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Standard
for
**AIRCRAFT DIRECT-CURRENT
APPARATUS VOLTAGE RATINGS**

(Effective July 15, 1947)



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PREFACE

It has been widely recognized that there is a distinct need for preferred voltage ratings for aircraft direct-current electric apparatus which will be generally acceptable to manufacturers and users to serve as a basis for voltage standards for aircraft systems and equipment.

Many difficulties and much confusion will be eliminated by adopting suitable standard voltage ratings for all aircraft electric equipment. These standard voltages should then be made a part of specifications and nameplates marked accordingly. Apparatus should be designed for satisfactory operation over the voltage ranges given in the table, but with performance not necessarily the same as guaranteed at rated voltage. Performance data and acceptance tests should be on the basis of standard voltages.

It is recognized that *special applications* may require operation over other voltage ranges than those shown as standard.

Standardization of voltage ratings for aircraft electric accessories is especially difficult because of the close margins for application of aircraft equipment. Even the designations used to identify various systems have long been a matter of controversy. The great majority of installations in use today utilize 12-cell, lead-plate storage batteries in parallel with the system. This system is designated as a "24 volt system" in spite of the fact that no part of the system normally operates at 24 volts. A "24 volt" motor, if actually designed and tested for operation at 24 volts, may be considerably overloaded when operated from a system maintained at a voltage high enough to keep a 24 volt battery reasonably well charged.

With modern high-capacity electric systems, and with the widespread use of plug-in power facilities at airline terminals, operation from battery power seldom occurs. For this reason, there has been considerable sentiment in favor of designating systems by the nominal value of the regulated voltage. Thus the system using 30 volt generators in conjunction with 12-cell, lead-plate batteries would be designated as a "28 volt system". In this report we have retained the 12 volt and 24 volt nominal designations which have been in use for many years and which agree with the standard values of nominal voltage adopted in ASA Committee C67.

Although the battery represents only a small portion of the available system capacity, its limitations determine the voltages which must be used. System voltage must be high enough to maintain the battery in a charged condition, but not high enough to cause excessive battery heating. Twenty-four volt systems are usually operated at between 27 and 28.5 volts at the point of regulation, and this accounts for the choice of 28 as the nominal system voltage. Voltage is adjusted by setting the generator regulators and the particular value chosen is at least partially dependent on operating conditions. Generators must be capable of 30 volts output over the specified speed range to allow for voltage drops totalling 1½ volts minimum (including the voltage drop in the paralleling resistors, when used) between each generator and its regulated point.

To obtain minimum weight, aircraft system wiring is deliberately loaded heavily and allowance must be made for voltage drop between the regulated point and the electric accessories. Best weight economy dictates the use of higher cable ratings for intermittent loads than for continuous loads. Rated voltage has been selected as 27 volts for continuous-duty devices and as 26 volts for intermittent-duty devices.

Accessories such as engine-starter motors must be capable of operation when the battery is the sole source of power. They must also operate after one or more generators have been paralleled with the battery and in most cases they must be suitable for operation from 30 volt starter trucks. Starters, in particular, require very heavy currents and are designed to operate at voltages of the order of 12 volts at the terminals when drawing power from a 24 volt battery. It does not appear possible to set up standard voltages for starters, as restrictive values would involve weight penalties which would be unacceptable to the users.

Dielectric test voltages for used or repaired equipment are not included in the table, because sufficient information upon which to base a standard is not available. Dielectric test should not be made unless the machine is clean and dry, and, even after thorough cleaning and drying, a used machine cannot be expected to withstand more than a fraction of the original factory test voltage. Testing used equipment at 40 to 50 percent of the test voltage for new machines is rather common practice. Several Army Technical Orders recommend a 220 volt test for 12 and 24 volt generators, or 44 percent of the original test voltage.

These matters have been studied carefully by the AIEE Committee on Air Transportation, and the attached tabulation gives recommended standard voltages for all types of aircraft d-c electric apparatus for which standards appear practical.

The original draft of this proposed standard was prepared by the following subcommittee of the Committee on Air Transportation:

J. D. Miner, Jr., Chairman; J. W. Allen; W. F. Fell; H. J. Finison;
A. D. Gilchrist; F. M. Roberts.

The AIEE Standards Committee takes this occasion to draw attention to the value of suggestions based upon experience gained in the application of the standards to general practice. Any suggestions looking toward improvement in the standards will be welcomed for the guidance of the committee in preparation of future editions, and should be communicated to the Secretary of the AIEE Standards Committee, 33 West 39th Street, New York 18, N. Y.