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# INTERNATIONAL STANDARD



# 2155

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## Aircraft — Fire-resisting electrical cables — Performance requirements

*Aéronefs — Câbles électriques résistant au feu — Caractéristiques requises*

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**Descriptors** : aircraft equipment, electrical cables, fire resistant equipment, specifications.

## FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up has the right to be represented on that Committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2155 was drawn up by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, and circulated to the Member Bodies in January 1971.

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It has been approved by the Member Bodies of the following countries:

Austria	India	South Africa, Rep. of
Belgium	Israel	Spain
Czechoslovakia	Italy	Thailand
Egypt, Arab Rep. of	Japan	Turkey
France	Netherlands	United Kingdom
Germany	New Zealand	U.S.A.
Greece	Romania	

No Member Body expressed disapproval of the document.

# Aircraft – Fire-resisting electrical cables – Performance requirements

## 1 SCOPE AND FIELD OF APPLICATION

This International Standard gives the performance requirements for fire-resisting electrical cables for the wiring of aircraft circuits, comprising single conductors with copper core covered with nickel or any other material of equivalent properties, suitable for use at a rated voltage up to 600 V and at a frequency not exceeding 2 000 Hz.

The cables are intended for use at a temperature which may reach 280 °C in continuous service (ambient temperature plus heating) and 400 °C for a limited period.

They retain a certain dielectric strength when subjected to a flame of 1 100 °C for 5 min and are suitable for fixed wiring the temperature of which may fall to –75 °C.

## 2 REFERENCES

ISO 1967, *Aircraft – Fire-resisting electrical cables – Dimensions, conductor resistance and mass.*

ISO 2156, *Aircraft – Fire-resisting electrical cables – Methods of test.*

ISO 2574, *Aircraft – Electrical cables – Identification.*<sup>1)</sup>

## 3 TERMINOLOGY

**3.1 conductor** : Conducting portion of a cable.

**3.2 wire** : Cylindrical metallic wire of uniform cross-section, used to form the conductor.

**3.3 stranded conductor** : Conductor composed of a number of wires twisted together. When the conductor consists of more than one layer, alternate layers are twisted in opposite directions.

**3.4 bunched conductor** : Conductor composed of a number of wires in which all wires are twisted together in the same direction.

**3.5 insulation** : Part of a cable which serves to insulate the conductor.

**3.6 primary insulation** : Concentric layers of insulation applied over the conductor.

**3.7 protective sheath; protective covering** : Covering provided for the cable, which is applied over the primary insulation, to ensure its protection against deterioration due to friction caused by a foreign body or to contact with a fluid.

**3.8 metal braid** : A number of wires applied spirally over the insulation and interwoven to form a uniform and substantially continuous covering.

**3.9 cable** : Complete assembly of conductor, insulation and metal braid.

**3.10 sample** : Amount of cable of one and the same dimension and type, taken from a batch.

**3.11 test piece** : Continuous length of cable taken from a sample.

## 4 DESCRIPTION OF THE PRODUCT

### 4.1 Conductor

#### 4.1.1 Material

The wires used for the manufacture of conductors shall be cylindrical, and made of electrolytic copper covered with nickel or any other material of equivalent properties.

#### 4.1.2 Resistance per unit length

The resistance per unit length shall be in accordance with that given in ISO 1967.

#### 4.1.3 Lay

The wires are assembled in strands or in single or cabled bunches. The direction of twist of the wires in the outside layer of the cable shall be in the form of an **S** (direction of the pitch of a left-hand thread).

1) At present at the stage of draft.

The pitch of the lay of the wires in a strand, or in a single bunch, when checked on a sample 1 m (3.3 ft) in length, shall conform to the conditions specified in table 1.

TABLE 1

Nominal diameter of wires forming the conductor	Upper limit of pitch
Up to and including 0,3 mm (0.012 in)	16 times the diameter of the conductor
Over 0,3 mm (0.012 in)	14 times the diameter of the conductor

When the conductor consists of bunches or strands twisted together, the pitch of the lay of a bunch or strand, measured on the outside layer of the conductor, shall not be greater than 14 times the diameter of the conductor. In this case, no conditions apply to the pitch of the wires forming each of the constituent bunches or strands.

4.1.4 Continuity of wires

In principle, the wires constituting the core should be continuous. However, each wire may include joints, which should preferably be effected by brazing.

