

Copper and copper alloys — Wire for general purposes

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ICS 77.150.30

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National foreword

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- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
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A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 40, an inside back cover, and a back cover.

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English version

Copper and copper alloys — Wire for general purposes

Cuivre et alliages de cuivre —
Fils pour usages généraux

Kupfer und Kupferlegierungen —
Drähte zur allgemeinen Verwendung

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European Committee for Standardization
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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 133, Copper and copper alloys, the Secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by July 1998, and conflicting national standards shall be withdrawn at the latest by July 1998.

Within its programme of work, Technical Committee CEN/TC 133 requested CEN/TC 133/WG 4, Rod/bar, wire, profiles, to prepare the following standard:

EN 12166, *Copper and copper alloys — Wire for general purposes*.

This is one of a series of European Standards for copper and copper alloy products in rod, wire and profile form. Other products are, or will be, specified as follows:

EN 12163, *Copper and copper alloys — Rod for general purposes*.

EN 12164, *Copper and copper alloys — Rod for free machining purposes*.

EN 12165, *Copper and copper alloys — Wrought and unwrought forging stock*.

EN 12167, *Copper and copper alloys — Profiles and rectangular bar for general purposes*.

...¹⁾ *Copper and copper alloys — Rod and wire for welding and braze welding*.
(W1:00133021)

...¹⁾ *Copper and copper alloys — Drawn round copper wire for the manufacture of electrical conductors*.
(W1:00133025)

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Switzerland and the United Kingdom.

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¹⁾ In course of preparation.

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1 Scope

This European Standard specifies the composition, property requirements and dimensional tolerances for copper and copper alloy wire intended for general purposes, spring and fastener manufacturing applications.

The sampling procedures, the methods of test for verification of conformity to the requirements of this standard, and the delivery conditions are also specified.

2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

EN 1655, *Copper and copper alloys — Declarations of conformity.*

EN 10002-1, *Metallic materials — Tensile testing — Part 1: Method of test (at ambient temperature).*

EN 10204, *Metallic products — Types of inspection documents.*

EN ISO 2624, *Copper and copper alloys — Estimation of average grain size.*
(ISO 2624:1990)

ISO 1811-2, *Copper and copper alloys — Selection and preparation of samples for chemical analysis — Part 2: Sampling of wrought products and castings.*

ISO 6507-1, *Metallic materials — Hardness test — Vickers test — Part 1: HV 5 to HV 100.*

ISO 6507-2, *Metallic materials — Hardness test — Vickers test — Part 2: HV 0,2 to less than HV 5.*

NOTE Informative references to documents used in the preparation of this standard, and cited at the appropriate places in the text, are listed in a bibliography, see annex A.

3 Definitions

For the purposes of this standard, the following definitions apply.

3.1

wire

solid wrought product of uniform cross-section along its whole length supplied in coil form or on spools, reels or in drums. The cross-sections are in the shape of circles, squares, regular polygons, rectangles with rolled or drawn edges or small profiles

3.2

circularity (wire)

difference between the maximum and the minimum diameters measured at any one cross-section of the wire

4 Designations

4.1 Material

4.1.1 General

The material is designated either by symbol or number (see Tables 1 to 7).

4.1.2 Symbol

The material symbol designation is based on the designation system given in ISO 1190-1.

NOTE Although material symbol designations used in this standard might be the same as those in other standards using the designation system given in ISO 1190-1, the detailed composition requirements are not necessarily the same.

4.1.3 Number

The material number designation is in accordance with the system given in EN 1412.

4.2 Material condition

For the purposes of this standard, the following designations, which are in accordance with the system given in EN 1173, apply for the material condition:

- M Material condition for the product as manufactured without specified mechanical properties;
- R... Material condition designated by the minimum value of tensile strength requirement for the product with mandatory tensile property requirements;
- H... Material condition designated by the minimum value of hardness requirement for the product with mandatory hardness requirements;
NOTE 1 The H... condition is not applicable to any round wires less than 1,5 mm diameter, or to round wires of any size in alloys given in Tables 4 and 5 and the non-lead alloys given in Table 3.
- G... Material condition designated by the mid-range value of grain size requirement for the product with mandatory grain size requirement;

NOTE 2 The G... condition is normally applicable only to round wires in the soft condition made from alloys given in Tables 1, 4 and 5, non-lead alloys given in Table 3 and alloys CuSi1 (CW115C) and CuSi3Mn1 (CW116C) given in Table 2.

