

This month we continue our study of electrical load analysis, a subset of *wiring systems*. As was explained previously, an electrical load determination is required when installing new equipment into an aircraft or when questions arise as to the state of an electrical system. However, documented procedures for doing this are ambiguous at best. The Repair Station presently uses guidance from the FAA's AC 43.13-1B Change 1 dated 9/27/01. Additionally, pilots are not being adequately trained in electrical load management and it is hoped that improved practices and procedures targeting these shortcomings are forthcoming.

When you stand back and think about it, it is hard to believe that an aircraft is delivered from the factory with no electrical system documentation except the ampere-hours specification of the battery and the generator/alternator rating. No one knows the life of the battery under an abnormal or emergency situation or the period the aircraft may be safely flown under such circumstances. As a matter of fact, we have not even defined what constitutes an abnormal or emergency situation. While we have periodic maintenance for all other systems, the years go by and the suite of electrical equipment is altered with no real electrical system inspection. The solution, in part, is for an electrical system to have an analysis at least once in its life and the results made a part of the aircraft records. This analysis, similar to a weight and balance computation, must be a living document that is updated with every change in the aircraft's source/load parameters.

Fortunately for us, aviation is a global industry and the British Civil Aviation Authority has already addressed many, if not all of these deficiencies through an *Airworthiness Information Leaflet* titled *AIL/0194, Issue 1, 25 March 2004*. This is a well written and thorough document and will be used as a guide in this series. It may be found at [www.caa.co.uk](http://www.caa.co.uk). As mentioned in last month's edition, the first step is to give definitions to concepts and practices that are universally interpreted. We begin now.

## Definitions

**Electrical System** The electrical power source, power distribution and electrical loads.

**Electrical Source** The electrical equipment which produces, converts, or transforms electrical power. Some common AC sources are identified as follows: AC Generators, inverters, transformers and frequency changers. Some common DC sources are DC Generators, converters and batteries. In practice an electrical source could be a combination of these units connected in parallel e.g. a typical AC bus may have both AC generators and inverters connected in parallel.

**Electrical Source – Primary** This is equipment that generates electrical power from energy other than electrical, and is independent of any other electrical source. For example, the Primary source of an AC electrical system may be the main engine-driven generator(s) or Auxiliary Power Unit-driven generator(s). The primary source of a DC electrical system may be a battery, main engine-driven generator(s) or Auxiliary Power Unit-driven generators. There may be both AC and DC Primary power sources in the same aircraft.

**Electrical Source – Secondary** This 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. There may be both an AC and DC Secondary source in the same aircraft.

**Electrical Source – Normal** Is that source which provides electrical power throughout the routine aircraft operation.

**Electrical Source – Alternate** Is a second power source, which may be used in lieu of the Normal source, usually upon failure of the Normal source. The use of alternate sources creates a new load and power configuration, and therefore a new electrical system, which may require separate source capacity analysis.

**Nominal Rating** This is the rating found on the dataplate of the power source. This rating may be considered its continuous duty rating or this value may be lowered for specified operating conditions as explained in FAA AC 43.13-1B.

**Growth Capacity** This is the measure of the power source capacity available to the aircraft electrical system to supply future load equipment. This value is expressed in terms of percent of source capacity.

**Taxi** This is the condition from the aircraft's first movement under its own power to the start of the take-off run and from completion of landing rollout to engine shutdown.

**Take-off and Climb** This condition commences with the take-off run and ends with the aircraft leveling off and set for cruising.

**Cruise** This condition occurs during which the aircraft is in level flight.

**Landing** This condition commences with the operation of navigational and indication equipment specific to the landing approach and following to the completion of the rollout

**Normal Electrical Power Operation (or Normal Operation)** This condition assumes that all of the available electrical power system is functioning correctly within published limitations (e.g. AC and/or DC Generators, Transformer Rectifier Units, Inverters, Main Batteries, Auxiliary Power Unit, etc.).

**Abnormal Electrical Power Operation (or Abnormal Operation)** This condition 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. The power source may operate in a degraded mode on a continuous basis where the power characteristics supplied to the utilization equipment exceed normal operation limits but remain within the limits for abnormal operation.

**Emergency Electrical Power Operation (or Emergency Operation)** This condition occurs following a loss of all normal electrical generating power sources or other malfunction that results in operation on standby power (batteries or other emergency generating source such as an APU or Ram Air Turbine) only. Also may be identified as "operation without normal electrical power".

**Power Factor** The ratio of real power (measured in watts) to apparent power (measured in volt-amperes).

**Electrical Load Analysis (ELA)** An analysis of average and maximum electrical demands under all applicable flight conditions.

**Power Source Capacity (PSC)** An estimate of system capacity (including generator sources, converters, contactors, busbars, etc.) needed to supply the worst case combinations of electrical loads.

**Most Severe Loading Conditions** Assumed to be night, icing conditions.

Next month: more definitions and procedures.