UDC 629.7.065.5 : 621.315.21 : 669.3 : 536.46

Ref. No. : ISO/R 1490-1970 (E)

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION

R 1490

PERFORMANCE REQUIREMENTS FOR HEAT-RESISTING (260 °C) ELECTRICAL CABLES WITH COPPER CONDUCTORS FOR AIRCRAFT

1st EDITION

July 1970

Printed in Switzerland

Also issued in French and Russian. Copies to be obtained through the national standards organizations.

BRIEF HISTORY

The ISO Recommendation R 1490, *Performance requirements for heat-resisting (260 °C) electrical cables with copper conductors for aircraft*, was drawn up by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question led to the adoption of Draft ISO Recommendation No. 1490, which was circulated to all the ISO Member Bodies for enquiry in June 1968. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Belgium	Netherlands	Thailand
Canada	New Zealand	Turkey
Czechoslovakia	Peru	U.A.R.
France	Poland	United Kingdom
Iran	South Africa, Rep. of	Yugoslavia
Israel	Spain	
Italy	Switzerland	

The following Member Body opposed the approval of the Draft :

U.S.S.R.

This Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided to accept it as an ISO RECOMMENDATION.

ISO Recommendation | R 1490 | July 1970

PERFORMANCE REQUIREMENTS FOR HEAT-RESISTING (260 °C) ELECTRICAL CABLES WITH COPPER CONDUCTORS FOR AIRCRAFT

1. SCOPE

1.1 This ISO Recommendation states the requirements for cables for the wiring of aircraft circuits in which the voltage between conductors, or between a conductor and a metal braid or the aircraft structure, does not exceed 600 V (r.m.s.) and in which the frequency does not exceed 1600 Hz. The cables are suitable for use where, in continuous service, no combination of ambient temperature and conductor current produces a stabilized conductor temperature in excess of 260 °C. The cables remain flexible at temperatures down to − 70 °C.

1.2 This ISO Recommendation includes the requirements for cables with copper conductors, including those with an outer covering in the form of a metal braid.

2. TERMINOLOGY

2.1 *Conductor.* Conducting portion of a cable.

2.2 *Wire.* Cylindrical metallic wire of uniform cross-sectional area, used to form the conductor.

2.3 *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.

2.4 *Bunched conductor.* Conductor composed of a number of wires in which all wires are twisted together in the same direction.

2.5 *Rope lay conductor.* Conductor in which a number of groups of wires are assembled in concentric layers. Each group may consist of wires assembled in bunched formation.

2.6 *Insulation.* Part of a cable which serves to insulate the conductor.

2.7 *Core.* Conductor and insulation of a cable, excluding all additional coverings.

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

2.9 *Cable.* Complete assembly of conductor, insulation and metal braid.

2.10 *Sample.* Amount of cable of one and the same dimension and type, taken from a batch.

2.11 *Test piece.* Continuous length of cable taken from a sample.

3. MATERIALS

3.1 Copper wires should be of annealed high conductivity copper having a resistivity not greater than the value fixed for "standard annealed copper" by the International Electrotechnical Commission, I.E.C. Publication 28, *International standard of resistance for copper.*

3.2 Wires for conductors and wires for the metal braid should be coated with nickel.

3.3 The tensile strength and elongation of wires taken from conductors should conform to the appropriate values shown in Table 1, which are based on a gauge length of 254 mm (10 in) held in clamps separated at a rate not exceeding 127 mm (5 in) per minute, the tensile strength being calculated on the original cross-sectional area of the wire.

TABLE 1 – **Tensile tests on wires**

Diameter		Tensile strength		Minimum elongation
mm	in	daN/cm^2	lbf/in^2	%
0.51 to 0.30	0.020 to 0.012	3023 max.	43 000 max.	13.5
0.28 to 0.15	0.011 to 0.006	3094 max.	44 000 max.	9.0

3.4 The materials used for the insulation of the cables should be such that the finished cable will comply with all the requirements of this ISO Recommendation. The materials should be free from ingredients likely to cause staining or discoloration of the cable.

4. CONSTRUCTION

4.1 Conductor

4.1.1 Conductors should consist of a number of wires, bunched, stranded or in rope lay formation. The wire should be of copper, nickel coated and complying with the relevant requirements of section 3.

4.1.2 The complete conductor should not be joined. Individual wires may be joined, preferably by brazing or hard soldering. Not more than one joint should occur in each 50 m of wire.

4.2 Complete cable

4.2.1 The insulation should consist of a combination of layers of polytetrafluorethylene and glass, forming a compact sintered mass, or other materials giving an equivalent performance.

4.2.2 The insulation should be of uniform circular cross section throughout the length of the cable and the conductor should be evenly centred in the insulation.

4.2.3 The insulation should not be loose, but it should be possible to strip the complete insulation, leaving the conductor in a condition sufficiently clean to permit satisfactory connections being made to terminations without further cleaning.

4.2.4 The cables should bear means of identification in accordance with section 11.

4.3 Metal-braided cables

4.3.1 Nickel-coated copper wires complying with the requirements of clause 3.1 should be used to form the overall outer cover of metal-braided cables.