NOTE 3 If G... condition material is required, the grain size requirement should be selected from Table 15 and agreed between the purchaser and the supplier and stated in the enquiry and/or order [see 5b)].

Exact conversion between material conditions designated R..., H... and G... is not possible.

Material condition is designated by only one of the above designations.

4.3 Product

The product designation provides a standardized pattern of designation from which a rapid and unequivocal description of a product is conveyed in communication. It provides mutual comprehension at the international level with regard to products which meet the requirements of the relevant European Standard.

The product designation is no substitute for the full content of the standard.

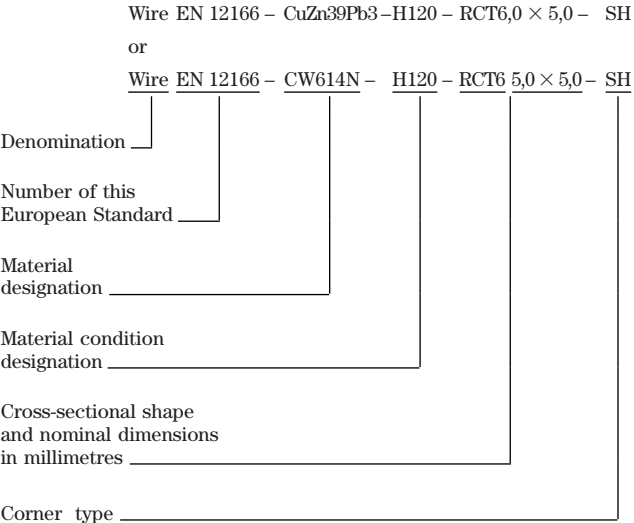
The product designation for products to this standard shall consist of:

- denomination (Wire);
- number of this European Standard (EN 12166);
- material designation, either symbol or number (see Tables 1 to 7);
- material condition designation (see 4.2 and Tables 8 to 15);
- cross-sectional shape (the following designations shall be used as appropriate: RND for round, SQR for square, RCT for rectangular, HEX for hexagonal, OCT for octagonal, PFL for profile);
- nominal cross-sectional dimension(s) (or the number of the profile or a fully dimensioned and toleranced drawing);
- tolerance class for round, square or polygonal wire (see Tables 16 and 17);
- corner type for square or rectangular wire, (the following designations shall be used as appropriate: SH for sharp, RD for rounded) (see Table 19).

The derivation of a product designation is shown in example 1 and another typical product designation is shown in example 2.

EXAMPLE 1

Wire conforming to this standard, in material designated either CuZn39Pb3 or CW614N, in material condition H120, rectangular, nominal cross-sectional dimensions 6,0 mm × 5,0 mm, with sharp corners, shall be designated as follows:



EXAMPLE 2

Wire conforming to this standard, in material designated either CuZn39Pb3 or CW614N, in material condition R420, round, nominal diameter 6,0 mm, tolerance class B, shall be designated as follows:

Wire EN 12166 – CuZn39Pb3 – R420 – RND6,0B

or

Wire EN 12166 – CW614N – R420 – RND6,0B.

5 Ordering information

In order to facilitate the enquiry, order and confirmation of order procedures between the purchaser and the supplier, the purchaser shall state on his enquiry and order the following information:

- a) quantity of product required (mass);
- b) denomination (Wire);
- c) number of this European Standard (EN 12166);
- d) material designation (see Tables 1 to 7);
- e) material condition designation (see 4.2 and Tables 8 to 15) if it is other than M. The purchaser may request, and it shall then be subject to agreement between the supplier and the purchaser, that the informative values of 0,2 % proof strength become mandatory, in which case the specified tensile strength values become informative;
- f) cross-sectional shape;
- g) nominal cross-sectional dimension(s) (diameter or width across-flats);
- h) for round, square and regular polygonal wire, the tolerance class required, unless the tolerance class is to be left to the discretion of the supplier; (see Tables 16 and 17). For profiles, the tolerances required (or a drawing with dimensions and tolerances);
- i) for square or rectangular wire, whether "sharp" or "rounded" corners are required, unless the corner radii are to be left to the discretion of the supplier (see Table 19);

NOTE 1 If G... condition material is required, the grain size requirement should be selected from Table 15 and agreed between the purchaser and the supplier.

