

OBSOLESCENT
NOVEMBER 1978

Specification for

Fepsil type electric cables with copper conductors

UDC 629.7.064.5:621.315.211

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

BSI
Documents

AVA

Document Sharing Hub

This British Standard, having been approved by the Aerospace Industry Standards Committee, was published under the authority of the Executive Board of the Institution on 30 January 1969

© BSI 01-2000

The following BSI reference relates to the work on this standard:
Committee reference ACE/6
Draft for comment 67/31277

ISBN 0 580 00424 4

Amendments issued since publication

Amd. No.	Date of issue	Comments
620	October 1970	
1099	January 1973	
2751	November 1978	Indicated by a sideline in the margin

Contents

	Page
Foreword	iii
1 Scope	1
Section 1. Requirements	
2 Materials	1
3 Construction	1
4 Colour fastness	2
5 Cable size identification	3
6 Identification of manufacturer and year of manufacture	3
7 Designation of cable	3
8 Packing and labelling	3
Section 2. Tests	
9 General	3
Type tests only	
10 Voltage test at high temperature	4
11 Ageing in air	4
12 Surface creepage test	5
13 Low temperature test	5
14 Heat test	5
15 Flexibility test	5
16 Abrasion test	5
17 Simulated installation test	5
18 Climatic test	6
Type and production routine tests	
19 Construction	6
20 Spark test on core	6
21 Spark and voltage tests on completed cable	6
22 Conductor resistance test	7
23 Identification, packing and labelling	7
Type and production quality tests	
24 Voltage test on core	7
25 Insulation test on core	7
26 Heat cycling test	7
27 Resistance to fluids	7
28 Resistance to hot kerosene	8
29 Shrinkage test	8
30 Flammability test	8
31 Fire resistance test	8
32 Tensile and elongation tests on wires from conductors	9
33 Visual inspection of wires	9
34 Tinning test	9
35 Test for nickel plating of conductors	9
Appendix A Maximum current rating for Fepsil cables	14
Appendix B	15
Appendix C Abrasion testing machine	16
Appendix D Dimensions of ferrule for hot kerosene test	18
Figure 1 — General arrangement of cable abrasion tester	16
Figure 2 — View of cable abrasion tester showing detector roller and wire with top weights removed	17

	Page
Figure 3 — Details of abrasion mechanism of cable abrasion tester	17
Figure 4 — Detail of ferrule	18
Table 1 — Details of Unifepsil cables	10
Table 2 — Details of Unifepsilmet cables	11
Table 3 — Details of Unifepsilmetsheath cables	11
Table 4 — Thickness of nickel on copper conductors	11
Table 5 — Letters for the identification of the year of extrusion of the silicone rubber	11
Table 6 — Resistance to fluids	12
Table 7 — Flammability test times	12
Table 8 — Tensile tests on wires from conductors	12
Table 9 — Abrasion test weights	12
Table 10 — Electrical tests on cores and cables	13

Foreword

This British Standard relates to cables for use at operating temperatures higher than those for which Nyvin and Minyvin cables complying with BS G 177 and BS G 195 respectively are suitable. It is comparable with Tersil cable to BS G 189 except for the outer sheath. At temperatures above 105 °C certain types of termination may be unsatisfactory on the cables. The cable will withstand one short period of 1 100 °C.

The cables are resistant to all liquids encountered on aircraft including ester based hydraulic fluids and ester based lubricating oils, (and splash conditions from high-test peroxide). Owing to the exposure of the silicone rubber insulation at a cut end, there is a tendency for it to absorb kerosine, resulting in the swelling of the rubber and a tendency for it to burst open the protective covering. The ends of the cable should therefore, if possible, be kept away from areas where they will be exposed to kerosine. Where this cannot be done special protection should be provided on installation.

It is important that the fluorinated ethylene propylene (FEP) sheath is not damaged or wrinkled during installation and therefore special care should be taken when fitting the cable through fireseals, pressure bungs, conduits, etc. A small amount of an approved lubricant may be used to assist these operations. Minimum bend radius should not be less than 10 times the cable diameter.

Where circuit identification markings are required to be printed by the aircraft manufacturer, special care should be taken to control the temperature and pressure of the printing operation to ensure the production of a clear print without damaging the FEP sheath.

The relevant requirements of the standard are in agreement with those adopted as a basis for recommendations for the dimensions, conductor resistance and performance of heat-resisting electrical cables for aircraft, in course of preparation by the International Organization for Standardization.

The standard makes reference to the following British Standards:

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

BS 381C, *Colours for specific purposes*.

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

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

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 The values in imperial 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, "*Conversion factors and tables*".

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 18 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 Scope

1.1 This British Standard specifies the requirements for “Fepsil” type cables for aircraft wiring of circuits where the potential between conductors, or between a conductor and metal braid, or between a conductor and the aircraft structure, does not exceed 600 volts (r.m.s.) and the frequency does not exceed 1 600 Hz, and where any combination of ambient temperature and conductor current for continuous service does not produce a stabilized conductor temperature in excess of 190 °C. The cables are suitable for fixed wiring in aircraft at temperatures down to – 75 °C, but are not suitable for severe flexing at temperatures below – 55 °C. The cables do not support combustion and comply with the Grade A fire resistance requirements of BS 2G 100-2.

