

Specification for

General requirements for aircraft electrical cables

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Foreword

This British Standard has been produced to specify those requirements which are common to all Aerospace Series Electrical Cables in the metric range. Reference is made to this standard in the following British Standards for aircraft metric cables:

BS G...., *Tersil type electrical cables*¹⁾.

BS G...., *Efglas type electrical cables*¹⁾.

BS G...., *Nyvin type electrical cables*¹⁾.

BS G...., *Minyvin type electrical cables*¹⁾.

BS G...., *Fepsil type electrical cables*¹⁾.

The specification may also be invoked in specifications, drawings or contracts for other types of aerospace electrical cables.

This standard makes reference to the following British Standards:

BS 3G 100, *General requirements for equipment in aircraft — Part 2: All equipment — Section 3: Environmental conditions*¹⁾.

BS 1154, *Vulcanized natural rubber (high quality)*.

BS 2627, *Wrought aluminium for electrical purposes. Wire*.

BS 2782, *Methods of testing plastics*.

BS 6004, *PVC-insulated cables (non-armoured) for electric power and lighting*.

BS 6360, *Copper conductors in insulated cables and cords*.

BS 6746, *PVC insulation and sheath of electric cables*.

BS 6746C, *Colour chart for PVC insulation and sheath of electric cables*.

NOTE Information concerning SI units is given in BS 350, “*Conversion factors and tables*”, and PD 5686, “*The use of SI units*”.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 24 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

¹⁾ In course of preparation.

1 General

1.1 Scope

This British Standard specifies a number of requirements applicable to aircraft general purpose cables from which requirements for specific cables may be selected for inclusion in the relevant individual cable detailed specification.

1.2 Definitions

(May be inserted by subsequent amendment.)

1.3 Materials

1.3.1 Copper and copper alloy conductors, wires and strips. Copper conductors and wires shall, as applicable, be in accordance with the requirements of BS 6360. The conductors only shall comply with the tensile test requirements stated in 2.32. Copper alloy conductors and wires shall, before stranding, satisfy the requirements of the individual cable specification.

Nickel coated conductors or wires shall be coated to the thickness stated in the individual cable specification, and shall also comply with the requirements of 2.34 and 2.36.

Silver plated conductors or wires shall be coated to the thickness stated in the individual cable specification, and shall also comply with the requirements of 2.34 and 2.37.

Copper strip shall comply with the requirements of the individual cable specification.

Tinned conductors or wires shall comply with the tinning tests specified in BS 6360.

1.3.2 Aluminium and aluminium alloy conductors and wires. Aluminium conductor wires shall, before stranding, comply with the requirements of BS 2627. Wires taken from the stranded or bunched conductor shall comply with 2.34. Aluminium alloy conductors and wires shall, before stranding, satisfy the requirements of the individual cable specification.

The hardness of the conductor wires shall be as specified in the individual cable specification.

NOTE Certain types of crimped terminations may not be suitable for use on conductors made from material in the 3/4 or fully hard condition.

1.3.3 Insulation. The insulation shall be as specified in the individual cable specification and shall be of such quality that the finished cable complies with all the requirements of this British Standard and the individual cable specification.

1.3.4 Glass braid. The free alkali content of glass braid shall not exceed 1 %. The glass shall be of such quality that the finished cable complies with all the requirements of this British Standard and the individual cable specification.

1.3.5 Outer covering. Outer covering materials such as sheath and tape shall be in accordance with all the requirements of this British Standard and of the individual cable specification. The material used shall be free from ingredients likely to cause staining or discoloration of the cable.

1.4 Construction

1.4.1 Conductors. The conductor shall comprise the number and diameter of wires which shall be bunched, stranded or rope stranded as specified in the individual cable specification. The material of the wires and their coating shall also be as specified in the individual cable specification.

There shall be no kinks or other irregularities in the complete conductor.

