BRITISH STANDARD

BS EN 12166:1998

Copper and copper alloys — Wire for general purposes

The European Standard EN 12166:1998 has the status of a British Standard

ICS 77.150.30

National foreword

This British Standard is the English language version of EN 12166:1998 published by the European Committee for Standardization (CEN). It supersedes BS 2873:1969 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee NFE/34, Copper and copper alloys, to Subcommittee NFE/34/1, Wrought and unwrought copper and copper alloys, which has the responsibility to:

— 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;

— monitor related international and European developments and promulgate them in the UK.

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

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

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

This British Standard, having been prepared under the direction of the Engineering Sector Board, was published under the authority of the Standards Board and comes into effect on 15 October 1998

Amendments issued since publication

Amd. No.	Date	Text affected

ISBN 0 580 29257 6

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12166

January 1998

ICS 77.150.30

Descriptors: Copper, copper alloys, wrought products, wire, designation, orders: sales documents, chemical composition, mechanical properties, sampling, mechanical tests, dimensions, dimensional tolerances, corrosion resistance, conformity tests, marking

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

This European Standard was approved by CEN on 26 December 1997.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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S

CEN

European Committee for Standardization

Comité Européen de Normalisation

Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Ref. No. EN 12166:1998 E

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.

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-leaded 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-leaded 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).

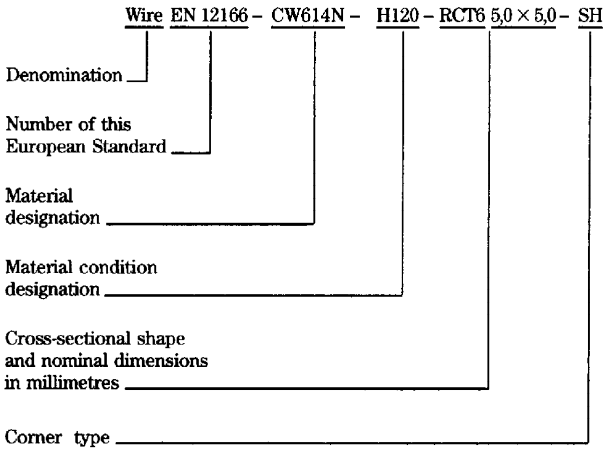
The derivation of a product designation is shown in example 1 and another typical product designation is shown in example 2.

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:

Wire EN 12166 – CuZn39Pb3 – H120 – RCT6,0 × 5,0 – SH

or



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;

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.

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 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-leaded 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-leaded 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

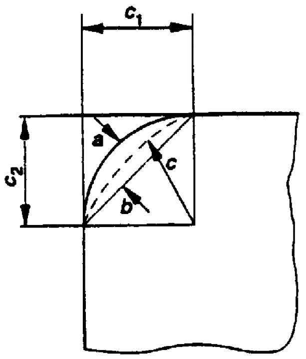
The sampling rate shall be in accordance with Table 20. Sampling units shall be selected from the finished products. The test samples shall be cut from the sampling units. Test samples, and test pieces prepared from them, shall not be subjected to any further treatment, other than any machining operations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



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".

Figure 1 — Calculation of corner radii

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, $11{,}3\sqrt{S_o}$ and $5{,}65\sqrt{S_o}$ respectively, where S_o 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/mm^2 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/cm³ approx.
Symbol	Number	Element	Cu[1]	P	Total of other elements (see note)	
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/cm³ approx.
Symbol	Number	Element	Cu	Al	Be	Co	Cr	Fe	Mn	Ni	P	Pb	Si	Te	Zn	Zr	Others total	
CuBe2	CW101C	min.	Rem.	—	1,8	—	—	—	—	—	—	—	—	—	—	—	—	8,3
		max.	—	—	2,1	0,3	—	0,2	—	0,3	—	—	—	—	—	—	0,5	
CuBe2Pb	CW102C	min.	Rem.	—	1,8	—	—	—	—	—	—	0,2	—	—	—	—	—	8,3
		max.	—	—	2,0	0,3	—	0,2	—	0,3	—	0,6	—	—	—	—	0,5	
CuCo1Ni1Be	CW103C	min.	Rem.	—	0,4	0,8	—	—	—	0,8	—	—	—	—	—	—	—	8,8
		max.	—	—	0,7	1,3	—	0,2	—	1,3	—	—	—	—	—	—	0,5	
CuCo2Be	CW104C	min.	Rem.	—	0,4	2,0	—	—	—	—	—	—	—	—	—	—	—	8,8
		max.	—	—	0,7	2,8	—	0,2	—	0,3	—	—	—	—	—	—	0,5	
CuCr1Zr	CW106C	min.	Rem.	—	—	—	0,5	—	—	—	—	—	—	—	—	0,03	—	8,9
		max.	—	—	—	—	1,2	0,08	—	—	—	—	0,1	—	—	0,3	0,2	
CuNi1Si	CW109C	min.	Rem.	—	—	—	—	—	—	1,0	—	—	0,4	—	—	—	—	8,8
		max.	—	—	—	—	—	0,2	0,1	1,6	—	0,02	0,7	—	—	—	0,3	
CuNi2Be	CW110C	min.	Rem.	—	0,2	—	—	—	—	1,4	—	—	—	—	—	—	—	8,8
		max.	—	—	0,6	0,3	—	0,2	—	2,2	—	—	—	—	—	—	0,5	
CuNi2Si	CW111C	min.	Rem.	—	—	—	—	—	—	1,6	—	—	0,4	—	—	—	—	8,8
		max.	—	—	—	—	—	0,2	0,1	2,5	—	0,02	0,8	—	—	—	0,3	
CuSi1	CW115C	min.	Rem.	—	—	—	—	—	—	—	—	—	0,8	—	—	—	—	8,8
		max.	—	0,02	—	—	—	0,8	0,7	—	0,02	0,05	2,0	—	1,5	—	0,5	
CuSi3Mn1	CW116C	min.	Rem.	—	—	—	—	—	0,7	—	—	—	2,7	—	–	—	—	8,8
		max.	—	0,05	—	—	—	0,2	1,3	—	0,05	0,05	3,2	—	0,4	—	0,5	
CuTeP	CW118C	min.	Rem.	—	—	—	—	—	—	—	0,003	—	—	0,4	—	—	—	8,9
		max.	—	—	—	—	—	—	—	—	0,012	—	—	0,7	—	—	0,1	
CuZr	CW120C	min.	Rem.	—	—	—	—	—	—	—	—	—	—	—	—	0,1	—	8,9
		max.	—	—	—	—	—	—	—	—	—	—	—	—	—	0,2	0,1	

[1) For information only.

Table 3 — Composition of copper-nickel-zinc alloys

Material designation		Composition in % (*m/m*)									Density[1)] g/cm³ 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/cm³ 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/cm³ 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/cm³ 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/cm³ 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)] mm			Tensile strength R_m N/mm²		0,2 % proof strength $R_{p0,2}$ N/mm²	Elongation[2)]			Hardness HV	
Material		Material condition							A_{100mm} %	$A_{11,3}$ %	A %		
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.

Table 9 — Mechanical properties of low alloyed copper alloys

Designations			Nominal diameter[1] mm			Tensile strength R_m N/mm²		0,2 % proof strength $R_{p0,2}$ N/mm²	Elongation[2]			Hardness HV	
Material		Material condition							A_{100mm} %	$A_{11,3}$ %	A %		
Symbol	Number		from	over	up to and including	min.	max.	approx.	min.	min.	min.	min.	max.
CuBe2	CW101C	R390[3]	0,2	—	1,0	390	540	(220)	35	—	—	—	—
CuBe2Pb	CW102C	R410[3]	—	1,0	10,0	410	540	(200)	30	25	20	—	—
		H090[3]	0,2	—	10,0	—	—	—	—	—	—	90	160
		R510[4]	1,0	—	10,0	510	610	(480)	—	—	15	—	—
		H120[4]	1,0	—	10,0	—	—	—	—	—	—	120	190
		R580[4]	1,0	—	10,0	580	690	(570)	6	8	10	—	—
		H170[4]	1,0	—	10,0	—	—	—	—	—	—	170	220
		R750[4]	0,2	—	1,0	750	1 140	(920)	10	—	—	—	—
		R750[4]	—	1,0	10,0	750	1 140	(800)	—	—	(2)	—	—
		H220[4]	0,2	—	10,0	—	—	—	—	—	—	220	290
		R1130[5]	0,2	—	1,0	1 130	1 350	(1 090)	(3)	—	—	—	—
		R1100[5]	—	1,0	10,0	1 000	1 320	(1 050)	5	7	8	—	—
		H350[5]	0,2	—	10,0	—	—	—	—	—	—	350	410
		R1190[6]	1,0	—	10,0	1 190	1 450	(1 150)	—	—	(2)	—	—
		H360[6]	1,0	—	10,0	—	—	—	—	—	—	360	450
		R1270[6]	1,0	—	10,0	1 270	1 490	(1 250)	—	—	(2)	—	—
		H370[6]	1,0	—	10,0	—	—	—	—	—	—	370	440
		R1310[6]	0,2	—	1,0	1 310	1 520	(1 300)	—	—	(1)	—	—
		H390[6]	0,2	—	1,0	—	—	—	—	—	—	390	460
		R1310[6]	—	1,0	10,0	1 310	1 520	(1 300)	—	—	(1)	—	—
		H380[6]	—	1,0	10,0	—	—	—	—	—	—	380	450
CuCo1Ni1Be	CW103C	R240[3]	1,0	—	10,0	240	380	(135)	15	18	20	—	—
CuCo2Be	CW104C	H090[3]	1,0	—	10,0	—	—	—	—	—	—	90	—
CuNi2Be	CW110C												
		R440[4]	1,0	—	10,0	440	560	(445)	—	—	(2)	—	—
		H125[4]	1,0	—	10,0	—	—	—	—	—	—	125	—
		R680[5]	1,0	—	10,0	680	900	(635)	6	8	10	—	—
		H215[5]	1,0	—	10,0	—	—	—	—	—	—	215	—
		R750[6]	1,0	—	10,0	750	970	(760)	6	8	10	—	—
		H230[6]	1,0	—	10,0	—	—	—	—	—	—	230	—

