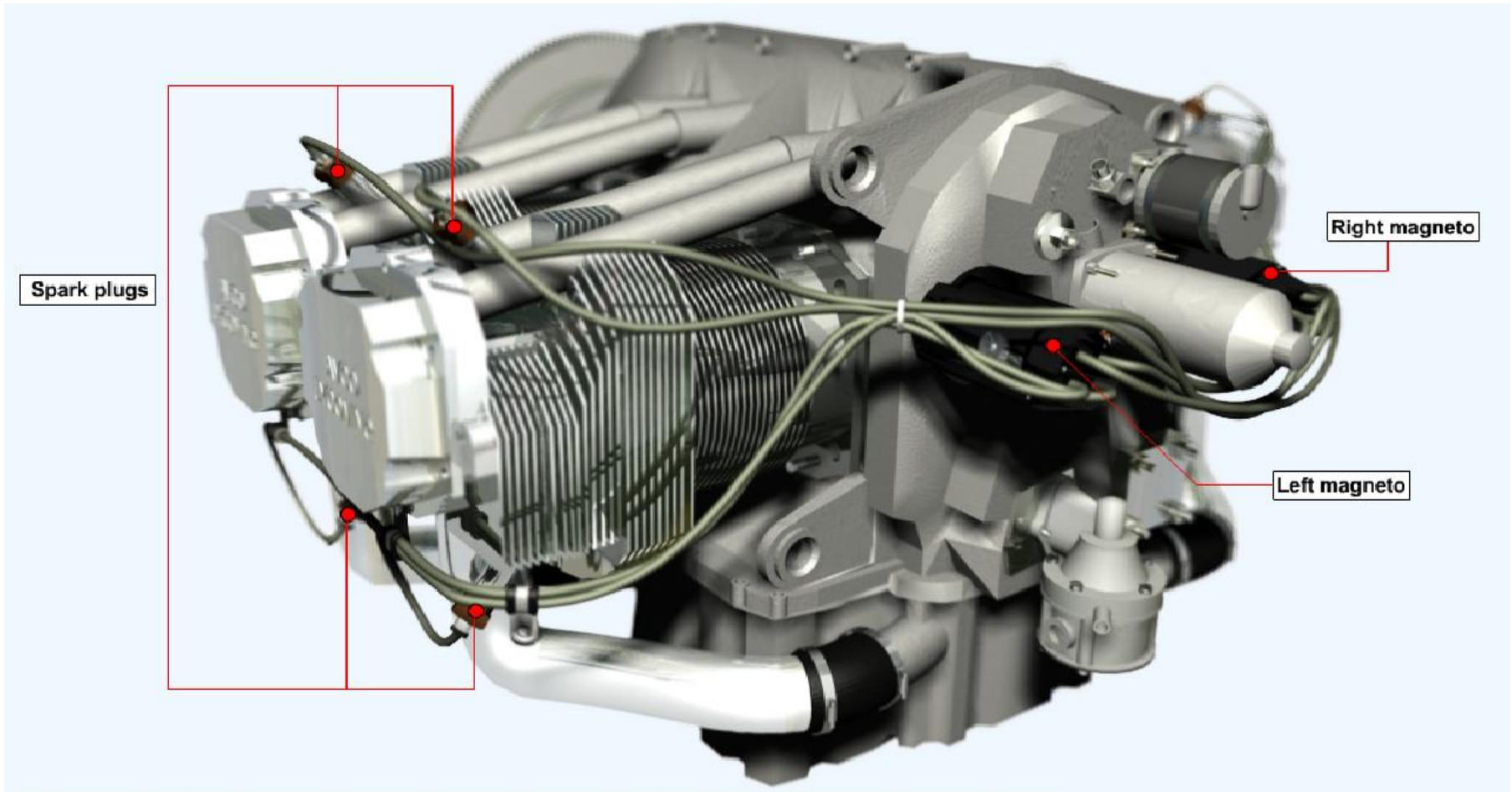


Ignition System

- Each cylinder actually has 2 spark plugs (**Dual Ignition System**), one spark plug being connected to each magneto. The purpose of this is:
 1. If one magneto fails, the other is still providing spark
 2. More even and more efficient combustion in each cylinder



