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Aerospace series — Testing of aircraft wiring

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National foreword

This British Standard is the UK implementation of EN 2283:2010. It supersedes BS EN 2283:1996 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee ACE/6, Aerospace avionic electrical and fibre optic technology.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Foreword

This document (EN 2283:2010) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2011, and conflicting national standards shall be withdrawn at the latest by June 2011.

This document supersedes EN 2283:1996.

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Introduction

Due to the diversity of aircraft, manufacturing and installing methods for wiring, the tests defined in Clause 1 are carried out at different stages in the manufacturing programme:

— after assembly of cables into bundles before installation in the aircraft;

— after installation of bundles into the aircraft;

— after repairs or modifications.

1 Scope

This European Standard specifies:

— the tests for finished wiring, including connectors and, if necessary, terminals, terminal ends, junction boxes, circuit breakers, etc.;

— these tests do not concern equipment installed in the aircraft (see operation of systems and do not apply to the wiring used instrumentation;

— the requirements for verification of aircraft electrical wiring;

  — continuity of circuits;

  — dielectric strength;

  — insulation resistance.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 2282, *Aerospace series – Characteristics of aircraft electrical supplies*

EN 61557-2, *Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 2: Insulation resistance (IEC 61557-2:2007)*

EN 61557-4, *Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 4: Resistance of earth connection and equipotential bonding (IEC 61557-4:2007)*

ISO 2678, *Environmental tests for aircraft equipment – Insulation resistance and high voltage tests for electrical equipment*

IEC 50 (461), *International Electrotechnical Vocabulary – Chapter 461: Electric cables*[1)]

IEC 50 (581), *International Electrotechnicla Vocabulary – Chapter 581: Electromechanical components for electronic equipment*[1)]

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 50 (461) and IEC 50 (581) apply.

4 Tests

4.1 General

For all the tests, the national safety regulations shall be observed.

These tests may be carried out manually or on automatic equipment. In this case, the equipment operates with programmable sequences and trip thresholds.

The test shall be stopped as soon as a fault is detected, or the fault shall be memorized. The voltage shall increase or decrease in a regular manner to each of the scheduled values and the measurements shall be made after stabilization.

Test equipment is capable of performing the dielectric strength and the insulation resistance tests in a single operation, according to the requirements laid down in Table 2.

4.2 Continuity

The test enables to verify the conformity of cables, bundles and their connections with the design documents.

The direct current or alternating current voltage shall not exceed 28 V.

The Test shall be carried out with equipment according to EN 61557-4.

The value of the current passed shall not cause damage to any part of the circuits.

4.3 Dielectric strength

The test enables to verify the insulation has the operating efficiency to withstand the voltage (limits) given in EN 2282.

The maximum voltage rise or drop during test shall not exceed 500 V per second; this will avoid unintended insulation damage.

When the permitted leakage current is exceeded, the warning or protection system shall operate to avoid damage to the components being tested.

It should be noted that in alternating current tests, the capacitive leakage currents add (vectorially) to the fault currents detected.

After each dielectric strength test, the measurement point shall be grounded in order to discharge the circuit (except when this circuit remains connected to the reference point).

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1) Published by: International Electrotechnical Commission (IEC), 3 rue de Varembé, 1211 Geneva 20, Switzerland.

4.4 Insulation resistance

The test enables to verify the insulation resistance of the wiring is in a proper state to meet the operating efficiency. The voltages used for these measurements are between 50 V and 500 V direct current.

The Test shall be carried out with equipment according to EN 61557-2. The fault current shall not exceed 5 mA (for a short-circuit).

The reading shall not be made until voltage and current stabilization is achieved.

4.5 Test preparation

The conductors and screens of screened or coaxial cables shall be tested in the same way as single core cables, provided they are accessible at both ends.

The screened cable test, with respect to the ground, shall be carried out before the screens are grounded.

The connector shells covered with conducting protection or other conductive supports shall be grounded.

Electronic components housed in junction boxes shall be short-circuited or disconnected.

Connectors, switches, circuit breakers, etc. can be left in circuit provided that they can withstand the test. Otherwise the test voltage shall be decreased.

No equipment shall be connected.

The parts of circuits having already been brought into contact with flammable liquids or hydraulic fluids shall only be tested when the national safety regulations are observed, so as to avoid any risk of explosion or fire.

