

Copper and copper alloys — Forgings

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ICS 77.150.30

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National foreword

This British Standard is the English language version of EN 12420:1999. It supersedes BS 3885:1965 which is withdrawn, and together with BS EN 12165:1998, it supersedes BS 2872:1989 which is withdrawn.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 international/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.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 37, and a back cover.

This British Standard, having been prepared under the direction of the Engineering Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 July 1999

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ISBN 0 580 32070 7

Amendments issued since publication

Amd. No.	Date	Comments

ICS 77.150.30

Descriptors: copper, copper alloys, forgings, die forgings, definitions, orders: sales documents, specifications, chemical composition, mechanical properties, tensile strength, electrical properties, dimensional tolerances, form tolerances, sampling, tests, conformity tests, marking

English version

Copper and copper alloys — Forgings

Cuivre et alliages de cuivre — Pièces forgées

Kupfer und Kupferlegierungen — Schmiedestücke

This European Standard was approved by CEN on 13 December 1998.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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

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Foreword

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

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 1999, and conflicting national standards shall be withdrawn at the latest by July 1999.

Within its programme of work, Technical Committee CEN/TC 133 requested CEN/TC 133/WG 6, Forgings, to prepare the following standard:

EN 12420, *Copper and copper alloys — Forgings*.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative annex ZA, which is an integral part of this standard.

Forging stock is specified in the following standard:

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

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, Sweden, Switzerland and the United Kingdom.

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1 Scope

This European Standard specifies the composition, the property requirements and tolerances on dimensions and form for copper and copper alloy die and hand forgings.

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 1976, *Copper and copper alloys — Cast unwrought copper products.*

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

EN 10003-1, *Metallic materials — Brinell hardness test — Part 1: Test method.*

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

EN ISO 196, *Wrought copper and copper alloys — Detection of residual stress — Mercury(I) nitrate test.* (ISO 196:1978)

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

ISO 1101, *Technical drawings — Geometrical tolerancing — Tolerancing of form, orientation, location and run-out — Generalities, definitions, symbols, indications on drawings.*

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

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

forgings

wrought products, hot formed by hammering or pressing

3.1.1

die forgings

forgings produced between closed dies

3.1.2

hand forgings

forgings produced between open dies

3.1.3

cored forgings

forgings produced between closed dies including cores

3.2

inspection lot

definite quantity of products of the same form, the same grade or alloy and material condition and the same thickness or cross-section, collected together for inspection (testing)

4 Designations

4.1 Material

4.1.1 General

The material is designated either by symbol or number (see Tables 1 to 8).

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;
- H Material condition designated by the minimum value of hardness requirement for the product with mandatory hardness requirements;

NOTE 1 Products in the H... condition may be specified to Vickers or Brinell hardness. The condition designation H... is the same for both hardness test methods.

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

NOTE 2 Products in the M or H... 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 g), 5 h) and 8.4].

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 (Forging);
- number of this European Standard (EN 12420);
- material designation, either symbol or number (see Tables 1 to 8);
- material condition designation (see Tables 10 to 12).

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

EXAMPLE

Forging conforming to this standard, in material designated either CuZn39Pb3 or CW614N, in material condition H080, shall be designated as follows:

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:

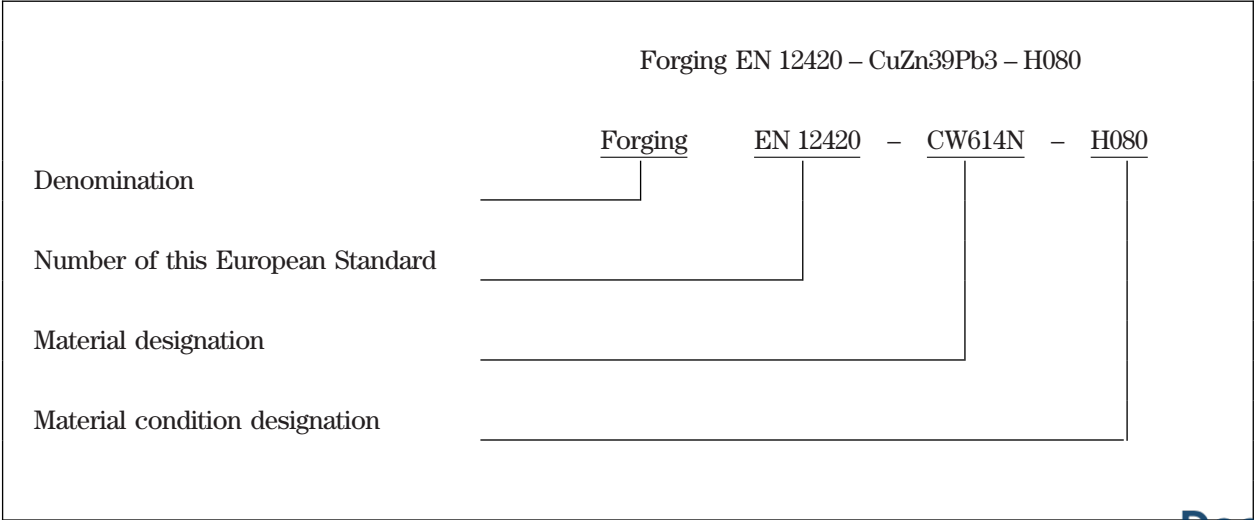
- a) quantity of product required (mass or number of pieces);
- b) denomination (Forging);
- c) number of this European Standard (EN 12420);
- d) material designation (see Tables 1 to 8);
- e) material condition designation (see 4.2 and Tables 10 to 12) if it is other than M;
- f) nominal dimensions and/or toleranced drawing of the forging or finished part including the number of the drawing (see 6.6).

NOTE 1 It is recommended that the product designation, as described in 4.3, is used for items b) to e).

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

- g) whether the products are required to pass a stress corrosion resistance test. If so, which test method is to be used (see 8.6) 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;
- h) whether the products are to be supplied in a thermally stress relieved condition;
- i) for products in alloy CuZn36Pb2As (CW602N), whether the dezincification resistance acceptance criterion required is other than grade A (see 6.4);
- j) test method to be used for measurement of hardness, i.e. Brinell or Vickers (see 8.2) unless the test method is left to the discretion of the supplier;
- k) whether in special cases tensile testing is required (see 6.2.2).

NOTE 2 The property requirements and details of testing should 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 (see clause 10).

EXAMPLE

Ordering details for 200 forgings conforming to EN 12420, in material designated either CuZn39Pb3 or CW614N, in material condition H080, according to drawing number XY000:

200 pieces
Forging EN 12420 — CuZn39Pb3 — H080
— drawing number XY000

or

200 pieces
Forging EN 12420 — CW614N — H080
— drawing number XY000

6 Requirements

6.1 Composition

The composition shall conform to the requirements for the appropriate material given in Tables 1 to 8.

NOTE As the materials specified in this standard vary considerably in their resistance to shaping, forging temperature and stresses generated in the die, they have been classified into three groups of similar hot working characteristics. They have also been subdivided into two categories that reflect their availability, category A materials being more generally available than those of category B (see Table 9).

6.2 Mechanical properties

6.2.1 Hardness

The hardness properties shall conform to the appropriate requirements given in Tables 10 to 12.

The purchaser shall indicate which test method shall be used. The test shall be carried out in accordance with the appropriate method given in 8.2.

For forgings produced from materials of category B the hardness properties shall be agreed between the purchaser and the supplier.

6.2.2 Tensile properties

This standard does not specify mandatory tensile properties. The values in brackets given in Tables 10 to 12 are for information only.

If a purchaser requires in special cases tensile property testing then the minimum values for tensile strength, 0,2 % proof strength and elongation, the location and size of test pieces and the sampling rate shall be agreed at the time of enquiry and order [see 5 k)]. In these cases the hardness values detailed in Tables 10 to 12 become non-mandatory.

6.3 Electrical properties

Forgings produced from the category A materials listed in Table 13 shall conform to the electrical properties specified in Table 13.

For forgings produced from category B materials listed in Table 9, if electrical properties are required, they shall be agreed between the purchaser and the supplier.

6.4 Resistance to dezincification

- for grade A: maximum 200 μm ;
- for grade B: mean not to exceed 200 μm and maximum 400 μm [see 5 i)].

The test shall be carried out in accordance with 8.5.

NOTE Products in this alloy may be subjected to heat treatment in the range 470 °C to 550 °C during manufacture. Should the user need to heat the material above 530 °C then advice should be sought from the supplier.

