This month we begin a new series on aircraft wiring. A preceding Tech Time series detailed the proper use of wire using the FAA's Advisory Circular AC 43.13-1B *Acceptable Methods, Techniques and Practices for Aircraft Inspection and Repair*. We are now going to expand our coverage by examining electrical wiring from a broader perspective.

SUMMARY

The topic of aircraft wiring has come to our attention due to several high profile airline accidents. The airline industry is addressing the issue through the establishment of FAA/industry working groups. The typical pattern of action is for Part 25 aircraft (and the airlines) to meet new mandates, then work down to Part 25 business and commercial aircraft, and finally to Part 23 aircraft. There is currently a debate about what wiring deficiencies exist in our fleet. What is not questioned is the age of the fleet and the condition of the wiring. We still have aircraft flying with aluminum conductors and most aircraft manufactured through the 1970s have wiring with PVC insulation. There is a growing consensus that we must begin to treat the wiring in an aircraft as an independent *system*, just like communications, navigation, fuel, pneumatic, hydraulic, etc. This is going to be the premise of this series.

How do you verify the serviceability of a wiring system? We currently use the data found in AC 43.13-1B. This information, due to its generalization, leaves much interpretation to the technician. This also leaves much interpretation to FAA Principal Inspectors. The result is a lack of standardization and industry wide compliance. We are going to review and explore one subset of wiring *systems*, that is, electrical load capacity and the corresponding determination of electrical load. Guidelines for technicians and real world examples will be included to make it easier to perform this service.

ELECTRICAL LOAD ANALYSIS

Let us begin by reviewing the FAA's AC 43.13-1B CHG 1 dated 9/27/01, found at www.faa.gov. Paragraphs 11-35 and 11-36 provide the current guidance for the Repair Station.

11-35 ACCEPTABLE MEANS OF CONTROLLING OR MONITORING THE ELECTRICAL LOAD

11-35 a. ***OUTPUT RATING****. The generator or alternator output ratings and limits prescribed by the manufacturer must be checked against the electrical loads that can be imposed on the affected generator or alternator by installed equipment. When electrical load calculations show that the total continuous electrical load can exceed 80 percent output load limits of the generator or alternator, and where special placards or monitoring devices are not installed, the electrical load must be reduced or the generating capacity of the charging system must be increased. (This is strictly a "rule of thumb" method and should not be confused with an electrical load analysis, which is a complete and accurate analysis, which is a complete and accurate (sic) of the composite aircraft power sources and all electrical loads) When a storage battery is part of the electrical power system, the battery will be continuously charged in flight.*

The devil is in the details. Guidance is lacking to tell the Repair Station how to perform electrical load calculations. Do you calculate with all lighting, anti-ice, electrical equipment on, gear and flaps down, transmitting with all transmitters i.e. communications, in-flight weather, sat-com, etc., auxiliary power jacks drawing rated current, and more? Or do you suppose a typical scenario (with perhaps 99% probability) with reduced loading? Where do you measure the electrical load being drawn? Do you measure from the generator/alternator source or at the storage battery that adds capacity for short durations? What special placards and/or monitoring devices specifically allow you to exceed the 80% output load limits prescribed? By how much?

11-35 b. describes the installation of placards to inform pilots of acceptable load/power source combinations and the use of low voltage warning lights.

11-35 c. describes installations where the ammeter is in-line with the battery lead. If such a system is regulated to limit the maximum current and a voltmeter is installed to read the aircraft buss voltage, the system is not considered to be overloaded if the ammeter never reads "discharge" (except for short periods of time) and the voltmeter remains at the system voltage. This paragraph helps establish how to determine acceptable loading but still leaves the question of how much you turn on for the test, how long is a "short period of time" and "system voltage".

11-35 d. describes another method of monitoring loading. ***In installations*** *where the ammeter is in the generator or alternator lead and the regulator system does not limit the maximum current that the generator or alternator can deliver, the ammeter can be redlined at 100 percent of the generator or alternator rating. If the ammeter reading is never allowed to exceed the red line, except for short intermittent loads, the generator or alternator will not be overloaded.* Again we do not know how much equipment to turn on for the test and further, when was the last time these current measuring devices were checked for accuracy? Should these load tests be performed with a calibrated device?

11-35 e. ***Where the use of placards*** *or monitoring devices is not practical or desired, and where assurance is needed that the battery will be charged in flight, the total continuous connected electrical load should be held to approximately 80 percent of the total generator output capacity. When more than one generator is used in parallel, the total rated output is the combined output of the installed generators.*

This is self-explanatory and in line with other guidance. It is left to the technician to quantify "*approximately 80%"*.

11-35 f. ***When two or more generators*** *and alternators are operated in parallel and the total connected system load can exceed the rated output of a single generator, a method should be provided for quickly coping with a sudden overload that can be caused by generator or engine failure. A quick load reduction system or procedure should be identified whereby the total load can be reduced by the pilot to a quantity within the rated capacity of the remaining operable generator or generators.*

This is self-explanatory and in line with other guidance.

11-36. ELECTRICAL LOAD DETERMINATION

The connected load of an aircraft's electrical system may be determined by any one or a combination of several acceptable methods, techniques, or practices. However, those with a need to know the status of a particular aircraft's electrical system should have accurate and up-to-date data concerning the capacity of the installed electrical power source(s) and the load(s) imposed by installed electrical power-consuming devices. Such data should provide a true picture of the status of the electrical system. New or additional electrical devices should not be installed in an aircraft, nor the capacity changed of any power source, until the status of the electrical system in the aircraft has been determined accurately and found not to adversely affect the integrity of the electrical system.

Few acceptable methods, techniques and practices to determine electrical load exist that are universally recognized and within the scope of most Repair Station's capabilities. What is needed is a clarification of concepts and acceptance of specific actions and measurements within the industry.

Next Month: A look at electrical loads.