BS EN 12163:2011

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Copper and copper alloys — Rod for general purposes

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National foreword

This British Standard is the UK implementation of EN 12163:2011. It supersedes BS EN 12163:1998 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee NFE/34, Copper and copper alloys.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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Date	Text affected

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NORME EUROPÉENNE

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EN 12163

June 2011

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Supersedes EN 12163:1998

English Version

Copper and copper alloys - Rod for general purposes

Cuivre et alliages de cuivre - Barres pour usages généraux

Kupfer und Kupferlegierungen - Stangen zur allgemeinen Verwendung

This European Standard was approved by CEN on 14 April 2011.

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Foreword

This document (EN 12163:2011) 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of an identical text or by endorsement, at the latest by December 2011, and conflicting national standards shall be withdrawn at the latest by December 2011.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 12163:1998.

Within its programme of work, Technical Committee CEN/TC 133 requested CEN/TC 133/WG 4 "Extruded and drawn products, forgings and scrap" to revise the following standard:

— EN 12163:1998, Copper and copper alloys — Rod for general purposes.

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

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

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

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

— EN 12167, Copper and copper alloys — Profiles and bars for general purposes;

— EN 12168, Copper and copper alloys — Hollow rod for free machining purposes;

— EN 13347, Copper and copper alloys — Rod and wire for welding and braze welding;

— EN 13601, Copper and copper alloys — Copper rod, bar and wire for general electrical purposes;

— EN 13602, Copper and copper alloys — Drawn, round copper wire for the manufacture of electrical conductors;

— EN 13605, Copper and copper alloys — Copper profiles and profiled wire for electrical purposes.

In comparison with EN 12163:1998, the following significant technical changes were made:

a) Removal of nineteen materials:

1) Cu-FRTP (CW006A), Cu-DLP (CW023A), Cu-DHP (CW024A);

2) CuCr1 (CW105C), CuNi1P (CW108C), CuNi3Si1 (CW112C), CuSi3Mn1 (CW116C) CuZn5 (CW500L), CuZn28 (CW504L), CuZn33 (CW506L);

3) CuAl6Si2Fe (CW301G), CuAl7Si2 (CW302G), CuAl10Fe3Mn2 (CW306G);

4) CuSn5 (CW451K);

5) CuZn25Al5Fe2Mn2Pb (CW705R), CuZn32Pb2AsFeSi (CW709R), CuZn38Mn1Al (CW716R), CuZn39Mn1AlPbSi (CW718R), CuZn40Mn2Fe1 (CW723R);

b) Addition of three new materials:

1) CuZn42 (CW510L), CuZn38As (CW511L) due to the market requirements on restriction of lead;

2) CuZn21Si3P (CW724R) due to the market requirements on restriction of lead;

c) Revision of the mechanical properties (Tables 8 to 14) to reflect market needs; in particular the 0,2 % proof strength that was previously informative is now mandatory since it is an important figure for design purposes;

d) Modification of the sampling rate (Table 19).

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

The European Committee for Standardization (CEN) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning the alloy CuZn21Si3P (CW724R) given in 6.1.

CEN takes no position concerning the evidence, validity and scope of this patent right.

The holder of this patent right has assured the CEN that he is willing to negotiate licenses under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with CEN. Information may be obtained from:

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Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those identified above. CEN shall not be held responsible for identifying any or all such patent rights.

1 Scope

This European Standard specifies the composition, property requirements and dimensional tolerances for copper alloy rod in the shape of circles, squares, hexagons or octagons, finally produced by drawing or extruding intended for general purposes.

The sampling procedures and the methods of test for verification of conformity to the requirements of this European Standard are also specified.

2 Normative references

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

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

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

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

EN 10204:2004, *Metallic products — Types of inspection documents*

EN 14977, *Copper and copper alloys — Detection of tensile stress — 5 % ammonia test*

EN ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method (ISO 6506-1:2005)*

EN ISO 6509:1995, *Corrosion of metals and alloys — Determination of dezincification resistance of brass (ISO 6509:1981)*

EN ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature (ISO 6892-1:2009)*

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

ISO 6957, *Copper alloys — Ammonia test for stress corrosion resistance*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
rod
straight product of uniform cross-section along its whole length

3.2
deviation from circular form
difference between the maximum and the minimum diameters measured at any one cross-section of a round product

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;

S (suffix) Material condition for a product which is stress relieved.

NOTE Products in the M, R... or H... material condition may be specially processed (i.e. mechanically or thermally stress relieved) in order to lower the residual stress level to improve the resistance to stress corrosion and the dimensional stability on machining [see 5 k), 5 l) and 8.4].

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

Except when the suffix S is used, 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 (Rod);

— number of this European Standard (EN 12163);

— material designation, either symbol or number (see Tables 1 to 7);

— material condition designation (see Tables 8 to 14);

— cross-sectional shape (the following designations shall be used, as appropriate: RND for round, SQR for square, HEX for hexagonal, OCT for octagonal);

— nominal cross-sectional dimension (diameter or width across-flats);

— tolerance class (see Table 15);

— for polygonal rod, the corner shape (the following designations shall be used as appropriate: SH for sharp, RD for rounded), (see Table 17).

The derivation of a product designation is shown in the following example.

EXAMPLE Rod for general purposes conforming to this standard, in material designated either CuZn36 or CW507L, in material condition R370, hexagonal, nominal width across-flats 14 mm, tolerance Class B, rounded corners, shall be designated as follows:

Rod EN 12163 — CuZn36 — R370 — HEX14B — RD

or

Rod EN 12163 — CW507L — R370 — HEX14B — RD

Denomination

Number of this European Standard

Material designation

Material condition designation

Cross-sectional shape, nominal cross-sectional dimension in millimetres, tolerance class

Corner designation

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 (Rod);

c) number of this European Standard (EN 12163);

d) material designation (see Tables 1 to 7);

e) material condition designation (see 4.2 and Tables 8 to 14) if it is other than M;

f) cross-sectional shape;

g) nominal cross-sectional dimension (diameter or width across-flats);

h) whether other than class A tolerances are required (see Table 15);

i) for polygonal rod: whether "sharp" or "rounded" corners are required unless the corner radii are to be left to the discretion of the supplier (see 6.5.5 and Table 17);

j) length and length tolerance (see 6.5.4).

