BS EN 4611-006:2012

BSI Standards Publication

Aerospace series — Cables, electrical, for general purpose, single and multicore assembly — XLETFE Family

Part 006: Silver plated copper — Operating temperatures, between –65 °C and 150 °C — Dual extruded wall for open applications — UV laser printable — Product Standard

National foreword

This British Standard is the UK implementation of EN 4611-006:2012.

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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 - Part 006: Silver plated copper - Operating temperatures, between -65 °C and 150 °C - Dual extruded wall for open applications - UV laser printable - Product standard

Série aérospatiale - Câbles, électriques, d'usage général, mono et multiconducteurs - Famille XLETFE - Partie 006: Cuivre argenté - Températures de fonctionnement comprises entre -65 °C et 150 °C - Fil double isolé pour applications externes - Marquable au laser UV - Norme de produit

Luft- und Raumfahrt - Ein- und mehradrige elektrische Leitungen zur allgemeinen Verwendung, XLETFE-Familie - Teil 006: Kupfer versilbert, Betriebstemperaturen zwischen -65 °C und 150 °C, doppelt extrudierte Isolierung für offene Anwendungen, UV-Laser bedruckbar - Produktnorm

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Foreword

This document (EN 4611-006:2012) 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.

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1 Scope

This European Standard specifies the characteristics of UV laser printable, silver plated copper conductor, electrical cables Crosslinked Ethylene Tetra Fluoro Ethylene co-polymer XLETFE family for use in the on-board electrical systems of aircraft at operating temperatures between – 65 ºC and 150 ºC, 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. In case of conflict between this European Standard and other referenced documents the requirements of this European Standard should take precedence.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 or copper alloys conductors for electrical cables – Product standard*

EN 2084,*Aerospace series – Cables, electric, single-core, general purpose, with conductors in copper or copper alloy – Technical specification*

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

EN 3475-100[1],*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*

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

3 Terms, definitions, symbols and abbreviations

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

[1] And all its parts

4 Materials and construction

4.1 Materials

Conductor

The cable conductors shall be made of silver plated copper according to EN 4611-002 and EN 2083 code C.

Insulation for conductor all size codes

- first insulator extruded XLETFE, coloured blue or a contrasting colour if the second is blue;
- second insulator extruded XLETFE.

For single core, it shall be possible to mark the outer insulation by UV laser printing.

4.2 Construction

See EN 4611-002, Table1 and Table 2.

Table 1 – Single core cables

Code for nominal section	Nominal section	AWG [a]	Linear resistance at 20 °C	Maximum external diameter	Mass	Minimum insulation thickness
			Ω/km		kg/km	
	mm^2		max.	mm	max.	mm
001 [b]	0,15	26	149,0	1,00	2,31	0,20
002 [b]	0,25	24	106,0	1,16	3,28	0,20
004	0,4	22	55,3	1,26	4,57	0,20
006	0,6	20	31,0	1,50	7,15	0,20
010	1	18	19,6	1,74	10,54	0,20
012	1,2	16	14,9	1,87	13,48	0,20
020	2	14	10,2	2,44	20,63	0,20
030	3	12	6,4	2,95	31,51	0,20
050	5	10	4,0	3,61	48,80	0,20
090	9	8	1,37	5,16	92,12	0,20
140	14	6	0,87	6,38	140,63	0,20
220	22	4	0,56	8,13	235,13	0,20
340	34	3	0,46	10,67	370,55	0,20
530	53	1	0,28	13,36	601,22	0,20
680	68	0	0,22	14,88	744,08	0,20

[a] AWG = Closest American Wire Gauge.

[b] Silver plated copper alloy conductor

Table 2 – Multicore without screen or jacket

Size	AWG [a]	2 core			3 core			4 core		
		Max. dia. mm	Mass max. kg/km	DC Res. Ω/km max.	Max. dia. mm	Mass max. kg/km	DC Res. Ω/km max.	Max. dia. mm	Mass max. kg/km	DC Res. Ω/km max.
001 [b]	26	2,00	4,69	153,5	2,16	7,04	153,5	2,42	9,39	153,5
002 [b]	24	2,32	6,65	109,2	2,51	9,97	109,2	2,81	13,30	109,2
004	22	2,52	9,23	60,0	2,72	13,85	60,0	3,05	18,47	60,0
006	20	3,00	14,49	31,9	3,24	21,74	31,9	3,63	28,98	31,9
010	18	3,48	21,29	20,2	3,76	31,93	20,2	4,21	42,57	20,2
012	16	3,74	27,37	15,3	4,41	41,05	15,3	4,53	54,74	15,3
020	14	4,88	41,67	10,5	5,27	62,51	10,5	5,90	83,34	10,5
030	12	5,90	63,64	6,6	6,37	95,46	6,6	7,14	127,29	6,6
050	10	7,22	98,57	4,1	7,80	147,86	4,1	8,74	197,14	4,1

[a] AWG = Closest American Wire Gauge.

