BS EN 12167:2016

BSI Standards Publication

Copper and copper alloys — Profiles and bars for general purposes

bsi.

National foreword

This British Standard is the UK implementation of EN 12167:2016. It supersedes BS EN 12167:2011 which is withdrawn.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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English Version

Copper and copper alloys - Profiles and bars for general purposes

Kupfer und Kupferlegierungen - Profile und Rechteckstangen zur allgemeinen Verwendung

This European Standard was approved by CEN on 9 April 2016.

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

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European foreword

This document (EN 12167:2016) 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of an identical text or by endorsement, at the latest by January 2017, and conflicting national standards shall be withdrawn at the latest by January 2017.

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

This document supersedes EN 12167:2011.

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 12167:2011, *Copper and copper alloys — Profiles and bars for general purposes*.

This document is one of a series of European Standards for the copper and copper alloy products rod, wire, profile and forgings. Other products are 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 12166, *Copper and copper alloys — Wire for general purposes*;

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

— 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 12167:2011, the following significant technical changes were made:

a) addition of four new materials: CuZn37Pb1 (CW605N), CuZn35Pb1,5AlAs (CW625N), CuZn33Pb1,5AlAs (CW626N) and CuZn33Pb1AlSiAs (CW725R) due to the market requirements on restriction of lead and modification of the chemical composition for CuZn39Pb1 (CW611N);

b) introduction of an optional procedure how to refer to restrictions to the chemical composition imposed by the 4 MS Common Composition List for materials used for products accepted for contact with drinking water;

c) requirements and test methods for resistance of dezincification modified;

d) provisions for surface quality added;

e) mechanical properties for CuZn21Si3P (CW724R) modified.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey 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) and CuZn33Pb1AlSiAs (CW725R) 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 ensured the CEN that he is willing to negotiate licenses either free of charge or 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.

— For CuZn21Si3P (CW724R) information may be obtained from:

Wieland-Werke AG
Graf Arco Straße 36
D-89079 Ulm
GERMANY

— For CuZn33Pb1AlSiAs (CW725R) information may be obtained from:

Diehl Metall Messing
Heinrich-Diehl-Straße 9
D-90552 Röthenbach/Pegnitz
GERMANY

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.

CEN and CENELEC maintain online lists of patents relevant to their standards. Users are encouraged to consult the lists for the most up to date information concerning patents (ftp://ftp.cencenelec.eu/EN/IPR/Patents/IPRdeclaration.pdf).

Due to developing legislation, the composition of a material may be restricted to the composition specified in this European Standard with respect to individual uses (e.g. for the use in contact with drinking water in some Member States of the European Union). These individual restrictions are not part of this European Standard. Nevertheless, for materials for which traditional and major uses are affected, these restrictions are indicated. The absence of an indication, however, does not imply that the material can be used in any application without any legal restriction.

1 Scope

This European Standard specifies the composition, property requirements and dimensional tolerances for copper alloy profiles including L-, T-, U-shaped cross-sections, and bars, finally produced by drawing or extruding.

This European Standard applies to profiles with L-, T- and U-shaped cross-sections which would fit within a circumscribing circle of a maximum 180 mm diameter and to bars with thicknesses from 3 mm up to and including 60 mm and with widths from 6 mm up to and including 120 mm.

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

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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, *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)*

EN ISO 6509-1, *Corrosion of metals and alloys - Determination of dezincification resistance of copper alloys with zinc - Part 1: Test method (ISO 6509-1)*

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

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

ISO 4739, *Wrought copper and copper alloy products — Selection and preparation of specimens and test pieces for mechanical testing*

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
profile
straight product of uniform cross-section along its whole length, in the shape other than rod, hollow rod, bar, tube, sheet or strip

3.2
bar
straight product of uniform rectangular cross-section along its whole length

4 Designations

4.1 Material

4.1.1 General

The material is designated either by symbol or by 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 strength requirement;

H... material condition designated by the minimum value of hardness requirement for the product with mandatory hardness requirement;

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

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 Clause 5 list entry i), list entry j) and 8.5].

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 can be 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 (profile or bar);

— number of this European Standard (EN 12167);

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

— DW for compliance in the chemical composition according to the 4 MS Common Composition List. This information is mandatory in the case in which the product is used for drinking water applications according to the 4 MS Common Composition List and not to be given in other cases;

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

— for profiles, the number of the profile or a fully dimensioned and toleranced drawing;

— for profiles with L-, T-, U-shaped cross-sections, the nominal cross-sectional dimensions;

— for bar, the nominal cross-sectional dimensions;

— for bar and profiles with L-, T-, U-shaped cross-sections, the tolerance class (see Table 15 to 17);

— for bar, the corner shape (the following designations shall be used as appropriate: SH for sharp, RD for rounded) (see Table 21).

