

Specification for

Nyvin type electrical cables for aircraft

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Contents

	Page
Foreword	iii
1 Scope	1
Section 1. Requirements	
2 Materials	1
3 Construction	2
4 Fastness of colours of cables	3
5 Cable size identification	3
6 <i>Deleted</i>	3
7 Nomenclature of cable	3
8 Packing and labelling	3
Section 2. Tests	
9 General	4
10 Voltage test	4
11 Resistance to fluids	4
12 Ageing in air	5
13 Surface creepage test	5
14 Low temperature test	5
15 Heat test	6
16 Flexibility	6
17 Climatic test	6
18 Melting point of Nylon	7
19 Properties of PVC insulation	7
20 Abrasion test	8
21 Test for pliability (Sizes 22 and 20)	8
22 Construction	8
23 Voltage test on core	8
24 Insulation resistance test on core	9
25 Spark test on core	9
26 Voltage test on completed cable	9
27 Conductor resistance test	9
28 Identification, packing and labelling	9
29 Flammability test	9
30 Mechanical strength of wires from conductors	9
31 Tinning test	9
32 Properties of PVC insulation	12
Appendix A Classification and identification of Pren and Nyvin cables	16
Appendix B Maximum current ratings for Nyvin and Nyvinal cables	17
Appendix C	18
Appendix D Abrasion testing machine	19
Appendix E Pliability test apparatus	20
Figure 2 — General arrangement of cable abrasion tester	19
Figure 3 — View of cable abrasion tester showing detector rolled and wire with top weights removed	20
Figure 4 — Details of abrasion mechanism of cable abrasion tester	20
Table 1 — Details of Uninyvin cables	10
Table 2 — Details of Uninyvinal cables	11
Table 3 — Details of Nyvinmet and Nyvinmetsheath cables	12
Table 5 — Resistance of fluids	12
Table 6 — Diameters of mandrels and test loads for bend tests	13

	Page
Table 7 — Diameters of mandrels and test loads for flexibility test	13
Table 8 — Abrasion test weights	14
Table 9 — Pliability	14
Table 10 — Electrical tests on cores and cables	14
Table 11 — Voltage test on completed metal-braided cables	14
Table 12 — Flammability test	15
Table 13 — Tensile tests on wires from conductors	15

Foreword

This British Standard represents a revision of BS E 24, prepared to bring that standard into line with the current requirements of the aircraft industry for general purpose electrical cables, and to embody changes shown to be desirable by experience of the production of cables in accordance with the first edition of BS E 24, issued in December 1957 and amended in April 1958 (PD 2989) and in May 1959 (PD 3360). It is published as BS G 177 in accordance with the policy of bringing together in one series all British Standards relating to aircraft electrical equipment.

The standard provides only for cables suitable for aircraft use at stabilized conductor temperatures up to 105 °C, introduced into BS E 24 by PD 3360 under the designation "Type A." They are distinguishable from "Type B" cables with a limiting temperature of 90 °C, provided for in the first edition of the standard, with black size markings, by the use of red markings on copper cables and of yellow markings on aluminium cables.

As a consequence of the revision, the standard no longer provides for Uninyvin¹⁾ 24 cable. Uninyvin 22 cable has the same overall dimensions as Uninyvin 24, and any small saving of weight achievable by the use of the latter cable would be likely to be outweighed by the additional cost involved. Supplies of Uninyvin 24 cable for replacement purposes may be obtained by ordering to the amended 1957 edition of BS E 24.

Other changes introduced are:

- a) provision for Uninyvin and Uninyvinal cables marked with coloured tracers for the purposes of phase identification, and for the supply of two or three such cores twisted together to form Dunyvin and Trinyvin, or Dunyvinal and Trinyvinal cables;
- b) minor changes in the limits on the diameters of conductors of Uninyvin 10 and Uninyvin 14 cables;
- c) the relation of the requirements for aluminium conductors to BS 2627 instead of BS 2791, and the specification of a maximum tensile strength for aluminium wires taken from finished cable;
- d) a modification of the climatic test cycles
- e) conditioning of specimens before submission to the low temperature, flexibility and flammability tests;
- f) changes in the mandrels and weights for the flexibility test;
- g) an improved method of checking Nyvinmetsheath cables for freedom from protruding ends of wire;
- h) a change in the method to be used for the heat test, and its requirement as a type test only;
- j) the addition of details of an abrasion test as a type test.