[b] Silver plated copper alloy conductor

4.3 Number of cores

See EN 4611-002.

See EN 2235 for cabling.

4.4 Colour coding of cores

See EN 4611-002.

5 Required characteristics

According to EN 2084 and EN 3475-100

See Table 3.

NOTE Tests EN 3475-302 to EN 3475-706 should be performed on the single core cables.

Table 3

EN 3475-	Test	Details
201	Visual examination	Applicable
202	Mass	Applicable; see Table 1 and Table 2.
203	Dimensions	Applicable; see Table 1 and Table 2.
301	Ohmic resistance per unit length	Applicable; see Table 1 and Table 2.
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	Applicable T_1 = (250 ± 5) °C; T_2 = (380 ± 5) °C
401	Accelerated ageing	Applicable Temperature (200 ± 3) °C
402	Shrinkage and delamination	Applicable Temperature (150 ± 5) °C Maximum shrinkage at each end of cable: 0,80 mm on size code 001 to 006 1,00 mm on size code 010 to 012 1,20 mm on size code 020 to 050
403	Delamination and blocking	Applicable Temperature (150 ± 5) °C
404	Thermal shock	Applicable Temperatures (– 65 ± 2) °C and (260 ± 5) °C Maximum shrinkage at each end of cable: 1,00 mm on size code 001 to 050
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	Applicable 50 000 hours Temperature 150 °C
411	Resistance to fluids	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 3 *(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 single core
Temperature (150 ± 3) °C
<table><tr><th>Size code</th><th>Nominal section
mm²</th><th>Cut-through force
N</th></tr><tr><td>001</td><td>0,15</td><td>15</td></tr><tr><td>002</td><td>0,25</td><td>20</td></tr><tr><td>004</td><td>0,4</td><td>25</td></tr><tr><td>006</td><td>0,6</td><td>25</td></tr><tr><td>010</td><td>1</td><td>25</td></tr><tr><td>012</td><td>1,2</td><td>25</td></tr><tr><td>020</td><td>2</td><td>25</td></tr><tr><td>030</td><td>3</td><td>25</td></tr><tr><td>050</td><td>5</td><td>25</td></tr><tr><td>090</td><td>9</td><td>25</td></tr><tr><td>140</td><td>14</td><td>25</td></tr><tr><td>220</td><td>22</td><td>25</td></tr><tr><td>340</td><td>34</td><td>25</td></tr><tr><td>530</td><td>53</td><td>25</td></tr><tr><td>680</td><td>68</td><td>25</td></tr></table></td></tr>
<tr><td>502</td><td>Notch propagation</td><td>Applicable
Notch depth 40 µm</td></tr>
<tr><td>503</td><td>Scrape abrasion</td><td>Applicable single core
Temperature (150 ± 3) °C
Minimum number of cycles = 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>2,0</td></tr><tr><td>002</td><td>0,25</td><td>3,0</td></tr><tr><td>004</td><td>0,4</td><td>3,5</td></tr><tr><td>006</td><td>0,6</td><td>4,0</td></tr><tr><td>010</td><td>1</td><td>4,5</td></tr><tr><td>012</td><td>1,2</td><td>5,0</td></tr><tr><td>020</td><td>2</td><td>5,5</td></tr><tr><td>030</td><td>3</td><td>6,0</td></tr><tr><td>050</td><td>5</td><td>6,5</td></tr><tr><td>090</td><td>9</td><td>7,0</td></tr><tr><td>140</td><td>14</td><td>7,5</td></tr><tr><td>220</td><td>22</td><td>8,0</td></tr><tr><td>340</td><td>34</td><td>8,5</td></tr><tr><td>530</td><td>53</td><td>9,5</td></tr><tr><td>680</td><td>68</td><td>10,0</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>Applicable</td></tr>
<tr><td>506</td><td>Plating continuity</td><td>Applicable</td></tr>
<tr><td>507</td><td>Adherence of plating</td><td>Applicable</td></tr>
</table>

(continued)

