

Test Code
for
D-C AIRCRAFT ROTATING MACHINES

(Effective January 15, 1953)

(Supersedes March 1947 issue)



Published by
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
33 West Thirty-ninth Street, New York 18, N. Y.

FOREWORD

In May 1929 the Board of Directors of the American Institute of Electrical Engineers gave approval to a proposition calling for the development of test codes for the principal types of electric machinery and apparatus.

In order to determine the performance characteristics of electric machines, methods of testing have been developed and are in common usage. It is the purpose of these test codes to provide in convenient reference form the more generally applicable and accepted methods of conducting and reporting tests of a commercial nature, which apply to the fulfillment of performance guarantees and to acceptance tests. It is not intended that the codes shall cover all possible tests or those of a research nature. It must be recognized that the selection of the most suitable test depends upon local conditions and the degree of precision desired.

This proposed test code was originally issued as AIEE No. 800 in March 1947 for one year's trial use. In 1948 the code was reviewed by the cognizant subcommittee of the Air Transportation Committee and was found to be lacking certain tests in common usage. The code has been expanded to include these tests.

The Committee on Air Transportation takes this occasion to draw attention to the value of criticisms based upon experience. Any suggestions looking toward improvement in this code will be welcome for guidance in the preparation of future editions and should be communicated to Secretary of the AIEE Standards Committee, 33 West 39th Street, New York 18, N. Y.

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ACKNOWLEDGMENT

The Institute wishes to acknowledge its indebtedness to those who have so freely given their time and knowledge and have conducted experimental work on which many of the AIEE Test Codes are based.

The major work of preparing this test code was carried out by a subcommittee of the AIEE Committee on Air Transportation.

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Test Code

of the

American Institute of Electrical Engineers

DIRECT-CURRENT AIRCRAFT ROTATING MACHINES

PURPOSE

1.000 It is the purpose of this code to define uniform acceptable methods of making tests to determine that the performance and other characteristics of d-c rotating machines for aircraft comply with specification and application requirements.

1.001 Rotating equipment for aircraft is subjected to requirements and operating conditions not normally encountered by commercial machines. For example, conditions of temperature, altitude, humidity, and vibration vary over much wider ranges. Aircraft requirements dictate minimum weight, and yet utmost reliability is essential. Weight reduction is generally achieved by sacrifice of life expectancy commensurate with aircraft practices. The necessity for accurate design requires that direct measurements to insure reliability and adequate life be an important part of this test code.

1.002 It is recognized that there may be acceptable methods of making tests other than those described; but such other methods may be considered as alternative procedures accepted by agreement between interested parties. Also, the tests outlined herein are not necessarily complete for any specific machine; and likewise the requirements in each case will determine the number of tests to be made. The intent is to formalize and standardize common testing insofar as practicable and to provide a source for convenient reference by those responsible for supervising test procedures.

SCOPE

1.100 This code covers rotating machines which operate from or are connected to a direct-current system of an aircraft.

STANDARD TEST CONDITIONS

1.200 Unless otherwise specified or required by the type of test, all tests in this code should be made under the standard conditions outlined below. For tests made under other conditions, the actual test conditions should be specifically noted and proper corrections should be made when necessary to reduce the results to equivalent performance under these standard conditions.

1.201 Temperature—Room ambient 30 — 40C.

Blast cooling air (if required)
30 — 40C.

Altitude—Sea Level +3000 ft.
—0 ft.

Humidity—Normal room ambient.

Operating Position—Rotational axis horizontal with base down for base-mounted units and flange in vertical plane for flange-mounted units.

Machine Temperature—Substantially stabilized at a temperature corresponding to operation at the specified load within the machine's rating.

Voltage—Rated value measured at terminals of the machine.

CHARACTERISTICS OF ELECTRIC POWER SUPPLY FOR TESTING

1.300 It is important to ascertain that the voltage at the machine terminals, when checking transient characteristics such as starting inrush, does not drop at any instant below the necessary value. This may best be checked by oscillograph record showing variation of terminal voltage during the test. No numerical value can be assigned to the relative capacity of the power source and that of the machine under test, as this varies over a wide range depending upon the type of machine being tested and the nature of the tests considered necessary to predict satisfactory operation on the systems to which it is to be connected in service.