Table 9 — Mechanical properties of low alloyed copper alloys *(continued)*

Designations			Nominal diameter[1)] mm			Tensile strength R_m N/mm²		0,2 % proof strength $R_{p0,2}$ N/mm²	Elongation[2)]			Hardness HV	
Material		Material condition							A_{100mm} %	$A_{11,3}$ %	A %		
Symbol	Number		from	over	up to and including	min.	max.	approx.	min.	min.	min.	min.	max.
CuCr1Zr	CW106C	M	All			As manufactured							
		R360[4)]	2,0	—	10,0	360	460	(270)	11	13	15	—	—
		H130[4)]	2,0	—	10,0	—	—	—	—	—	—	130	160
		R440[6)]	2,0	—	10,0	440	540	(400)	8	9	10	—	—
		H165[6)]	2,0	—	10,0	—	—	—	—	—	—	165	195
		R470[7)]	2,0	—	10,0	470	570	(440)	5	7	8	—	—
		H170[7)]	2,0	—	10,0	—	—	—	—	—	—	170	200
CuNi1Si	CW109C	M	All			As manufactured							
		R450[4)]	1,5	—	6,0	450	—	(440)	5	6	—	—	—
		H135[4)]	1,5	—	6,0	—	—	—	—	—	—	135	175
		R410[4)]	—	6,0	15,0	410	—	(400)	—	6	8	—	—
		H120[4)]	—	6,0	15,0	—	—	—	—	—	—	120	160
		R650[6)]	1,5	—	6,0	650	—	(620)	7	8	—	—	—
		H190[6)]	1,5	—	6,0	—	—	—	—	—	—	190	240
		R590[6)]	—	6,0	15,0	590	—	(580)	7	8	10	—	—
		H170[6)]	—	6,0	15,0	—	—	—	—	—	—	170	220
CuNi2Si	CW111C	M	All			As manufactured							
		R480[4)]	1,5	—	6,0	480	—	(450)	(4)	5	—	—	—
		H140[4)]	1,5	—	6,0	—	—	—	—	—	—	140	180
		R410[4)]	—	6,0	15,0	410	—	(400)	—	6	8	—	—
		H130[4)]	—	6,0	15,0	—	—	—	—	—	—	130	170
		R700[6)]	1,5	—	6,0	700	—	(680)	6	7	—	—	—
		H200[6)]	1,5	—	6,0	—	—	—	—	—	—	200	250
		R640[6)]	—	6,0	15,0	640	—	(620)	—	8	10	—	—
		H190[6)]	—	6,0	15,0	—	—	—	—	—	—	190	240
CuSi1	CW115C	M	All			As manufactured							
		R260	0,1	—	20,0	260	380	(150)	40	45	50	—	—
		H085	0,1	—	20,0	—	—	—	—	—	—	85	115
		R410	0,1	—	20,0	410	510	(200)	15	17	20	—	—
		H130	0,1	—	20,0	—	—	—	—	—	—	130	160

Table 9 — Mechanical properties of low alloyed copper alloys *(continued)*

Designations			Nominal diameter[1)] mm			Tensile strength R_m N/mm²		0,2 % proof strength $R_{p0,2}$ N/mm²	Elongation[2)]			Hardness HV	
Material		Material condition							A_{100mm} %	$A_{11,3}$ %	A %		
Symbol	Number		from	over	up to and including	min.	max.	approx.	min.	min.	min.	min.	max.
CuSi1	CW115C	R510	0,1	—	20,0	510	650	(300)	10	12	15	—	—
		H145	0,1	—	20,0	—	—	—	—	—	—	145	175
		R620	0,1	—	12,0	620	760	(350)	6	8	10	—	—
		H170	0,1	—	12,0	—	—	—	—	—	—	170	200
		R690	0,1	—	6,0	690	—	(400)	—	—	—	—	—
		H190	0,1	—	6,0	—	—	—	—	—	—	190	—
CuSi3Mn1	CW116C	M	All			As manufactured							
		R360	0,1	—	20,0	360	450	(240)	40	43	45	—	—
		H085	0,1	—	20,0	—	—	—	—	—	—	85	115
		R440	0,1	—	20,0	440	540	(290)	28	30	32	—	—
		H115	0,1	—	20,0	—	—	—	—	—	—	115	145
		R530	0,1	—	20,0	530	680	(480)	15	18	20	—	—
		H125	0,1	—	20,0	—	—	—	—	—	—	125	155
		R670	0,1	—	10,0	670	810	(600)	8	9	10	—	—
		H155	0,1	—	10,0	—	—	—	—	—	—	155	185
		R800	0,1	—	6,0	800	—	(750)	5	6	—	—	—
		H210	0,1	—	6,0	—	—	—	—	—	—	210	—
CuTeP	CW118C	M	All			As manufactured							
		R250	0,1	—	20,0	250	350	(200)	(3)	7	12	—	—
		H090	0,1	—	20,0	—	—	—	—	—	—	90	120
		R300	0,1	—	20,0	300	400	(250)	(1)	(3)	8	—	—
		H100	0,1	—	20,0	—	—	—	—	—	—	100	130
		R360	0,1	—	6,0	360	—	(320)	—	—	—	—	—
		H110	0,1	—	6,0	—	—	—	—	—	—	110	—
CuZr	CW120C	M	All			As manufactured							
		R200[3)]	0,1	—	20,0	200	300	(80)	20	25	30	—	—
		H050[3)]	0,1	—	20,0	—	—	—	—	—	—	50	80

Table 9 — Mechanical properties of low alloyed copper alloys *(continued)*

Designations			Nominal diameter[1] mm			Tensile strength R_m N/mm²		0,2 % proof strength $R_{p0,2}$ N/mm²	Elongation[2]			Hardness HV	
Material		Material condition							A_{100mm} %	$A_{11,3}$ %	A %		
Symbol	Number		from	over	up to and including	min.	max.	approx.	min.	min.	min.	min.	max.
CuZr	CW120C	R300[6]	0,1	—	20,0	300	400	(250)	12	15	20	—	—
		H115[6]	0,1	—	20,0	—	—	—	—	—	—	115	145
		R350[6]	0,1	—	20,0	350	450	(300)	10	14	18	—	—
		H135[6]	0,1	—	20,0	—	—	—	—	—	—	135	165
		R400[6]	0,1	—	10,0	400	500	(350)	6	10	15	—	—
		H145[6]	0,1	—	10,0	—	—	—	—	—	—	145	—

[1] Or equivalent cross-sectional area for polygonal wire.

[2] See note 2 to **8.2**.

[3] Solution heat treated (see note 2).

[4] Solution heat treated and cold worked (see note 2).

[5] Solution heat treated and precipitation hardened.

[6] Solution heat treated, cold worked and precipitation hardened (see note 2).

[7] Solution heat treated, cold worked, precipitation hardened and cold worked (see note 2).

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

NOTE 2 If the specified mechanical properties have been achieved by a process route other than that indicated, the supplier shall indicate the fact to the purchaser.

NOTE 3 1 N/mm² is equivalent to 1 MPa.

