ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL FOUR

INSTRUCTIONAL GUIDE

SECTION 4

EO C432.01 – DESCRIBE IGNITION AND ELECTRICAL SYSTEMS

Total Time: 30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-804/PG-001, *Proficiency Level Four Qualification Standard and Plan*, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Prepare slides located at Attachment A.

PRE-LESSON ASSIGNMENT

Nil.

APPROACH

An interactive lecture was chosen for this lesson to clarify, emphasize, and summarize the ignition and electrical systems.

INTRODUCTION

REVIEW

Nil.

OBJECTIVES

By the end of this lesson the cadet shall have described ignition and electrical systems.

IMPORTANCE

It is important for cadets to be able to describe ignition and electrical systems as a solid understanding of ignition and electrical systems provides knowledge for potential instructional duties and is part of the fundamentals that cadets pursuing future aviation training will require.

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Teaching point 1 **Describe the ignition system.**

Time: 15 min Method: Interactive Lecture



Show slide of Figure A-1 to the cadets.

The ignition system provides an electrical spark to ignite the fuel / air mixture in each cylinder. The system usually consists of:

- two magnetos,
- two spark plugs per cylinder,
- ignition leads, and
- a magneto switch (on the instrument panel).

The magneto is an engine-driven generator which produces an electrical current without using an external current. It combines all elements of the ignition system, including:

- generating a low tension current;
- transforming the low tension current to high tension; and
- distributing the current to the individual spark plugs and causing them to fire.

When the magneto switch is off, the system is grounded and the electrical charge does not flow through the magneto and a spark is not produced. When the switch is on, the system is not grounded and the electrical charge flows through the magneto and a spark can be produced.

Dual ignition systems include two spark plugs in each cylinder, and two magnetos.

One spark plug in each cylinder is fired by one magneto. The other magneto fires the second spark plug in each cylinder. This dual ignition system provides improved:

- **Safety.** If one system fails, the engine will still operate.
- **Performance.** Improved combustion of the fuel / air mixture increases the power output and gives better engine performance.

The magneto switch allows the pilot to select either one or both magneto systems. The engine should always be operated on both magneto systems during takeoff and normal flight.



The magneto switch shall be turned to off when the aircraft is parked. If the propeller is moved, the engine can fire if the ignition switch is on.

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Correctly set ignition timing allows the magneto to fire at the right time. If the spark plug fires too early, poor engine performance may occur, including:

- loss of power, and
- overheating which can lead to:
  - detonation,
  - pre-ignition,
  - piston burning,
  - scored cylinders, and
  - broken rings.

The wires in the ignition system are shielded (a metal covering which is grounded). Shielding prevents the ignition current from interfering with the radio, whole ignition system, magnetos, plugs, and wiring.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS:

Q1. What are the parts of the ignition system?

Q2. What does correct set ignition timing allow?

Q3. What does shielding prevent?

ANTICIPATED ANSWERS:

A1. The ignition system has:

- two magnetos,
- two spark plugs per cylinder,
- ignition leads, and
- a magneto switch (on the instrument panel).

A2. Allows the magneto to fire at the right time.

A3. The ignition current from interfering with the radio, whole ignition system, magnetos, plugs, and wiring.

Teaching point 2 **Describe the electrical system.**

Time: 10 min Method: Interactive Lecture



Show slide of Figure A-2 to the cadets.

The electrical system includes everything that operates electrically except the magnetos. There is no connection from the aircraft's electrical system to the ignition system.

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The basic electrical system includes:

- a storage battery,
- master switch and battery solenoid,
- starter motor and solenoid,
- generator (or alternator),
- voltage regulator,
- bus bar, and
- circuit breakers.

The electrical system is either a 12- or 24-volt system and is direct current. The battery solenoid activated by the master switch completes the circuit between the electrical energy from the storage battery and the electrical system. The most important action by a pilot is to have the battery fully charged for the electrical components to function satisfactorily.

The starter switch activates the starter solenoid which allows current to enter and drive the starter motor.

The engine drives the generator or alternator for the purpose of providing current to the electrical system, and recharging the battery.



An alternator produces sufficient current to operate the various electrical components at low engine speeds.

A generator will not begin to supply current until the engine is turning at a faster speed.

The voltage regulator is used to prevent the generator or alternator from overloading the system, and the battery from becoming overcharged.

The current produced by the generator or alternator and battery is received by the bus bar which passes the current through the various circuit breakers and branches out to the various electrical circuits.

Circuit breakers or other fuses protect all electrical circuits from damage from excess voltage or current, and short-circuits. Most circuit breakers have a push button to reset. If the circuit breaker continues to fail, there may be malfunction in the component that could cause an electrical fire.

The pilot monitors the electrical system in the cockpit using:

- an ammeter,
- a voltmeter, and / or
- a warning light.