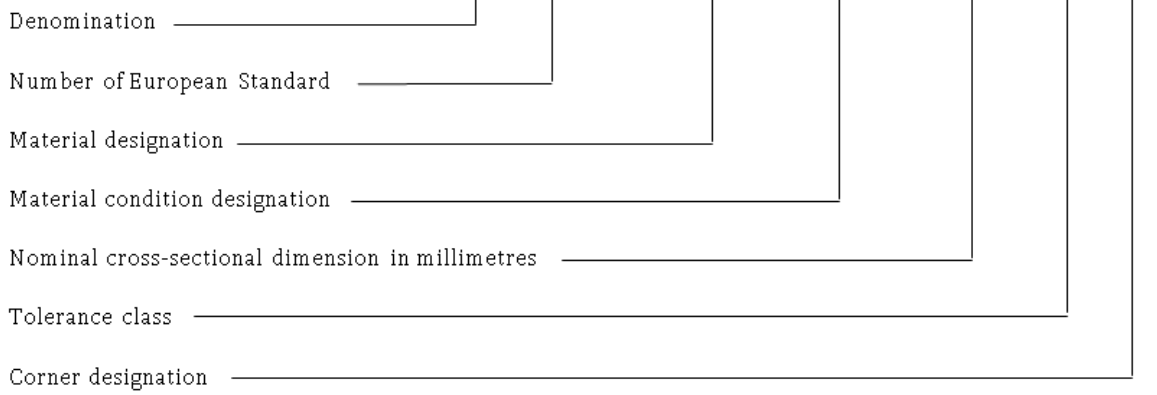
The derivation of a product designation is shown in in the following examples.

EXAMPLE 1 Bar conforming to this standard, in material designated either CuZn40Pb2 or CW617N, for standard applications, in material condition H110, nominal cross-sectional dimensions 30 mm × 10 mm, tolerance Class B, with sharp corners, will be designated as follows:

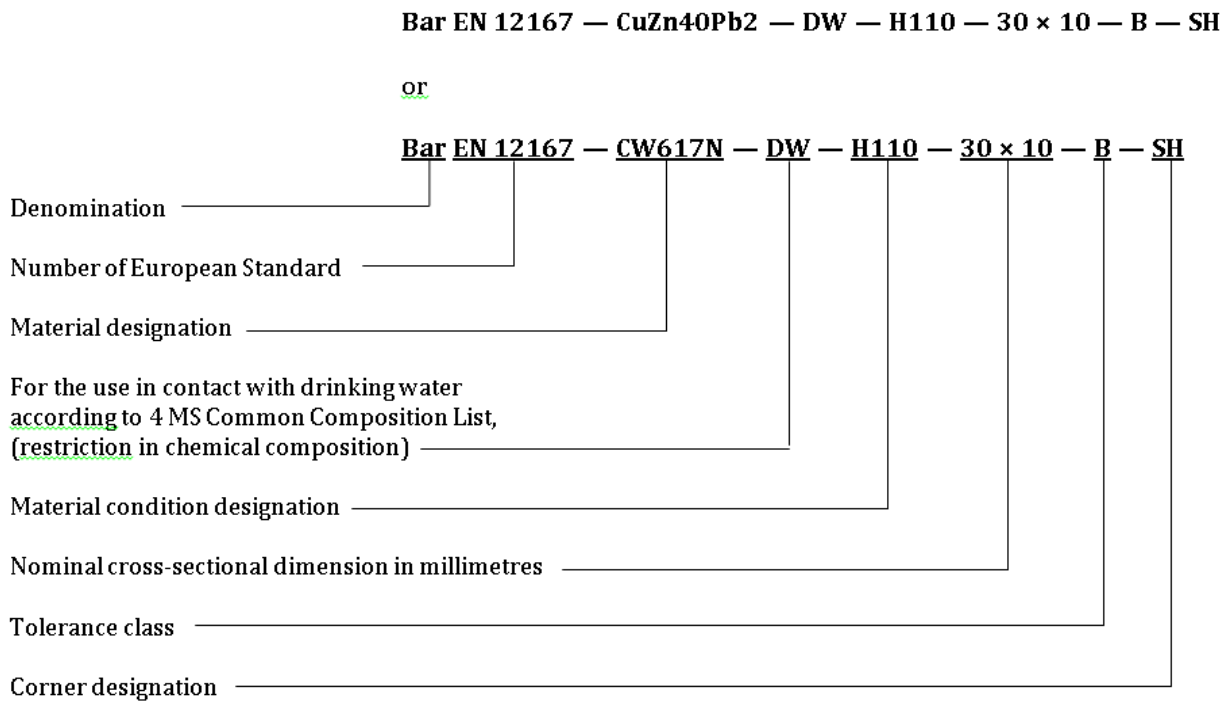
Bar EN 12167 — CuZn40Pb2 — H110 — 30 × 10 — B — SH

