BS EN 4612-004:2011

BSI Standards Publication

Aerospace series — Cables, electrical, for general purpose, single and multicore assembly — XLETFE Family — Jacketed or screened and jacketed

Part 004: Tin plated copper — Operating temperatures, between — 65 °C and 135 °C — Single extruded wall for for open applications, with jacket and screen (braid) - UV laser printable - Product standard

National foreword

This British Standard is the UK implementation of EN 4612-004:2011.

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A list of organizations represented on this committee can be obtained on request to its secretary.

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Aerospace series - Cables, electrical, for general purpose, single and multicore assembly - XLETFE Family - Jacketed or screened and jacketed - Part 004: Tin plated copper - Operating temperatures, between - 65 °C and 135 °C - Single extruded wall for open applications, with jacket and screen (braid) - UV laser printable - Product standard

Série aérospatiale - Câbles, électriques, d'usage général, mono et multiconducteurs - Famille XLETFE - Gainés ou blindés et gainés - Partie 004: Cuivre étamé - Températures de fonctionnement comprises entre - 65 °C et 135 °C - Fil simple isolé pour applications externes, gainé et blindé (tressé) - Marquable au laser UV - Norme de produit

Luft- und Raumfahrt - Ein- und mehradrige elektrische Leitungen für allgemeine Verwendung - XLETFE Familie - Mit Mantel oder geschirmt und Mantel - Teil 004: Kupfer verzinnt - Betriebstemperaturen zwischen - 65 °C und 135 °C - Einfach extrudierte Isolierung für externe Verwendung, mit Mantel und Schirm (Geflecht) - UV-Laser bedruckbar - Produktnorm

This European Standard was approved by CEN on 15 July 2011.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Page

Foreword

This document (EN 4612-004:2011) has been prepared by the Aerospace and Defence Industries Association of Europe - Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this Standard has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2012, and conflicting national standards shall be withdrawn at the latest by April 2012.

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1 Scope

This European Standard specifies the characteristics of UV laser printable jacket, tin plated copper conductor, electrical cables Crosslinked Ethylene Tetra Fluoro Ethylene co-polymer (XLETFE) family for use in the on-board electrical systems of aircraft operating at temperatures between – 65 °C and 135 °C, operating at voltages not exceeding 600 V r.m.s and frequencies not exceeding 2 000 Hz. These cables are suitable for airframe use without additional protection when the jacket is present. When the jacket is stripped back the cores may need additional protection. In case of conflict between this standard and other referenced documents the requirements of this standard shall take precedence.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 2083, *Aerospace series — Copper and copper alloys conductors for electrical cables — Product standard*

EN 2235, *Aerospace series — Single and multicore electrical cables, screened and jacketed*

EN 3475-100 (all parts), *Aerospace series — Cables, electrical, aircraft use — Test methods — Part 100: General*

EN 4611-002, *Aerospace series — Cables, electrical, for general purpose, single and multicore assembly — XLETFE Family — Part 002: General* [1)]

EN 4611-003, *Aerospace series — Cables, electrical, for general purpose, single and multicore assembly — XLETFE Family — Part 003: Tin plated copper — Operating temperatures, between – 65 °C and 135 °C — Single extruded wall for enclosed applications — UV laser printable — Product standard* [1)]

EN 4612-002, *Aerospace series — Cables electrical, for general purpose, single and multicore assembly — XLETFE Family — Jacketed or screened and jacketed — Part 002: General*

EN 9133, *Aerospace series — Quality management systems — Qualification procedure for aerospace standard parts*

3 Terms, definitions and symbols

For the purposes of this document, the terms, definitions and symbols given in EN 3475-100 apply.

1) Published as ASD-STAN Prestandard at the date of publication of this standard (www.asd-stan.org).

4 Materials and construction

4.1 Materials

These cables shall consist of the following:

— cores according to EN 4611-003;

— number of cores 1 (one) to 4 (four).

2 (two) core to 4 (four) core shall be twisted together according to EN 2235.

Filler cores shall not be permitted.

Screen:

— tin plated copper stranded woven braid, for dimensions of strands, see Table 1;

— material according to EN 2083, tests according to EN 3475-100;

— construction according to EN 2235.

Outer jacket:

— XLETFE;

— it shall be possible to mark the jacket by UV laser printing;

— minimum thickness single core and 2 (two) core shall be 0,13 mm;

— minimum thickness 3 (three) core and 4 (four) core shall be 0,15 mm.

4.2 Construction

See Table 1.