The ammeter measures in amperes the rate of flow of the electrical current being produced and when power is being used by the battery.

The voltmeter indicates the voltage in the electrical system.

The generator warning light shows when the generator is not working.

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If the ammeter is showing on the plus (+) side of 0 on the gauge, there is satisfactory electrical operation.

If the ammeter is showing discharge or minus (-), energy is drawing from the battery rather than from the generator / alternator.

All contacts between the battery, voltage regulator, and the alternator or generator need to be clean and secure. Battery water level should be checked regularly and an aged battery that is no longer working properly should immediately be replaced.

CONFIRMATION OF TEACHING POINT 2

QUESTIONS:

Q1. What is the most important action by a pilot regarding the electrical system?

Q2. What instruments does the pilot monitor?

Q3. What do all the contacts between the battery, voltage regulator, and the alternator or generator need to be?

ANTICIPATED ANSWERS:

A1. Ensure the battery is fully charged.

A2. An ammeter, a voltmeter, and / or a warning light.

A3. To be clean and secure.

END OF LESSON CONFIRMATION

QUESTIONS:

Q1. What is the difference between an alternator and a generator?

Q2. What shall the magneto switch be turned to when the aircraft is parked?

Q3. What is included in the basic electrical system?

ANTICIPATED ANSWERS:

A1. An alternator produces sufficient current to operate the various electrical components at low engine speeds while a generator will not begin to supply current until the engine is turning at a faster speed.

A2. The magneto switch shall be turned to off when the aircraft is parked.

A3. The basic system includes:

- a storage battery,
- master switch and battery solenoid,
- starter motor and solenoid,
- generator (or alternator),
- voltage regulator,

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- bus bar, and
- circuit breakers.

CONCLUSION

HOMEWORK / READING / PRACTICE

Nil.

METHOD OF EVALUATION

Nil.

CLOSING STATEMENT

Being able to describe ignition and electrical systems is important for understanding more complex material. A solid understanding of ignition and electrical systems is required to pursue future aviation training.

INSTRUCTOR NOTES / REMARKS

Cadets who are qualified Advanced Aviation may assist with this instruction.

REFERENCES

C3-116 ISBN 0-9680390-5-7 MacDonald, A. F., & Peppler, I. L. (2000). *From the ground up: Millennium edition*. Ottawa, ON: Aviation Publishers Co. Limited.

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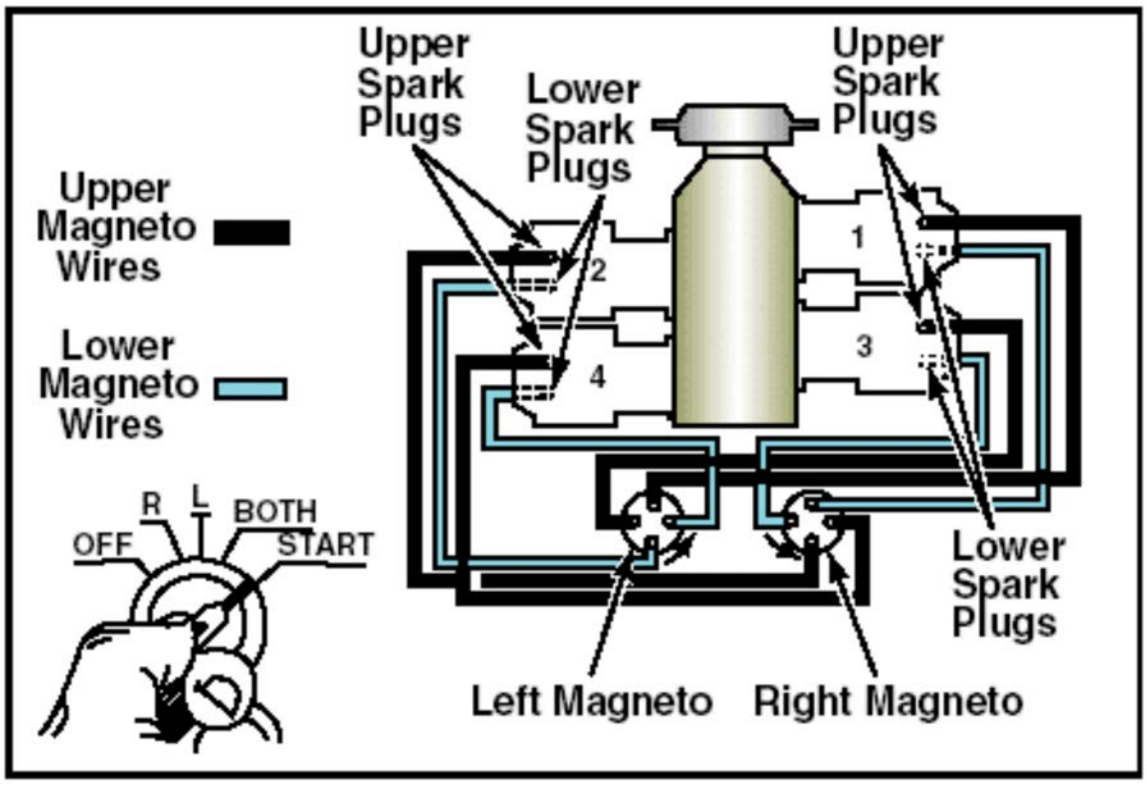