Table 10 — Mechanical properties of copper-nickel-zinc alloys

Designations			Nominal diameter[1] mm			Tensile strength R_m N/mm²		0,2 % proof strength $R_{p0,2}$ N/mm²	Elongation[2]			Hardness HV		Previous condition designation (for information only)
Material		Material condition							A_{100mm} %	$A_{11,3}$ %	A %			
Symbol	Number		from	over	up to and including	min.	max.	approx.	min.	min.	min.	min.	max.	
CuNi7Zn39Pb3Mn2	CW400J	M	1,5	—	12,0	As manufactured								
		R520	1,5	—	12,0	520	—	(250)	12	15	18	—	—	half hard
		H130	1,5	—	12,0	—	—	—	—	—	—	130	170	
		R620	1,5	—	10,0	620	—	(500)	(3)	5	7	—	—	hard
		H160	1,5	—	10,0	—	—	—	—	—	—	160	200	
		R700	1,5	—	5,0	700	—	(620)	—	—	—	—	—	spring hard
		H190	1,5	—	5,0	—	—	—	—	—	—	190	230	
CuNi10Zn27 CuNi12Zn24	CW401J CW403J	M	All			As manufactured								
		R430	0,1	—	0,5	430	530	(190)	(20)	—	—	—	—	soft
		R400	—	0,5	1,5	400	510	(180)	25	—	—	—	—	
		R370	—	1,5	4,0	370	480	(170)	30	—	—	—	—	
		H085	1,5	—	4,0	—	—	—	—	—	—	85	140	
		R360	—	4,0	20,0	360	480	(160)	—	35	40	—	—	
		H080	—	4,0	20,0	—	—	—	—	—	—	80	130	
		R520	0,1	—	0,5	520	620	(340)	(5)	—	—	—	—	quarter hard
		R480	—	0,5	1,5	480	580	(320)	(8)	—	—	—	—	
		R460	—	1,5	4,0	460	560	(310)	(12)	—	—	—	—	
		R440	—	4,0	20,0	440	540	(290)	—	(15)	(20)	—	—	
		H130	1,5	—	20,0	—	—	—	—	—	—	130	170	

Table 10 — Mechanical properties of copper–nickel–zinc alloys *(continued)*

Designations: Material: Symbol	Designations: Material: Number	Designations: Material condition	Nominal diameter[1)] mm: from	Nominal diameter[1)] mm: over	Nominal diameter[1)] mm: up to and including	Tensile strength R_m N/mm^2: min.	Tensile strength R_m N/mm^2: max.	0,2 % proof strength $R_{p0,2}$ N/mm^2: approx.	Elongation[2)] A_{100mm} %: min.	Elongation[2)] $A_{11,3}$ %: min.	Elongation[2)] A %: min.	Hardness HV: min.	Hardness HV: max.	Previous condition designation (for information only)
CuNi10Zn27	CW401J	R620	0,1	—	0,5	620	730	(510)	—	—	—	—	—	half hard
CuNi12Zn24	CW403J	R580	—	0,5	1,5	580	680	(470)	—	—	—	—	—	
		R560	—	1,5	4,0	560	660	(460)	(5)	—	—	—	—	
		H170	1,5	—	4,0	—	—	—	—	—	—	170	200	
		R530	—	4,0	8,0	530	630	(440)	—	(6)	—	—	—	
		H165	—	4,0	8,0	—	—	—	—	—	—	165	195	
		R730	0,1	—	0,5	730	850	(710)	—	—	—	—	—	hard
		R680	—	0,5	1,5	680	800	(670)	—	—	—	—	—	
		R660	—	1,5	4,0	660	780	(650)	—	—	—	—	—	
		H195	1,5	—	4,0	—	—	—	—	—	—	195	225	
		R630	—	4,0	8,0	630	750	(620)	—	—	—	—	—	
		H185	—	4,0	8,0	—	—	—	—	—	—	185	215	
		R850	0,1	—	0,5	850	—	(860)	—	—	—	—	—	spring hard
		R800	—	0,5	1,5	800	—	(810)	—	—	—	—	—	
		R780	—	1,5	4,0	780	—	(790)	—	—	—	—	—	
		H210	1,5	—	4,0	—	—	—	—	—	—	210	—	
CuNi10Zn42Pb2	CW402J	M	1,5	—	12,0	As manufactured								
		R540	1,5	—	12,0	540	—	(300)	10	12	15	—	—	half hard
		H150	1,5	—	12,0	—	—	—	—	—	—	150	190	
		R640	1,5	—	10,0	640	—	(500)	(2)	(4)	6	—	—	hard
		H180	1,5	—	10,0	—	—	—	—	—	—	180	230	

Table 10 — Mechanical properties of copper–nickel–zinc alloys *(continued)*

Designations			Nominal diameter[1)] mm			Tensile strength R_m N/mm²		0,2 % proof strength $R_{p0,2}$ N/mm²	Elongation[2)]			Hardness HV		Previous condition designation (for information only)
Material		Material condition							A_{100mm} %	$A_{11,3}$ %	A %			
Symbol	Number		from	over	up to and including	min.	max.	approx.	min.	min.	min.	min.	max.	
CuNi12Zn30Pb1	CW406J	M	1,5	—	12,0	As manufactured								
		R410	1,5	—	12,0	410	—	(300)	8	10	12	—	—	half hard
		H110	1,5	—	12,0	—	—	—	—	—	—	110	150	
		R530	1,5	—	10,0	530	—	(440)	—	(3)	5	—	—	hard
		H140	1,5	—	10,0	—	—	—	—	—	—	140	190	
CuNi18Zn19Pb1	CW408J	M	1,5	—	12,0	As manufactured								
		R450	1,5	—	12,0	450	—	(320)	8	10	12	—	—	half hard
		H120	1,5	—	12,0	—	—	—	—	—	—	120	160	
		R570	1,5	—	10,0	570	—	(460)	(2)	5	8	—	—	hard
		H150	1,5	—	10,0	—	—	—	—	—	—	150	200	
		M	All			As manufactured								
CuNi18Zn20	CW409J	R450	0,1	—	0,5	450	560	(200)	(20)	—	—	—	—	soft
		R430	—	0,5	1,5	430	550	(200)	25	—	—	—	—	
		R420	—	1,5	4,0	420	540	(190)	30	—	—	—	—	
		H100	1,5	—	4,0	—	—	—	—	—	—	100	150	
		R410	—	4,0	20,0	410	530	(180)	—	35	40	—	—	
		H095	—	4,0	20,0	—	—	—	—	—	—	95	145	

Table 10 — Mechanical properties of copper–nickel–zinc alloys *(continued)*

Designations: Material: Symbol	Designations: Material: Number	Material condition	Nominal diameter[1)] mm: from	over	up to and including	Tensile strength R_m N/mm² min.	max.	0,2 % proof strength $R_{p0,2}$ N/mm² approx.	Elongation[2)] A_{100mm} % min.	$A_{11,3}$ % min.	A % min.	Hardness HV min.	max.	Previous condition designation (for information only)
CuNi18Zn20	CW409J	R550	0,1	—	0,5	550	650	(360)	—	—	—	—	—	quarter hard
		R530	—	0,5	1,5	530	630	(350)	(6)	—	—	—	—	
		R510	—	1,5	4,0	510	610	(340)	(10)	—	—	—	—	
		H150	1,5	—	4,0	—	—	—	—	—	—	150	185	
		R490	—	4,0	20,0	490	590	(320)	—	(12)	(15)	—	—	
		H145	—	4,0	20,0	—	—	—	—	—	—	145	180	
		R570	0,1	—	0,5	640	750	(520)	—	—	—	—	—	half hard
		R620	—	0,5	1,5	620	720	(500)	—	—	—	—	—	
		R600	—	1,5	4,0	600	700	(490)	—	—	—	—	—	
		H180	1,5	—	4,0	—	—	—	—	—	—	180	210	
		R570	—	4,0	8,0	570	670	(470)	—	—	—	—	—	
		H175	—	4,0	8,0	—	—	—	—	—	—	175	205	
		R750	0,1	—	0,5	750	880	(730)	—	—	—	—	—	hard
		R720	—	0,5	1,5	720	830	(700)	—	—	—	—	—	
		R700	—	1,5	4,0	700	800	(680)	—	—	—	—	—	
		H205	1,5	—	4,0	—	—	—	—	—	—	205	235	
		R660	—	4,0	8,0	660	770	(640)	—	—	—	—	—	
		H200	—	4,0	8,0	—	—	—	—	—	—	200	230	
		R880	0,1	—	0,5	880	—	(880)	—	—	—	—	—	spring hard
		R830	—	0,5	1,5	830	—	(840)	—	—	—	—	—	
		R800	—	1,5	4,0	800	—	(810)	—	—	—	—	—	
		H235	1,5	—	4,0	—	—	—	—	—	—	235	—	

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.