Table 1 — Single and multicore screened and jacketed

Number of cores	Code for nominal section	AWG [a]	Linear resistance at 20 °C Ω/km max.	Screen strands nominal diameter mm	External diameter mm max.	Mass kg/km max.
1	001 [b]	26	149,0	0,10	1,58	6,05
	002 [b]	24	106,0		1,69	7,02
	004	22	60,0		1,87	8,94
	006	20	33,2		2,11	12,31
	010	18	21,1	0,13	2,37	16,40
	012	16	15,3		2,61	21,12
	020	14	10,9		2,90	26,76
	030	12	6,8		3,39	38,50
2	001 [b]	26	153,5	0,10	2,41	10,43
	002 [b]	24	109,2		2,62	12,68
	004	22	61,8		2,98	16,50
	006	20	23,2		3,50	23,35
	010	18	21,7	0,13	4,02	31,62
	012	16	15,8		4,50	41,18
	020	14	11,2		5,09	52,76
	030	12	7,0		6,04	76,51
3	001 [b]	26	153,5	0,10	2,63	14,16
	002 [b]	24	109,2		2,79	16,92
	004	22	61,8		3,21	22,56
	006	20	23,2		3,74	32,08
	010	18	21,7	0,13	4,30	44,03
	012	16	15,8		4,84	58,32
	020	14	11,2		5,46	74,89
	030	12	7,0		6,45	109,33
4	001 [b]	26	153,5	0,10	2,83	17,38
	002 [b]	24	109,2		3,08	21,44
	002	22	61,8		3,51	28,46
	004	20	23,2		4,10	40,85
	006	18	21,7	0,13	4,75	56,84
	010	16	15,8		5,33	75,17
	012	14	11,2		6,04	97,36
	020	12	7,0		7,18	143,29

[a] AWG = Closest American Wire Gage.

[b] Tin plated copper alloy component conductor.

4.3 Colour coding of cores and jacket

See EN 4611-002.

5 Required characteristics

According to EN 2235 and EN 3475-100.

See Table 2.

Table 2

EN 3475-	Test	Details
201	Visual examination	Applicable
202	Mass	Applicable; see Table 1.
203	Dimensions	Applicable; see Table 1.
–	Lay Factor	Less than 3 in accordance with Annex A (normative)
–	Screen coverage, see EN 2235	Applicable not less than 85 % in accordance with Annex A.
301	Ohmic resistance per unit length	Applicable; see Table 1.
302	Voltage proof test	Applicable
303	Insulation resistance	Applicable (20 ± 2) °C, 500 MΩ.km minimum (95 ± 2) °C, 1 MΩ.km minimum
304	Surface resistance	Applicable 12 500 MΩ.mm minimum
305	Overload resistance	Not applicable
401	Accelerated ageing	Applicable Temperature (200 ± 3) °C
402	Shrinkage and delamination	Applicable Temperature (150 ± 5) °C Maximum shrinkage at each end of cable: Jacket: 2 mm on size 001 to 010 3 mm on size 012 to 030 Cores: 0,80 mm on size 001 to 006 1,00 mm on size 010 to 012 1,20 mm on size 020 to 030

continued

Table 2 *(continued)*

EN 3475-	Test	Details
403	Delamination and blocking	Applicable Temperature (150 ± 5) °C
404	Thermal shock	Applicable Temperatures (– 65 ± 2) °C and (135 ± 3) °C Maximum shrinkage at each end of cable: Jacket: 2 mm on size 001 to 010 3 mm on size 012 to 030 Cores: 0,80 mm on size 001 to 006 1,00 mm on size 010 to 012 1,20 mm on size 020 to 030
405	Bending at ambient temperature	Applicable
406	Cold bend test	Applicable Temperature (– 65 ± 2) °C
407	Flammability	Applicable Methods 1 and 2 Flame application 15 s Extinguishing time: 3 s max.
408	Fire resistance	Not applicable
409	Air-excluded ageing	Not applicable
410	Thermal endurance	Not applicable
411	Resistance to fluids	Applicable Volume swell not greater than 10 % Scrape not applicable
412	Humidity resistance	Applicable Method B Temperature (90 ± 2) °C Duration 672 hours
413	Wrap back test	Not applicable
414	Differential scanning calorimeter (DSC test)	Not applicable