Note. From "Online Free Private Pilot Ground School", The Aircraft Powerplant. Retrieved March 13, 2009, from http://www.free-online-private-pilot-ground-school.com/aircraft-powerplant.html

Figure A-1 Ignition System

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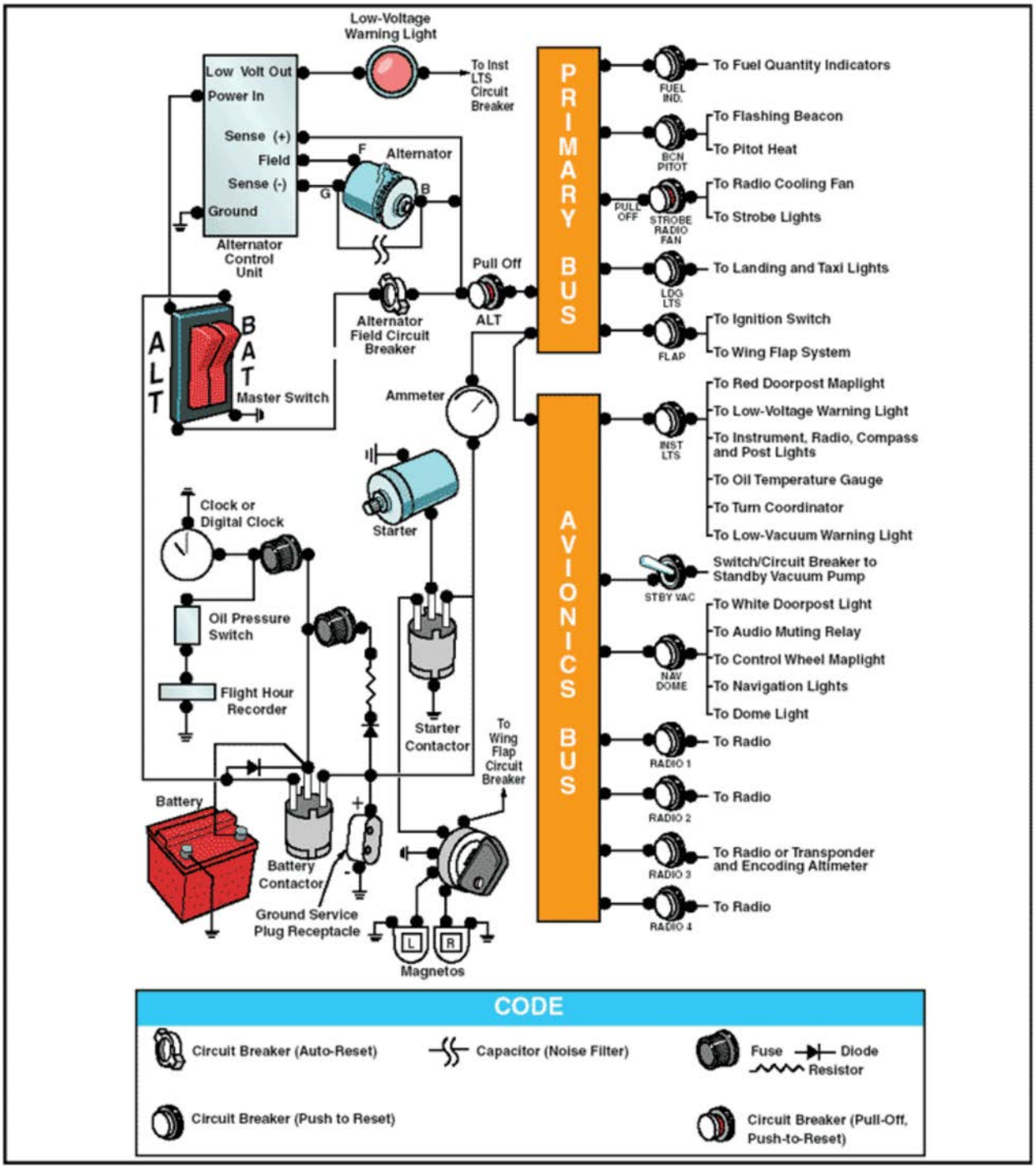

Note. From "Online Free Private Pilot Ground School", The Aircraft Powerplant. Retrieved March 13, 2009, from http://www.free-online-private-pilot-ground-school.com/aircraft-powerplant.html

Figure A-2 Electrical System

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