NOTE 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 or the following, if required:

k) whether the products are required to pass a stress corrosion resistance test. If so, which test method is to be used (see 8.5) if the choice is not to be left to the discretion of the supplier. If the purchaser chooses ISO 6957, the pH value for the test solution is to be selected;

l) whether the products are to be supplied in a thermally stress relieved material condition;

m) whether a declaration of conformity is required (see 9.1);

n) whether an inspection document is required, and if so, which type (see 9.2);

o) whether there are any special requirements for marking, packaging or labelling (see Clause 10).

EXAMPLE Ordering details for 500 kg rod for general purposes conforming to EN 12163, in material designated either CuZn36 or CW507L, in material condition R370, hexagonal, nominal width across-flats 14 mm, tolerance class B, rounded corners, length 3 000 mm ± 100 mm:

500 kg Rod EN 12163 — CuZn36 — R370 — HEX14B — RD
— length 3 000 mm ± 100 mm

or

500 kg Rod EN 12163 — CW507L — R370 — HEX14B — RD
— length 3 000 mm ± 100 mm

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 or the hardness properties 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.

6.3 Resistance to dezincification

The maximum depth of dezincification of CuZn38As (CW511L) and CuZn21Si3P (CW724R) products shall be 100 µm for sizes up to 40 mm. For greater sizes the average depth of dezincification shall be less than 100 µm and the maximum measured value shall be less than 200 µm.

The test shall be carried out in accordance with 8.4.

Products in CuZn21Si3P (CW724R) that have passed the test shall be marked with “Si”.

NOTE Products in alloy CuZn38As (CW511L) may be subjected to heat treatment in the range 450 °C to 550 °C during manufacture. If the user needs to heat the material above 530 °C during subsequent processing then advice should be sought from the supplier.

6.4 Residual stress level

Products ordered and supplied in the stress relieved condition (see NOTE of 4.2) shall show no evidence of cracking when tested. The tests shall be carried out in accordance with 8.5.

6.5 Dimensions and tolerances

6.5.1 Diameter or width across-flats

The diameter or width across-flats shall conform to the tolerances given in Table 15.

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

6.5.2 Shape tolerances

6.5.2.1 Round rod

The deviation from circular form shall not exceed half the range of the tolerance on diameter given in Table 15.

6.5.2.2 Polygonal rod

The width across-flats, measured at the centre of the faces at any one cross-section, shall not differ by more than half the range of the tolerance given for the size in Table 15.

6.5.3 Straightness

For rod of diameter, or width across-flats, from 10 mm up to and including 50 mm, and of length 1 000 mm or over, the deviation from straightness, defined as the curvature (depth of arc) against a datum line when the product is lying flat in a horizontal plane, shall conform to the tolerances given in Table 16.

NOTE Outside this range, the deviation from straightness is subject to agreement between the purchaser and the supplier.

6.5.4 Length

The length and length tolerance shall conform to the requirements stated on the enquiry and order [see 5 j)].

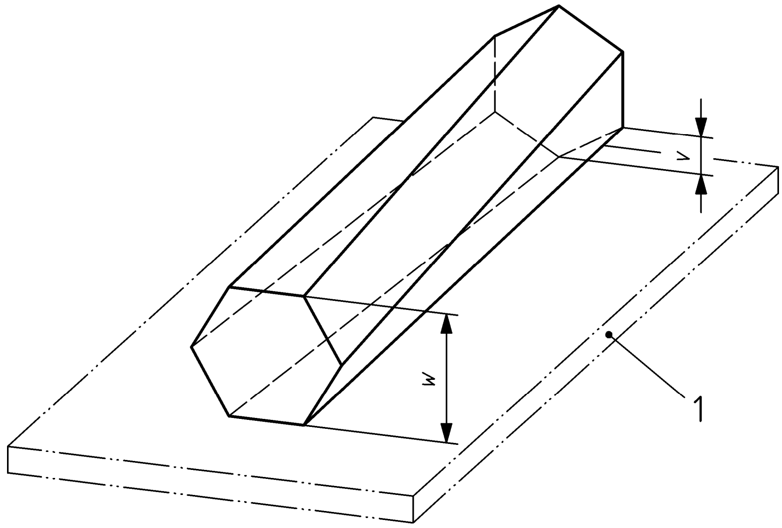
6.5.5 Corner radii

The corner radii of polygonal rod shall conform to Table 17 [see 5 i)].

NOTE Except in cases of dispute, the corners should be measured directly, either by use of a gauge or an optical projector. In cases of dispute, the method by optical projector should be used.

6.5.6 Twist of polygonal rod

The maximum permitted twist V (see Figure 1) of polygonal rod, as measured between two cross-sections along the rod, shall conform to Table 18.



Key

1 Reference plane

V twist

W width across-flats

Figure 1 — Measurement of twist of polygonal rod

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 to 7.4.

7.2 Analysis

The sampling rate shall be in accordance with Table 19. 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.

NOTE 3 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.

7.3 Mechanical tests

The sampling rate shall be in accordance with Table 19. 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.

7.4 Dezincification resistance and stress corrosion resistance test

The sampling rate which shall be applied to finished products shall be:

— for products that have been heat treated: one sampling unit per heat treatment batch;

— for products that have not been heat treated: in accordance with Table 19.

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. In cases of dispute the methods of analysis to be used shall be agreed between the disputing parties. For expression of results, the rounding rules given in 8.8 shall be used.

8.2 Tensile test

8.2.1 General

Tensile test pieces shall be prepared in accordance with 8.2.2 and 8.2.3 and the test shall be carried out in accordance with 8.2.4.

8.2.2 Location of test pieces

Test pieces shall be machined from one of the following locations in the test sample obtained in accordance with 7.3:

a) for test samples from products up to and including 30 mm diameter, or width across-flats, the test piece shall be coaxial with the product;

b) for test samples from products over 30 mm diameter, or width across-flats, the longitudinal axis of the test piece shall be parallel to that of the product and shall be between 15 mm and 20 mm from the surface of the product.

8.2.3 Shape and size of test pieces

Test pieces shall be in accordance with EN ISO 6892-1, except that 200 mm gauge length is not permitted.