6.5 Residual stress level

Forgings ordered in the stress relieved condition (see Note 2 to 4.2) shall show no evidence of cracking when tested. The tests shall be carried out in accordance with 8.6.

6.6 Tolerances for die forgings

6.6.1 General

The tolerances specified in 6.6.2 to 6.6.7 apply to all category A and category B materials listed in Table 9.

Tolerances on dimensions and on form indicated in the drawings of a forging shall conform to the tolerances specified in this standard. If no tolerances are indicated in the drawings, the tolerances given in this standard shall apply.

NOTE 1 It is recommended that reference to this standard is made on the drawings.

Two different types of dimensions are distinguished for die forgings.

- a) dimensions within the die cavity which originate from the forging shape in one separate die part and which does not have components moving towards one another, see dimensions *n* in Figure 1.

NOTE 2 These die parts can consist of one single piece or of several components immovable towards one another.

- b) dimensions across the die parting line which originate from two or more die parts moving towards one another, see dimensions *t* in Figure 2.

NOTE 3 The die forging produced in the dies demonstrated in Figures 1 and 2 is shown in Figure 3.

Table 1 — Composition of copper

Material designation		Composition in % (m/m)								Density ²⁾ g/cm ³ approx.
Symbol	Number	Element	Cu ¹⁾	Bi	O	P	Pb	Other elements (see note)		
								total	excluding	
Cu-ETP	CW004A	min. max.	99,90 —	— 0,000 5	— 0,040 ³⁾	— —	— 0,005	— 0,03	Ag, O	8,9
Cu-OF	CW008A	min. max.	99,95 —	— 0,000 5	— — ⁴⁾	— —	— 0,005	— 0,03	Ag	8,9
Cu-HCP	CW021A	min. max.	99,95 —	— 0,000 5	— —	0,002 0,007	— 0,005	— 0,03	Ag, P	8,9
Cu-DHP	CW024A	min. max.	99,90 —	— —	— —	0,015 0,040	— —	— —	—	8,9
¹⁾ Including silver, up to a maximum of 0,015 %. ²⁾ For information only. ³⁾ Oxygen content up to 0,060 % is permitted, subject to agreement between the purchaser and the supplier. ⁴⁾ The oxygen content shall be such that the material conforms to the hydrogen embrittlement requirements of EN 1976. NOTE The total of other elements (than copper) is defined as the sum of Ag, As, Bi, Cd, Co, Cr, Fe, Mn, Ni, O, P, Pb, S, Sb, Se, Si, Sn, Te and Zn, subject to the exclusion of any individual elements indicated.										

Table 2 — Composition of low alloyed copper alloys

Material designation		Composition in % (m/m)												Density ¹⁾ g/cm ³ approx.
Symbol	Number	Element	Cu	Be	Co	Cr	Fe	Mn	Ni	Pb	Si	Zr	Others total	
CuBe2	CW101C	min.	Rem.	1,8	—	—	—	—	—	—	—	—	—	8,3
		max.	—	2,1	0,3	—	0,2	—	0,3	—	—	—	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	
CuCr1	CW105C	min.	Rem.	—	—	0,5	—	—	—	—	—	—	—	8,9
		max.	—	—	—	1,2	0,08	—	—	—	0,1	—	0,2	
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	—	2,4	—	—	—	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	
CuNi3Si1	CW112C	min.	Rem.	—	—	—	—	—	2,6	—	0,8	—	—	8,8
		max.	—	—	—	—	0,2	0,1	4,5	0,02	1,3	—	0,5	
CuZr	CW120C	min.	Rem.	—	—	—	—	—	—	—	—	0,1	—	8,9
		max.	—	—	—	—	—	—	—	—	—	0,2	0,1	

¹⁾ For information only.