NOTE 2 It is recommended that the product designation, as described in 4.3, is used for items b) to i).

In addition, the purchaser shall also state on the enquiry and order any of the following, if required:

- j) for profiles, if the shape is such that the position of the cross-section within the coil, reel, spool or drum is of importance to the purchaser, this should be stated on the drawing (see annex B for illustration);
- k) for profiles, whether mechanical properties are required. If so, the method of test and the level of properties shall be agreed between the purchaser and the supplier;
- l) whether a declaration of conformity is required (see 9.1);
- m) whether an inspection document is required, and if so, which type (see 9.2);
- n) whether there are any special requirements for marking, labelling or packaging including, if necessary, any limitation on dimensions or mass of coils, spools, reels or drums (see clause 10).

EXAMPLE 1

Ordering details for 1 000 kg wire for general purposes conforming to EN 12166, in material designated either CuZn39Pb3 or CW614N, in material condition H120, rectangular, nominal cross-sectional dimensions 6,0 mm × 5,0 mm, with sharp corners, in 25 kg coils:

1 000 kg Wire EN 12166– CuZn39Pb3– H120– RCT 6,0 × 5,0 – SH
– 25 kg coils

or

1 000 kg Wire EN 12166– CW614N– H120– RCT 6,0 × 5,0 – SH
– 25 kg coils.

EXAMPLE 2

Ordering details for 5 000 kg wire for general purposes conforming to EN 12166, in material designated either CuZn39Pb3 or CW614N, in material condition R420, round, nominal diameter 6,0 mm, tolerance class B, on 1 000 kg spools:

5 000 kg Wire EN 12166 – CuZn39Pb3 – R420 – RND6,0B
– 1 000 kg spools

or

5 000 kg Wire EN 12166 – CW614N – R420 – RND6,0B
– 1 000 kg spools.

6 Requirements

6.1 Composition

The composition shall conform to the requirements for the appropriate material given in Tables 1 to 7.

6.2 Mechanical properties

The tensile properties of R... condition material or the hardness properties of H... condition material shall conform to the appropriate requirements given in Tables 8 to 14. The tests shall be carried out in accordance with 8.2 or 8.3.

NOTE 1 The H... condition is not applicable to any round wires less than 1,5 mm diameter, or to round wires of any size in alloys given in Tables 4 and 5, and the non-lead alloys given in Table 3.

NOTE 2 Elongation values are not applicable to wire sizes less than 0,5 mm (or equivalent cross-sectional areas for polygonal wires).

6.3 Grain size

The grain size of G... condition material shall conform to the appropriate ranges in Table 15. The tests shall be carried out in accordance with 8.4.

NOTE The G... condition is normally applicable only to round wires in the soft condition made from alloys given in Tables 1, 4 and 5, non-lead alloys in Table 3 and alloys CuSi1 (CW115C) and CuSi3Mn1 (CW116C) given in Table 2.

6.4 Dimensions and tolerances

6.4.1 Diameter or width across-flats

The diameter or width across-flats shall conform to the tolerances given in Tables 16 to 18.

NOTE The diameter of round wire is calculated as the mean of one or more pairs of measurements taken at right angles at the same cross-section of the wire.

6.4.2 Shape tolerances for round wire

The deviation from circularity of round wire less than 3,0 mm diameter, shall not exceed half the range of the tolerance on diameter given in Table 16. The deviation from circularity of round wire equal to or greater than 3,0 mm diameter, shall not exceed the range of the tolerance on diameter given in Table 16.