Table 11 — Mechanical properties of copper–tin alloys

Designations			Nominal diameter[1)]			Tensile strength		0,2 % proof strength	Elongation[2)]			Hardness		Previous condition designation (for information only)
Material		Material condition	mm			R_m N/mm²		$R_{p0,2}$ N/mm²	A_{100mm} %	$A_{11,3}$ %	A %	HV		
Symbol	Number		from	over	up to and including	min.	max.	approx.	min.	min.	min.	min.	max.	
CuSn4 CuSn5	CW450K CW451K	M	All			As manufactured								
		R360	0,1	—	0,5	360	450	(160)	(30)	—	—	—	—	soft
		R350	—	0,5	1,5	350	440	(150)	40	—	—	—	—	
		R330	—	1,5	4,0	330	420	(150)	45	—	—	—	—	
		H080	1,5	—	4,0	—	—	—	—	—	—	80	130	
		R320	—	4,0	20,0	320	410	(140)	—	50	55	—	—	
		H075	—	4,0	20,0	—	—	—	—	—	—	75	125	
		R450	0,1	—	0,5	450	550	(300)	(7)	—	—	—	—	quarter hard
		R440	—	0,5	1,5	440	540	(290)	(10)	—	—	—	—	
		R410	—	1,5	4,0	410	510	(280)	(15)	—	—	—	—	
		H130	1,5	—	4,0	—	—	—	—	—	—	130	160	
		R400	—	4,0	20,0	400	500	(270)	—	(20)	(25)	—	—	
		H125	—	4,0	20,0	—	—	—	—	—	—	125	160	
		R550	0,1	—	0,5	550	660	(420)	—	—	—	—	—	half hard
		R540	—	0,5	1,5	540	640	(410)	—	—	—	—	—	
		R500	—	1,5	4,0	500	600	(390)	(6)	—	—	—	—	
		H155	1,5	—	4,0	—	—	—	—	—	—	155	185	
		R470	—	4,0	8,0	470	570	(360)	—	(8)	—	—	—	
		H150	—	4,0	8,0	—	—	—	—	—	—	150	180	

Table 11 — Mechanical properties of copper–tin alloys *(continued)*

Designations: Material: Symbol	Designations: Material: Number	Designations: Material condition	Nominal diameter[1)] mm: from	Nominal diameter[1)] mm: over	Nominal diameter[1)] mm: up to and including	Tensile strength R_m N/mm^2: min.	Tensile strength R_m N/mm^2: max.	0,2 % proof strength $R_{p0,2}$ N/mm^2: approx.	Elongation[2)] A_{100mm} %: min.	Elongation[2)] $A_{11,3}$ %: min.	Elongation[2)] A %: min.	Hardness HV: min.	Hardness HV: max.	Previous condition designation (for information only)
CuSn4	CW450K	R660	0,1	—	0,5	660	780	(580)	—	—	—	—	—	three-quarter hard
CuSn5	CW451K	R630	—	0,5	1,5	630	740	(550)	—	—	—	—	—	
		R590	—	1,5	4,0	590	690	(510)	—	—	—	—	—	
		H180	1,5	—	4,0	—	—	—	—	—	—	180	210	
		R560	—	4,0	8,0	560	660	(490)	—	—	—	—	—	
		H175	—	4,0	8,0	—	—	—	—	—	—	175	205	
		R780	0,1	—	0,5	780	930	(770)	—	—	—	—	—	hard
		R730	—	0,5	1,5	730	900	(720)	—	—	—	—	—	
		R690	—	1,5	4,0	690	850	(690)	—	—	—	—	—	
		H200	1,5	—	4,0	—	—	—	—	—	—	200	230	
		R930	0,1	—	0,5	930	—	(920)	—	—	—	—	—	spring hard
		R900	—	0,5	1,5	900	—	(880)	—	—	—	—	—	
		R850	—	1,5	4,0	850	—	(850)	—	—	—	—	—	
		H225	1,5	—	4,0	—	—	—	—	—	—	225	—	
CuSn6	CW452K	M	All			As manufactured								
		R380	0,1	—	0,5	380	480	(170)	(50)	—	—	—	—	soft
		R370	—	0,5	1,5	370	470	(170)	55	—	—	—	—	
		R360	—	1,5	4,0	360	440	(160)	60	—	—	—	—	
		H085	1,5	—	4,0	—	—	—	—	—	—	85	125	
		R340	—	4,0	20,0	340	420	(150)	—	60	65	—	—	
		H080	—	4,0	20,0	—	—	—	—	—	—	80	120	

Table 11 — Mechanical properties of copper–tin alloys *(continued)*

Designations			Nominal diameter[1]			Tensile strength		0,2 % proof strength	Elongation[2]			Hardness		Previous condition designation (for information only)
Material		Material condition	mm			R_m N/mm²		$R_{p0,2}$ N/mm²	A_{100mm} %	$A_{11,3}$ %	A %	HV		
Symbol	Number		from	over	up to and including	min.	max.	approx.	min.	min.	min.	min.	max.	
CuSn6	CW452K	R480	0,1	—	0,5	480	590	(320)	(10)	—	—	—	—	quarter hard
		R460	—	0,5	1,5	460	560	(310)	(14)	—	—	—	—	
		R430	—	1,5	4,0	430	530	(290)	(20)	—	—	—	—	
		H125	1,5	—	4,0	—	—	—	—	—	—	125	165	
		R420	—	4,0	20,0	420	520	(280)	—	(25)	(30)	—	—	
		H120	—	4,0	20,0	—	—	—	—	—	—	120	160	
		R590	0,1	—	0,5	590	710	(460)	(5)	—	—	—	—	half hard
		R560	—	0,5	1,5	560	670	(430)	(6)	—	—	—	—	
		R530	—	1,5	4,0	530	630	(410)	(8)	—	—	—	—	
		H165	1,5	—	4,0	—	—	—	—	—	—	165	195	
		R510	—	4,0	8,0	510	610	(390)	—	(12)	—	—	—	
		H160	—	4,0	8,0	—	—	—	—	—	—	160	190	
		R700	0,1	—	0,5	700	830	(610)	—	—	—	—	—	three-quarter hard
		R670	—	0,5	1,5	670	790	(580)	—	—	—	—	—	
		R630	—	1,5	4,0	630	740	(550)	—	—	—	—	—	
		H190	1,5	—	4,0	—	—	—	—	—	—	190	225	
		R600	—	4,0	8,0	600	710	(520)	—	(6)	—	—	—	
		H185	—	4,0	8,0	—	—	—	—	—	—	185	220	

Table 11 — Mechanical properties of copper–tin alloys *(continued)*

Designations: Material: Symbol	Designations: Material: Number	Material condition	Nominal diameter[1)] mm: from	over	up to and including	Tensile strength R_m N/mm² min.	max.	0,2 % proof strength $R_{p0,2}$ N/mm² approx.	Elongation[2)] A_{100mm} % min.	$A_{11,3}$ % min.	A % min.	Hardness HV min.	max.	Previous condition designation (for information only)
CuSn6	CW452K	R830	0,1	—	0,5	830	980	(810)	—	—	—	—	—	hard
		R790	—	0,5	1,5	790	950	(770)	—	—	—	—	—	
		R740	—	1,5	4,0	740	900	(730)	—	—	—	—	—	
		H215	1,5	—	4,0	—	—	—	—	—	—	215	250	
		R980	0,1	—	0,5	980	—	(960)	—	—	—	—	—	spring hard
		R950	—	0,5	1,5	950	—	(930)	—	—	—	—	—	
		R900	—	1,5	4,0	900	—	(890)	—	—	—	—	—	
		H245	1,5	—	4,0	—	—	—	—	—	—	245	—	
CuSn8	CW453K	M	All			As manufactured								
		R440	0,1	—	0,5	440	550	(200)	(50)	—	—	—	—	soft
		R420	—	0,5	1,5	420	520	(190)	55	—	—	—	—	
		R400	—	1,5	4,0	400	490	(180)	55	—	—	—	—	
		H090	1,5	—	4,0	—	—	—	—	—	—	90	145	
		R390	—	4,0	20,0	390	470	(170)	—	60	65	—	—	
		H085	—	4,0	20,0	—	—	—	—	—	—	85	140	
		R530	0,1	—	0,5	530	630	(350)	(14)	—	—	—	—	quarter hard
		R510	—	0,5	1,5	510	610	(340)	(16)	—	—	—	—	
		R490	—	1,5	4,0	490	590	(320)	(24)	—	—	—	—	
		H145	1,5	—	4,0	—	—	—	—	—	—	145	190	
		R460	—	4,0	20,0	460	560	(310)	—	(28)	(33)	—	—	
		H140	—	4,0	20,0	—	—	—	—	—	—	140	180	