NOTE Elongation requirements for rod of diameter or width across-flats:

a) less than 4 mm ($A_{100\ mm}$);

b) 4 mm up to and including 8 mm ($A_{11,3}$);

c) greater than 8 mm (A);

are based on original gauge lengths of 100 mm, 11,3 $\sqrt{S_o}$ mm and 5,65 $\sqrt{S_o}$ mm respectively, where S_o is the original cross-sectional area of the test piece in square millimetres.

8.2.4 Procedure for testing

The tensile test shall be carried out in accordance with the method given in EN ISO 6892-1.

8.2.5 Determination of results

The tensile strength and the elongation shall be determined from the tensile test results obtained in accordance with 8.2.4. For expression of results, the rounding rules given in 8.8 shall be used.

8.3 Hardness test

Hardness shall be determined on test pieces cut from the test sample obtained in accordance with 7.3. The test shall be carried out in accordance with EN ISO 6506-1.

The position of the impression/indentation shall be:

a) for rod of diameter or width across-flats less than 5 mm upon agreement between customer and supplier;

b) for rod of diameter or width across-flats greater (equal) than 5 mm on the cross-section of the product midway between the central axis and the outside surface.

8.4 Dezincification resistance test

The test method given in EN ISO 6509 shall be used on the test samples obtained in accordance with 7.4. A test piece shall be taken from each test sample so as to expose a prepared cross-sectional surface to the test solution.

At the completion of the test:

— the maximum depth of dezincification in a longitudinal direction shall be measured;

— for thicknesses greater than 40 mm, the mean depth of dezincification (in accordance with Annex A) in a longitudinal direction shall also be measured.

8.5 Stress corrosion resistance test

The test method given in either ISO 6957 or EN 14977 shall be used on the test pieces prepared from the test samples obtained in accordance with 7.4. The choice of which of these tests is used shall be at the discretion of the supplier, unless a preference is expressed by the purchaser [see 5k)].

8.6 Determination of the electrical conductivity

If not otherwise specified the test method is left to the discretion of the supplier, e.g. eddy current method or resistance bridge.

8.7 Retests

8.7.1 Analysis, tensile, hardness and dezincification resistance tests and determination of the electrical conductivity

If there is a failure of one, or more than one, of the tests in 8.1, 8.2, 8.3 or 8.6, 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.

8.7.2 Stress corrosion resistance test

If a test piece fails the test in 8.5, the inspection lot represented by the failed test piece shall be permitted to be subjected to a stress relieving treatment. A further test sample shall then be selected in accordance with 7.4.

If a test piece from the further test sample passes the test, the stress relieved product shall be deemed to conform to the requirements of this standard for residual stress level and shall then be subjected to all the other tests called for on the purchase order, except for analysis. If the test piece from the further test sample fails the test, the stress relieved product shall be deemed not to conform to this standard.

8.8 Rounding of results

For the purpose of determining conformity to the limits specified in this standard 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 80000-1:2009. 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 and 0,2 % proof strength the rounding interval shall be 10 N/mm^2 and for elongation the value shall be rounded to the nearest 1 %.

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 5m)] 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 5n)] and agreed with the supplier, the supplier shall issue for the products the appropriate inspection document, in accordance with EN 10204.

10 Marking, packaging, labelling

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

Table 1 — Composition of low alloyed copper alloys

Material designation		Composition % (mass fraction)															Density[a] g/cm³	Electrical conductivity[a, b]	
Symbol	Number	Element	Cu	Al	Be	Co	Cr	Fe	Mn	Ni	P	Pb	Si	Zn	Zr	Others total	approx.	MS/m approx.	% IACS approx.
CuBe2	CW101C	min.	Rem.	—	1,8	—	—	—	—	—	—	—	—	—	—	—	8,3	15	26
		max.	—	—	2,1	0,3	—	0,2	—	0,3	—	—	—	—	—	0,5			
CuCo1Ni1Be	CW103C	min.	Rem.	—	0,4	0,8	—	—	—	0,8	—	—	—	—	—	—	8,8	28	48
		max.	—	—	0,7	1,3	—	0,2	—	1,3	—	—	—	—	—	0,5			
CuCo2Be	CW104C	min.	Rem.	—	0,4	2,0	—	—	—	—	—	—	—	—	—	—	8,8	25	43
		max.	—	—	0,7	2,8	—	0,2	—	0,3	—	—	—	—	—	0,5			
CuCr1Zr	CW106C	min.	Rem.	—	—	—	0,5	—	—	—	—	—	—	—	0,03	—	8,9	46	79
		max.	—	—	—	—	1,2	0,08	—	—	—	—	0,1	—	0,3	0,2			
CuNi1Si	CW109C	min.	Rem.	—	—	—	—	—	—	1,0	—	—	0,4	—	—	—	8,8	22	38
		max.	—	—	—	—	—	0,2	0,1	1,6	—	0,02	0,7	—	—	0,3			
CuNi2Be	CW110C	min.	Rem.	—	0,2	—	—	—	—	1,4	—	—	—	—	—	—	8,8	38	65
		max.	—	—	0,6	0,3	—	0,2	—	2,4	—	—	—	—	—	0,5			
CuNi2Si	CW111C	min.	Rem.	—	—	—	—	—	—	1,6	—	—	0,4	—	—	—	8,8	20	34
		max.	—	—	—	—	—	0,2	0,1	2,5	—	0,02	0,8	—	—	0,3			
CuZr	CW120C	min.	Rem.	—	—	—	—	—	—	—	—	—	—	—	0,1	—	8,9	50	86
		max.	—	—	—	—	—	—	—	—	—	—	—	—	0,2	0,1			

[a] For information only.

[b] Only for solution heat treated and precipitation hardened material conditions.

Table 2 — Composition of copper-aluminium alloys

Material designation		Composition % (mass fraction)											Density[a] g/cm³
Symbol	Number	Element	Cu	Al	Fe	Mn	Ni	Pb	Si	Sn	Zn	Others total	approx.
CuAl10Fe1	CW305G	min.	Rem.	9,0	0,5	—	—	—	—	—	—	—	7,6
		max.	—	10,0	1,5	0,5	1,0	0,02	0,2	0,1	0,5	0,2	
CuAl10Ni5Fe4	CW307G	min.	Rem.	8,5	3,0	—	4,0	—	—	—	—	—	7,6
		max.	—	11,0	5,0	1,0	6,0	0,05	0,2	0,1	0,4	0,2	
CuAl11Fe6Ni6	CW308G	min.	Rem.	10,5	5,0	—	5,0	—	—	—	—	—	7,4
		max.	—	12,5	7,0	1,5	7,0	0,05	0,2	0,1	0,5	0,2	

[a] For information only.