6.4.3 Corner and edge geometry (square and rectangular wire only)

The radii of the corners of square or rectangular wires shall conform to the requirements given in Table 19 for sharp or rounded corners.

For wires with the minimum dimensions across-flats less than 3 mm the corners shall be calculated according to Figure 1. For wires with both across-flats dimensions equal to or greater than 3 mm, except in cases of dispute, the corners shall be measured directly, either by use of a gauge or an optical projector. In cases of dispute the method by optical projector shall be used.

Shaped wire corners and edges shall be smooth and shall not have projecting edges.

6.5 Joins

Welds made before the final drawing sequence are permissible. Joins made after the final drawing sequence are not permitted unless there has been agreement between the purchaser and the supplier on the method of performing and marking these joins.

7 Sampling

7.1 General

When required (e.g. if necessary in accordance with specified procedures of a supplier's quality system, or when the purchaser requests inspection documents with test results, or for use in cases of dispute) an inspection lot shall be sampled in accordance with 7.2 and 7.3.

7.2 Analysis

The sampling rate shall be in accordance with Table 20. A test sample, depending on the analytical technique to be employed, shall be prepared from each sampling unit and used for the determination of the composition.

NOTE 1 When preparing the test sample, care should be taken to avoid contaminating or overheating the test sample. Carbide tipped tools are recommended; steel tools, if used, should be made of magnetic material to assist in the subsequent removal of extraneous iron. If the test samples are in finely divided form (e.g. drillings, millings), they should be treated carefully with a strong magnet to remove any particles of iron introduced during preparation.

NOTE 2 In cases of dispute concerning the results of analysis, the full procedure given in ISO 1811-2 should be followed.

Results may be used from analyses carried out at an earlier stage of manufacturing the product, e.g. at the casting stage, if the material identity is maintained and if the quality system of the manufacturer is certified as conforming to EN ISO 9001 or EN ISO 9002.

7.3 Tensile, hardness and grain size tests

The sampling rate shall be in accordance with Table 20. Sampling units shall be selected from the finished products. The test samples shall be cut from the sampling units. Test samples, and test pieces prepared from them, shall not be subjected to any further treatment, other than any machining operations necessary in the preparation of the test pieces.

8 Test methods

8.1 Analysis

Analysis shall be carried out on the test pieces, or test portions, prepared from the test samples obtained in accordance with 7.2. Except in cases of dispute, the analytical methods used shall be at the discretion of the supplier. For expression of results, the rounding rules given in 8.6 shall be used.

NOTE In cases of dispute concerning the results of analysis, the methods of analysis to be used should be agreed between the disputing parties.

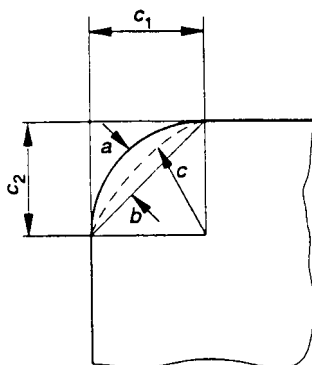


Figure 1 — Calculation of corner radii

For sizes below 3 mm, the corner radius c is calculated from the formula:

$$c = \frac{c_1 + c_2}{2}$$

and may fall anywhere between fully circular "a" and a chamfer "b".

8.2 Tensile test

The tensile test shall be performed on a coaxial test piece cut from a test sample obtained in accordance with 7.3. The test shall be carried out in accordance with the method given in EN 10002-1. For expression of results, the rounding rules given in 8.6 shall be used.

NOTE 1 For other than round wire, the tensile test results should be calculated using nominal cross-sectional areas.

NOTE 2 Elongation requirements for wire of diameter:

- a) equal to or greater than 0,5 mm but less than 4 mm;
 - b) 4 mm up to and including 8 mm;
 - c) greater than 8 mm; (or equivalent cross-sectional areas for polygonal wires), are based on original gauge lengths of 100 mm, $11,3\sqrt{S_0}$ and $5,65\sqrt{S_0}$ respectively, where S_0 is the original cross-sectional area of the wire in square millimetres.
- Elongation values are not applicable to wire sizes less than 0,5 mm (or equivalent cross-sectional areas for polygonal wires).