4.3.2 The metal braids should be close fitting, but wherever the cable is cut it should be possible to slide the metal braid back by hand a distance of 100 mm (4 in) in a length of 600 mm (2 ft), one end of the cable being clamped. The metal braid should subsequently be capable of being returned to within 25 mm (1 in) of its original position.

4.3.3 Where breaks in the individual wires occur, the ends should be soldered or tucked out of the braid, and there should not be more than one such break in any 25 mm (1 in) length of cable and in each 10 m of individual wire.

5. DIMENSIONS AND CONDUCTOR RESISTANCE

The dimensions and conductor resistance of the finished cables should comply with ISO Recommendation R 539, *Dimensions and conductor resistance of heat-resisting (260 °C) electrical cables with copper conductors for aircraft,* and with the requirements of the relevant specification.

6. RESISTANCE TO ADVERSE ENVIRONMENTAL CONDITIONS

The finished cables should be suitable for fixed wiring at temperature down to – 70 °C. They should be non-hygroscopic and resistant to fluids likely to be encountered on aircraft; they should not support mould growth. All colours should be fast to light and moisture, even after storage for long periods in the tropics.

7. TESTS

The tests listed below should be in accordance with the relevant national standard for electrical cables for aircraft suitable for operation at stabilized conductor temperatures up to 260 °C.

Preferred methods of test are stated in ISO Recommendation R 1491, *Methods of test for heat-resisting (260 °C) electrical cables with copper conductors for aircraft.* Evidence should be available to the purchaser that cable covered by this ISO Recommendation has satisfactorily passed type tests conducted in accordance with sections 8, 9 and 10. It is not necessarily intended that a type test should be made on every size of cable. The national standard may, subject to the agreement of the national airworthiness authority, permit the division of the range of sizes into groups, tests on one sample being accepted as representative of all of the cables in the group.

In order that a consistent standard of quality be maintained, the manufacturer should conduct production routine tests (see section 9) and production quality tests (see section 10).

8. TYPE TESTS ONLY

Samples of cable should have passed the tests listed in sections 9 and 10 before submission to the following type tests :

(*a*) voltage test at high temperature;

(*b*) resistance to typical aircraft fluids (fuel, hydraulic fluid, lubricating oil, including synthetic ester-based oils, and de-icing fluids);

(*c*) ageing in air at high temperature, followed by an insulation test whilst immersed in water at room temperature;

(*d*) flexibility test at room temperature;

(*e*) bend test at low temperature;

(*f*) surface creepage test while immersed in water.

9. TYPE AND PRODUCTION ROUTINE TESTS

Each length of cable produced should be submitted to the following tests :

(*a*) conductor resistance tests;

(*b*) insulation tests :

(1) all finished cable (except metal-braided cable) should be submitted to a spark test in the dry state. Metal-braided cable should, in the dry state, withstand 2000 V a.c. (r.m.s.), 25 to 100 Hz, applied gradually and maintained for 1 minute between conductor and braid;

(2) the spark test should be made by means of a suitable chain-electrode device that will subject the insulation to an impressed a.c. voltage not less than the value shown in Table 2.

TABLE 2 – **Spark test**

Size	Nominal conductor area	Test voltage (r.m.s.), frequency 25 to 100 Hz
22 to 4	0.38 to 21.6 mm^2 inclusive	6000 V
2 to 0000	33.9 to 107 mm^2 inclusive	8000 V

10. TYPE AND PRODUCTION QUALITY TESTS

10.1 The following tests should be made periodically during the manufacture of a batch of cable in order to establish that certain important physical qualities are being maintained. It is recommended that such tests should be made on each 10 000 m of cable or at least once during each period of two months' production, whichever is the less.

10.2 Two samples taken at random, one sample being of the smallest size produced, should be subjected to the tests listed below. Should either of the samples fail any one of the tests, the tests should be repeated on four further samples taken at random. Should any one of these samples fail, the batch should be deemed not to comply with this ISO Recommendation.

(*a*) Insulation test on the core, consisting of a voltage test followed by an insulation resistance test, applied after immersion in water (distilled water should not be used) for not less than twelve consecutive hours. The core should withstand a voltage of 2000 V a.c. (r.m.s.), 25 to 100 Hz, applied gradually between the conductor and the water and maintained at the value for 15 minutes. The insulation resistance, measured after 1 minute's electrification at 500 V d.c., should be not less than 100 MΩ per 1000 m.

(*b*) Flammability test.

(*c*) Abrasion test.

(*d*) Tensile and elongation tests on conductor wires.

(*e*) Tests of coating of conductor wires and braid wires.

(*f*) Test of stability of the insulation.

11. MARKING AND IDENTIFICATION

11.1 Identification of type and size of cable

The cable should be indelibly marked with the cable type and size as listed in ISO Recommendation R 539, *Dimensions and conductor resistance of heat-resisting (260 °C) electrical cables with copper conductors for aircraft.*

11.2 Identification of manufacturer

The cable should have, along its length, means of identification of the manufacturer and year of manufacture. Each length of cable after testing should also bear a label giving the following particulars :

(*a*) name of manufacturer;

(*b*) designation of cable and national specification number;

(*c*) conductor size and stranding;

(*d*) date (month and year) and place of manufacture;

(*e*) inspector's reference;

(*f*) actual length of cable.

Date of the first printing :
August 1970

Price based on 5 pages