continued

Table 2 *(continued)*

<table>
<tr><th>EN 3475-</th><th>Test</th><th>Details</th></tr>
<tr><td>501</td><td>Dynamic cut-through</td><td>Applicable to jackets of single core cables only
Temperature (135 ± 3) °C
<table>
<tr><th>Size code</th><th>Nominal section
mm²</th><th>Cut-through force to screen
N</th></tr>
<tr><td>001</td><td>0,15</td><td>7,5</td></tr>
<tr><td>002</td><td>0,20</td><td>10</td></tr>
<tr><td>004</td><td>0,40</td><td rowspan="4">15</td></tr>
<tr><td>006</td><td>0,60</td></tr>
<tr><td>010</td><td>1,00</td></tr>
<tr><td>012</td><td>1,20</td></tr>
<tr><td>020</td><td>2,00</td><td rowspan="2">25</td></tr>
<tr><td>030</td><td>3,00</td></tr>
</table>
</td></tr>
<tr><td>502</td><td>Notch propagation</td><td>Not applicable</td></tr>
<tr><td>503</td><td>Scrape abrasion</td><td>Applicable to jackets of single core cables only
Temperature (135 ± 3) °C
Minimum number of cycles to screen = 100
<table>
<tr><th>Size code</th><th>Nominal section
mm²</th><th>Load
N</th></tr>
<tr><td>001</td><td>0,15</td><td>3,0</td></tr>
<tr><td>002</td><td>0,20</td><td>3,5</td></tr>
<tr><td>004</td><td>0,40</td><td>4,0</td></tr>
<tr><td>006</td><td>0,60</td><td>4,5</td></tr>
<tr><td>010</td><td>0,95</td><td>5,0</td></tr>
<tr><td>012</td><td>1,35</td><td>5,5</td></tr>
<tr><td>020</td><td>1,80</td><td>6,0</td></tr>
<tr><td>030</td><td>3,00</td><td>6,5</td></tr>
</table>
</td></tr>
<tr><td>504</td><td>Torsion</td><td>Not applicable</td></tr>
<tr><td>505</td><td>Tensile test on conductors and strands</td><td>Not applicable</td></tr>
<tr><td>506</td><td>Plating continuity</td><td>Not applicable</td></tr>
</table>

continued

Table 2 *(concluded)*

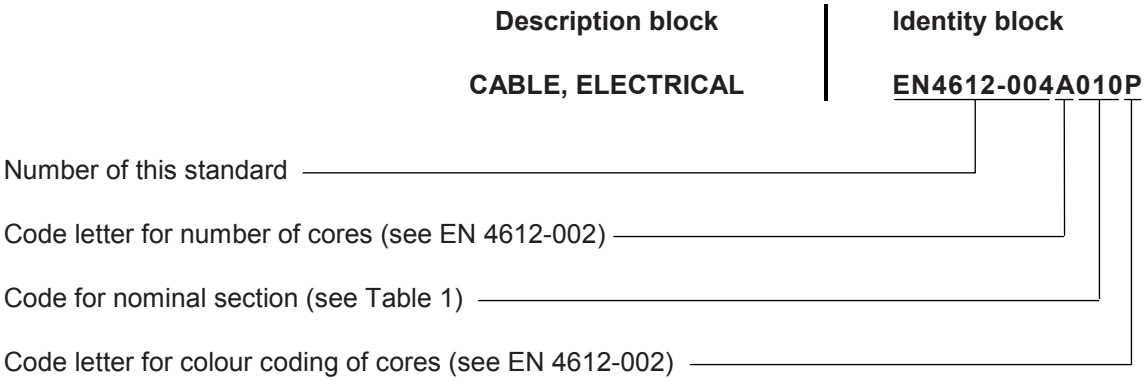
EN 3475-	Test	Details
507	Adherence of plating	Not applicable
508	Plating thickness	Not applicable
509	Solderability	Applicable braid only
510	Tensile strength and elongation of extruded insulation, sheath and jacket material	Applicable for jacket Eb 75 % minimum TS 34 MPa minimum
511	Cable-to-cable abrasion	Applicable Single core 006 only Load 1 kg – 6 000 000 cycles minimum to screen
512	Flexure endurance	Not applicable
601	Smoke density	Subject to agreement between customer and supplier
602	Toxicity	Subject to agreement between customer and supplier
603	Resistance to wet arc tracking	Not applicable
604	Resistance to dry arc propagation	Not applicable
605	Wet short circuit test	Not applicable
701	Strippability and adherence of insulation to the conductor	Not applicable
702	Screen pushback capability	Applicable
703	Permanence of manufacturer's marking	Applicable
704	Flexibility	Not applicable
705	Contrast measurement	Laser Marking $K \geq 50$ %
706	Laser markability	Not applicable

6 Quality assurance

See EN 9133.

7 Designation

EXAMPLE



8 Identification and marking

See EN 4612-002.

9 Packaging, labelling and delivery lengths

See EN 2235.

10 Technical specification

See EN 2235.

Annex A
(normative)

Formulae for calculating braid details

A.1 The filling factor K_f is given by the following formula

$$K_f = \frac{mnd_w}{2\pi D} - \left(1 + \frac{\pi^2 D^2}{L^2}\right)^{1/2}$$

where

D is the mean diameter braid (i.e. diameter under braid + $2d_r$);

d_w is the effective width of one end;

d_r is the effective radial depth of one end;

L is the lay length;

m is the total number of spindles;

n is the total number of ends per spindle.

A.2 Lay factor

The lay factor (K_L) is given by:

$$K_L = 1 + \frac{\pi^2 D^2}{L^2}$$

where D and L are defined in A.1 above.

A.3 Coverage

The percentage coverage is given by the formula:

$100\ (2K_L - K_L^2)$

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