Because the standard defines the materials to be used in the cables, it has not been considered necessary to include a test for the emission of smoke upon heating.

The relevant requirements of the standard are in agreement with those adopted as a basis for ISO Recommendations for the dimensions, conductor resistance and performance of general purpose electrical cables with copper conductors for aircraft, in course of preparation by the International Organization for Standardization.

¹⁾ The various combinations of the word "Nyvin" used to distinguish these cables were originated by the Royal Aircraft Establishment of the Ministry of Aviation.

The standard requires reference to the following:

British Standards

BS G 100, *General requirements for electrical equipment and indicating instruments for aircraft*²⁾.

BS G 212, *General requirements for aircraft electrical cables*.

BS 7, *Rubber-insulated cables and flexible cords for electric power and lighting*.

BS 872, *Abrasive papers and cloths (technical products)*.

BS 2571, *Flexible polyvinyl chloride (P.V.C.) extrusion compounds*.

BS 2627, *Wrought aluminium for electrical purposes (wire)*.

BS 2746, *P.V.C. insulation and sheath of electric cables*.

PD 2379, *Register of colours of manufacturers' identification threads for electric cables and cords*.

Ministry of Aviation specification

D.T.D 1085, *Climatic testing of airborne instruments and equipment*.

NOTE The values in British units are to be regarded as the standard. Where metric equivalents are given they are approximate and for information only. In Table 1, Table 2 and Table 3 such equivalents are shown only for the more essential features of the cables, i.e. the nominal conductor areas, the overall diameters of the finished cables, and the weights of the cables. Equivalents of other values in these tables and more accurate conversions of the metric values which are quoted should be based on the tables in BS 350.

Obsolescent (by Amendment No. 4)

The need for the continuance of this British Standard has been reviewed and it has been decided that it should be regarded as obsolescent. Its use for new designs is not therefore recommended. The standard will be withdrawn in due course.

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 20 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.

²⁾ In course of revision.

1 Scope

a) This British Standard states the requirements for “Nyvin” type cables for aircraft wiring. The cables are suitable for use in circuits in which the voltage between conductors, between a conductor and a metal braid surrounding it and between a conductor and the aircraft structure nowhere exceeds 600 volts r.m.s, and in which the frequency does not exceed 1 600 c/s.

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 105 °C. They are suitable for fixed wiring in aircraft at temperatures down to – 75 °C, but are not suitable for severe flexing at temperatures below – 30 °C.

The cables do not support combustion but they do not comply with the requirements of BS G 100 in respect of fire resistance.

The cables are suitable for use in areas where ester-base fluids are present.

b) The generic name “Nyvin” is applicable only to cables covered by this British Standard and complying with all its requirements.

c) The standard includes the following ranges of cables:

- i) *Nyvin*. Cable with a copper conductor and an insulation of PVC compound and glass braid with an outer protective covering of nylon.
- ii) *Nyvinal*. Similar to the Nyvin range but with a conductor of aluminium instead of copper.
- iii) *Nyvinmet*. Similar to the Nyvin range but with the addition of a metal braid.
- iv) *Nyvinmetsheath*. Similar to the Nyvin range but with the addition of a metal braid and a sheath comprising a polyester film tape, a nylon fibre or ribbon braid, nylon lacquered, to prevent abrasion in installations where Nyvinmet cable is in contact with cables without a metal braid.
- v) *Dunyvin*, *Trinyvin*, *Dunyvinal* and *Trinyvinal*. Two- or three-core cables consisting of two or three single Nyvin or Nyvinal cables twisted together.

d) The cables are classified and identified by a series of numbers indicative of the conductor cross-sectional area. The numbers correspond to those used for equivalent American cables. An indication of the relationship between this system of identification and that provided by BS E 21, “*Pren type electric cables for aircraft*,” is given in Appendix A for information. The maximum current ratings for Nyvin and Nyvinal cables are quoted in Appendix B.