1.301 In addition to satisfactory starting and running of the machine itself, the effect of transients in the machine upon other electric components connected to the system may require consideration.

1.302 For steady-state tests the power source must be capable of maintaining any desired voltage throughout the full range required. For tests such as radio interference and audio or low-frequency ripple, the characteristics of the power source are generally included in connection with the quantitative performance specifications.

INSULATION RESISTANCE*

1.400 The insulation resistance may afford a useful indication whether or not a machine is in suitable condition for application of the dielectric or other tests; and if, in the case of a new installation or for a machine which has been idle for a period of time, the machine is in suitable condition for service. A high value of insulation resistance is not by itself proof that the insulation does not have cracks or other faults which may cause breakdown upon application of voltage. These faults do not greatly affect the measured value of insulation resistance of a clean dry machine. The insulation-resistance test is often useful as a periodic test of machines in service for detecting weakness in the insulation or an accumulation of moisture or dirt as indicated by a marked decrease in the measured value.

1.401 The insulation resistance is subject to wide variation with temperature, humidity and cleanliness of the parts. When the insulation resistance falls, it can, in most cases of good design and where no defect exists, be brought up to a proper value by cleaning with a suitable solvent, if necessary, and by drying.

1.402 If the machine has been exposed to excessive moisture, it should be dried either by baking at between 75 and 100C or by circulating current in the windings. Should the machine show extremely low insulation resistance, drying out at standstill is advisable. With the application of heat, the insulation resistance will usually decrease rapidly, but as the drying process becomes effective, it will increase finally reaching an approximately constant value. Drying should be continued well beyond the time at which the insulation resistance has started to increase after reaching a minimum.

1.410 Minimum Value of Insulation Resistance—It is difficult to prescribe definite rules for the actual value of insulation resistance of a machine since this varies with type, size, voltage rating, kind and condition of insulating material used, method of construction and the insulation record of the machine. Considerable judgment based upon experience must be exercised to determine whether or not a machine is suitable for service. Periodic records are of value in this determination.

1.411 For all new or reconditioned machines, an insulation resistance of at least 1 megohm is desirable. With old machines in service much lower values may often be obtained.

*Note: Reference AIEE Test Code for Synchronous Machines, No. 503.

1.412 The insulation resistance test should ordinarily be made with all circuits of equal voltage above ground connected together. If the reading for the connected windings shows an abnormally low value, then a local condition for any one winding may be detected by testing each winding separately. The insulation resistance should also be checked, when the circuit permits, between windings which may be energized separately and which may be in close proximity, such as shunt and series windings.

1.413 The insulation resistance may be measured by a self-contained 500 volt instrument such as the direct indicating ohmmeter of the generator, battery or electronic type, with a resistance bridge, or with a milliammeter, a voltmeter and a d-c supply not to exceed 500 volts. As an expedient, where no insulation testing device is available, the test may be made with a high-resistance voltmeter and a suitable d-c supply. The resistance measurement should be taken after the test potential has been applied to the insulation for at least one minute and sometimes several minutes to eliminate the electrification effect in the insulation.

Caution

Care should be taken when using either self-contained instruments or a d-c supply, that the voltage applied to the windings is restricted to a value commensurate with the voltage rating of the winding and the condition of the insulation to be tested.

1.414 The voltmeter method is based on the principle of comparing the current flowing when a fixed d-c voltage is impressed on a known resistance and when impressed on the same resistance in series with the unknown. In the application of the method, the resistance of the voltmeter is the known resistance. The sensitivity of the instrument will have a direct bearing on the values of insulation resistance which can be measured with reasonable accuracy. For the more generally available commercial voltmeters (100 ohms per volt) the application with a 500 volt d-c source should be restricted to measurements of 1 to 2 megohms maximum. The maximum resistance which can be measured at voltages lower than 500 volts is proportionately less. For instruments of higher sensitivity the maximum value of insulation resistance which can be measured is increased in direct ratio to the sensitivity in ohms per volt. The figure describes the circuit arrangement used for these measurements. A reading is first taken across the circuit and then a second reading with the insulation in series with the voltmeter.