or

Bar EN 12167 — CW617N — H110 — 30 × 10 — B — SH



EXAMPLE 2 Bar conforming to this standard, in material designated either CuZn40Pb2 or CW617N for drinking water applications according to the 4 MS Common Composition List, in material condition H110, nominal cross-sectional dimensions 30 mm × 10 mm, tolerance Class B, with sharp corners, will be designated as follows:



EXAMPLE 3 Profile conforming to this standard, in material designated either CuZn43Pb2Al or CW624N, for standard applications, in material condition M, drawing number S123, will be designated as follows:

Profile EN 12167 — CuZn43Pb2Al — M — S123

or

Profile EN 12167 — CW624N — M — S123

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) mass of product required;

b) denomination (profile or bar);

c) number of this European Standard (EN 12167);

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

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

f) DW for compliance in the chemical composition according to the 4 MS Common Composition List. This information is mandatory in the case in which the product is used for drinking water applications according to the 4 MS Common Composition List and not to be given in other cases;

g) size and shape required:

1) for profiles, by fully dimensioned and toleranced drawing, which shall include any specific requirements for straightness and twist and, if appropriate, for flatness;

2) for profiles with L-, T- and U-shaped cross-sections by dimensions and tolerance class (i.e. Class A, B — see Tables 15 and 16), unless the choices of tolerance class are left to the discretion of the supplier;

3) for bar, by dimensions and tolerance class (i.e. Class A, B or C — see Tables 17, 19, 20 and 6.5.3.2), and whether sharp or rounded corners (see Table 21) are required, unless the choices of tolerance class and corner radii are left to the discretion of the supplier;

h) length of product required:

1) for profiles, the length and the tolerance on length, unless the lengths supplied are left to the discretion of the supplier;

2) for bar, the nominal length (see Table 18).

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

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

i) whether the products are required to pass a stress corrosion resistance test; if so, which test method shall 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 shall be selected;

j) whether the products shall be supplied in a thermally stress relieved material condition;

k) for profiles, whether any additional properties or requirements, not specified within the standard, are required;

Details of any mechanical property requirements for profiles, together with the location in the profile from which the test piece should be machined, should be agreed between the purchaser and the supplier (see 6.2.1).

l) whether special surface quality is required (see 6.6);

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 1 Ordering details for 500 kg bar conforming to EN 12167, in material designated either CuZn40Pb2 or CW617N, for drinking water application according to the 4 MS Common Composition List in material condition H110, nominal cross-sectional dimensions 30 mm 10 mm, tolerance Class B, with sharp corners, nominal length 3 000 mm.

500 kg **Bar** **— CuZn40Pb2 — DW — H110 — 30 × 10 — B — SH**
EN 12167
— nominal length 3 000 mm

or

500 kg **Bar** **— CW617N — DW — H110 — 30 × 10 — B — SH**
EN 12167
— nominal length 3 000 mm

EXAMPLE 2 Ordering details for 1 000 kg profiles conforming to EN 12167, in material designated either CuZn43Pb2Al or CW624N, in material condition M, to drawing number S123, nominal length 3 000 mm.

1 000 kg **Profile** **— CuZn43Pb2Al — M — S123**
EN 12167

— nominal length 3 000 mm

or

1 000 kg **Profile** **— CW624N — M — S123**
EN 12167

— nominal length 3 000 mm

6 Requirements

6.1 Composition

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

Due to developing legislation, specific applications (see 4.3) may require restrictions in the chemical composition. In this case the limitations shall be specified in the ordering information [see Clause 5, list entry f)].

6.2 Mechanical properties

6.2.1 Profiles

Mechanical properties of profiles depend on the shape, dimensions and the material. For this reason, mechanical properties of profiles are not specified in this standard but, if needed, are subject to agreement between the purchaser and the supplier [see Clause 5, list entry k)].