Ignition System



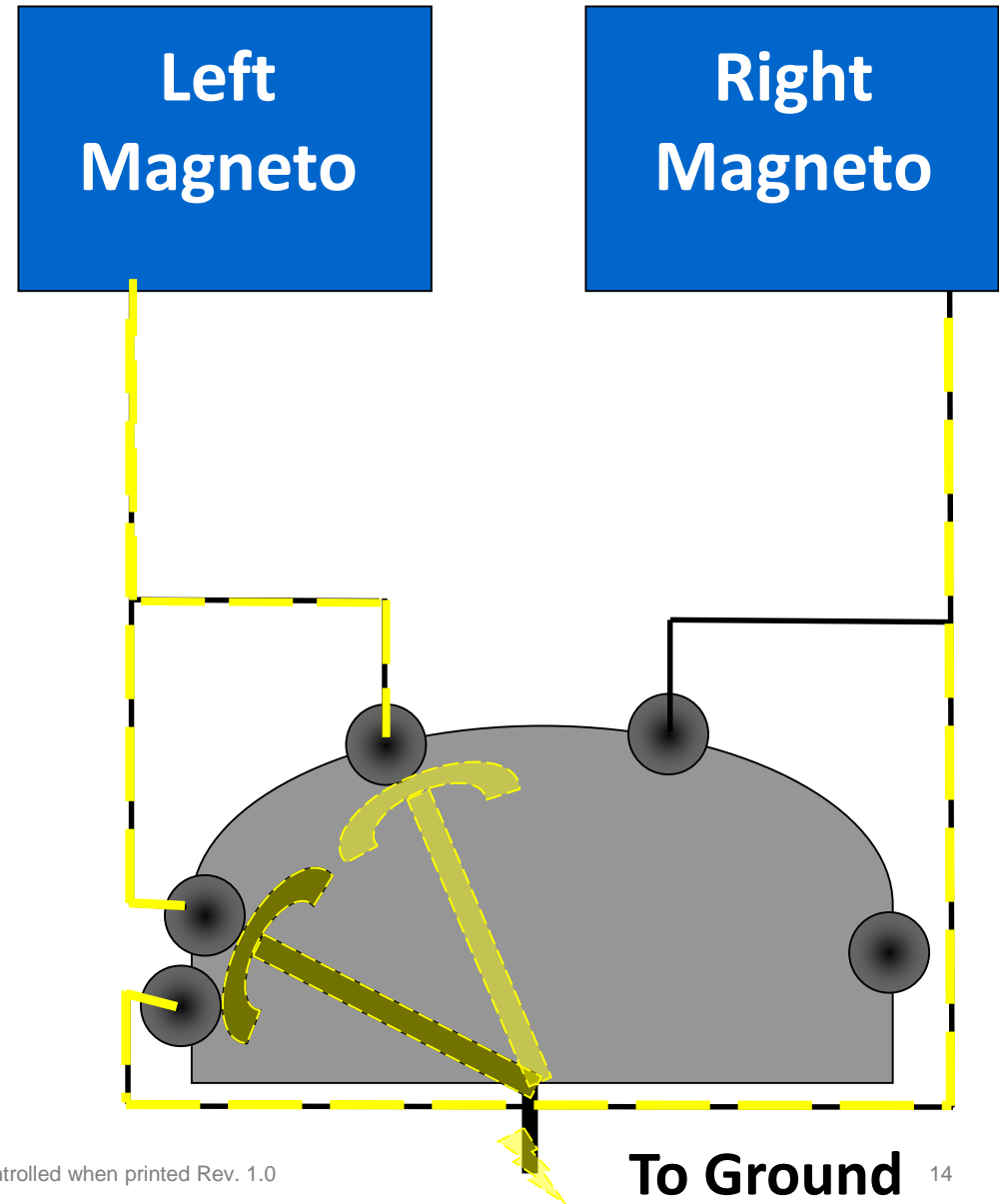
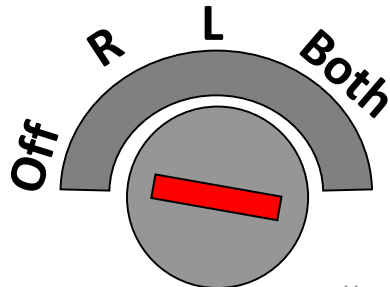
Ignition System

- Whilst they produce electric current, magnetos are **completely independent** of the aircraft electrical system
- Magnetos are actually run off the accessory gearbox (gears at the back of the engine). All they require is **mechanical energy** to begin rotation of the magnet

THEREFORE, IF THE ALTERNATOR FAILS AND THE BATTERY RUNS OUT, ELECTRICAL SYSTEM POWER WILL BE LOST BUT THE ENGINE WILL KEEP RUNNING NORMALLY!