Table 11 — Mechanical properties of copper–tin alloys *(continued)*

Designations: Material: Symbol	Designations: Material: Number	Material condition	Nominal diameter[1)] mm: from	over	up to and including	Tensile strength R_m N/mm² min.	max.	0,2 % proof strength $R_{p0,2}$ N/mm² approx.	Elongation[2)] A_{100mm} % min.	$A_{11,3}$ % min.	A % min.	Hardness HV min.	max.	Previous condition designation (for information only)
CuSn8	CW453K	R630	0,1	—	0,5	630	750	(480)	(6)	—	—	—	—	half hard
		R610	—	0,5	1,5	610	720	(470)	(8)	—	—	—	—	
		R590	—	1,5	4,0	590	690	(440)	(10)	—	—	—	—	
		H180	1,5	—	4,0	—	—	—	—	—	—	180	215	
		R560	—	4,0	8,0	560	660	(430)	—	(15)	—	—	—	
		H175	—	4,0	8,0	—	—	—	—	—	—	175	210	
		R750	0,1	—	0,5	750	880	(650)	—	—	—	—	—	three-quarter hard
		R720	—	0,5	1,5	720	840	(620)	—	—	—	—	—	
		R690	—	1,5	4,0	690	790	(590)	(6)	—	—	—	—	
		H200	1,5	—	4,0	—	—	—	—	—	—	200	240	
		R650	—	4,0	8,0	650	750	(560)	—	(8)	—	—	—	
		H195	—	4,0	8,0	—	—	—	—	—	—	195	235	
		R870	0,1	—	0,5	870	1 000	(840)	—	—	—	—	—	hard
		R840	—	0,5	1,5	840	950	(810)	—	—	—	—	—	
		R790	—	1,5	4,0	790	900	(760)	—	—	—	—	—	
		H230	1,5	—	4,0	—	—	—	—	—	—	230	270	
		R1000	0,1	—	0,5	1 000	—	(1 000)	—	—	—	—	—	spring hard
		R950	—	0,5	1,5	950	—	(950)	—	—	—	—	—	
		R900	—	1,5	4,0	900	—	(900)	—	—	—	—	—	
		H265	1,5	—	4,0	—	—	—	—	—	—	265	—	

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.

Table 12 — Mechanical properties of copper–zinc alloys

Designations: Material: Symbol	Number	Material condition	Nominal diameter[1)] mm: from	over	up to and including	Tensile strength R_m N/mm² min.	max.	0,2 % proof strength $R_{p0,2}$ N/mm² approx.	Elongation[2)] A_{100mm} % min.	$A_{11,3}$ % min.	A % min.	Hardness HV min.	max.	Previous condition designation (for information only)
CuZn10	CW501L	M	All			As manufactured								
		R290	0,1	—	0,5	290	390	(140)	(25)	—	—	—	—	soft
		R280	—	0,5	1,5	280	380	(130)	30	—	—	—	—	
		R270	—	1,5	4,0	270	370	(130)	35	—	—	—	—	
		H070	1,5	—	4,0	—	—	—	—	—	—	70	120	
		R240	—	4,0	20,0	240	340	(120)	—	35	40	—	—	
		H060	—	4,0	20,0	—	—	—	—	—	—	60	110	
		R380	0,5	—	1,5	380	480	(260)	(8)	—	—	—	—	quarter hard
		R350	—	1,5	4,0	350	450	(240)	(12)	—	—	—	—	
		H115	1,5	—	4,0	—	—	—	—	—	—	115	145	
		R330	—	4,0	20,0	330	430	(230)	—	(15)	(20)	—	—	
		H105	—	4,0	20,0	—	—	—	—	—	—	105	135	
		R470	0,5	—	1,5	470	570	(390)	—	—	—	—	—	half hard
		R440	—	1,5	4,0	440	540	(370)	—	—	—	—	—	
		H135	1,5	—	4,0	—	—	—	—	—	—	135	165	
		R410	—	4,0	8,0	410	510	(350)	—	—	—	—	—	
		H125	—	4,0	8,0	—	—	—	—	—	—	125	155	
		R570	0,5	—	1,5	570	—	(560)	—	—	—	—	—	hard
		R530	—	1,5	4,0	530	—	(520)	—	—	—	—	—	
		H155	1,5	—	4,0	—	—	—	—	—	—	155	—	

Table 12 — Mechanical properties of copper–zinc alloys *(continued)*

Designations			Nominal diameter[1)]			Tensile strength		0,2 % proof strength	Elongation[2)]			Hardness		Previous condition designation (for information only)
Material		Material condition	mm			R_m N/mm²		$R_{p0,2}$ N/mm²	A_{100mm} %	$A_{11,3}$ %	A %	HV		
Symbol	Number		from	over	up to and including	min.	max.	approx.	min.	min.	min.	min.	max.	
CuZn15	CW502L	M	All			As manufactured								
CuZn20	CW503L	R310	0,1	—	0,5	310	410	(140)	(25)	—	—	—	—	soft
		R300	—	0,5	1,5	300	400	(140)	25	—	—	—	—	
		R290	—	1,5	4,0	290	390	(140)	30	—	—	—	—	
		H070	1,5	—	4,0	—	—	—	—	—	—	70	125	
		R260	—	4,0	20,0	260	360	(120)	—	40	45	—	—	
		H065	—	4,0	20,0	—	—	—	—	—	—	65	120	
		R400	0,5	—	1,5	400	500	(270)	(10)	—	—	—	—	quarter hard
		R370	—	1,5	4,0	370	470	(250)	(14)	—	—	—	—	
		H120	1,5	—	4,0	—	—	—	—	—	—	120	150	
		R360	—	4,0	20,0	360	460	(250)	—	(18)	(20)	—	—	
		H115	—	4,0	20,0	—	—	—	—	—	—	115	145	
		R480	0,5	—	1,5	480	580	(400)	—	—	—	—	—	half hard
		R450	—	1,5	4,0	450	550	(380)	(3)	—	—	—	—	
		H140	1,5	—	4,0	—	—	—	—	—	—	140	170	
		R430	—	4,0	8,0	430	530	(360)	(6)	—	—	—	—	
		H135	—	4,0	8,0	—	—	—	—	—	—	135	165	
		R600	0,1	—	0,5	600	—	(590)	—	—	—	—	—	hard
		R580	—	0,5	1,5	580	—	(570)	—	—	—	—	—	
		R540	—	1,5	4,0	540	—	(530)	—	—	—	—	—	
		H165	1,5	—	4,0	—	—	—	—	—	—	165	—	

Table 12 — Mechanical properties of copper–zinc alloys *(continued)*

Designations: Material: Symbol	Designations: Material: Number	Material condition	Nominal diameter[1)] mm: from	over	up to and including	Tensile strength R_m N/mm² min.	max.	0,2 % proof strength $R_{p0,2}$ N/mm² approx.	Elongation[2)] A_{100mm} % min.	$A_{11,3}$ % min.	A % min.	Hardness HV min.	max.	Previous condition designation (for information only)
CuZn30	CW505L	M	All			As manufactured								
		R350	0,1	—	0,5	350	450	(160)	(30)	—	—	—	—	soft
		R340	—	0,5	1,5	340	440	(150)	35	—	—	—	—	
		R310	—	1,5	4,0	310	410	(140)	40	—	—	—	—	
		R300	—	4,0	20,0	300	400	(130)	—	45	50	—	—	
		H065	1,5	—	20,0	—	—	—	—	—	—	65	115	
		R430	0,1	—	0,5	430	530	(240)	(10)	—	—	—	—	one eighth hard
		R410	—	0,5	1,5	410	510	(230)	(14)	—	—	—	—	
		R380	—	1,5	4,0	380	480	(220)	(18)	—	—	—	—	
		H095	1,5	—	4,0	—	—	—	—	—	—	95	135	
		R360	—	4,0	20,0	360	460	(210)	—	(22)	(25)	—	—	
		H085	—	4,0	20,0	—	—	—	—	—	—	85	130	
		R520	0,1	—	0,5	520	620	(340)	—	—	—	—	—	quarter hard
		R500	—	0,5	1,5	500	600	(330)	—	—	—	—	—	
		R460	—	1,5	4,0	460	560	(310)	(7)	—	—	—	—	
		H125	1,5	—	4,0	—	—	—	—	—	—	125	160	
		R440	—	4,0	8,0	440	540	(290)	—	(10)	—	—	—	
		H120	—	4,0	8,0	—	—	—	—	—	—	120	155	