Table 3 — Composition of copper-nickel alloys

Material designation		Composition % (mass fraction)													Density[a] g/cm³
Symbol	Number	Element	Cu	C	Co	Fe	Mn	Ni	P	Pb	S	Sn	Zn	Others total	approx.
CuNi10Fe1Mn	CW352H	min.	Rem.	—	—	1,0	0,5	9,0	—	—	—	—	—	—	8,9
		max.	—	0,05	0,1[b]	2,0	1,0	11,0	0,02	0,02	0,05	0,03	0,5	0,2	
CuNi30Mn1Fe	CW354H	min.	Rem.	—	—	0,4	0,5	30,0	—	—	—	—	—	—	8,9
		max.	—	0,05	0,1[b]	1,0	1,5	32,0	0,02	0,02	0,05	0,05	0,5	0,2	

[a] For information only.

[b] Co max. 0,1 % is counted as Ni.

Table 4 — Composition of copper-nickel-zinc alloys

Material designation		Composition % (mass fraction)									Density[a] g/cm³
Symbol	Number	Element	Cu	Fe	Mn	Ni	Pb	Sn	Zn	Others total	approx.
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	
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	

[a] For information only.

Table 5 — Composition of copper-tin alloys

Material designation		Composition % (mass fraction)									Density[a] g/cm^3
Symbol	Number	Element	Cu	Fe	Ni	P	Pb	Sn	Zn	Others total	approx.
CuSn6	CW452K	min. max.	Rem. —	— 0,1	— 0,2	0,01 0,4	— 0,02	5,5 7,0	— 0,2	— 0,2	8,8
CuSn8	CW453K	min. max.	Rem. —	— 0,1	— 0,2	0,01 0,4	— 0,02	7,5 8,5	— 0,2	— 0,2	8,8
CuSn8P	CW459K	min. max.	Rem. —	— 0,1	— 0,3	0,2 0,4	— 0,05	7,5 8,5	— 0,3	— 0,2	8,8

[a] For information only.

Table 6 — Composition of copper-zinc alloys

Material designation		Composition % (mass fraction)											Density[a] g/cm^3
Symbol	Number	Element	Cu	As	Al	Fe	Mn	Ni	Pb	Sn	Zn	Others total	approx.
CuZn10	CW501L	min. max.	89,0 91,0	— —	— 0,02	— 0,05	— —	— 0,3	— 0,05	— 0,1	Rem. —	— 0,1	8,8
CuZn15	CW502L	min. max.	84,0 86,0	— —	— 0,02	— 0,05	— —	— 0,3	— 0,05	— 0,1	Rem. —	— 0,1	8,8
CuZn20	CW503L	min. max.	79,0 81,0	— —	— 0,02	— 0,05	— —	— 0,3	— 0,05	— 0,1	Rem. —	— 0,1	8,7
CuZn30	CW505L	min. max.	69,0 71,0	— —	— 0,02	— 0,05	— —	— 0,3	— 0,05	— 0,1	Rem. —	— 0,1	8,5
CuZn36	CW507L	min. max.	63,5 65,5	— —	— 0,02	— 0,05	— —	— 0,3	— 0,05	— 0,1	Rem. —	— 0,1	8,4
CuZn37	CW508L	min. max.	62,0 64,0	— —	— 0,05	— 0,1	— —	— 0,3	— 0,1	— 0,1	Rem. —	— 0,1	8,4
CuZn40	CW509L	min. max.	59,0 61,5	— —	— 0,05	— 0,2	— —	— 0,3	— 0,2	— 0,2	Rem. —	— 0,2	8,4
CuZn42	CW510L	min. max.	57,0 59,0	— —	— 0,05	— 0,3	— —	— 0,3	— 0,2	— 0,3	Rem. —	— 0,2	8,4
CuZn38As	CW511L	min. max.	61,5 63,5	0,02 0,15	— 0,05	— 0,1	— —	— 0,3	— 0,2	— 0,1	Rem. —	— 0,2	8,4

[a] For information only.

Table 7 — Composition of complex copper-zinc alloys

Material designation		Composition % (mass fraction)													Density[a] g/cm³
Symbol	Number	Element	Cu	Al	As	Fe	Mn	Ni	P	Pb	Si	Sn	Zn	Others total	approx.
CuZn23Al6Mn4Fe3Pb	CW704R	min.	63,0	5,0	—	2,0	3,5	—	—	0,2	—	—	Rem.	—	8,2
		max.	65,0	6,0	—	3,5	5,0	0,5	—	0,8	0,2	0,2	—	0,2	
CuZn31Si1	CW708R	min.	66,0	—	—	—	—	—	—	—	0,7	—	Rem.	—	8,4
		max.	70,0	—	—	0,4	—	0,5	—	0,8	1,3	—	—	0,5	
CuZn35Ni3Mn2AlPb	CW710R	min.	58,0	0,3	—	—	1,5	2,0	—	0,2	—	—	Rem.	—	8,3
		max.	60,0	1,3	—	0,5	2,5	3,0	—	0,8	0,1	0,5	—	0,3	
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	
CuZn39Sn1	CW719R	min.	59,0	—	—	—	—	—	—	—	—	0,5	Rem.	—	8,4
		max.	61,0	—	—	0,1	—	0,2	—	0,2	—	1,0	—	0,2	
CuZn21Si3P	CW724R	min.	75,0	—	—	—	—	—	0,02	—	2,7	—	Rem.	—	8,3
		max.	77,0	0,05	—	0,3	0,05	0,2	0,10	0,10	3,5	0,3	—	0,2	

[a] For information only.