6.2.2 Bar

Bar in the R... or H... condition shall conform to the appropriate tensile or hardness 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, in any direction, of CuZn38As (CW511L), CuZn36Pb2As (CW602N), CuZn32Pb2AsFeSi (CW709R), CuZn21Si3P (CW724R) and CuZn33Pb1AlSiAs (CW725R) products shall be 100 µm. For the alloys CuZn35Pb1,5AlAs (CW625N), CuZn33Pb1,5AlAs (CW626N) the maximum depth of dezincification, in any direction, shall be 200 µm.

The test shall be carried out in accordance with 8.4.

NOTE Shape and distribution of beta phase aggregates can influence the dezincification resistance of products. Special requirements relating to shape and distribution of ß phase aggregates are subject to agreement between purchaser and supplier.

Products in alloys other than CuZn21Si3P (CW724R) shall be subjected to heat treatment approximately in the range 500 °C to 550 °C. Should the user need to heat the material above 530 °C (i.e. soldering, brazing or welding operations) then advice should be sought from the supplier.

6.4 Residual stress level

Products ordered and supplied in the stress relieved material condition (see 4.2, 2nd paragraph) 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 Cross-sectional dimensions

6.5.1.1 Profiles

The cross-sectional dimensions of the profile shall conform to the tolerances specified in the drawing supplied by the purchaser and agreed with the supplier at the time of the enquiry and/or order [see Clause 5 list entry g)].

6.5.1.2 Profiles with L-, T- and U-shaped cross-sections

The width of the base *b* and the height of a leg *h* of the profile shall conform to the tolerances given in Table 15 [see Clause 5 list entry g)]. The thickness of the profile shall conform to the tolerances given in Table 16 [see Clause 5 list entry g)]. The allowed angle deviation in mm is $w = \pm 0{,}025\, b$ or $w = \pm 0{,}025\, h$.

The tolerances given in Table 15 and 16 are applicable to the profiles within a circumscribing circle with a maximum diameter of 180 mm.

6.5.1.3 Bar

The width and thickness of bar shall conform to the tolerances given in Table 17 for the appropriate alloy and tolerance class [see Clause 5 list entry g)].

6.5.2 Length

6.5.2.1 Profiles

The length of the profiles shall conform to the tolerances specified by the purchaser [see Clause 5 list entry h)].

6.5.2.2 Bar

The length of bar shall conform to the tolerances given in Table 18.

Subject to agreement between the purchaser and the supplier, an agreed proportion of underlength profiles or bar may be included in a consignment.

6.5.3 Flatness

6.5.3.1 Profiles

If appropriate, the maximum deviation from flatness shall be agreed between the purchaser and the supplier and stated on the order/drawing [see Clause 5 list entry g)].

6.5.3.2 Bar

The maximum deviation from flatness ("*e*" in Figure 1) of bar (thickness *a*, width *b*) is dependent on the tolerance class [see Clause 5 list entry g)] and shall be:

— Class A: 0,4 mm;

— Class B: 0,3 mm;

— Class C: 0,2 mm.

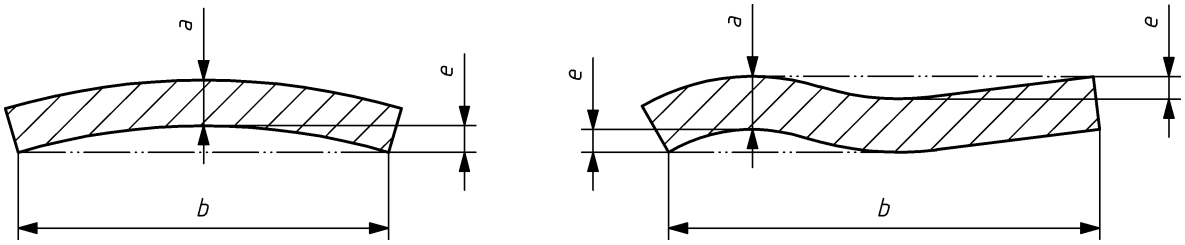


Figure 1 — Measurement of flatness of bar

6.5.4 Straightness

6.5.4.1 Profiles

The tolerance on straightness shall be agreed between the purchaser and the supplier and stated on the order/drawing, [see Clause 5 list entry g)].

6.5.4.2 Bar

For widths 10 mm and over, and lengths 1 000 mm and 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 19 for the appropriate tolerance class [see Clause 5 list entry g)].

