

Θέμα 1^ο

Aircraft Electrical Systems I

Pre-reading Activity

Answer the following questions.

- What is the function of the aircraft electrical system?
- What do you know about the More Electric Aircraft (MEA) and its use?

Reading 1 (ΜΕΤΑΦΡΑΣΗ)

Now read the text below and check your answers.

The Role of Electrical Power Systems

The function of the aircraft electrical system is to generate, regulate and distribute electrical power throughout the aircraft. New-generation aircraft rely heavily on electrical power because of the wide use of electronic **flight instrument** systems. The use of electrical power to drive aircraft systems and sub-systems that had earlier been driven by hydraulic, pneumatic, and mechanical systems is becoming a dominant trend in the aviation industry. Advances in the areas of power electronics are providing the technology to improve efficiency and safety of aircraft systems operation.

The MEA

The aircraft industry is developing the More Electric Aircraft (MEA) with an ultimate goal of distributing only electrical power across the **airframe**.

“More Electric Architecture helps reduce fuel consumption, increasing overall aircraft performance and energy usage.”

The replacement of existing systems with electric equivalents has and will continue to significantly increase the electrical power requirement. Increasing use of electrical power is seen as the direction of technological opportunity for aircraft power systems based on rapidly evolving advancements in power electronics, **fault tolerant** power distribution systems and electrically driven **actuators**. The use of **More Electric**

Architecture on aircraft offers significant cost benefits with lower recurring costs due to fewer parts, **integration** of key sub-systems and multi-use of components. It also reduces the overall cost of operation and ownership because More Electric Architecture helps reduce fuel **consumption**, increasing overall aircraft performance and energy

usage. Reduced **maintenance** and ground support also help to lower the cost of ownership and operation. The more electric architecture helps reduce

the dependability on engine **bleed air** to drive cabin systems, thereby increasing the **efficiency** of engine operations.

Reading Activity – Comprehension Questions

Read the text again and answer the following questions.

1. What kind of systems preceded the extensive use of electrical power in the aviation industry?
2. According to the text, how can efficiency and safety of aircraft systems operations be improved?
3. What are some of the benefits of the More Electric Architecture? Name at least two benefits.

Word Study

Read the text again and choose the words in bold that mean the following.

Example:

1. The term **airframe** refers to the structural components of an airplane, including the framework and skin of such parts as the fuselage, empennage, wings, landing gear (minus tires), and engine mounts.
2. A mechanism that causes a device to be turned on or off, adjusted or moved. The motor and mechanism that moves the head assembly on a disk drive or an arm of a robot is called a(n)
3. refers to the amount of fuel used up.
4. The act of combining or adding parts to make a unified whole is called
5. The work of keeping something in proper condition is called
6. A system is a system that is capable of providing either full functionality or reduced functionality after a failure has occurred.

7. refers to high pressure air ducted from gas turbine engines to pressurize cabin and other uses (cabin temperature control, deicing & anti-icing, etc.).

Vocabulary Review – Environment Friendly Solution

Fill in the gaps of the following text using the words from the list below.

components	application	propulsion	influence	fuel
manufacturers	hydraulic	reducing	emissions	efficiency

The More Electric Architecture offers tremendous benefits to the environment, compared to other systems. The need for environmental sustainability, **1.**, and economy in aviation is translating into a process for **2.** aircraft weight and refining its systems. Policies like “Clean Skies” have driven aircraft **3.** to move toward manufacturing more efficient and quiet aircraft with reduced **4.** Reduced aircraft weight has a direct **5.** on the fuel consumption of aircraft. Manufacturers have started replacing **6.** and pneumatic systems with electric **7.**, thus, substantially reducing the weight of aircraft. Noise, emissions, and **8.** efficiency benefit from More Electric Systems. Boeing’s new 787 Dreamliner, due in service by 2010, leads the way in the **9.** of more electric technology, and by consequence, its demands for increased electrical power. Beyond 2015, aircraft are moving toward complete electric **10.** fuelled by the advent of fuel cell technology. The value contribution by Electrical Power Systems has increased significantly, contributing to around 14% of the aircraft by value.



Pre-reading Activity

Provide the meaning of the following abbreviations.

- | | | | |
|---------|-------|---------|-------|
| 1. AC: | | 4. GPU: | |
| 2. DC: | | 5. RAT: | |
| 3. APU: | | 6. Hz: | |

Reading 2 (ΜΕΤΑΦΡΑΣΗ)

Read the text below and check your answers.

Electrical Power Uses

As aircraft fly higher, faster and grow larger, the services that the power supply has to satisfy also grow more complex. Both civil and military aircraft have increased power demands for actuators, lighting systems, **avionics** and heating. Aircraft electrical power is used to operate:

- a) Flight Instruments which are used in the control of the direction of flight, **attitude, altitude,** or speed of an aircraft;
- b) Essential systems such as engine, **induction, ignition** systems as well as the fuel, **lubrication,** cooling, electrical, **landing gear,** and environmental control systems to support flight;
- c) Passenger services such as cabin lighting, operation of entertainment systems and preparation of food.