1.4.1.1 Joints in single copper wires shall be brazed or hard soldered and there shall be not more than one such joint in each 50 m of wire. The complete conductor shall not be joined, and joints in single wires shall not be within 300 mm of any other joint in the same layer.

1.4.1.2 In aluminium conductors the ends of individual wires may be tucked into the conductor.

1.4.2 Complete cable

1.4.2.1 The details of construction shall be in accordance with the requirements of the individual cable specification.

1.4.2.2 Insulation and other coverings shall be applied to give a circular cross section; they shall not be loose but it shall be possible to strip them to allow satisfactory termination.

1.4.2.3 The finish of the cable shall be such that it is capable of being printed satisfactorily with the cable identification in accordance with 1.8, and with the appropriate circuit identification.

1.5 Phase identification

Where required by the purchaser, phase identification shall be provided on the cables by means of a helical stripe of left-hand lay, in the colours red, yellow or blue. The colours shall match reasonably those shown in BS 6746C.

The width of the stripe shall be as follows:

Sizes 24 to 12	3 ± 1.5 mm
Sizes 10 to 0000	5 ± 1.5 mm

The length of lay for all sizes shall be 10 mm minimum and 38 mm maximum.

1.6 Colour fastness

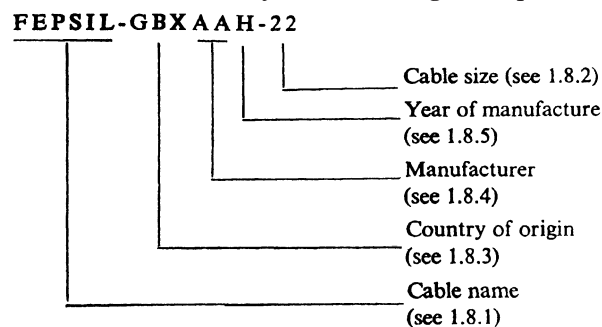
All colours used in the manufacture of the finished cable shall be fast to light and moisture, and shall match reasonably those shown in BS 6746C. The materials used shall be capable of retaining their colours after storage for long periods in the tropics.

1.7 Metal and glass braids

The formulae for calculating braiding details shall be as shown in Appendix A.

1.8 Cable identification²⁾

The cable shall be identified by its name and size, together with code letters to indicate country of origin, manufacturer and year of manufacture in the manner shown by the following example:



NOTE The use of the code letters GBX is intended to take effect not later than 1 January 1978. In the meantime the code letter “G” is still acceptable.

This nomenclature shall be applied to the cable in the manner specified in the individual cable specification. It shall be permanent and legibly printed, on the cable and shall, unless otherwise specified, be black and repeated at a spacing of 150 mm to 500 mm.

The horizontal axis of the characters shall preferably be parallel to the axis of the cable.

The height of the characters on cable sizes 10 to 24 shall be approximately two thirds of the maximum cable diameter, and on cable sizes 8 to 0000 shall be as applied to size 10 cables. All letters shall be capitals.

1.8.1 Cable name. The cable name shall be that required by the individual cable specification. Abbreviations of the name shall only be those permitted by the individual cable specification.

1.8.2 Cable size. The cable size shall correspond with conductor requirements stated in the individual cable specification.

1.8.3 Country of origin. The code letter for the country of origin of the cable shall be “GBX” for cables manufactured in the United Kingdom.

NOTE The use of the code letters “GBX” is to take effect not later than 1 January 1977. In the meantime the code letter “G” is still acceptable.

1.8.4 Manufacturer’s code letters. The manufacturer shall not mark the cable itself with his name or address, but with code letters in accordance with the list of manufacturers’ identification marks for aircraft electrical cables stated in Appendix B.

1.8.5 Year of manufacture. This character in the nomenclature shall be a letter, selected from Table 1, to indicate the year of manufacture. All manufacturers shall use the same letter for the current year, which shall be the year in which the insulation was extruded (or sintered in the case of PTFE).