Section 1. Requirements

2 Materials

a) *Copper conductors and wires*. Copper conductors and wires shall be in accordance with BS 7, as far as applicable. Wires taken from conductors, but not from braids, shall meet the requirements for maximum tensile strength and minimum elongation at break specified in Clause 30 of this British Standard.

b) *Aluminium conductors and wires*. Aluminium wires shall be three-quarter hard and, before stranding, shall comply with the requirements of BS 2627 as far as applicable. Aluminium wires taken from the stranded or bunched conductor shall comply with the tensile and wrapping test requirements of Clause 30 of this British Standard.

NOTE Certain types of crimped termination may not be suitable for use with conductors made from material in the three-quarter hard condition.

c) *PVC insulation*. The PVC insulation shall be a white, high temperature grade insulation of such quality that the finished cable complies with all the test requirements of this British Standard.

d) *Glass braid*. The free alkali content of the glass shall not exceed one per cent. The glass shall be of such quality that the finished cable complies with all the test requirements of this British Standard.

e) *Nylon braid and lacquer*. The nylon braid shall be in the form of twisted fibres or ribbon. The nylon braid and lacquer shall be free from ingredients likely to cause staining or discoloration of the cable, and the braid shall be of such quality that the finished cable complies with all the test requirements of this British Standard.

f) *Nylon sheath*. The nylon shall be stabilized, colourless and transparent and free from ingredients likely to cause staining or discoloration of the cable. It shall be of such a quality that the finished cable complies with all the test requirements of this British Standard.

Specimens of the nylon sheath removed from the finished cable shall comply with Clause 18.

g) *Polyester film tape*. The tape shall be of such quality that the finished cable complies with all the test requirements of this British Standard.

3 Construction

- a) *General*.
- i) *Conductor*. The conductor shall be bunched, stranded, or rope stranded, as specified. It shall consist of tinned annealed copper wires complying with the requirements of Clause 2 a) or of aluminium wires complying with the requirements of Clause 2 b). Joints in single copper wires shall be brazed or hard soldered but there shall be not more than one such joint in each 50 yards or 50 metres of wire, and the complete conductor shall not be joined. In aluminium conductors the ends of the wires may be tucked into the conductor. There shall be no kinks or other irregularities in the conductor.
- Table 1 and Table 2 state the number and diameter of individual wires and the formation to be used for the complete conductor.
- ii) *Complete cable*. The insulation adjacent to the conductor shall consist of a white PVC compound as specified in Clause 2 c). The insulation shall be of uniform circular cross-section throughout the length of the cable and the conductor shall be evenly centred in the insulation.
- The insulation shall not be loose, but it shall be possible to strip the complete insulation, leaving the conductor in a condition sufficiently clean to permit satisfactory connection to terminations.
- The radial thickness at any point in the wall of the PVC compound shall be not less than the values given in Table 1 and Table 2.

A glass fibre braid, uncoloured unless otherwise specified in this British Standard, shall be applied over the PVC insulation. The braid shall be closely woven and of uniform surface. The number of spindles and ends per spindle shall be such as to ensure that the filling factor is not less than 0.70. The lay factor for the different sizes of cable shall not be less than the following:

Cable size	Lay factor
22	1.5
20	1.5
18	1.5
16	2.0
14	2.25
12 and larger	3.0

The formulae to be used for calculating the above details are given in Appendix C.

Cables Uninyvin 22 to Uninyvin 12 shall have an outer protective covering of a concentric nylon sheath. Cables Uninyvin 10 to Uninyvin 0000 and all Uninyvinal cables shall have an outer protective covering of a nylon braid coated with clear nylon lacquer. Alternatively, all sizes may have an outer covering of braided nylon ribbon coated with a clear nylon lacquer.

Cable size shall be identified by the method stated in Clause 5.