Table 8 — Mechanical properties of rod of low alloyed copper alloys

Designations Material Symbol	Number	Material condition	Diameter mm from	over	up to and including	Width across-flats mm from	over	up to and including	Tensile strength R_m N/mm² (MPa) min.	0,2 % proof strength $R_{p0,2}$ N/mm² (MPa) min.	Elongation [a] $A_{100\,mm}$ % min.	$A_{11,3}$ % min.	A % min.	Hardness HB min.	max.
CuBe2	CW101C	M	All			All			As manufactured						
		R1150		25	80		25	80	1 150	1 000			2		
		H340		25	80		25	80						340	410
		R1300	2		25	2		25	1 300	1 100	-	-	2		
		H350	2		25	2		25						350	430
CuCo1Ni1Be CuCo2Be	CW103C CW104C	M	All			All			As manufactured						
		R680	2		100	2		100	680	550	6	8	10		
		H220	2		100	2		100						220	270
		R730	2		60	2		60	730	610	4	6	8		
		H230	2		60	2		60						230	310
CuCr1Zr	CW106C	M	All			All			As manufactured						
		R370		50	100		25	100	370	250			16		
		H120		50	100		25	100						120	160
		R430		30	50	10		25	430	350			10		
		H135		30	50	10		25						135	175
		R470	4	30					470	420	-	6	8		
		H150	4	30										150	180
CuNi1Si	CW109C	M	All			All			As manufactured						
		R440		50	80		50	80	440	300			16		
		H120		50	80		50	80						120	180
		R540		30	50		30	50	540	470			10		
		H140		30	50		30	50						140	190
		R590	2		30	2		30	590	540	8	10	12		
		H160	2		30	2		30						160	210

Table 8 *(continued)*

Designations			Diameter			Width across-flats			Tensile strength	0,2 % proof strength	Elongation[a]			Hardness	
Material		Material condition	mm			mm			R_m N/mm² (MPa)	$R_{p\,0,2}$ N/mm² (MPa)	$A_{100\,mm}$ %	$A_{11,3}$ %	A %	HB	
Symbol	Number		from	over	up to and including	from	over	up to and including	min.	min.	min.	min.	min.	min.	max.
CuNi2Be	CW110C	M	All			All			As manufactured						
		R620	2	—	100	2	—	100	620	460	6	8	10	—	—
		H190	2	—	100	2	—	100	—	—	—	—	—	190	250
		R680	2	—	60	2	—	60	680	540	4	6	8		
		H210	2	—	60	2	—	60	—	—	—	—	—	210	260
CuNi2Si	CW111C	M	All			All			As manufactured						
		R550	20	—	80	20	—	80	550	430	—	—	15	—	—
		H150	20	—	80	20	—	80	—	—	—	—	—	150	190
		R600	20	—	50	20	—	50	600	520	—	—	10	—	—
		H165	20	—	50	20	—	50	—	—	—	—	—	165	210
		R640	2	—	30	2	—	30	640	590	6	8	10	—	—
		H180	2	—	30	2	—	30	—	—	—	—	—	180	230
CuZr	CW120C	M	All			All			As manufactured						
		R250	—	50	80	—	50	80	250	170	—	—	20	—	—
		H075	—	50	80	—	50	80	—	—	—	—	—	75	115
		R280	—	25	50	—	25	50	280	210	—	—	15	—	—
		H090	—	25	40	—	25	40	—	—	—	—	—	90	130
		R350	4	—	25	2	—	25	350	260	—	10	12	—	—
		H120	4	—	25	2	—	25	—	—	—	—	—	120	160

[a] See 8.2.3.

Table 9 — Mechanical properties of rod of copper-aluminium alloys

Designations			Diameter			Width across-flats			Tensile strength	0,2 % proof strength	Elongation[a]			Hardness	
Material		Material condition	mm			mm			R_m N/mm² (MPa)	$R_{p\,0,2}$ N/mm² (MPa)	$A_{100\,mm}$ %	$A_{11,3}$ %	A %	HB	
Symbol	Number		from	over	up to and including	from	over	up to and including	min.	min.	min.	min.	min.	min.	max.
CuAl10Fe1	CW305G	M	All			All			As manufactured						
		R530	10	—	80	10	—	80	530	290	—	—	10	—	—
		H130	10	—	80	10	—	80	—	—	—	—	—	130	170
		R630	10	—	30	10	—	30	630	490	—	—	5	—	—
		H155	10	—	30	10	—	30	—	—	—	—	—	155	—
CuAl10Ni5Fe4	CW307G	M	All			All			As manufactured						
		R680	10	—	120	10	—	120	680	320	—	—	10	—	—
		H170	10	—	120	10	—	120	—	—	—	—	—	170	210
		R740	10	—	80	10	—	80	740	400	—	—	8	—	—
		H200	10	—	80	10	—	80	—	—	—	—	—	200	—
CuAl11Fe6Ni6	CW308G	M	All			All			As manufactured						
		R740	10	—	120	10	—	120	740	420	—	—	5	—	—
		H220	10	—	120	10	—	120	—	—	—	—	—	220	260
		R830	10	—	80	10	—	80	830	550	—	—	—	—	—
		H240	10	—	80	10	—	80	—	—	—	—	—	240	—

[a] See 8.2.3.

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

Designations			**Diameter**			**Width across-flats**			**Tensile strength**	**0,2 % proof strength**	**Elongation[a]**			**Hardness**	
Material		Material condition	mm			mm			R_m N/mm² (MPa)	$R_{p0,2}$ N/mm² (MPa)	$A_{100\,mm}$ %	$A_{11,3}$ %	A %	HB	
Symbol	Number		from	over	up to and including	from	over	up to and including	min.	min.	min.	min.	min.	min.	max.
CuNi10Fe1Mn	CW352H	M	All			All			As manufactured						
		R280	10	—	80	10	—	80	280	90	—	—	30	—	—
		H070	10	—	80	10	—	80	—	—	—	—	—	70	100
		R350	2	—	20	2	—	20	350	150	6	8	10	—	—
		H100	2	—	20	2	—	20	—	—	—	—	—	100	—
CuNi30Mn1Fe	CW354H	M	All			All			As manufactured						
		R340	10	—	80	10	—	80	340	120	—	—	30	—	—
		H080	10	—	80	10	—	80	—	—	—	—	—	80	110
		R420	2	—	20	2	—	20	420	180	10	12	14	—	—
		H110	2	—	20	2	—	20	—	—	—	—	—	110	—

[a] See 8.2.3.