Table 12 — Mechanical properties of copper–zinc alloys *(continued)*

Designations: Material Symbol	Designations: Material Number	Material condition	Nominal diameter[1)] mm from	over	up to and including	Tensile strength R_m N/mm² min.	max.	0,2 % proof strength $R_{p0,2}$ N/mm² approx.	Elongation[2)] A_{100mm} % min.	$A_{11,3}$ % min.	A % min.	Hardness HV min.	max.	Previous condition designation (for information only)
CuZn30	CW505L	R610	0,1	—	0,5	610	710	(500)	—	—	—	—	—	half hard
		R590	—	0,5	1,5	590	690	(480)	—	—	—	—	—	
		R540	—	1,5	4,0	540	640	(440)	—	—	—	—	—	
		H150	1,5	—	4,0	—	—	—	—	—	—	150	180	
		R530	—	4,0	8,0	530	630	(440)	—	—	—	—	—	
		H145	—	4,0	8,0	—	—	—	—	—	—	145	175	
		R700	0,1	—	0,5	700	800	(680)	—	—	—	—	—	hard
		R670	—	0,5	1,5	670	770	(650)	—	—	—	—	—	
		R620	—	1,5	4,0	620	720	(600)	—	—	—	—	—	
		H170	1,5	—	4,0	—	—	—	—	—	—	170	200	
		R800	0,1	—	0,5	800	—	(810)	—	—	—	—	—	spring hard
		R750	—	0,5	1,5	750	—	(760)	—	—	—	—	—	
		R700	—	1,5	4,0	700	—	(710)	—	—	—	—	—	
		H195	1,5	—	4,0	—	—	—	—	—	—	195	—	
CuZn36 CuZn37	CW507L CW508L	M	All			As manufactured								
		R360	0,1	—	0,5	360	450	(160)	(30)	—	—	—	—	soft
		R330	—	0,5	1,5	330	420	(150)	33	—	—	—	—	
		R300	—	1,5	4,0	300	380	(140)	35	—	—	—	—	
		H070	1,5	—	4,0	—	—	—	—	—	—	70	105	
		R280	—	4,0	20,0	280	370	(130)	—	40	45	—	—	
		H065	—	4,0	20,0	—	—	—	—	—	—	60	100	

Table 12 — Mechanical properties of copper–zinc alloys *(continued)*

Designations: Material Symbol	Designations: Material Number	Material condition	Nominal diameter[1)] mm: from	over	up to and including	Tensile strength R_m N/mm^2: min.	max.	0,2 % proof strength $R_{p0,2}$ N/mm^2: approx.	Elongation[2)] A_{100mm} %: min.	$A_{11,3}$ %: min.	A %: min.	Hardness HV: min.	max.	Previous condition designation (for information only)
CuZn36	CW507L	R420	0,5	—	1,5	420	510	(280)	(12)	—	—	—	—	one eighth hard
CuZn37	CW508L	R380	—	1,5	4,0	380	480	(260)	(16)	—	—	—	—	
		H105	1,5	—	4,0	—	—	—	—	—	—	105	140	
		R370	—	4,0	20,0	370	470	(250)	—	(20)	(25)	—	—	
		H095	—	4,0	20,0	—	—	—	—	—	—	95	135	
		R510	0,5	—	1,5	510	610	(420)	—	—	—	—	—	quarter hard
		R470	—	1,5	4,0	470	570	(390)	(5)	—	—	—	—	
		H130	1,5	—	4,0	—	—	—	—	—	—	130	160	
		R460	—	4,0	8,0	460	560	(380)	—	(8)	—	—	—	
		H135	—	4,0	8,0	—	—	—	—	—	—	135	165	
		R610	0,5	—	1,5	610	750	(610)	—	—	—	—	—	half hard/hard
		R560	—	1,5	4,0	560	700	(570)	—	—	—	—	—	
		H160	1,5	—	4,0	—	—	—	—	—	—	160	190	
		R550	—	4,0	8,0	550	680	(550)	—	—	—	—	—	
		H155	—	4,0	8,0	—	—	—	—	—	—	155	185	
		R800	0,1	—	0,5	800	—	(810)	—	—	—	—	—	spring hard
		R750	—	0,5	1,5	750	—	(760)	—	—	—	—	—	
		R700	—	1,5	4,0	700	—	(710)	—	—	—	—	—	
		H190	1,5	—	4,0	—	—	—	—	—	—	190	—	

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/mm^2 is equivalent to 1 MPa.

Table 13 — Mechanical properties of copper–zinc–lead alloys

Designations			Nominal diameter[1)] mm			Tensile strength R_m N/mm²		0,2 % proof strength $R_{p0,2}$ N/mm²	Elongation[2)]			Hardness HV		Previous condition designation (for information only)
Material		Material condition							A_{100mm} %	$A_{11,3}$ %	A %			
Symbol	Number		from	over	up to and including	min.	max.	approx.	min.	min.	min.	min.	max.	
CuZn35Pb1 CuZn35Pb2	CW600N CW601N	M	All			As manufactured								
		R380	0,5	—	1,5	380	—	(200)	—	—	—	—	—	half hard
		R380	—	1,5	8,0	380	—	(200)	18	20	—	—	—	
		H120	1,5	—	8,0	—	—	—	—	—	—	120	150	
		R370	—	8,0	20,0	370	—	(200)	—	—	25	—	—	
		H110	—	8,0	20,0	—	—	—	—	—	—	110	140	
		R450	0,5	—	1,5	450	—	(320)	—	—	—	—	—	hard
		R450	—	1,5	4,0	450	—	(320)	6	—	—	—	—	
		H155	1,5	—	4,0	—	—	—	—	—	—	155	185	
		R450	—	4,0	8,0	450	—	(320)	—	10	—	—	—	
		H145	—	4,0	8,0	—	—	—	—	—	—	145	175	
		R440	—	8,0	14,0	440	—	(320)	—	—	15	—	—	
		H140	—	8,0	14,0	—	—	—	—	—	—	140	170	
		R540	0,5	—	4,0	540	—	(480)	—	—	—	—	—	spring hard
		H165	1,5	—	4,0	—	—	—	—	—	—	165	—	
CuZn36Pb3 CuZn37Pb2	CW603N CW606N	M	All			As manufactured								
		R380	0,5	—	1,5	380	—	(180)	—	—	—	—	—	quarter hard
		R370	—	1,5	4,0	370	—	(180)	15	—	—	—	—	
		H100	1,5	—	4,0	—	—	—	—	—	—	100	130	
		R360	—	4,0	20,0	360	—	(180)	—	15	20	—	—	
		H090	—	4,0	20,0	—	—	—	—	—	—	90	125	

Table 13 — Mechanical properties of copper–zinc–lead alloys *(continued)*

Designations			Nominal diameter[1]			Tensile strength		0,2 % proof strength	Elongation[2]			Hardness		Previous condition designation (for information only)
Material		Material condition	mm			R_m N/mm²		$R_{p0,2}$ N/mm²	A_{100mm} %	$A_{11,3}$ %	A %	HV		
Symbol	Number		from	over	up to and including	min.	max.	approx.	min.	min.	min.	min.	max.	
CuZn36Pb3	CW603N	R440	0,5	—	1,5	440	—	(300)	—	—	—	—	—	half hard
CuZn37Pb2	CW606N	R420	—	1,5	4,0	420	—	(280)	6	—	—	—	—	
		H120	1,5	—	4,0	—	—	—	—	—	—	120	150	
		R410	—	4,0	8,0	410	—	(280)	—	10	—	—	—	
		H115	—	4,0	8,0	—	—	—	—	—	—	115	145	
		R400	—	8,0	20,0	400	—	(280)	—	—	15	—	—	
		H110	—	8,0	20,0	—	—	—	—	—	—	110	140	
		R500	1,5	—	4,0	500	—	(380)	(3)	—	—	—	—	hard
		H140	1,5	—	4,0	—	—	—	—	—	—	140	170	
		R490	—	4,0	8,0	490	—	(360)	—	6	—	—	—	
		R480	—	8,0	14,0	480	—	(360)	—	—	8	—	—	
		H130	—	4,0	14,0	—	—	—	—	—	—	130	160	
		R580	1,5	—	4,0	580	—	(520)	—	—	—	—	—	spring hard
		H155	1,5	—	4,0	—	—	—	—	—	—	155	—	
CuZn38Pb2	CW608N	M	All			As manufactured								
CuZn39Pb0,5	CW610N	R400	0,5	—	1,5	400	—	(200)	—	—	—	—	—	quarter hard
CuZn39Pb2	CW612N	R400	—	1,5	4,0	400	—	(200)	10	—	—	—	—	
		H110	1,5	—	4,0	—	—	—	—	—	—	110	140	
		R390	—	4,0	8,0	390	—	(180)	—	15	—	—	—	
		R380	—	8,0	20,0	380	—	(180)	—	—	20	—	—	
		H100	—	4,0	20,0	—	—	—	—	—	—	100	130	