NOTE 3 Elongation measurements less than 5 % may be reported as "less than 5 %". This accords with the precision of the method given in EN 10002-1.

8.3 Hardness test

The hardness shall be determined on a test piece cut from a test sample obtained in accordance with 7.3. The test shall be carried out in accordance with ISO 6507-1 or ISO 6507-2 and the indentation made:

- a) for round wire 5 mm diameter and over, at a mid-radius position on a cross-section (see note);
- b) for rectangular sections, on the surface of the wire at the approximate mid-point of the major dimension;
- c) for square or polygonal cross-sections, on the surface of the wire at the approximate mid-point of one of the flats;
- d) for profiles, unless otherwise specified by the purchaser, on the cross-section at the mid-point of the thickest part.

NOTE In the case of round wire less than 5 mm diameter, the test should be performed at a position, and by a method, agreed between the supplier and the purchaser.

For the Vickers test according to ISO 6507-1 a test force of 49,03 N, 98,07 N or 294,21 N shall be used. For the Vickers test according to ISO 6507-2 a test force of 4,903 N or 9,807 N shall be used.

8.4 Estimation of average grain size

When a purchaser specifies a grain size requirement [see 5e)], the estimation of average grain size shall be carried out in accordance with EN ISO 2624.

8.5 Retests

If there is a failure of one, or more than one, of the tests in 8.1, 8.2, 8.3 or 8.4, two test samples from the same inspection lot shall be permitted to be selected for retesting the failed property (properties). One of these test samples shall be taken from the same sampling unit as that from which the original failed test piece was taken, unless that sampling unit is no longer available, or has been withdrawn by the supplier.

If the test pieces from both test samples pass the appropriate test(s), then the inspection lot represented shall be deemed to conform to the particular requirement(s) of this standard. If a test piece fails a test, the inspection lot represented shall be deemed not to conform to this standard.

8.6 Rounding of results

For the purpose of determining conformity to the limits specified in this standard, excluding dimensions, an observed or a calculated value obtained from a test shall be rounded in accordance with the following procedure, which is based upon the guidance given in annex B of ISO 31-0:1992. It shall be rounded in one step to the same number of figures used to express the specified limit in this standard, except that for tensile strength the rounding interval shall be 10 N/mm² and for elongation the value shall be rounded to the nearest 0,5 %.

The following rules shall be used for rounding:

- a) if the figure immediately after the last figure to be retained is less than 5, the last figure to be retained shall be kept unchanged;
- b) if the figure immediately after the last figure to be retained is equal to or greater than 5, the last figure to be retained shall be increased by one.

9 Declaration of conformity and inspection documentation

9.1 Declaration of conformity

When requested by the purchaser [see 5l)] and agreed with the supplier, the supplier shall issue for the products the appropriate declaration of conformity in accordance with EN 1655.

9.2 Inspection documentation

When requested by the purchaser [see 5m)] and agreed with the supplier, the supplier shall issue for the products the appropriate inspection document in accordance with EN 10204.

10 Marking, labelling, packaging

Unless otherwise specified by the purchaser and agreed by the supplier, the marking, labelling and packaging shall be left to the discretion of the supplier [see 5n)].

Table 1 — Composition of copper

Material designation		Composition in % (m/m)				Density ²⁾ g/cm ³
Symbol	Number	Element	Cu ¹⁾	P	Total of other elements (see note)	approx.
Cu-DHP	CW024A	min.	99,90	0,015	—	8,9
		max.	—	0,040	—	
¹⁾ Including Ag, up to a maximum of 0,015 %.						
²⁾ For information only.						
NOTE The total of other elements (than copper) is defined as the sum of Ag, As, Bi, Cd, Co, Cr, Fe, Mn, Ni, O, P, Pb, S, Sb, Se, Si, Sn, Te and Zn, subject to the exclusion of any individual elements indicated.						