Table 11 — Mechanical properties of rod of copper-nickel-zinc alloys

Designations			Diameter			Width across-flats			Tensile strength	0,2 % proof strength		Elongation[a]			Hardness	
Material		Material condition	mm			mm			R_m N/mm² (MPa)	$R_{p\,0,2}$ N/mm² (MPa)		$A_{100\,mm}$ %	$A_{11,3}$ %	A %	HB	
Symbol	Number		from	over	up to and including	from	over	up to and including	min.	min.	max.	min.	min.	min.	min.	max.
CuNi12Zn24	CW403J	M	All			All			As manufactured							
		R380	2	—	50	2	—	50	380	—	290	28	33	38	—	—
		H085	2	—	50	2	—	50	—	—	—	—	—	—	85	125
		R450	2	—	40	2	—	40	450	200	—	8	10	12	—	—
		H125	2	—	40	2	—	40	—	—	—	—	—	—	125	150
		R540	2	—	10	2	—	10	540	400	—	2	3	5	—	—
		H160	2	—	10	2	—	10	—	—	—	—	—	—	160	190
		R640	2	—	4	2	—	4	640	500	—	—	—	—	—	—
		H190	2	—	4	2	—	4	—	—	—	—	—	—	190	—
CuNi18Zn20	CW409J	M	All			All			As manufactured							
		R400	2	—	50	2	—	50	400	—	290	25	30	35	—	—
		H095	2	—	50	2	—	50	—	—	—	—	—	—	95	135
		R480	2	—	40	2	—	40	480	250	—	7	9	11	—	—
		H140	2	—	40	2	—	40	—	—	—	—	—	—	140	175
		R580	2	—	10	2	—	10	580	400	—	—	—	—	—	—
		H170	2	—	10	2	—	10	—	—	—	—	—	—	170	210
		R660	2	—	4	2	—	4	660	550	—	—	—	—	—	—
		H200	2	—	4	2	—	4	—	—	—	—	—	—	200	—

[a] See 8.2.3.

Table 12 — Mechanical properties of rod of copper-tin alloys

Designations			Diameter			Width across-flats			Tensile strength	0,2 % proof strength		Elongation[a]			Hardness	
Material		Material condition	mm			mm			R_m N/mm² (MPa)	$R_{p\,0,2}$ N/mm² (MPa)		$A_{100\,mm}$ %	$A_{11,3}$ %	A %	HB	
Symbol	Number		from	over	up to and including	from	over	up to and including	min.	min.	max.	min.	min.	min.	min.	max.
CuSn6	CW452K	M	All			All			As manufactured							
		R340	2	—	60	2	—	60	340	—	270	35	40	45	—	—
		H080	2	—	60	2	—	60	—	—	—	—	—	—	80	110
		R420	2	—	40	2	—	40	420	220	—	—	25	30	—	—
		H120	2	—	40	2	—	40	—	—	—	—	—	—	120	155
		R520	2	—	8	—	—	—	520	400	—	4	5	—	—	—
		H150	2	—	8	—	—	—	—	—	—	—	—	—	150	180
		R700	2	—	4	—	—	—	700	600	—	—	—	—	—	—
		H180	2	—	4	—	—	—	—	—	—	—	—	—	180	215
CuSn8 CuSn8P	CW453K CW459K	M	All			All			As manufactured							
		R390	2	—	60	2	—	60	390	—	280	35	40	45	—	—
		H085	2	—	60	2	—	60	—	—	—	—	—	—	85	125
		R450	2	—	50	2	—	50	450	280	—	18	22	26	—	—
		H135	2	—	50	2	—	50	—	—	—	—	—	—	135	165
		R550	2	—	12	2	—	12	550	400	—	10	12	15	—	—
		H160	2	—	12	2	—	12	—	—	—	—	—	—	160	190
		R620	2	—	8	—	—	—	620	500	—	5	8	—	—	—
		H180	2	—	8	—	—	—	—	—	—	—	—	—	180	—
		R750	2	—	4	—	—	—	750	680	—	—	—	—	—	—
		H210	2	—	4	—	—	—	—	—	—	—	—	—	210	—

[a] See 8.2.3.

Table 13 — Mechanical properties of rod of copper-zinc alloys

Designations			Diameter			Width across-flats			Tensile strength	0,2 % proof strength		Elongation [a]			Hardness	
Material		Material condition	mm			mm			R_m N/mm² (MPa)	$R_{p0,2}$ N/mm² (MPa)		$A_{100\,mm}$ %	$A_{11,3}$ %	A %	HB	
Symbol	Number		from	over	up to and including	from	over	up to and including	min.	min.	max.	min.	min.	min.	min.	max.
CuZn10	CW501L	M	All			All			As manufactured							
		R240	4	—	80	4	—	80	240	—	150	—	40	45	—	—
		H050	4	—	80	4	—	80	—	—	—	—	—	—	50	95
		R320	4	—	40	4	—	40	320	220	—	—	23	25	—	—
		H090	4	—	40	4	—	40	—	—	—	—	—	—	90	120
		R380	4	—	10	4	—	10	380	280	—	—	11	12	—	—
		H110	4	—	10	4	—	10	—	—	—	—	—	—	110	150
CuZn15	CW502L	M	All			All			As manufactured							
		R260	4	—	80	4	—	80	260	—	170	—	40	45	—	—
		H060	4	—	80	4	—	80	—	—	—	—	—	—	60	115
		R340	4	—	40	4	—	40	340	200	—	—	20	22	—	—
		H100	4	—	40	4	—	40	—	—	—	—	—	—	100	130
		R430	4	—	10	4	—	10	430	350	—	—	8	10	—	—
		H130	4	—	10	4	—	10	—	—	—	—	—	—	130	170
CuZn20	CW503L	M	All			All			As manufactured							
		R260	4	—	80	4	—	80	260	—	170	—	40	45	—	—
		H065	4	—	80	4	—	80	—	—	—	—	—	—	65	100
		R360	4	—	40	4	—	40	360	210	—	—	18	20	—	—
		H100	4	—	40	4	—	40	—	—	—	—	—	—	100	130
		R450	4	—	10	4	—	8	450	300	—	—	6	7	—	—
		H130	4	—	10	4	—	8	—	—	—	—	—	—	130	190