1.9 Designation of the cable

For the purposes of references on drawings and orders, the cables shall be designated by the individual cable specification number, together with the individual cable name, and size and, if relevant, the phase colour or colours; e.g.

BS G .../Uninyvin 22

BS G .../Minyvinmetsheath 14

BS G .../Unitersil 16/blue.

BS G .../Duefglas 12/red/yellow.

1.10 Packaging and labelling

Unless otherwise stated in the individual cable specification or contract the cable shall be supplied in a single nominal length of 100 m on a reel or drum.

Where several shorter lengths are permitted, the number of lengths and actual length(s) shall be stated. Cable shall not be supplied in coils unless required by the contract.

After testing, the cable shall have its ends sealed to prevent the ingress of moisture.

Each reel or drum shall bear a durable label upon which the following particulars shall be plainly and permanently printed:

- 1) name of manufacturer;
- 2) name and size of cable (see 1.8.1 and 1.8.2);
- 3) formation of conductor, e.g. 37/0.2 mm;
- 4) the individual cable specification number and year of issue;
- 5) date of manufacture, i.e. year and month;
- 6) release reference number or contract number, or both;
- 7) actual length in metres.

²⁾ Conforms to ISO 2574.

If the manufacturer so desires, the information may be written, provided a permanent ink is used and the characters are legible. The label may be attached permanently to the side of the reel or drum by adhesive or staples, or may be a tie-on label with one side blank.

2 Tests

2.1 General

Tests shall be made to prove compliance with the relevant requirements of this British Standard and also the individual cable specification. It is not intended or recommended that all tests be made on all or every cable length supplied.

“-met” and “-metsheath” cables may, where permitted by their individual specifications, be made from the basic “uni-” cable and shall satisfy the requirements of further tests.

The manufacturer shall produce evidence to the satisfaction of the Approving Authority³⁾ that cables of the types to be supplied to the specifications fulfil the requirements.

The manufacturer shall also disclose to the purchaser and the Approving Authority any proposal to introduce constructions or processes differing from those used for the cable submitted to type tests, and shall obtain the written approval of the Approving Authority before applying the change to production.

Three types of test are specified, as follows:

1) *Type tests.* Type tests selected as appropriate from the following tests and as specified in the individual cable specification shall be made on separate specimens from a sample selected by the manufacturer from each group of cable types and sizes stated in the individual cable specification. A sample shall be regarded as being representative of all cables in its group, provided that they are made by the same process and with the same materials within the group from which it is selected:

In Group 1 the cable tested shall be the smallest size it is proposed to manufacture.

2) *Production routine tests.* Production routine tests selected as appropriate from the following tests and as required by the individual cable specification shall be made to every length of cable.

3) *Production quality tests.* Production quality tests selected as appropriate from the following tests and as specified in the individual cable specification shall be made on each batch of 100 km of cable, or at least once on each two months' production, whichever is the less. A batch of cable may consist of different sizes and types but, wherever possible, the sample should be representative of the sizes and types being produced.

Tests for the coating of the conductor or braiding copper wires, in accordance with **2.35**, **2.36** and **2.37**, shall normally be made on the wires before manufacture of the cable, and shall be applied with the frequency stated above. The Approving Authority may, however, require these tests to be applied to conductors taken from the finished cable.

Two samples of cable or core as required by the test shall be selected from the production batch, one sample being of the smallest size produced. Specimens from each of these samples shall each be subjected to the specified production quality tests excepting the tests for tinning of metal braids (**2.35**) the nickel plating test (**2.36**), and the silver plating test (**2.37**). Should either of the samples fail any one of the tests, the test shall be repeated on specimens from four further samples taken at random but including two samples of the smallest size produced. Should any one of these samples fail, the batch shall be deemed not to comply with the specification.