5 Procedures

5.1 General

The types of wiring, the systems to which they belong and their functions require several categories (see Table 1).

Table 1

Categories	Description
A	All wiring apart from specific cases dealt with under B or C
B	Specific circuits for each type of aircraft to be defined by mutual agreement between manufacturers and authorities
C	Screened wiring, in principle isolated from the ground for tests, before being connected to the ground

Aircraft wiring presenting installation difficulties and wiring that are not complete and require to be finished in the aircraft shall be subject to test and inspection after installation (Table 2, Part II).

Table 2

	Tests	Characteristics	Categories (see Table 1)		
			A	B	C
Part I : Tests after manufacture (prior to installation in aircraft)	**Voltage strength**	–	1 000 V a.c. [a] or 1 300 V d.c.	380 V a.c. [a] or 500 V d.c.	40 V a.c. [a] or 50 Vd.c.
		Minimum application time	1 s	0,1 s	0,1 s
	Minimum insulation resistance	Measuring voltage (± 10 %)	500 V d.c.	500 V d.c.	50 V d.c.
		RH [b] = 70 %	20 MΩ	50 MΩ	10 MΩ
Part II : Tests of assembled bundles (after installation in aircraft)	**Voltage strength**	–	1 000 V a.c. [a] or 1 300 V d.c.	380 V a.c. [a] or 500 V d.c	40 V a.c [a] or 50 V d.c.
		Application time	0,1 s to 1 min	0,1 s to 1 min	0,1 s to 1 min
	Minimum insulation resistance	Measuring voltage (± 10 %)	500 V d.c.	500 V d.c.	50 V d.c.
		RH [b] = 70 %	10 MΩ	20 MΩ	2 MΩ
		RH [b] 70 % to 80 %	5 MΩ	10 MΩ	1 MΩ

[a] Root mean square, frequency 50 Hz to 60 Hz.

[b] Relative humidity.

All the tests for wiring shall take place before the connection of equipment.

Electrical and electronic components connected within the wiring shall not be exposed to voltages and currents, which could damage them (see 4.5).

Dielectric strength and insulation resistance tests shall be carried out between each conductor and any other conductor, and between each conductor and earth (structure). See Table 2 for conditions and requirements.

Tests on pre-assembled wiring shall comply with the requirements in 5.2 and the requirements of Table 2, Part I.

Tests on finished wiring (assembled and installed) shall comply with the requirements of 5.3 and the requirements of Table 2, Part II.

5.2 Testing of wiring in production

5.2.1 Continuity

The test shall be carried out successively on each section of the circuit, suitably established by the control units (switches, isolators, etc.).

The purpose of the test is not to measure possible voltage drop on line, since this is covered by the functional tests (see EN 2282).

5.2.2 Dielectric strength

See Table 2, Part I. The aircraft test specification shall state the value to be applied or the specific circuits to be subjected to the relevant requirements.

The choice of direct current or alternating current can depend on the test devices or national requirements.

The use of direct current is recommended and is necessary where the circuit capacity causes leakage currents affecting measurements.

5.3 Testing of assembled and installed bundles

Perform the tests of 5.2.

The applicability of these tests, either on the complete aircraft or sub-assemblies, and the specific circuits is defined in the aircraft test specification.

The tests are usually carried out by automatic test equipment which, combines the dielectric strength test and insulation resistance measurements.

For tests, which are to be repeated, in-service inspection, repair, etc., the voltage values in Part II of Table 2 shall apply with a possible coefficient of reduction (for example 0,8).

All the conductors affected by modifications or repairs on a wiring shall be tested.

When screens and certain return conductors are finally connected to the aircraft structure, they shall be considered as earth and shall no longer be disconnected. Then they will only be subject to continuity tests.

6 Requirements

No deterioration due to breakdown caused by the insulation material damage or by ionisation shall appear or be detected.

If, because of too high wiring capacity the alternating current dielectric strength test results are not satisfactory, the direct current test is valid.

The insulation resistance values shall be complied with.

7 Test report

It shall include the following data:

— Degree of relative humidity of the environment;

— The values obtained;

— The procedure;

— The test means;

— Defects;

— Possible deviations.

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