

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION R 1491

METHODS OF TEST
FOR HEAT-RESISTING (260 °C) ELECTRICAL CABLES
WITH COPPER CONDUCTORS FOR AIRCRAFT

1st EDITION

July 1970

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Printed in Switzerland

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

BRIEF HISTORY

The ISO Recommendation R 1491, *Methods of test 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. 1491 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	Italy	Switzerland
Canada	Netherlands	Thailand
Czechoslovakia	New Zealand	Turkey
France	Peru	U.A.R.
Iran	South Africa, Rep. of	United Kingdom
Israel	Spain	Yugoslavia

No Member Body opposed the approval of the Draft.

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

METHODS OF TEST
FOR HEAT-RESISTING (260 °C) ELECTRICAL CABLES
WITH COPPER CONDUCTORS FOR AIRCRAFT

1. SCOPE

This ISO Recommendation describes the tests suitable for establishing the compliance of heat-resisting (260 °C) electrical cables with copper conductors for aircraft with the performance requirements stated in ISO Recommendation R 1490, *Performance requirements for heat-resisting (260 °C) electrical cables with copper conductors for aircraft*. They are intended for use as a basis for specifying tests in the relevant national specifications where the national type approving authorities consider that existing tests are inadequate.

The tests are classified as follows :

- I. Type tests only.
- II. Type and production routine tests.
- III. Type and production quality tests.

I. TYPE TESTS ONLY**2. VOLTAGE TEST AT HIGH TEMPERATURE**

- 2.1 The object of this test is to check that the cable is able to withstand voltages expected in service, even when at a high temperature and the insulation is in a mechanically strained condition.
- 2.2 Five turns of cable should be wound on, and retained in close contact with, a metal mandrel, the diameter of which is ten times the maximum specified diameter of the cable for sizes 22 to 10 and fifteen times the diameter of the cable for sizes 8 to 0000.
- 2.3 The assembly should be placed in an air oven, the temperature of which should be raised slowly to a temperature within the range 311 to 316 °C. After 120 hours at this temperature, a voltage of 1500 V (r.m.s.) should be applied between the conductor and the mandrel for cables that are not metal braided, and between the conductor and the metal braid where a metal braid is incorporated. The cable should withstand this voltage for 30 minutes without signs of electrical failure.

3. RESISTANCE TO TYPICAL AIRCRAFT FLUIDS

- 3.1 The object of this test is to check that the cable will not be affected in such a way as to cause failure in service, or undue difficulties in servicing, by any of the fluids with which it is likely to come into contact on modern aircraft.
- 3.2 Separate cable samples should be bent into a loop of a diameter approximately six times the overall diameter of the cable and each immersed in one of the following fluids, with the ends 38 mm (1 1/2 in) above the surface of the fluid, for not less than 24 hours, at a temperature such as is likely to be experienced in service by the particular fluid :
 - (a) aviation fuels;
 - (b) lubricating oils (including ester-based oils);
 - (c) hydraulic fluids (including ester-based hydraulic fluids);
 - (d) de-icing fluids.
- 3.3 At the conclusion of this period each sample should be removed from the fluid, allowed to cool to a temperature of $20 \pm 5^{\circ}\text{C}$ and wiped twice with a clean cloth.

After this treatment the samples should comply with the following conditions :

- (a) when examined by normal vision there should be no signs of splitting, cracking or other deterioration;
- (b) the overall diameter should not have increased by more than 5 %;
- (c) the cable identification should remain effective.

4. AGEING IN AIR AT HIGH TEMPERATURE FOLLOWED BY AN INSULATION TEST WHILE IMMersed IN WATER

- 4.1 The object of this test is to check that there is no cracking of the outer coverings of the cable after heating and that the cable will not break down electrically due to displacement of the conductor resulting from deformation of the insulation at high temperature.
- 4.2 Two specimens of cable should be bent into U loops, each with an internal diameter ten times the maximum specified diameter of the cable for sizes 22 to 10 and fifteen times the diameter of the cable for size 8 and larger. The specimens should then be placed in an air oven at a temperature within the range 311 to 316°C for 120 hours. At the conclusion of this period the specimens should be removed from the oven and should show no signs of splitting or cracking when examined by normal vision. Discoloration of the cable should not be deemed a failure but the printing and phase identification on the cable should remain legible.

The specimens of cables that are not metal braided should then be immersed in water at $20 \pm 5^{\circ}\text{C}$ for 5 minutes with the ends protruding 100 mm (4 in) above the surface and whilst thus immersed, they should withstand, without breakdown, 1500 V (r.m.s.), applied gradually and maintained for 1 minute between the conductor and the water. Metal braided cables should be tested between the conductor and the metal braid without immersion in water.

5. SURFACE CREEPAGE TEST WHILE IMMersed IN WATER

- 5.1 The object of this test is to check that there is no significant current leakage at the terminations of the cable even under moist conditions where wicking might occur.
- 5.2 A 760 mm (30 in) length of cable should have the insulation removed 25 mm (1 in) at each end, care being taken not to fray the end of the insulation. The cable should then be immersed in water at a temperature of $50 \pm 2^{\circ}\text{C}$ for 24 hours with the ends of the insulation protruding 38.1 mm (1 1/2 in) above the surface of the water and with a current limiting resistance of $75\,000\,\Omega$ inserted in the circuit. At the end of that period, while the cable is still immersed, a voltage of 1400 V d.c. should be applied between the conductor and the water for 1 minute. The leakage current flowing should not exceed 0.2 mA.