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

1.3 The standard includes the following ranges of cables:

- 1) *Fepsil*. Cable with a nickel plated copper conductor and composite insulation of silicone rubber, glass or glass and polyethylene terephthalate, and fluorinated ethylene propylene (FEP).
- 2) *Fepsilmet*. Similar to the Fepsil range with the addition of a metal braid.
- 3) *Fepsilmetsheath*. Similar to the Fepsilmet range but with the addition of an external sheath of FEP.
- 4) *Dufepsil* and *Trifepsil*. Two-core or three-core cables consisting of two or three Fepsil cables twisted together.

1.4 The cables are classified and identified not by current ratings, but by a series of numbers indicative of the conductor cross sectional area. These numbers correspond to those for equivalent American cables. The maximum current ratings for Fepsil cables are quoted in Appendix A.

Section 1. Requirements

2 Materials

2.1 Copper conductors and wires. Annealed copper wire shall be in accordance with BS 6360 as far as applicable. The wire for conductors shall be nickel coated and shall comply with the requirements of Clause 33 and Clause 35. They shall also comply with the tensile and elongation requirements of Clause 32.

The wires for metal braiding shall be tinned and shall comply with the tinning tests specified in BS 6360, where applicable.

2.2 Insulation. The insulation shall be of silicone rubber of such a quality that the finished cable complies with all the requirements of this British Standard.

2.3 Glass braid. The glass used for the braids shall be of such quality that the finished cable complies with all the test requirements of this British Standard. The glass shall be uncoloured, and its free alkali content shall not exceed one per cent.

2.4 Fluorinated ethylene propylene sheath. The fluorinated ethylene propylene (FEP) used shall be of such a quality that the finished cable meets all the test requirements of this British Standard.

3 Construction

3.1 Conductor. The conductor shall be stranded, bunched, or rope stranded as specified in Table 1. It shall consist of nickel-plated copper wires complying with the requirements of 2.1. Joints in single wires shall be brazed or hard soldered but the complete conductor shall not be joined, and joints in single wires shall not be within 12 in (300 mm) of any other joint in the same layer.

Table 1 states the number and diameter of individual wires and the formation to be used for the complete conductor. The resistance of the insulated conductor, measured as specified in Clause 22, shall not be greater than the values given in Table 1.

3.2 Insulation. The insulation adjacent to the conductor shall consist of silicone rubber of uniform circular cross-section throughout the length of the cable, and the conductor shall be evenly centred in this material. The diameter over the silicone rubber shall not be less than the value given in Table 1.

A glass fibre braid shall be applied over the silicone rubber insulation. If desired by the manufacturer, a lapped polyethylene terephthalate tape may be interposed between the silicone rubber and the glass braid. The braid shall be closely woven and of uniform surface. The number of spindles and ends per spindles shall be such as to ensure that the filling factor is not less than 0.70. The formula used for calculating the filling factor is given in Appendix B. To prevent “wicking” along the glass braid in service, the glass braid shall be treated with a suitable saturant which matches reasonably “Verdigris Green” colour reference No. 280 in BS 381C. 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 connections to terminations.

3.3 Protective covering. The protective covering of the cable shall consist of an extruded sheath of fluorinated ethylene propylene (FEP), such that the cable meets all the requirements of this British Standard. For Unifepsil cables this sheath shall be clear. The sheath shall be free from holes, bubbles and blisters. The radial thickness of the sheath shall be within the limits given in Table 1 and Table 3. The cable size shall be identified by the method stated in Clause 5.

3.4 Unifepsil cables. The cables shall consist of single cores complying with the requirements of Clauses 2 and 3. The dimensions of the cables shall be in accordance with those stated in Table 1.

When 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 specified in BS 6746. Such helical stripes may be applied directly to the impregnated glass braid or the clear extruded FEP sheath.

Cables to be so identified shall be ordered by the addition to the cable nomenclature of the word “red”, “yellow” or “blue”, as appropriate (see Clause 7).

The width of stripe shall be:

Fepsil 22 to $12 \frac{1}{8} \pm \frac{1}{16}$ in (3.2 ± 1.6 mm)

Fepsil 10 to $4 \frac{1}{16} \pm \frac{1}{16}$ in (4.8 ± 1.6 mm)

and the lay for all sizes shall be 1 in (25.4 mm) minimum, $1 \frac{1}{2}$ in (38.1 mm) maximum.

3.5 Unifepsilmet cables. The cables shall consist of Unifepsil cables to which have been added a metal braid. Tinned copper wires, as specified in 2.1, shall be used to form the metal braid. The braid shall be close fitting, but when the cable is cut, it shall be possible to slide the metal braid back by hand a distance of 4 inches (100 mm) in a length of 2 feet (600 mm), one end of the cable being clamped. The braid shall subsequently be capable of being returned to within 1 inch (25.4 mm) of the free end of the cable. 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 ten 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 (300 mm) length of cable. There shall be no joints in the complete braid.

The diameter of wire used shall be as stated in Table 2. 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 B.

The dimensions of the cable shall be in accordance with those stated in Table 2.

3.6 Unifepsilmetsheath cables. These cables shall consist of Unifepsilmet cables covered with an extruded sheath of FEP in accordance with 3.3 but shall be coloured green to match that specified in 3.2.

The dimensions of the cable shall be in accordance with those stated in Table 3.

3.7 Dufepsil and Trifepsil cables. These cables shall consist of two or three Unifepsil cables of the same size, with phase identification in accordance with 3.4, in the combinations stipulated by the purchaser. The cables shall be assembled from Unifepsil cables for which type approval has been obtained by the manufacturer, the cores being twisted together with a right hand lay approximately $12\frac{1}{2}$ times the pitch circle diameter.

4 Colour fastness

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.