Table 3 *(continued)*

<table>
<tr><th>EN 3475-</th><th>Test</th><th>Details</th></tr>
<tr><td>508</td><td>Plating thickness</td><td>Applicable</td></tr>
<tr><td>509</td><td>Solderability</td><td>Applicable
Wetting time 1 s max.</td></tr>
<tr><td>510</td><td>Tensile strength and elongation of extruded insulation, sheath and jacket material</td><td>Not applicable</td></tr>
<tr><td>511</td><td>Cable to cable abrasion</td><td>Applicable size code 006
Load 1 kg – 6 000 000 cycles</td></tr>
<tr><td>512</td><td>Flexure endurance</td><td>Applicable code 006
Mandrel ∅ 15 mm
Weight 0,75 kg – 750 cycles</td></tr>
<tr><td>601</td><td>Smoke density</td><td>Applicable code 006
$D_s < 50$, 4 minutes</td></tr>
<tr><td>602</td><td>Toxicity</td><td>Applicable code 006</td></tr>
<tr><td>603</td><td>Resistance to wet arc tracking</td><td>Applicable
Wire damage ≤ 70 mm
75 % of collateral wires shall not be open circuit wet dielectric voltage proof test (EN 3475-302) not applicable</td></tr>
<tr><td>604</td><td>Resistance to dry arc propagation</td><td>Applicable
Wire damage ≤ 70 mm
75 % of collateral wires must pass the wet dielectric voltage proof test at 1 kV r.m.s. (EN 3475-302)</td></tr>
<tr><td>605</td><td>Wet short circuit test</td><td>Not applicable</td></tr>
<tr><td>701</td><td>Strippability and adherence of insulation to the conductor</td><td>Applicable
<table>
<tr><th>Size code</th><th>Nominal section
mm²</th><th>min.
N</th><th>max.
N</th></tr>
<tr><td>001</td><td>0,15</td><td>5,0</td><td>20</td></tr>
<tr><td>002</td><td>0,25</td><td>5,0</td><td>20</td></tr>
<tr><td>004</td><td>0,40</td><td>5,0</td><td>25</td></tr>
<tr><td>006</td><td>0,60</td><td>8,5</td><td>25</td></tr>
<tr><td>010</td><td>1</td><td>12,5</td><td>30</td></tr>
<tr><td>012</td><td>1,2</td><td>12,5</td><td>30</td></tr>
<tr><td>020</td><td>2</td><td>12,5</td><td>35</td></tr>
<tr><td>030</td><td>3</td><td>15</td><td>35</td></tr>
<tr><td>050</td><td>5</td><td>20</td><td>40</td></tr>
<tr><td>090</td><td>9</td><td>20</td><td>40</td></tr>
<tr><td>140</td><td>14</td><td>20</td><td>40</td></tr>
<tr><td>220</td><td>22</td><td>20</td><td>40</td></tr>
<tr><td>340</td><td>34</td><td>20</td><td>40</td></tr>
<tr><td>420</td><td>42</td><td>20</td><td>40</td></tr>
<tr><td>530</td><td>53</td><td>20</td><td>40</td></tr>
<tr><td>680</td><td>68</td><td>20</td><td>40</td></tr>
</table></td></tr>
<tr><td>702</td><td>Screen pushback capability</td><td>Not applicable</td></tr>
<tr><td>703</td><td>Permanence of manufacturer’s marking</td><td>Applicable</td></tr>
</table>

(continued)

Table 3 *(concluded)*

<table>
<tr><th>EN 3475-</th><th>Test</th><th>Details</th></tr>
<tr><td>704</td><td>Flexibility</td><td>Method 2
<table>
<tr><th>Size code</th><th>Nominal section
mm^2</th><th>Force
N</th><th>Recoil
Deg.</th><th>Mandrel
mm</th></tr>
<tr><td>001</td><td>0,15</td><td>5</td><td>70</td><td>15</td></tr>
<tr><td>002</td><td>0,25</td><td>10</td><td>70</td><td>15</td></tr>
<tr><td>004</td><td>0,40</td><td>15</td><td>60</td><td>15</td></tr>
<tr><td>006</td><td>0,60</td><td>15</td><td>60</td><td>15</td></tr>
</table></td></tr>
<tr><td>705</td><td>Contrast measurement</td><td>Applicable Laser marking
K ≥ 50 %</td></tr>
<tr><td>706</td><td>Laser markability</td><td>Not applicable</td></tr>
</table>

6 Quality assurance

See EN 9133.

7 Designation

EXAMPLE:

Description block	Identity block
CABLE, ELECTRICAL	EN4611-006A010P

Number of this European Standard

Code letter for number of cores (see EN 4611-002, Table 2)

Code for nominal section (see Table 1)

Code letter for colour coding of cores (see EN 4611-002)

8 Identification and marking

See EN 4611-002.

9 Packaging, labelling and delivery lengths

See EN 2084.

10 Technical specification

See EN 2084.

See EN 2235.

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