Table 2 — Composition of low alloyed copper alloys

Material designation		Composition in % (m/m)																Density ¹⁾ g/cm ³ approx.
Symbol	Number	Element	Cu	Al	Be	Co	Cr	Fe	Mn	Ni	P	Pb	Si	Te	Zn	Zr	Others total	
CuBe2	CW101C	min. max.	Rem. —	— —	1,8 2,1	— 0,3	— —	— 0,2	— —	— 0,3	— —	— —	— —	— —	— —	— —	— 0,5	8,3
CuBe2Pb	CW102C	min. max.	Rem. —	— —	1,8 2,0	— 0,3	— —	— 0,2	— —	— 0,3	— —	0,2 0,6	— —	— —	— —	— —	— 0,5	8,3
CuCo1Ni1Be	CW103C	min. max.	Rem. —	— —	0,4 0,7	0,8 1,3	— —	— 0,2	— —	0,8 1,3	— —	— —	— —	— —	— —	— —	— 0,5	8,8
CuCo2Be	CW104C	min. max.	Rem. —	— —	0,4 0,7	2,0 2,8	— —	— 0,2	— —	— 0,3	— —	— —	— —	— —	— —	— —	— 0,5	8,8
CuCr1Zr	CW106C	min. max.	Rem. —	— —	— —	— —	0,5 1,2	— 0,08	— —	— —	— —	— —	— 0,1	— —	— —	0,03 0,3	— 0,2	8,9
CuNi1Si	CW109C	min. max.	Rem. —	— —	— —	— —	— —	— 0,2	— 0,1	1,0 1,6	— —	— 0,02	0,4 0,7	— —	— —	— —	— 0,3	8,8
CuNi2Be	CW110C	min. max.	Rem. —	— —	0,2 0,6	— 0,3	— —	— 0,2	— —	1,4 2,2	— —	— —	— —	— —	— —	— —	— 0,5	8,8
CuNi2Si	CW111C	min. max.	Rem. —	— —	— —	— —	— —	— 0,2	— 0,1	1,6 2,5	— —	— 0,02	0,4 0,8	— —	— —	— —	— 0,3	8,8
CuSi1	CW115C	min. max.	Rem. —	— 0,02	— —	— —	— —	— 0,8	— 0,7	— —	— 0,02	— 0,05	0,8 2,0	— —	— 1,5	— —	— 0,5	8,8
CuSi3Mn1	CW116C	min. max.	Rem. —	— 0,05	— —	— —	— —	— 0,2	0,7 1,3	— —	— 0,05	— 0,05	2,7 3,2	— —	— 0,4	— —	— 0,5	8,8
CuTeP	CW118C	min. max.	Rem. —	— —	— —	— —	— —	— —	— —	— —	0,003 0,012	— —	— —	0,4 0,7	— —	— —	— 0,1	8,9
CuZr	CW120C	min. max.	Rem. —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	— —	0,1 0,2	— 0,1	8,9
For information only.																		

Table 3 — Composition of copper–nickel–zinc alloys

Material designation		Composition in % (m/m)									Density ¹⁾ g/cm ³ approx.
Symbol	Number	Element	Cu	Fe	Mn	Ni	Pb	Sn	Zn	Others total	
CuNi7Zn39Pb3Mn2	CW400J	min.	47,0	—	1,5	6,0	2,3	—	Rem.	—	8,5
		max.	50,0	0,3	3,0	8,0	3,3	0,2	—	0,2	
CuNi10Zn27	CW401J	min.	61,0	—	—	9,0	—	—	Rem.	—	8,6
		max.	64,0	0,3	0,5	11,0	0,05	—	—	0,2	
CuNi10Zn42Pb2	CW402J	min.	45,0	—	—	9,0	1,0	—	Rem.	—	8,4
		max.	48,0	0,3	0,5	11,0	2,5	0,2	—	0,2	
CuNi12Zn24	CW403J	min.	63,0	—	—	11,0	—	—	Rem.	—	8,7
		max.	66,0	0,3	0,5	13,0	0,03	0,03	—	0,2	
CuNi12Zn30Pb1	CW406J	min.	56,0	—	—	11,0	0,5	—	Rem.	—	8,6
		max.	58,0	0,3	0,5	13,0	1,5	0,2	—	0,2	
CuNi18Zn19Pb1	CW408J	min.	59,5	—	—	17,0	0,5	—	Rem.	—	8,7
		max.	62,5	0,3	0,7	19,0	1,5	0,2	—	0,2	
CuNi18Zn20	CW409J	min.	60,0	—	—	17,0	—	—	Rem.	—	8,7
		max.	63,0	0,3	0,5	19,0	0,03	0,03	—	0,2	

¹⁾ For information only.