4) *Current rating test.* Current rating tests shall be made in accordance with Appendix F on all new designs of cable manufactured after the publication of this amendment, and each cable manufacturer shall show compliance with the current rating data⁴⁾ in the individual cable specification. Once compliance has been established by a manufacturer, it shall not be necessary for that manufacturer to repeat the tests unless there has been an alteration in the dimensions of the cable or in the basic materials of design: a change in process or in the place of manufacture within a manufacturing organization (which normally entails a repetition of those type tests that the approving authority considers critical) shall not entail a repetition of the current rating tests.

³⁾ For cables for aircraft to British Civil or Military airworthiness requirements, the approving authorities are the Air Registration Board (through a Design Authority approved by the Board) and the Ministry of Aviation Supply respectively.

⁴⁾ For the cable manufacturer, these figures are to be regarded as minima. For the cable user, these figures are to be regarded as maxima.

The ratings in the individual specifications were based on commercial frequencies. If the cables are used to the limit of the maximum frequency declared, corrections for skin effect may be necessary.

2.2 Check voltage

At the conclusion of each of the tests specified in 2.4, 2.10, 2.13 and 2.14, each specimen of cable (excepting “-met” and “-metsheath” cables) shall be immersed in water at room temperature for 5 minutes with 100 mm at each end protruding above the surface and, whilst thus immersed, it shall withstand, without breakdown, a voltage as stated in the individual cable specification, and of waveform as specified in 2.21, applied gradually and maintained for 1 minute between the conductor and the water. Metal braided cables shall be tested between the conductor and the metal braid without immersion in water.

2.3 Voltage at high temperature

Five turns of cable shall be wound on a metal mandrel, the diameter of which is 10 times the maximum specified diameter of the cable for sizes 24 to 10, and 15 times the diameter of the cable for sizes 8 and larger.

The assembly shall be placed in an air oven, the temperature of which shall be slowly raised to the temperature specified in the individual cable specification. After the specified time at this temperature a voltage as stated in the individual cable specification, and of waveform as specified in 2.21, shall be applied between the conductor and the mandrel. “-met” cables may have the voltage applied between the conductor and the metal braid. The cable shall withstand this voltage without signs of electrical failure, for the period of time stated in the individual cable specification.

2.4 Resistance to fluids

Five test specimens shall be bent into single “U” loops, each with an internal diameter as stated in the individual cable specification. The specimens shall be immersed each in one of the fluids listed in Table 2 with the ends 40 mm above the surface of the fluid and maintained at the temperature required by the individual cable specification for not less than 24 hours.

At the conclusion of this period each cable shall be removed from the fluid, and either of the two following procedures shall be adopted, as required by the individual cable specification:

1) Allow to cool to room temperature and wipe twice with a clean cloth. Each sample shall be subjected to a check voltage test (see 2.2), and then be examined by normal vision for compliance with 2.4.1.

2) Straighten each sample, wipe clean and allow to cool to room temperature. Within 1 hour after straightening, the cable shall be bent through 360° around a mandrel of the same diameter as the original loop, and in the same direction as the original bend. The specimen shall be kept on the mandrel for 1 minute and then unwound, subjected to a check voltage test (see 2.2), and then examined in accordance with 2.4.1.

2.4.1 Each sample shall be examined by normal vision for compliance with the following requirements:

- 1) There shall be no signs of splitting, cracking or other deterioration.
- 2) When the cable is cut through cleanly at the middle of the immersed portion, there shall be no significant shrinkage or looseness, or fraying of outer braid, either at the cut ends or at the outer ends.
- 3) The insulant shall not have formed blisters.
- 4) If a polyethylene terephthalate tape is used in the cable construction, this tape shall show no signs of deterioration.
- 5) The sheath shall show no signs of deterioration. A change in colour may be disregarded.
- 6) The change in overall diameter shall not exceed the values given in the individual cable specification.
- 7) The cable identification shall remain effective, but a change in colour may be disregarded.
- 8) The phase identification, where appropriate, shall remain effective.