Ignition System

- When the magnetos are “off”, any current is “earthed” and the magnetos are not live
- Turning the key to BOTH, allows both magnetos to run, and all the spark plugs will fire. This is the normal position for flight
- If any fault occurs in the wiring, then the magneto will remain live, even when the switch is OFF
- Turning the key to either L or R will allow that magneto to become live Any current that enters the magneto will begin charging to create a spark
- If the engine is running when this occurs, the engine will continue to operate off the live magneto.



Ignition System

- A selector panel is in the cockpit and for safety reasons is operated with a key

Settings

BOTH Both magnetos are providing sparks to the cylinders

Used for normal operations as it provides the most efficient combustion

L The left magneto is engaged, right magneto is grounded

R The right magneto is engaged, left magneto is grounded

OFF Both magnetos are disengaged/grounded/earthed

START Used to engage the starter motor



Ignition System

- Most light aircraft have an electric starter motor powered from the battery
- When engaged, the starter motor rotates the engine, allowing the magnetos to produce electrical current that initiates the engine's operation under its own power
- There are, however, two problems associated with engine starting:
 1. During start, the magneto is only rotating around 60 RPM (we require about 100-200 RPM to generate a sufficient spark for combustion)
 2. The valve timing is set for normal engine RPM (800-2400). At low engine RPM during start, we may experience kickback – where the piston moves in the wrong direction and the crankshaft rotates the wrong way
- To overcome these problems, a device called an **Impulse Coupling** is fitted to the magnetos

Ignition System

➤ The Impulse Coupling assists engine starting by providing:

- 1. A stronger (hotter) spark**
- 2. A delayed (retarded) spark**



- The basic function is that the Impulse Coupling initially prevents the magnet rotating, building up energy
- It stores this energy in a spring until sufficient energy has built up to rotate the magnet at the RPM required for sufficient spark

WHAT NOT TO DO!

What Not To Do!

Prolonged Use of Starter Motor:

- The starter motor is designed to provide a very high turning force for a very short time for engine start
- To do this, a large current is sent to the starter motor from the battery
- If the engine fails to start and the starter motor is continuously operated, the high current can cause the motor to overheat and become damaged
- After about 5 seconds of cranking you should stop, wait for the starter to cool down then try again
- If the starter has been operated for more than 30 seconds (cumulative total) then several minutes should be allowed for the system to cool down before attempting start

WHAT TO DO!

What To Do!

Ignition Check before Take-off:

The pre takeoff magneto check is completed to ensure:

1. each magneto is operating normally
2. the switches are functioning normally
3. spark plugs are firing normally

Procedure:

1. In the run-up bay, engage brakes and increase the RPM to 1800rpm
2. Using the key, switch to the left magneto.
The right magneto will be grounded and there should be a drop in the RPM
Ensure the drop does not exceed 150rpm
3. Switch back to both
4. Complete steps 3 and 4 using the right magneto
5. The maximum difference between the two rpm drops must not exceed 50RPM

What To Do!

Ignition Check before Take-off: Excessive RPM Drop with Engine Running Smoothly

- The magneto timing is incorrect
- Do not take off – report the fault

Ignition Check before Take-off: Excessive RPM Drop with Engine Running Roughly

- One or more of the spark plugs are faulty or fouled

Action: Attempt the clearing procedure

Step 1: Select magnetos to both & increase to 2000rpm

Step 2: Lean out the mixture till it begins to run rough. Wind back in for smooth running

Step 3: Wait for the excess oil to be burnt off the spark plugs

Step 4: After about 30sec wind the mixture back in and retest the faulty magneto at 1800RPM

Step 5: If still faulty do not takeoff

What To Do!

Ignition Check before Take-off: No RPM Drop with Smooth Running

- There is a fault in the switch or magneto wiring – both magnetos remain live!
- Do not take off – report the fault
- **Warning: the magnetos may remain live even if the key is not in the ignition – treat the propeller with caution!**

Ignition Check before Shutdown:

- An ignition check is also carried out before shutdown to ensure that neither of the magnetos remain 'live'