Table 4 — Composition of copper–tin alloys

Material designation		Composition in % (m/m)									Density ¹⁾ g/cm ³ approx.
Symbol	Number	Element	Cu	Fe	Ni	P	Pb	Sn	Zn	Others total	
CuSn4	CW450K	min.	Rem.	—	—	0,01	—	3,5	—	—	8,9
		max.	—	0,1	0,2	0,4	0,02	4,5	0,2	0,2	
CuSn5	CW451K	min.	Rem.	—	—	0,01	—	4,5	—	—	8,9
		max.	—	0,1	0,2	0,4	0,02	5,5	0,2	0,2	
CuSn6	CW452K	min.	Rem.	—	—	0,01	—	5,5	—	—	8,8
		max.	—	0,1	0,2	0,4	0,02	7,0	0,2	0,2	
CuSn8	CW453K	min.	Rem.	—	—	0,01	—	7,5	—	—	8,8
		max.	—	0,1	0,2	0,4	0,02	8,5	0,2	0,2	

¹⁾ For information only.

Table 5 — Composition of copper–zinc alloys

Material designation		Composition in % (m/m)									Density ¹⁾ g/cm ³ approx.
Symbol	Number	Element	Cu	Al	Fe	Ni	Pb	Sn	Zn	Others total	
CuZn10	CW501L	min.	89,0	—	—	—	—	—	Rem.	—	8,8
		max.	91,0	0,02	0,05	0,3	0,05	0,1	—	0,1	
CuZn15	CW502L	min.	84,0	—	—	—	—	—	Rem.	—	8,8
		max.	86,0	0,02	0,05	0,3	0,05	0,1	—	0,1	
CuZn20	CW503L	min.	79,0	—	—	—	—	—	Rem.	—	8,7
		max.	81,0	0,02	0,05	0,3	0,05	0,1	—	0,1	
CuZn30	CW505L	min.	69,0	—	—	—	—	—	Rem.	—	8,5
		max.	71,0	0,02	0,05	0,3	0,05	0,1	—	0,1	
CuZn36	CW507L	min.	63,5	—	—	—	—	—	Rem.	—	8,4
		max.	65,5	0,02	0,05	0,3	0,05	0,1	—	0,1	
CuZn37	CW508L	min.	62,0	—	—	—	—	—	Rem.	—	8,4
		max.	64,0	0,05	0,1	0,3	0,1	0,1	—	0,1	

¹⁾ For information only.

Table 6 — Composition of copper–zinc–lead alloys

Material designation		Composition in % (m/m)									Density ¹⁾ g/cm ³ approx.
Symbol	Number	Element	Cu	Al	Fe	Ni	Pb	Sn	Zn	Others total	
CuZn35Pb1	CW600N	min.	62,5	—	—	—	0,8	—	Rem.	—	8,5
		max.	64,0	0,05	0,1	0,3	1,6	0,1	—	0,1	
CuZn35Pb2	CW601N	min.	62,0	—	—	—	1,6	—	Rem.	—	8,5
		max.	63,5	0,05	0,1	0,3	2,5	0,1	—	0,1	
CuZn36Pb3	CW603N	min.	60,0	—	—	—	2,5	—	Rem.	—	8,5
		max.	62,0	0,05	0,3	0,3	3,5	0,2	—	0,2	
CuZn37Pb2	CW606N	min.	61,0	—	—	—	1,6	—	Rem.	—	8,4
		max.	62,0	0,05	0,2	0,3	2,5	0,2	—	0,2	
CuZn38Pb2	CW608N	min.	60,0	—	—	—	1,6	—	Rem.	—	8,4
		max.	61,0	0,05	0,2	0,3	2,5	0,2	—	0,2	
CuZn38Pb4	CW609N	min.	57,0	—	—	—	3,5	—	Rem.	—	8,4
		max.	59,0	0,05	0,3	0,3	4,2	0,3	—	0,2	
CuZn39Pb0,5	CW610N	min.	59,0	—	—	—	0,2	—	Rem.	—	8,4
		max.	60,5	0,05	0,2	0,3	0,8	0,2	—	0,2	
CuZn39Pb2	CW612N	min.	59,0	—	—	—	1,6	—	Rem.	—	8,4
		max.	60,0	0,05	0,3	0,3	2,5	0,3	—	0,2	
CuZn39Pb3	CW614N	min.	57,0	—	—	—	2,5	—	Rem.	—	8,4
		max.	59,0	0,05	0,3	0,3	3,5	0,3	—	0,2	
CuZn40Pb2	CW617N	min.	57,0	—	—	—	1,6	—	Rem.	—	8,4
		max.	59,0	0,05	0,3	0,3	2,5	0,3	—	0,2	

