BRITISH STANDARD AEROSPACE SERIES

BS EN
4434:2005

Copper or copper alloy lightweight conductors for electrical cables — Product standard (Normal and tight tolerances)

The European Standard EN 4434:2005 has the status of a British Standard

ICS 49.060

BSI
British Standards

National foreword

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The UK participation in its preparation was entrusted by Technical Committee ACE/6, Aerospace avionic electrical and fibre optic technology, to Subcommittee ACE/6/-/2, Aerospace — Cables, which has the responsibility to:

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 8, an inside back cover and a back cover.

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 28 April 2006

ISBN 0 580 48094 1

Amendments issued since publication

Amd. No.	Date	Comments

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 4434

November 2005

ICS 49.060

English Version

Aerospace series - Copper or copper alloy lightweight conductors for electrical cables - Product standard (Normal and tight tolerances)

Série aérospatiale - Conducteurs à tolérances réduites en cuivre ou alliage de cuivre pour câbles électriques - Norme de produit (Tolérances normales et réduites)

Luft- und Raumfahrt - Leichter Leiter aus Kupfer oder Kupferlegierung für elektrische Leitungen - Produktnorm (Normale und enge Toleranzen)

This European Standard was approved by CEN on 19 September 2005.

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 4434:2005: E

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Foreword

This European Standard (EN 4434:2005) has been prepared by the European Association of Aerospace Manufacturers - Standardization (AECMA-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 AECMA, 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 May 2006, and conflicting national standards shall be withdrawn at the latest by May 2006.

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1 Scope

This standard specifies the dimensions, linear resistance, mechanical characteristics, construction and mass of lightweight conductors, normal and tight tolerances, in copper or copper alloy for electrical cables for aerospace applications.

It applies to stranded conductors, with a nominal cross-sectional area of 0,15 mm^2 to 14 mm^2 inclusive.

The conductors for thermocouple extension and fire-resistant cables are not covered by this standard.

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 or copper alloy conductors for electrical cables — Product standard.*

EN 3475-100, *Aerospace series — Cables, electrical, aircraft use — Test methods — Part 100: General.*

EN 3475-301, *Aerospace series — Cables, electrical, aircraft use — Test methods — Part 301: Ohmic resistance per unit length.*

EN 3475-506, *Aerospace series — Cables, electrical, aircraft use — Test methods — Part 506: Plating continuity.*

EN 3475-507, *Aerospace series — Cables, electrical, aircraft use — Test methods — Part 507: Adherence of plating.*

IEC 60028 (1925-01), *International standard of resistance for copper.*

IEC 60344 (1980-01), *Guide to the calculation of resistance of plain and coated copper conductors of low-frequency cables and wires.*

3 Terms, definitions and symbols

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

4 Conductor materials and construction

4.1 Materials

Conductors complying with this standard are made from strands in high conductivity annealed electrolytic copper (see IEC 60028) or copper alloy.

The conductors for nominal cross-sectional areas 0,15 mm^2 and 0,25 mm^2 shall be made from copper alloy.

4.2 Metal plating

The individual strands may be:

— uncoated (code A);

— or provided with uniform platings of tin (code B) or silver (code C) or nickel (code D).

Plating thicknesses shall be at least 1,0 µm for silver and at least 1,3 µm for nickel.

When tin plating is authorized, the thickness shall be sufficient to comply with the tests specified in EN 3475-506 and EN 3475-507.

4.3 Electrolytic copper

The elongation prior to rupture, for each copper strand, shall not be less than 10 %.

The tensile strength, for each copper strand, shall be at least 220 MPa.

4.4 Copper alloy

For cross-sectional areas 0,15 mm^2 and 0,25 mm^2 in copper alloy, use an alloy with the following characteristics:

— maximum resistivity: $2{,}46 \times 10\text{-}8\ \Omega \cdot m$ [1)];

— minimum tensile strength: 350 MPa;

— minimum elongation: 6 %.

4.5 Construction of conductors

4.5.1 Lay length

Up to 9 mm^2 cross-section inclusive (code 090), concentric conductors are used. The lay for the strands of a concentric conductor, checked over the outside layer of a test piece 1 m long, shall be between eight times and 16 times the maximum diameter of this conductor.

For sectional area of 14 mm^2 (code 140), the conductor comprises concentric or bunched conductors twisted together. The lay of the strands for the basic concentric or bunched conductors shall not exceed 30 times the diameter of the concentric or bunched conductor in question.

The lay for concentric (or bunched) conductors, measured over the outer layer of the conductor, shall be between 8 times and 16 times the maximum conductor diameter.

In all cases the lay of the outer layer shall be left-hand.

4.5.2 Joints

The conductors shall be free from any joints. Each strand comprising the conductors may, however, include soldered or brazed joints. For strands with a diameter of 0,25 mm or greater, butt joints shall be used.

The distance between two joints in individual strands shall exceed 3 m, measured between different strands.

4.5.3 Compaction

Compaction of the conductor, causing deformation of the strands or damage to the plating, is not permitted.

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1) Or $24{,}6\ \Omega \cdot mm^2/km$.

5 Required characteristics

5.1 General

Table 1 defines normal tolerances, Table 2 defines tight tolerances of lightweight conductors.

If nothing is mentioned in the product standard, normal tolerances shall be applied.

5.2 Normal tolerances

See Table 1.