Table 13 — Mechanical properties of copper-zinc-lead alloys *(continued)*

Designations			Nominal diameter[1] mm			Tensile strength R_m N/mm²		0,2 % proof strength $R_{p0,2}$ N/mm²	Elongation[2]			Hardness HV		Previous condition designation (for information only)
Material		Material condition							A_{100mm} %	$A_{11,3}$ %	A %			
Symbol	Number		from	over	up to and including	min.	max.	approx.	min.	min.	min.	min.	max.	
CuZn38Pb2	CW608N	R450	0,5	—	1,5	450	—	(300)	—	—	—	—	—	half hard
CuZn39Pb0,5	CW610N	R440	—	1,5	4,0	440	—	(300)	8	—	—	—	—	
CuZn39Pb22	CW612N	H130	1,5	—	4,0	—	—	—	—	—	—	130	160	
		R430	—	4,0	8,0	430	—	(300)	—	10	—	—	—	
		R420	—	8,0	20,0	420	—	(300)	—	—	15	—	—	
		H120	—	4,0	20,0	—	—	—	—	—	—	120	155	
		R500	0,5	—	1,5	500	—	(400)	—	—	—	—	—	hard
		R500	—	1,5	4,0	500	—	(400)	4	—	—	—	—	
		H150	1,5	—	4,0	—	—	—	—	—	—	150	180	
		R490	—	4,0	8,0	490	—	(400)	—	5	—	—	—	
		R480	—	8,0	14,0	480	—	(400)	—	—	8	—	—	
		H140	—	4,0	14,0	—	—	—	—	—	—	140	170	
		R570	1,5	—	4,0	570	—	(520)	—	—	—	—	—	spring hard
		H165	1,5	—	4,0	—	—	—	—	—	—	165	—	
CuZn38Pb4	CW609N	M	All			As manufactured								
CuZn39Pb3	CW614N													
CuZn40Pb2	CW617N	R450	0,5	—	1,5	450	—	(200)	—	—	—	—	—	half hard
		R430	—	1,5	4,0	430	—	(200)	6	—	—	—	—	
		H130	1,5	—	4,0	—	—	—	—	—	—	130	165	
		R420	—	4,0	8,0	420	—	(200)	—	8	—	—	—	
		H120	—	4,0	8,0	—	—	—	—	—	—	120	155	

Table 13 — Mechanical properties of copper–zinc–lead alloys *(continued)*

Designations			Nominal diameter[1] mm			Tensile strength R_m N/mm²		0,2 % proof strength $R_{p0,2}$ N/mm²	Elongation[2]			Hardness HV		Previous condition designation (for information only)
Material		Material condition							A_{100mm} %	$A_{11,3}$ %	A %			
Symbol	Number		from	over	up to and including	min.	max.	approx.	min.	min.	min.	min.	max.	
CuZn38Pb4	CW609N	R410	—	8,0	14,0	410	—	(200)	—	—	10	—	—	half hard
CuZn39Pb3	CW614N	R400	—	14,0	20,0	400	—	(200)	—	—	10	—	—	
CuZn40Pb2	CW617N	H110	—	8,0	20,0	—	—	—	—	—	—	110	145	
		R520	0,5	—	1,5	520	—	(400)	—	—	—	—	—	hard
		R510	—	1,5	4,0	510	—	(400)	(4)	—	—	—	—	
		H155	1,5	—	4,0	—	—	—	—	—	—	155	185	
		R500	—	4,0	8,0	500	—	(390)	—	6	—	—	—	
		R490	—	8,0	14,0	490	—	(390)	—	—	8	—	—	
		H145	—	4,0	14,0	—	—	—	—	—	—	145	175	
		R570	1,5	—	4,0	570	—	(520)	—	—	—	—	—	spring hard
		H170	1,5	—	4,0	—	—	—	—	—	—	170	—	

[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.

Table 14 — Mechanical properties of complex copper–zinc alloys

Designations			Nominal diameter[1)] mm			Tensile strength R_m N/mm²		0,2 % proof strength $R_{p0,2}$ N/mm²	Elongation[2)] A_{100mm} %	Elongation[2)] $A_{11,3}$ %	Elongation[2)] A %	Hardness HV	
Material Symbol	Material Number	Material condition	from	over	up to and including	min.	max.	approx.	min.	min.	min.	min.	max.
CuZn19Sn	CW701R	M	All			As manufactured							
		R330	0,1	—	0,5	330	420	—	30	—	—	—	—
		R310	—	0,5	1,5	310	400	—	30	—	—	—	—
		R310	—	1,5	4,0	310	400	—	35	—	—	—	—
		H080	1,5	—	4,0	—	—	—	—	—	—	80	110
		R290	—	4,0	20,0	290	380	—	—	45	50	—	—
		H070	—	4,0	20,0	—	—	—	—	—	—	70	100
		R850	0,1	—	0,5	850	—	—	—	—	—	—	—
CuZn36Sn1Pb CuZn37Pb1Sn1	CW712R CW714R	M	All			As manufactured							
		R350	0,1	—	20,0	350	450	—	15	18	20	—	—
		H100	0,1	—	20,0	—	—	—	—	—	—	100	130
		R400	1,5	—	8,0	400	—	—	10	13	—	—	—
		H120	1,5	—	8,0	—	—	—	—	—	—	120	—
CuZn40Mn1Pb1	CW720R	M	All			As manufactured							
		R430	1,5	—	8,0	430	530	—	10	12	—	—	—
		H115	1,5	—	8,0	—	—	—	—	—	—	115	145

Table 14 — Mechanical properties of complex copper–zinc alloys *(continued)*

Designations			Nominal diameter[1] mm			Tensile strength R_m N/mm²		0,2 % proof strength $R_{p0,2}$ N/mm²	Elongation[2]			Hardness HV	
Material		Material condition							A_{100mm} %	$A_{11,3}$ %	A %		
Symbol	Number		from	over	up to and including	min.	max.	approx.	min.	min.	min.	min.	max.
CuZn40Mn1Pb1	CW720R	R500	1,5	—	8,0	500	600	—	5	7	—	—	—
		H145	1,5	—	8,0	—	—	—	—	—	—	145	175
		R570	1,5	—	8,0	570	—	—	—	—	—	—	—
		H170	1,5	—	8,0	—	—	—	—	—	—	170	—

[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.

Table 15 — Grain size designations

Grain size designation	Range of average grain size mm	
	min.	max.
G015	—	0,025
G025	0,015	0,035
G040	0,025	0,055
G055	0,035	0,070
G085	0,050	0,120
G100	0,070	—
NOTE Average grain size ranges other than those in this table are subject to agreement between the purchaser and the supplier.		

Table 16 — Tolerances on diameter of round wire

Values in millimetres

Nominal diameter		Tolerance				
over	up to and including	class A	class B	class C	class D	class E
—	0,25	±0,005	—	—	0 −0,025	0 −0,006
0,25	0,5	±0,008	—	—	0 −0,03	0 −0,010
0,5	1,0	±0,012	—	—	0 −0,03	0 −0,014
1,0	2,0	±0,02	0 −0,10	0 −0,06	0 −0,04	0 −0,025
2,0	4,0	±0,03	0 −0,10	0 −0,06	0 −0,04	0 −0,025
4,0	6,0	±0,04	0 −0,12	0 −0,08	0 −0,05	0 −0,030
6,0	10,0	±0,06	0 −0,15	0 −0,09	0 −0,06	0 −0,036
10,0	18,0	±0,08	0 −0,18	0 −0,011	0 −0,07	0 −0,043

Table 17 — Tolerances on width across-flats of square or regular polygonal wire

Values in millimetres

Nominal width across-flats		Tolerance		
over	up to and including	class A	class B	class C
—	0,50	±0,015	—	—
0,5	1,0	±0,02	—	—
1,0	2,0	±0,03	—	—
2,0	4,0	±0,05	0 −0,12	0 −0,08
4,0	6,0	±0,06	0 −0,12	0 −0,08
6,0	10,0	±0,08	0 −0,15	0 −0,09
10,0	18,0	±0,10	0 −0,18	0 −0,11

Table 18 — Tolerances on width and thickness of rectangular wire

Values in millimetres

Nominal width across-flats		Tolerance on width	Tolerance on thickness, for range of thickness						
over	up to and including		up to and including 1,0	over 1,0 up to and including 2,0	over 2,0 up to and including 4,0	over 4,0 up to and including 6,0	over 6,0 up to and including 10,0	over 10,0 up to and including 18,0	over 18,0
—	1,0	±0,02	±0,02	—	—	—	—	—	—
1,0	2,0	±0,03	±0,02	±0,03	—	—	—	—	—
2,0	4,0	±0,05	±0,02	±0,03	±0,05	—	—	—	—
4,0	6,0	±0,06	±0,02	±0,03	±0,05	±0,06	—	—	—
6,0	10,0	±0,08	±0,02	±0,03	±0,05	±0,07	±0,08	—	—
10,0	18,0	±0,10	—	±0,03	±0,05	±0,07	±0,09	±0,10	—
18,0	—	±0,15	—	—	±0,05	±0,07	±0,09	±0,10	±0,15