¹⁾ For information only.

Table 7 — Composition of complex copper–zinc alloys

Material designation		Composition in % (m/m)											Density ¹⁾ g/cm ³ approx.
Symbol	Number	Element	Cu	Al	Fe	Mn	Ni	Pb	Si	Sn	Zn	Others total	
CuZn19Sn	CW701R	min.	80,0	—	—	—	—	—	—	0,2	Rem.	—	8,6
		max.	82,0	—	0,05	—	0,3	0,05	—	0,5	—	0,2	
CuZn36Sn1Pb	CW712R	min.	61,0	—	—	—	—	0,2	—	1,0	Rem.	—	8,3
		max.	63,0	—	0,1	—	0,2	0,6	—	1,5	—	0,2	
CuZn37Pb1Sn1	CW714R	min.	59,0	—	—	—	—	0,4	—	0,5	Rem.	—	8,4
		max.	61,0	—	0,1	—	0,3	1,0	—	1,0	—	0,2	
CuZn40Mn1Pb1	CW720R	min.	57,0	—	—	0,5	—	1,0	—	—	Rem.	—	8,3
		max.	59,0	0,2	0,3	1,5	0,6	2,0	0,1	0,3	—	0,3	

¹⁾ For information only.

Table 8 — Mechanical properties of copper

Designations			Nominal diameter ¹⁾			Tensile strength		0,2 % proof strength	Elongation ²⁾			Hardness	
									A _{100mm}	A _{11,3}	A		
Material		Material condition	mm			R _m		R _{p0,2}	%	%	%	HV	
Symbol	Number		from	over	up to and including	min.	max.	approx.	min.	min.	min.	min.	max.
Cu-DHP	CW024A	M	All			As manufactured							
		R200	1,5	—	20,0	200	270	(60)	33	37	40	—	—
		H040	1,5	—	20,0	—	—	—	—	—	—	40	70
		R270	1,0	—	8,0	270	—	(250)	10	12	—	—	—
		H065	1,0	—	8,0	—	—	—	—	—	—	65	90
		R250	—	8,0	20,0	250	—	(230)	—	—	15	—	—
		H065	—	8,0	20,0	—	—	—	—	—	—	65	90
		R330	1,0	—	8,0	330	—	(290)	(4)	7	—	—	—
		H090	1,0	—	8,0	—	—	—	—	—	—	90	105
		R300	—	8,0	15,0	300	—	(250)	—	—	10	—	—
		H090	—	8,0	15,0	—	—	—	—	—	—	90	105
		R400	1,0	—	8,0	400	—	(380)	—	—	—	—	—
		H105	1,0	—	8,0	—	—	—	—	—	—	105	—
		R350	—	8,0	12,0	350	—	(320)	—	—	—	—	—
		H105	—	8,0	12,0	—	—	—	—	—	—	105	—

¹⁾ Or equivalent cross-sectional area for polygonal wire.

²⁾ See note 2 to 8.2.

NOTE 1 Figures in parentheses are not requirements of this standard, but are given for information only.

NOTE 2 1 N/mm² is equivalent to 1 MPa.