Table 1

Code	Nominal section	Number of strands	Nominal diameter of strands	Diameter of conductor [a]		Linear resistance max. at 20 °C [b]		Breaking load	Mass of conductor		AWG [d]	Number of missing strands
				mm		Ω/km		N	kg/km [a c]			
	mm^2		mm	min.	max.	A and C	B and D	min.	min.	max.		
001	0,15	19	0,10	0,45	0,49	149	160 [e]	46	1,20	1,40	26	0
002	0,25	19	0,12	0,55	0,60	106	114 [e]	67	1,77	2,00	24	0
004	0,40	19	0,15	0,70	0,75	55,3	60	71	2,83	3,26	22	0
006	0,60	19	0,20	0,94	1,00	31,0	33,2	127	5,15	5,70	20	0
010	1	19	0,25	1,18	1,25	19,6	21,1	198	8,16	8,90	18	0
012	1,20	19	0,30	1,39	1,50	13,6	14,5	285	11,63	12,50	16	0
020	2	37	0,25	1,68	1,75	10,2	10,9	385	16,02	17,30	14	0
030	3	37	0,32	2,12	2,20	6,4	6,8	645	26,06	27,50	12	0
050	5	37	0,40	2,69	2,82	4,0	4,2	1 000	41,23	44,00	10	0
051	5 [f]	61	0,32	2,72	2,83	3,9	4,1	1 000	43,25	45,80	10	0
090	9 [g]	127	0,30	–	4,20	2,1	2,3	–	76	85	8	0
140	14 [g]	27 × 7	0,30	–	5,40	1,44	1,58	–	114	126	6	0

[a] Values for minimum diameter and minimum mass are the same as in EN 2083 to allow the use of existing tooling (stripping and crimping)

[b] The linear resistance at other temperatures may be calculated using the formulae given in EN 3475-301.

[c] Not taking into consideration metal platings, assuming that their effect is minimal.

[d] AWG: closest American Wire Gage

[e] Not available as code letter B

[f] This gives a more flexible construction which may be used as an alternative.

[g] Codes 090 and 140:

Linear resistance calculated in accordance with the procedure in IEC 60344; where:

k_1 is 1,04 (A and C) and 1,145 (B and D);

k_2 is 1,04 (code 090) and 1,02 (codes ≥ 140);

k_3 is 1 (code 090) and 1,05 (codes ≥ 140).

5.3 Tight tolerances

See Table 2.

Table 2

Code	Nominal section	Number of strands	Nominal diameter of strands	Diameter of conductor		Linear resistance max. at 20 °C [a]		Breaking load	Mass of conductor		AWG [c]	Number of missing strands
				mm		Ω/km		N	kg/km [b]			
	mm^2		mm	min.	max.	A and C	B and D	min.	min.	max.		
001	0,15	19	0,10	0,47	0,49	149	160 [d]	46	1,20	1,40	26	0
002	0,25	19	0,12	0,555	0,585	106	114 [d]	67	1,77	2,0	24	0
004	0,40	19	0,15	0,71	0,73	55,3	60	71	2,83	3,26	22	0
006	0,60	19	0,20	0,94	0,97	31,0	33,2	127	5,15	5,70	20	0
010	1	19	0,25	1,19	1,22	19,6	21,1	198	8,16	8,90	18	0
012	1,20	19	0,30	1,41	1,45	13,6	14,5	285	11,63	12,50	16	0
020	2	37	0,25	1,69	1,73	10,2	10,9	385	16,02	17,30	14	0
030	3	37	0,32	2,13	2,18	6,4	6,8	645	26,06	27,50	12	0
051	5	61	0,32	2,73	2,77	3,9	4,1	1 000	43,25	45,8	10	0
090	9 [e]	127	0,30	3,55	3,85	2,1	2,3	–	76	85	8	0
140	14 [e]	27 × 7	0,30	4,8	5,20	1,44	1,58	–	114	126	6	0

[a] The linear resistance at other temperatures may be calculated using the formulae given in EN 3475-301.

[b] Not taking into consideration metal platings, assuming that their effect is minimal.

[c] AWG: closest American Wire Gage.

[d] Not available as code letter B.

[e] Codes 090 and 140:

Linear resistance calculated in accordance with the procedure in IEC 60344; where:

k_1 is 1,04 (A and C) and 1,145 (B and D);

k_2 is 1,04 (code 090) and 1,02 (codes ≥ 140);

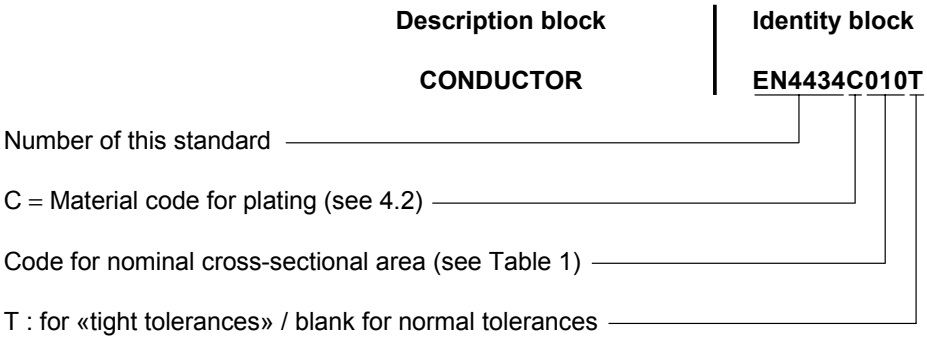
k_3 is 1 (code 090) and 1,05 (codes ≥ 140).

6 Test methods

See EN 3475-100.

7 Designation

EXAMPLE



NOTE If necessary, the code I9005 shall be placed between the description block and the identity block.

8 Marking, packaging and delivery lengths

On delivery the identification reference shall be completed by the length, date and inspection mark.

The conductors shall be delivered on spools or reels.

They shall be wound in a regular and uniform manner and require an appropriate protection, not affecting the product delivered.

Each unit delivered may contain one or several lengths as specified by the purchaser.

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