Power Used

Aircraft electrical components operate on many different voltages both AC and DC. However, most of the aircraft systems use 115 volts (V) AC at 400 hertz (Hz) or 28 volts DC. Also, 26 volts AC is also used in some aircraft for lighting purposes. DC power is

generally provided by “self-exciting” generators containing electro-magnetics, where the power is generated by a **commutator** which regulates the output voltage of 28 volts DC. AC power, normally at a phase voltage of 115 V, is generated by an alternator, general-ly in a three-phase system and at a frequency of 400 Hz. Higher than usual frequencies, such as 400 Hz, offer several advantages over lower frequencies (e.g. 60 Hz) – notably in allowing

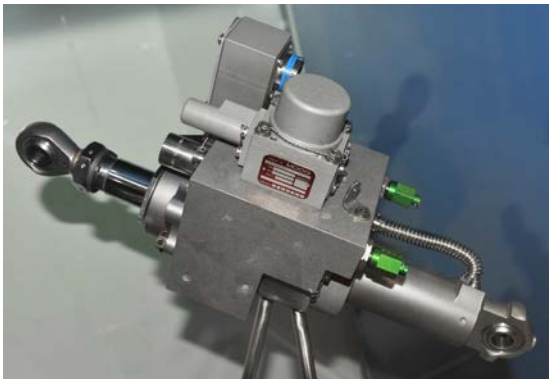
smaller, lighter power supplies to be used for military hardware, commercial aircraft operations and computer applications. As aircraft space is at a premium and weight is critical to aircraft engine thrust and fuel burn (and by consequence to the aircraft range and engine horsepower per pound), 115 volts at 400 Hz offers a distinct advantage and is much better than the usual 60 Hz used in utility power generation.

Power Sources

There are several different power sources on large aircraft to be able to handle excessive loads, for **redundancy**, and for emergency situations. These power sources include:

1. Engine driven **AC generators**. Each of the engines on an aircraft drives an AC generator. The power produced by these generators is used in normal flight to supply the entire aircraft with power.

2. **Auxiliary Power Units (APU)**. Most often the APUs power is used while the aircraft is on the ground during maintenance or for engine starting. However, most aircraft can use the APU while in flight as a backup power source. One exception to this is the Boeing 272, which only allows APU operation in the ground.



🕒 A rudder actuator

3. External power which may only be used with the aircraft on the ground. This system utilizes a **Ground Power Unit (GPU)** to provide AC power through an external **plug** on the nose of the aircraft. GPUs may be either **portable** or **stationary** units.

4. **Ram Air Turbines**: Some aircraft are equipped with Ram Air Turbines, or “RATs”. These may be used, in the case of a generator or APU failure, as an emergency power source. When necessary, the RAT may be deployed to be used as an AC power source.

Aircraft Batteries

The aircraft’s nickel cadmium battery is the final source of backup power. The battery provides 28 volts DC. It is also possible to change the 28 volts DC into 115 volts AC 400 Hz with the use of a static **inverter**. When using the battery, power usage is limited by the short life of the battery.



A smart aileron actuator 🕒

Note: An actuator is a mechanical device for moving or controlling a mechanism or system. It typically is a mechanical device that takes energy, usually transported by air, electric current, or liquid, and converts that into some kind of motion.

Reading Activity 1 – Comprehension Questions

Read the text again and answer the following questions.

1. Which needs does aircraft electrical power satisfy?
2. According to the text, what kind of frequencies allow for smaller and lighter power supplies to be used for military hardware?
3. Which are the four large aircraft power sources that are used for handling excessive loads?

Reading Activity 2 – Photo Identification

Match the aircraft electrical components pictured below with the appropriate label provided in the box. One of these labels is irrelevant.

APU

AC-DC GPU

Ram air turbine

Piper aircraft battery



1.

2.

3.

Word Study 1

Read the text on pages 4-5 again and find words in bold that mean the following.

1. The generation of electromotive force in a closed circuit by a varying magnetic flux through the circuit is called
2. refers to an electrical system, typically powered by a battery or magneto, that provides the spark to ignite the fuel mixture in an internal-combustion engine.

3. A device used to convert direct current into alternating current is called a(n)
4. The refers to the components of an aircraft or a spacecraft that support the weight of the craft and its load and give it mobility on ground or water.
5. An electromechanical device that converts mechanical energy to electrical energy in the form of alternating current is called a(n)
6. In a, three circuit conductors carry three alternating currents (of the same frequency) which reach their instantaneous peak values at different times.

Word Study 2

Circle the answer choices that best complete the following sentences.

1. The introduction of any of various substances between sliding surfaces to reduce wear and friction.
- a.** *ignition* **b.** *lubrication* **c.** *induction*
2. The duplication of critical components of a system with the intention of increasing reliability of the system, usually in the case of a backup or fail-safe.
- a.** *shortage* **b.** *discharge* **c.** *redundancy*
3. The forward-directed force developed in a jet or rocket engine as a reaction to the high-velocity rearward ejection of exhaust gases.
- a.** *thrust* **b.** *drag* **c.** *lift*
4. Something that is not capable of being moved, or that is fixed.
- a.** *stationary* **b.** *portable* **c.** *auxiliary*
5. A cylindrical arrangement of insulated metal bars connected to the coils of a direct-current electric motor or generator, providing a unidirectional current from the generator or a reversal of current into the coils of the motor.
- a.** *gear* **b.** *commutator* **c.** *stator*

- 6.** A fitting, commonly with two metal prongs for insertion in a fixed socket, used to connect an appliance to a power supply.

a. *plug*

b. *coil*

c. *outlet*