Table 13 *(continued)*

Designations			Diameter			Width across-flats			Tensile strength	0,2 % proof strength		Elongation [a]			Hardness	
Material		Material condition	mm			mm			R_m N/mm² (MPa)	$R_{p\ 0,2}$ N/mm² (MPa)		$A_{100\ mm}$ %	$A_{11,3}$ %	A %	HB	
Symbol	Number		from	over	up to and including	from	over	up to and including	min.	min.	max.	min.	min.	min.	min.	max.
CuZn30	CW505L	M	All			All			As manufactured							
		R280	4	—	80	4	—	80	280	—	250	—	40	45	—	—
		H070	4	—	80	4	—	80	—	—	—	—	—	—	70	115
		R370	4	—	40	4	—	35	370	230	—	—	14	16	—	—
		H105	4	—	40	4	—	35	—	—	—	—	—	—	105	135
		R460	4	—	10	4	—	8	460	310	—	—	7	9	—	—
		H135	4	—	10	4	—	8	—	—	—	—	—	—	135	—
CuZn36 CuZn37	CW507L CW508L	M	All			All			As manufactured							
		R290	4	—	80	4	—	80	290	—	230	—	40	45	—	—
		H070	4	—	80	4	—	80	—	—	—	—	—	—	70	110
		R370	4	—	40	4	—	35	370	240	—	—	12	14	—	—
		H105	4	—	40	4	—	35	—	—	—	—	—	—	105	145
		R460	4	—	8	4	—	6	460	330	—	—	6	8	—	—
		H140	4	—	8	4	—	6	—	—	—	—	—	—	140	—
CuZn40	CW509L	M	All			All			As manufactured							
		R360	6	—	80	5	—	60	360	—	300	—	15	20	—	—
		H070	6	—	80	5	—	60	—	—	—	—	—	—	70	100
		R410	2	—	40	2	—	35	410	230	—	8	10	12	—	—
		H100	2	—	40	2	—	35	—	—	—	—	—	—	100	145
		R500	2	—	14	2	—	10	500	350	—	3	5	8	—	—
		H120	2	—	14	2	—	10	—	—	—	—	—	—	120	—

Table 13 *(continued)*

Designations			Diameter			Width across-flats			Tensile strength	0,2 % proof strength		Elongation[a]			Hardness	
Material		Material condition	mm			mm			R_m N/mm² (MPa)	$R_{p\,0,2}$ N/mm² (MPa)		$A_{100\,mm}$ %	$A_{11,3}$ %	A %	HB	
Symbol	Number		from	over	up to and including	from	over	up to and including	min.	min.	max.	min.	min.	min.	min.	max.
CuZn42	CW510L	M	All			All			As manufactured							
		R360	6	—	80	5	—	60	360	—	320	—	15	20	—	—
		H090	6	—	80	5	—	60	—	—	—	—	—	—	90	125
		R430	2	—	40	2	—	35	430	220	—	6	8	10	—	—
		H110	2	—	40	2	—	35	—	—	—	—	—	—	110	160
		R500	2	—	14	2	—	10	500	350	—	—	3	5	—	—
		H135	2	—	14	2	—	10	—	—	—	—	—	—	135	—
CuZn38As	CW511L	M	All			All			As manufactured							
		R280	6	—	80	5	—	60	280	—	200	—	25	30	—	—
		H070	6	—	80	5	—	60	—	—	—	—	—	—	70	110
		R320	6	—	60	5	—	50	320	200	—	—	15	20	—	—
		H090	6	—	60	5	—	50	—	—	—	—	—	—	90	135
		R400	4	—	15	4	—	13	400	250	—	—	5	8	—	—
		H105	4	—	15	4	—	13	—	—	—	—	—	—	105	—

[a] See 8.2.3.

Table 14 — Mechanical properties of rod of complex copper-zinc alloys

Designations			Diameter			Width across-flats			Tensile strength	0,2 % proof strength		Elongation [a]			Hardness	
Material		Material condition	mm			mm			R_m N/mm² (MPa)	$R_{p\,0,2}$ N/mm² (MPa)		$A_{100\,mm}$ %	$A_{11,3}$ %	A %	HB	
Symbol	Number		from	over	up to and including	from	over	up to and including	min.	min.	max.	min.	min.	min.	min.	max.
CuZn23Al6Mn4Fe3Pb	CW704R	M	All			All			As manufactured							
		R780	10	—	80	10	—	60	780	540	—	—	—	8	—	—
		H190	10	—	80	10	—	60	—	—	—	—	—	—	190	—
CuZn31Si1	CW708R	M	All			All			As manufactured							
		R460	5	—	40	5	—	40	460	240	—	—	18	22	—	—
		H120	5	—	40	5	—	40	—	—	—	—	—	—	120	160
		R530	5	—	14	5	—	14	530	350	—	—	10	12	—	—
		H140	5	—	14	5	—	14	—	—	—	—	—	—	140	—
CuZn35Ni3Mn2AlPb	CW710R	M	All			All			As manufactured							
		R490	5	—	40	5	—	40	490	290	—	—	15	18	—	—
		H120	5	—	40	5	—	40	—	—	—	—	—	—	120	160
CuZn36Sn1Pb	CW712R	M	All			All			As manufactured							
		R340	5	—	60	5	—	60	340	160	—	—	20	25	—	—
		H080	5	—	60	5	—	60	—	—	—	—	—	—	80	120
		R400	5	—	50	5	—	40	400	200	—	—	16	20	—	—
		H105	5	—	50	5	—	40	—	—	—	—	—	—	105	135
CuZn39Sn1	CW719R	M	All			All			As manufactured							
		R340	5	—	80	5	—	60	340	140	—	—	15	20	—	—
		H080	5	—	80	5	—	60	—	—	—	—	—	—	80	120
		R400	5	—	50	5	—	40	400	180	—	—	10	15	—	—
		H105	5	—	50	5	—	40	—	—	—	—	—	—	105	145
		R450	5	—	25	5	—	20	450	250	—	—	5	10	—	—
		H120	5	—	25	5	—	20	—	—	—	—	—	—	120	160

Table 14 *(continued)*

Designations			Diameter			Width across-flats			Tensile strength	0,2 % proof strength		Elongation[a]			Hardness	
Material		Material condition	mm			mm			R_m N/mm² (MPa)	$R_{p\,0,2}$ N/mm² (MPa)		$A_{100\,mm}$ %	$A_{11,3}$ %	A %	HB	
Symbol	Number		from	over	up to and including	from	over	up to and including	min.	min.	max.	min.	min.	min.	min.	max.
CuZn21Si3P	CW724R	M	All			All			As manufactured							
		R500	2	—	80	2	—	80	500	—	450	12	13	15	—	—
		H110	2	—	80	2	—	80	—	—	—	—	—	—	110	170
		R600	2	—	40	2	—	40	600	300	—	10	11	12	—	—
		H130	2	—	40	2	—	40	—	—	—	—	—	—	130	190
		R670	2	—	15	2	—	15	670	400	—	8	9	10	—	—
		H160	2	—	15	2	—	15	—	—	—	—	—	—	160	220

[a] See 8.2.3.