Alternatively, in the case of wires less than 0,3 mm (0.012 in) in diameter, the joint may be made by twisting the ends together.

There shall not be more than one joint in each 50 m (165 ft) of conductor.

4.1.5 Elongation and breakage of wires

The cable shall be subjected to the test specified in clause 12 of ISO 2156.

4.2 Insulation (Primary insulation)

The primary insulation shall be made of a material which takes on the circular shape of the core, brought into close contact with it but without adhering to it, so that it reduces the corona effect and the risks of blistering and heat corrosion due to pockets or discharges of gas. However, this insulation shall be neither too adherent nor too slippery, in order to afford satisfactory mechanical properties and to be readily stripped off. The corresponding stresses will be given in the appropriate national specifications.

5 DIMENSIONS AND RESISTANCE PER UNIT LENGTH OF CONDUCTORS

The dimensions and resistance per unit length of conductors of finished cables shall be in accordance with ISO 1967, and with the provisions of the relevant specifications.

6 RESISTANCE TO ADVERSE ENVIRONMENTAL CONDITIONS

The finished cables shall be suitable for fixed wiring at temperatures down to -75 °C. They shall be non-hygroscopic and shall be resistant to fluids likely to be encountered on aircraft; they shall not support mould growth. All colours shall be fast to light and moisture even after storage for long periods in the tropics.

7 TESTS

Preferred methods of test are given in ISO 2156.

Proof that the cable covered by this International Standard has satisfactorily passed the various tests specified in clauses 8, 9 and 10 shall be available to the purchaser.

8 TYPE TESTS ONLY

The samples of cable shall successfully pass the following type tests :

- a) fire-resistance test;
- b) hot cutting test;
- c) ageing test;
- d) test for resistance to aircraft fluids;
- e) humidity cycling test;
- f) capillary attraction test;
- g) abrasion test.

9 TYPE TESTS AND ROUTINE PRODUCTION TESTS

Every cable produced shall be subjected to the following tests :

- a) spark test No. 1;
- b) spark test No. 2;
- c) test for resistance per unit length of the conductor or core.

NOTE — With regard to No. 1 and No. 2 spark tests, the national standard should specify which of them is to be applied to the cable.

9.1 Spark test No. 1

The cable, provided with its primary insulation only, shall successfully withstand exposure in a dry state in a fault detector (also known as "SPARKER").

The continuous spark test shall be carried out by means of a device which enables the insulation to be subjected to an a.c. voltage not less than that indicated in table 2 for the cable concerned.

TABLE 2

Nominal cross-section mm <sup>2</sup>	Cable No.	Test voltage (r.m.s. value), frequency 50 to 60 Hz	
		On primary insulation	On finished cable
0,38 to 8,55	22 to 8	3 000 V	6 000 V
13,6 to 107	6 to 0000	4 000 V	8 000 V

## 9.2 Spark test No. 2

During this test, an a.c. voltage of 1 500 V (r.m.s.), 50 to 60 Hz, shall be applied between the core of the cable and the water and maintained for at least 1 min.

## 10 TYPE TESTS AND PRODUCTION QUALITY TESTS

**10.1** The following tests shall be carried out periodically during the production of a batch of cable in order to ensure that the principal properties of the cables are maintained.

A batch shall comprise only cables of the same brand, type and section. The cables may be the subject of separate orders as it is not essential for their manufacture to be continuous in time.

**10.2** It is recommended that the following tests be carried out in accordance with the appropriate national standard:

- wire elongation and breakage test;
- checking of stresses on the insulation specified in 4.2;

- test on the diameter, composition and lay of the conductors;
- weighing test on the finished cable;
- checking of the thickness of the insulation on the finished cable;
- checking of the outside diameter of the finished cable;
- cold coiling test;
- fire-resistance test;
- accelerated ageing test (production quality test only).

## 11 MARKING AND IDENTIFICATION

**11.1** The cables shall be indelibly and continuously marked with the details given in ISO 2574 in the order shown in that document.

**11.2** Each unit of a consignment (reel, coil or drum) shall carry a label giving the following particulars:

- the manufacturer's name;
- the cable designation and the number of the national standard;
- size and composition of the conductor;
- date (month and year) and place of manufacture;
- inspector's reference;
- actual length of each length of cable and total of all lengths.

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