6. BEND TEST AT LOW TEMPERATURE

- 6.1 The purpose of this test is to check that no constituent parts of the cable will crack under conditions of severe flexing at temperatures down to -70°C . The test is not necessarily applicable to cables of size 4 and larger.
- 6.2 A test piece of the cable 300 mm (12 in) long, should be stored in air at a temperature of $-75 \pm 1^{\circ}\text{C}$ for a period of 6 hours, immediately after which it should be wound on a mandrel. The mandrels used in the test should be of metal and should be allowed to cool to the specified temperature with the cable. The diameter of the mandrel should be ten times the maximum specified diameter of the cable. The rate of bending should be uniform at one complete turn each second. A revolving mandrel should be used.
- After 1 minute and with the cable still on the mandrel there should be no signs, to normal vision, of cracking of the constituent parts.

7. FLEXIBILITY TEST AT ROOM TEMPERATURE

- 7.1 The object of this test is to check that none of the constituent parts of the cable will crack during the flexing which is likely to be experienced during installation or service.
- 7.2 A test piece of the complete cable should be wound on a mandrel at a temperature of $20 \pm 5^{\circ}\text{C}$ under a tensile load of 2.3 daN (5 lbf) for cables of sizes 22 to 1 and 4.5 daN (10 lbf) for cables of sizes 0 to 0000, into a close helix, the internal diameter of which is three times the maximum specified overall diameter of the cable for sizes 22 to 10 and six times the maximum specified diameter of the cable for sizes 8 to 0000.
- 7.3 The complete test should comprise five test cycles, each cycle consisting of the winding of the cable on the mandrel, unwinding and rewinding in the reverse direction so that the surface of the cable inside the helix during the first winding is on the outside of the helix upon rewinding. No part of the cable should show signs of damage after this test.

II. TYPE AND PRODUCTION ROUTINE TESTS

8. CONDUCTOR RESISTANCE TESTS

The maximum values should be in accordance with ISO Recommendation R 539, *Dimensions and conductor resistance of heat-resisting (260°C) electrical cables with copper conductors for aircraft*.

9. INSULATION TESTS

The cable should be subjected to insulation tests in accordance with section 9, paragraph (b), of ISO Recommendation R 1490, *Performance requirements for heat-resisting (260°C) electrical cables with copper conductors for aircraft*.

III. TYPE AND PRODUCTION QUALITY TESTS

10. ELECTRICAL TESTS

The cable should be subjected to electrical tests in accordance with clause 10.2, paragraph (a) of ISO Recommendation R 1490.

11. FLAMMABILITY TEST

- 11.1 Five lengths of cable should be bent into U loops, the internal diameters of which are six times the maximum specified diameter of the cable, and immersed, one in each of the fluids listed in clause 3.2, at the appropriate temperature, for 15 minutes with the cable ends out of the liquid. At the conclusion of this period the samples should be removed from the fluid, straightened and wiped with a clean cloth to remove surplus fluid.
- 11.2 Each test piece should then be supported horizontally in a draught-free chamber and the hottest point of a vertical 76 mm (3 in) non-luminous flame with a blue cone 25 mm (1 in) high * should be arranged to impinge on the central portion of the specimen for 15 seconds. During the test no flaming particles should fall from the cable. After the source of the flame has been removed, the cable should meet the following requirement :
- (a) the cable should cease to burn within 10 seconds;
 - (b) the total length burned or charred should not exceed 76 mm (3 in).

12. ABRASION TEST

- 12.1 The abrasive tape used in the test is of the greatest importance as the test results can only be compared if the tapes used are new and of essentially the same characteristics. For this reason it is recommended that the tapes and weights used in the test should be as specified in the relevant national specification.
- 12.2 The test piece should be clamped in the abrasion test apparatus described in the Annex and the appropriate weight applied to the saddle. Starting with a graphite band under the cable, the tape should be drawn across the cable. When the next band passes the cable the indicator lamp should not light. The test should be made four times and after each test the test piece should be moved 76 mm (3 in) towards one of the clamps and rotated through 90° in the same direction.

13. TENSILE AND ELONGATION TEST ON CONDUCTOR WIRES

Wires from the conductors of the cables should comply with clause 3.3 of ISO Recommendation R 1490.

14. COATING OF WIRES

Compliance with requirements for the nickel coating of the conductors and braid wires should be checked by inspection as required by the relevant national specifications.

15. STABILITY OF INSULATION

A 2 m (6 ft) length of cable should be stored in an oven at a temperature of $275 \pm 5^\circ\text{C}$ for 1 hour. At the end of this time it should be examined for any retraction of any part of the insulation. Any such retraction should not exceed 3 mm (1/8 in) total (the sum of the retractions at the two ends of the cable).

* 9.5 mm (3/8 in) Bunsen burner.