Table 19 — Corner radii for square or rectangular wire

Dimensions in millimetres

Nominal thickness		Radii for sharp and rounded corners	
over	up to and including	sharp max.	rounded range
—	0,60	0,05	0,05 to 0,25
0,60	1,5	0,08	0,08 to 0,25
1,5	3,0	0,2	0,2 to 0,3
3,0	6,0	0,3	0,3 to 0,5
6,0	10,0	0,4	0,4 to 0,8
10,0	12,0	0,5	0,5 to 1,2

Table 20 — Sampling rate

Nominal diameter[1)] mm		Size of inspection lot for one test sample kg
over	up to and including	up to and including
0,1	0,8	100
0,8	3,0	250
3,0	10,0	500
10,0	—	1 000

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

NOTE 1 Larger quantities require sampling in proportion, up to a maximum of three test samples.

NOTE 2 If piece weights are greater than the weight of inspection lot indicated, the sampling rate may be reduced to one per piece weight.

Annex A (informative)

Bibliography

In the preparation of this European Standard, use was made of a number of documents for reference purposes. These informative references are cited at the appropriate places in the text and the publications are listed hereafter.

EN 1173, *Copper and copper alloys — Material condition or temper designation.*

EN 1412, *Copper and copper alloys — European numbering system.*

EN ISO 9001, *Quality systems — Model for quality assurance in design/development, production, installation and servicing.*

(ISO 9001:1994)

EN ISO 9002, *Quality systems — Model for quality assurance in production, installation and servicing.* (ISO 9002:1994)

ISO 31-0:1992, *Quantities and units — Part 0: General principles.*

ISO 1190-1, *Copper and copper alloys — Code of designation — Part 1: Designation of materials.*

Annex B (informative)

Position of wire cross-section within a coil, reel, spool or drum

The position of the wire cross-section within the coil/reel/spool/drum is illustrated in Figure B.1 for coil and Figure B.2 for reel/spool/drum.

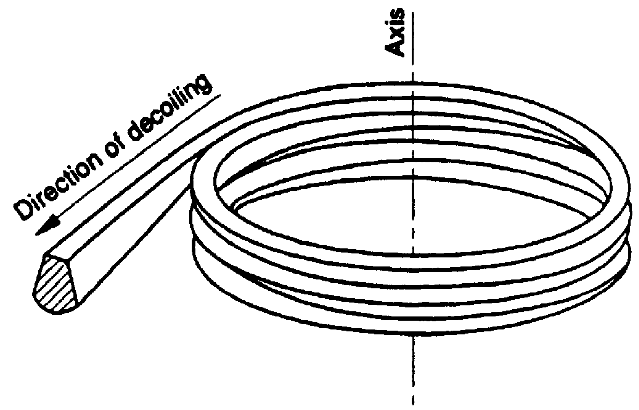


Figure B.1 — Illustration of position of wire cross-section within the coil (bunched or stagger/traverse wound)

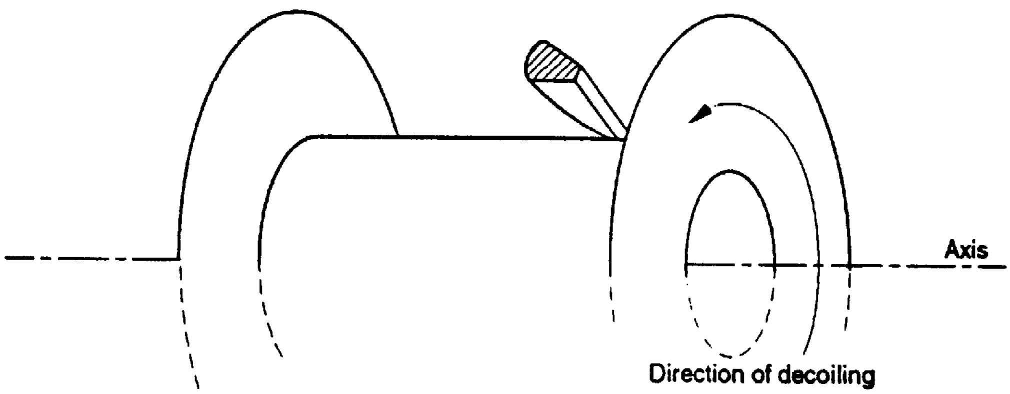


Figure B.2 — Illustration of position of wire cross-section within the reel/spool/drum (stagger/traverse wound)

If a cross-section is characterized by one clearly defined base line the position of this base line in relation to the axis of the coil/reel/spool/drum may be defined by letter A, B, C or D, see Figure B.3 for coil and Figure B.4 for reel/spool/drum.

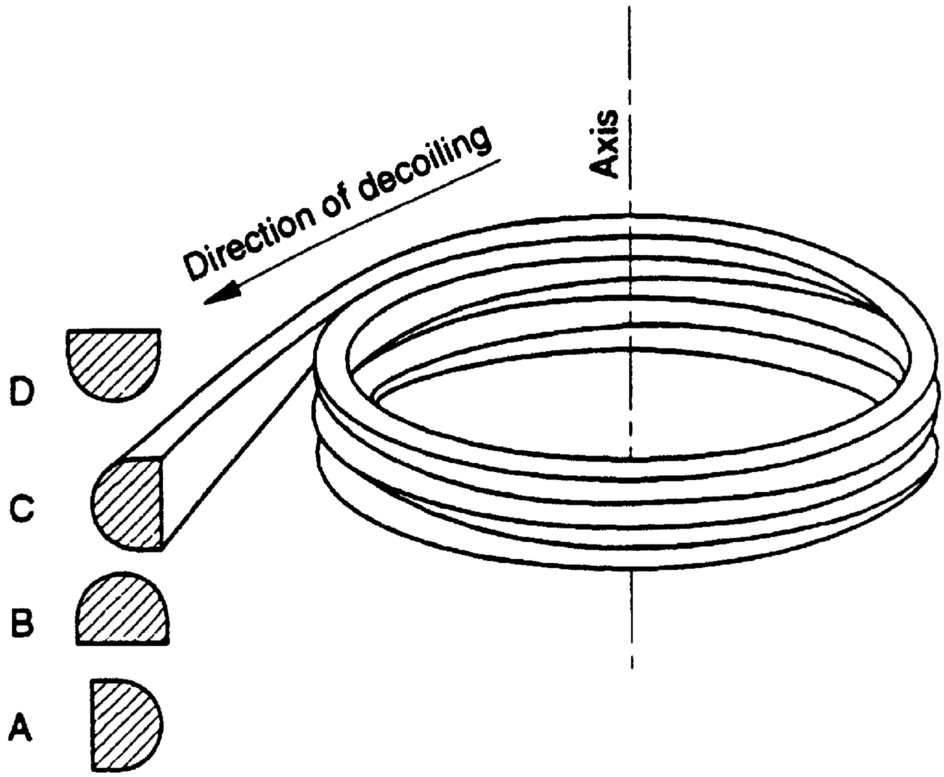


Figure B.3 — Illustration of position of wire cross-section within the coil (bunched or stagger/traverse wound)

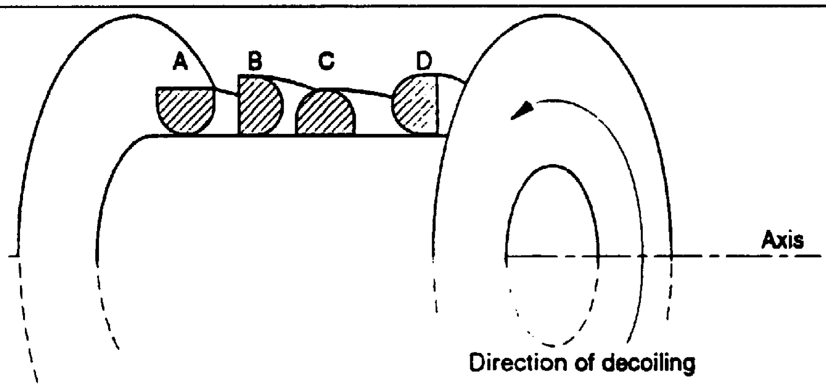


Figure B.4 — Illustration of position of wire cross-section within the reel/spool/drum (stagger/traverse wound)

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