Chapter 1  Aircraft Electrical System
Chapter 1 Aircraft Electrical system

- Electrical component
- Storage Battery
- DC & AC Generator
- Control and Protection in DC Electrical System
- Electrical Machine and control
- Lighting
When, Why Electric Energy was used in an aircraft?
Electrical energy is being widely used

- Clean form of energy – absence of smoke, ashes, dust, etc.
- Easily convertible to light, heat, mechanical, chemical energy etc.
- Easily and economically transportable by means of running cables.
• Electrical systems have been an onboard fixture since the Wright Flyer. In those days the role of electricity was limited to the magneto which provides sufficient voltage to spark the fuel/air mixture.
Magnetos still supplied the spark to the engines, but 14- or 28-volt direct-current generator supplied current to operate the navigation and landing lights, the radios. Generators kept the batteries charged to operate the electric motor used to start the engines.
• The years between the two world wars is the golden age of aviation, improved in importance and complexity.
• As the twentieth century ended, electrical systems have become just about equal in importance with the engines.
• For many years, light planes exclusively used the 14-volt electrical system. Starting approximately in the early 1980s, the 28-volt system began to take over light aircraft.

• The primary purpose of igniting the fuel/air mixture is still the domain of the magneto. However, the demand for electrical energy in the airplane has increased tremendously.
• Jet airliners have extremely complex electrical systems and use alternating current as the primary source of electricity.
• Batteries are used for emergency and backup operations and for some special applications.
DEFINITIONS OF AIRCRAFT ELECTRICAL SYSTEM
An electrical system consists of an electrical power source, its power distribution system and the electrical load connected to that system.
A typical aircraft electrical system consists of a primary (main) power source, emergency power source, secondary power conversion equipment, system control and protection devices, interconnection network, and power distribution system.
Electrical Source

The electrical equipment which produces, converts or transforms electrical power.
Some common AC sources are identified as follows:

- AC alternators
- inverters
- transformers
- frequency changers.
Some common DC sources are

- DC generators
- converters
- batteries.
Primary Power Source

A primary source is equipment that generates electrical power from energy other than electrical, and is independent of any other electrical source.
Secondary Source

- A secondary source is equipment that transforms and/or converts primary source power to supply electrical power to either AC or DC powered equipment.
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- A secondary source is equipment that transforms and/or converts primary source power to supply electrical power to either AC or DC powered equipment.
- A secondary source is entirely dependent upon the primary source and is considered part of the load of the primary source.
Emergency Power Source

Civil Aircraft Electrical System
In the event of a primary power source failure, **emergency power** is usually provided from independent auxiliary power unit (APU)-driven generator(s), ram air or hydraulically-driven generator(s), or batteries.
Ground power
A ground power source can be connected to the bus bar distribution system thus allowing all electrical systems to be powered independently of aircraft battery or generating systems. The source can be either a motorised generating unit or a battery unit.
Nominal rating

This rating is usually a continuous duty rating for specified operating conditions.
Condition of Power Sources

• Normal electrical power operation
• Abnormal electrical power operation
• Emergency electrical power operation
Normal electrical power operation

- Normal operating conditions assumes that all of the available electrical power system is functioning correctly within Master Minimum Equipment List (MMEL) limitations (e.g. AC and/or DC Generators, Transformer Rectifier Units, Inverters, Main Batteries, APU etc.).
Abnormal electrical power operation

- Abnormal operation occurs when a malfunction or failure in the electric system has taken place and the protective devices of the system are operating to remove the malfunction or the failure from the remainder of the system before the limits of abnormal operation are exceeded.
Emergency operation is a condition that occurs following a loss of all normal electrical generating power sources or other malfunction that results in operation on standby power (batteries and or other emergency generating source such as an APU or Ram Air Turbine (RAT) only.)
Classification of electrical load

- Vital (critical, emergency)
- Essential
- Non-essential
Typical Aircraft Electrical System

- Primary (main) power source
- Emergency power source
- Secondary power conversion equipment
- System control and protection devices
- Interconnection network
- Power distribution system
As an engineer, we should know the following information:

- Electrical system operation, which describes primary and secondary power sources, bus configuration with circuit breakers and connected loads for each bus. A copy of the bus wiring diagram or electrical schematic should also be considered for inclusion in the report.
As an engineer, we should know the following information

- alternators and other power source description and related data (including such items as battery discharge curves, Transformer Rectifier Unit (TRU), Inverter, APU, RAT, etc.)
# List of Electrical Data

<table>
<thead>
<tr>
<th>IDENTIFICATION ITEM</th>
<th>1 - DC Starter Generator</th>
<th>2 - Inverter</th>
<th>3 - Battery</th>
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<tbody>
<tr>
<td>No. of Units</td>
<td>2</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Continuous Rating (Nameplate)</td>
<td>250A</td>
<td>300VA (Total)</td>
<td>35Ah</td>
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<tr>
<td>5 second Rating</td>
<td>400A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 minute Rating</td>
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<tr>
<td>Voltage</td>
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<td>115VAC</td>
<td>24VDC</td>
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</tr>
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<td>Power Factor</td>
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<td>Manufacturer</td>
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<td>XYZ</td>
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<td>Voltage Reg</td>
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</tr>
<tr>
<td>Frequency Regulation</td>
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<td>400Hz ±1%</td>
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END OF CHAPTER 1