Table 3 — Composition of copper-aluminium alloys

Material designation		Composition in % (<i>m/m</i>)											Density ¹⁾ g/cm ³ approx.
Symbol	Number	Element	Cu	Al	Fe	Mn	Ni	Pb	Si	Sn	Zn	Others total	
CuAl6Si2Fe	CW301G	min.	Rem.	6,0	0,5	—	—	—	2,0	—	—	—	7,7
		max.	—	6,4	0,7	0,1	0,1	0,05	2,4	0,1	0,4	0,2	
CuAl7Si2	CW302G	min.	Rem.	6,3	—	—	—	—	1,5	—	—	—	7,7
		max.	—	7,6	0,3	0,2	0,2	0,05	2,2	0,2	0,5	0,2	
CuAl8Fe3	CW303G	min.	Rem.	6,5	1,5	—	—	—	—	—	—	—	7,7
		max.	—	8,5	3,5	1,0	1,0	0,05	0,2	0,1	0,5	0,2	
CuAl9Ni3Fe2	CW304G	min.	Rem.	8,0	1,0	—	2,0	—	—	—	—	—	7,4
		max.	—	9,5	3,0	2,5	4,0	0,05	0,1	0,1	0,2	0,3	
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	
CuAl10Fe3Mn2	CW306G	min.	Rem.	9,0	2,0	1,5	—	—	—	—	—	—	7,6
		max.	—	11,0	4,0	3,5	1,0	0,05	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	
1) For information only.													

Table 4 — Composition of copper-nickel alloys

Material designation		Composition in % (m/m)													Density ¹⁾ g/cm ³ approx.
Symbol	Number	Element	Cu	C	Co	Fe	Mn	Ni	P	Pb	S	Sn	Zn	Others total	
CuNi10Fe1Mn	CW352H	min.	Rem.	—	—	1,0	0,5	9,0	—	—	—	—	—	—	8,9
		max.	—	0,05	0,1 ²⁾	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 ²⁾	1,0	1,5	32,0	0,02	0,02	0,05	0,05	0,5	0,2	

¹⁾ For information only.

²⁾ Co max. 0,1 % is counted as Ni.

Table 5 — Composition of copper-nickel-zinc alloys

Material designation		Composition in % (m/m)									Density ¹⁾ g/cm ³ approx.
Symbol	Number	Element	Cu	Fe	Mn	Ni	Pb	Sn	Zn	Others total	
CuNi7Zn39Pb3Mn2	CW400J	min.	47,0	—	1,5	6,0	2,3	—	Rem.	—	8,5
		max.	50,0	0,3	3,0	8,0	3,3	0,2	—	0,2	
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	

¹⁾ For information only.

¹⁾ For information only.

Table 6 — Composition of copper-zinc alloys

Material designation		Composition in % (m/m)									Density ¹⁾ g/cm ³ approx.
Symbol	Number	Element	Cu	Al	Fe	Ni	Pb	Sn	Zn	Others total	
CuZn37	CW508L	min.	62,0	—	—	—	—	—	Rem.	—	8,4
		max.	64,0	0,05	0,1	0,3	0,1	0,1	—	0,1	
CuZn40	CW509L	min.	59,5	—	—	—	—	—	Rem.	—	8,4
		max.	61,5	0,05	0,2	0,3	0,3	0,2	—	0,2	

¹⁾ For information only.

Table 7 — Composition of copper-zinc-lead alloys

Material designation		Composition in % (m/m)											Density ¹⁾ g/cm ³ approx.
Symbol	Number	Element	Cu	Al	As	Fe	Mn	Ni	Pb	Sn	Zn	Others total	
CuZn36Pb2As	CW602N	min.	61,0	—	0,02	—	—	—	1,7	—	Rem.	—	8,4
		max.	63,0	0,05	0,15	0,1	0,1	0,3	2,8	0,1	—	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	
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	
CuZn39Pb1	CW611N	min.	59,0	—	—	—	—	—	0,8	—	Rem.	—	8,4
		max.	60,0	0,05	—	0,2	—	0,3	1,6	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	
CuZn39Pb2Sn	CW613N	min.	59,0	—	—	—	—	—	1,6	0,2	Rem.	—	8,4
		max.	60,0	0,1	—	0,4	—	0,3	2,5	0,5	—	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	
CuZn39Pb3Sn	CW615N	min.	57,0	—	—	—	—	—	2,5	0,2	Rem.	—	8,4
		max.	59,0	0,1	—	0,4	—	0,3	3,5	0,5	—	0,2	
CuZn40Pb1Al	CW616N	min.	57,0	0,05	—	—	—	—	1,0	—	Rem.	—	8,3
		max.	59,0	0,30	—	0,2	—	0,2	2,0	0,2	—	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	
CuZn40Pb2Sn	CW619N	min.	57,0	—	—	—	—	—	1,6	0,2	Rem.	—	8,4
		max.	59,0	0,1	—	0,4	—	0,3	2,5	0,5	—	0,2	
1) For information only.													