

Aircraft Electrical Systems

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Aircraft Electrical 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

Electrical Power Uses

- Aircraft electrical power is used to operate:
 - Aircraft Flight Instruments
 - Essential Systems
 - Passenger Services

Electrical Power Uses (cont.)

- Essential power is power that the aircraft needs to be able to continue safe operation
- Passenger services power is the power that used for:
 - Cabin lighting
 - Operation of entertainment systems
 - Preparation of food

Power Used

- Aircraft electrical components operate on many different voltages both AC and DC
- However, most of the systems use:
 - 115 VAC @ 400 Hz
 - 28 VDC
- 26 VAC is also used in some aircraft for lighting

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:
 - Engine driven AC generators
 - Auxiliary Power Units
 - External power
 - Ram Air Turbines

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

APU Power

- 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 B272, which only allows APU operation in the ground

External Power

- External power 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

Ram Air Turbine

- 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 final source of backup power
- The battery provides 28 VDC
- It is also possible to change the 28 VDC into 115 VAC 400Hz with the use of a static inverter
- When using the battery, power usage is limited by the short life of the battery



Electrical Power System Components

- AC Generator
- Constant Speed Drive
- Integrated Drive Generator
- Transformer Rectifier Unit
- Generator Control Unit

Constant Speed Drive

- The purpose of the Constant Speed Drive (CSD) is to take rotational power from the engine and, no matter the engine speed, turn the generator at a constant speed
- This is necessary because the generator output must be 400Hz
- CSD Operation
 - The engine turns the CSD which uses a differential assembly and hydraulic pumps to turn the generator

Integrated Drive Generator

- Another method of regulating the generator speed is with the use of an Integrated Drive Generator (IDG)
- An IDG is simply a CSD and generator combined into one unit
- There are two ways to mount the IDG:
 - Co-axially
 - Side-by-side

Transformer Rectifier Unit

- Transformer Rectifier Units (TRUs) are utilized to convert 115 VAC, 400Hz into 28 VDC
- A transformer is used to reduce the voltage from 115 volts to 28 volts
- At this point the 28 volts is still AC current
- To change the current from AC to DC, a rectifier is used
- Each aircraft AC bus feeds a TRU which feeds a DC bus

Other Generator Controls and Monitoring Devices

- A Generator Control Unit (GCU), or voltage regulator, is used to control generator output
- Generator circuit protection monitors electrical system parameters
 - Voltage
 - Frequency
 - Overcurrent
 - Undercurrent
 - Differential Fault

Other Generator Controls and Monitoring Devices

- Load controls sense real system load to provide a signal to the CSD for frequency control
- Current transformers are used for current load sensing and differential fault protection
- The electrical system control panel may be found either on the pilot's overhead panel or on the flight engineer's panel

Function of System Components

- The basic functions of the electrical system's components are to:
 - Generate Power
 - Control Electrical Power
 - Protect the Electrical System
 - Distribute Electrical Power Throughout the Aircraft

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