- b) *Uninyvin cables*.
- i) The cables shall consist of single cores complying with the requirements of Clauses 2 a), 2 c), 2 d), 2 e) or 2 f) and 3 a).
- ii) When required by the purchaser, phase identification shall be provided on the cables by tracers, in the colours red, yellow or blue, with a left-hand lay, from two adjacent spindles in the outer braid. The colours shall match reasonably those specified in BS 2746. Such cables shall be identified for ordering purposes by the addition to the cable nomenclature of the word “red,” “yellow” or “blue” as appropriate.
- c) *Uninyvinal cables*.
- i) The cables shall consist of single cores complying with the requirements of Clauses 2 b), 2 c), 2 d), 2 e) and 3 a).
- ii) When required by the purchaser, phase identification in accordance with b) ii) shall be provided on the cables.

d) *Uninyvinmet cables*. The cables shall consist of Nyvin cables to which has been added an overall metal braid. Tinned copper wires, as specified in Clause 2 a), shall be used to form the metal braid. The braid shall be close fitting, but wherever the cable is cut it shall be possible to slide the metal braid back by hand a distance of 4 in (102 mm) in a length of 2 ft (60 cm), one end of the cable being clamped. The braid shall subsequently be capable of being returned to within 1 in (25.4 mm) of its original position.

Where breaks in the individual wires occur, the ends shall be soldered or tucked out of the braid and there shall not be more than one such break in any 1-inch (25.4 mm) length of cable, or in each 10 yards or 10 metres of individual wire.

Where renewal of the spindles is necessary, the ends shall be tucked out of the braid, and there shall not be more than one spindle renewal in any 12-inch (30 cm) length of cable.

There shall be no joints in the complete braid.

The diameter of wire used shall be as stated in Table 3. The number of spindles and ends per spindle shall be such as to ensure that the filling factor is not less than 0.70. The lay factor shall not exceed 3. The formulae to be used for the calculation of the above details are given in Appendix C.

e) *Uninyvinmetsheath cables*. The cables shall consist of Uninyvin cables, with or without the cable size identification, to which has been added a metal braid in accordance with the requirements of d). The cables shall be sheathed overall by the application successively of polyester film tape, nylon fibre or ribbon braid, and a coating of clear nylon lacquer. The sheath shall not be loose but it shall be possible to remove it without damaging the metal braid.

The overall dimensions of the cable shall comply with the values given in Table 3.

The cable size identification shall be applied to the finished cable by the method stated in Clause 5.

f) *Dunyvin, Trinyvin, Dunyvinal and Trinyvinal cables*. The cables shall consist of two or three Uninyvin or Uninyvinal cables of the same size, with phase identification in accordance with Clause 3 b) ii) in the combinations stipulated by the purchaser. The cables shall be assembled from Uninyvin or Uninyvinal cables for which the manufacturer has type approval, the cores being twisted together with a right-hand lay approximately $12\frac{1}{2}$ times the pitch circle diameter for sizes 22 to 4 and of approximately 16 times the pitch circle diameter for sizes 2 to 0000.

4 Fastness of colours of cables

All colours shall be fast to light and moisture. The materials used shall be capable of retaining their colours after storage for long periods in the tropics.

5 Identification

The system of identification shall be that specified in 1.8 of BS G 212³⁾.

The cable name shall be Nyvin, Nyvinal, Nyvinmet, Nyvinmetsheath, Dunyvin, Trinyvin, Dunyvinal or Trinyvinal as appropriate. The printing shall be in red on Nyvin cables and in black on Nyvinal cable.

6 Deleted.

7 Nomenclature of cable

For the purposes of references on drawings and orders the cables shall be identified by the number of this British Standard, together with the individual cable name, and, if relevant, the phase colour or colours, e.g.:

“BS G 177/Uninyvin 22”

“BS G 177/Uninyvinmet 10”

“BS G 177/Uninyvin 16/black”

“BS G 177/Dunyvin 12/red/yellow”

8 Packing and labelling

The length of cable, in one piece and on a separate coil, reel or drum shall be 100 yards (90 m), or as stated on the contract.

After testing, the cable shall have the ends sealed to prevent the ingress of moisture. Each length shall bear a linen label giving the following particulars:

- Name of manufacturer.
- Name of cable, e.g. Uninyvin 22.
- Size of conductor, e.g. 19/006.
- British Standard number and year of issue.

³⁾ The system of identification specified in 1.8 of BS G 212 is intended to take effect not later than 1 January 1979.