Table 15 — Dimensional tolerances for rod

Values in millimetres

Nominal diameter or width across-flats		Tolerances	
over	up to and including	class A	class B
1,6[a]	3	± 0,10	± 0,05
3	6	± 0,15	± 0,08
6	10	± 0,20	± 0,11
10	18	± 0,25	± 0,14
18	30	± 0,30	± 0,17
30	50	± 0,60	± 0,20
50	80	± 0,70	± 0,37

[a] Including 1,6.

Table 16 — Tolerances on straightness of rod

Nominal diameter or width across-flats mm		Maximum deviation from straightness (see 6.5.3) mm	
from	up to and including	localised over any 400 mm length	over whole length L of rod in metres ($L \geq 1$ m)
10	50	2,5	$6 \times L$

Table 17 — Corner radii for square and polygonal rod

Dimensions in millimetres

Nominal width across-flats		Radii for sharp and rounded corners	
		sharp	rounded
over	up to and including	max.	range
1,6[a]	3	0,2	0,2 to 0,3
3	6	0,3	0,3 to 0,5
6	10	0,4	0,4 to 0,8
10	18	0,5	0,5 to 1,2
18	30	0,6	0,6 to 1,8
30	50	0,7	0,7 to 2,8
50	60	0,8	0,8 to 4,0

[a] Including 1,6.

Table 18 — Maximum twist of square and polygonal rod

Dimensions in millimetres

Nominal width across-flats *W*		Maximum permitted twist *V* in any 1 m length of rod
over	up to and including	
10[a]	18	2,0
18	30	3,0
30	60	4,0

[a] Including 10.

Table 19 — Sampling rate

Nominal diameter or width across-flats mm		Mass of inspection lot for one test sample kg
over	up to and including	up to and including
—	25	1 000
25	—	2 000

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

Annex A
(normative)

Determination of mean depth of dezincification

A.1 Introduction

EN ISO 6509 specifies a method for the determination of the maximum depth of dezincification of a zinc containing specimen. In accordance with the ruling given in 7.5.3 of EN ISO 6509:1995, the following procedure extends the method to cover the determination of the mean depth of dezincification in order to verify conformity to the dezincification resistance acceptance criteria for products.

The principle of the method, the reagents, materials and apparatus required, and the procedure for the selection and preparation of the test pieces, are all in accordance with EN ISO 6509.

A.2 Procedure

Having determined the maximum depth of dezincification in a longitudinal direction, in accordance with Clause 7 of EN ISO 6509:1995 (see 8.4), carry out the following operations to determine the mean depth of dezincification.

Adjust the magnification of the microscope to suit the general depth of dezincification and use the same magnification for all measurements. Examine the entire length of the section for evaluation, in contiguous visual fields of the microscope.

NOTE To ensure the best accuracy of measurement, measure the largest number of contiguous fields at the greatest possible magnification.

Using the measuring scale incorporated in the microscope, measure and record the dezincification depth, i.e. the point of intersection of the scale and the dezincification front [see Figure A.1.a)], for each contiguous field. If the scale lies between two dezincified areas within the visual field, the dezincification depth shall be recorded as the point of intersection of the scale and an imaginary line joining the extremities of the two dezincification fronts adjacent to the scale [see Figure A.1.b)].

If there is no evidence of dezincification in the field examined, or only one dezincified area which does not intersect the scale, then record the dezincification depth of that field as zero [see Figure A.1.c)].

A.3 Expression of results

After measurement of all the contiguous fields along the entire length of the section for evaluation, calculate and report the mean dezincification depth as the sum of the measured depths for every field, divided by the number of contiguous fields examined.

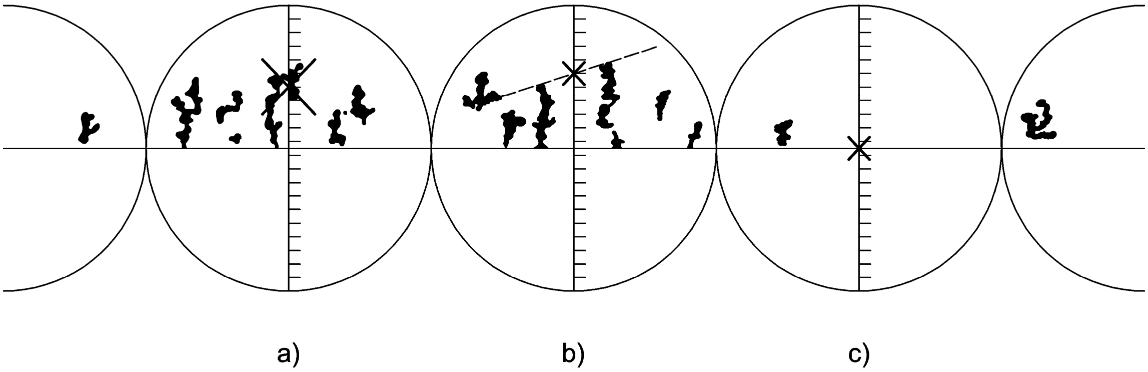


Figure A.1 — Example of contiguous fields

NOTE The locations for the measurement of dezincification depth, in three different cases, are marked X.

Bibliography

[1] EN ISO 9001, *Quality management systems — Requirements (ISO 9001:2008)*

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

[3] ISO 80000-1:2009, *Quantities and units — Part 1: General*

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