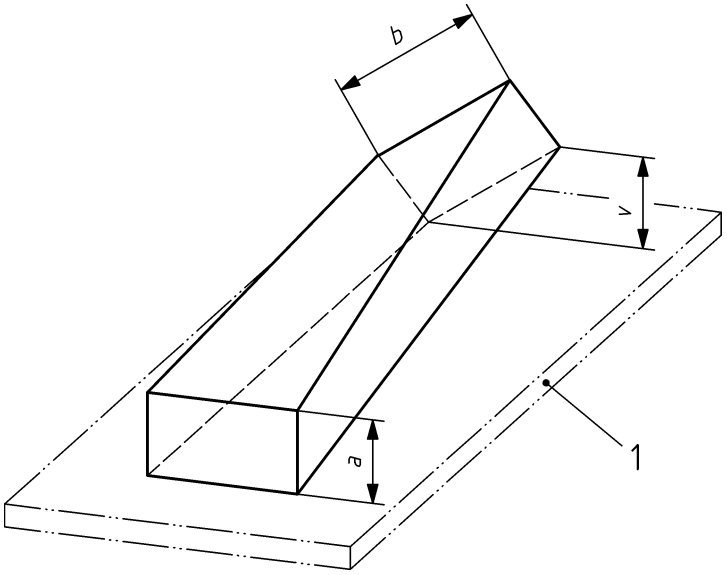
6.5.5 Twist

6.5.5.1 Profiles

The tolerance on twist shall be agreed between the purchaser and the supplier and stated on the order/drawing [see Clause 5 list entry g)].

6.5.5.2 Bar

The maximum permitted twist *V* (see Figure 2) of bar (thickness *a*, width *b*), as measured between two cross-sections along the bar, shall conform to Table 20 for the appropriate tolerance class [see Clause 5 list entry g)].



Key

1 reference plane

a thickness

b width

V twist

Figure 2 — Measurement of twist of bar

6.5.6 Corner radii of bar

The corner radii of bar shall conform to Table 21 [see Clause 5 list entry g)].

If a purchaser requires the corners to have larger radii than those specified in Table 21, then the product is effectively a profile and the dimensions and tolerances of the corner radii required should be stated on the order/drawing.

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.

6.6 Surface quality

The surfaces shall be clean and smooth. The profiles and bars may have a superficial film of drawing lubricant or, if annealed or thermally stress relieved, a superficial, dull, iridescent oxide film, securely adherent on the surfaces.

Discontinuous irregularities on the surfaces of the profiles and bars are permitted if they are within the dimensional tolerances.

Special requirements (e.g. pickling, degreasing, etc.) relating to the surface quality shall be agreed between the purchaser and the supplier [see Clause 5, list entry l)].

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 of profiles or bars shall be sampled in accordance with 7.2 to 7.4.

7.2 Analysis

The sampling rate shall be in accordance with Table 22. 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.

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.

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 e.g. as conforming to EN ISO 9001.

7.3 Tensile and hardness tests

The sampling rate shall be in accordance with Table 22. 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 tests

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 22.

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 8.7 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

For bar, test pieces shall be machined from one of the following locations, in accordance with ISO 4739, in the test sample obtained in accordance with 7.3:

a) for bar of thickness up to and including 10 mm, use a flat test piece, made so that the two wider surfaces are included undisturbed;

b) for bar of thickness over 10 mm, up to and including 25 mm, use a round test piece, the longitudinal axis of which shall be located at a distance from the surface equal to half the thickness;

c) for bar of thickness over 25 mm, use a round test piece, the longitudinal axis of which shall be located 13 mm from one of the wider faces.

For profiles, test pieces shall be machined from the location in the profiles requested by the purchaser [see Clause 5 list entry j)].

In all cases, the axis of the test piece shall be parallel to the extrusion (or working) direction.

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 thickness or diameter equivalent to the cross sectional area:

a) less than 4 mm (A100 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 $\sqrt{S_0}$ mm and 5,65 $\sqrt{S_0}$ 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 Expression of results

Tensile strength shall be calculated from the tensile test results obtained in accordance with 8.2.4. For expression of results, the rounding rules given in 8.7 shall be used.

8.3 Hardness test

Hardness shall be determined on test pieces cut from a test sample obtained in accordance with 7.3. The test shall be carried out in accordance with EN ISO 6506-1 and the impression/indentation made:

a) in the case of bar, on the cross-section of the product midway between the central axis and the outside surface;

b) in the case of profiles, at the midpoint of the thickest part of the profile cross-section, unless otherwise specified by the purchaser.

8.4 Dezincification resistance test

The test method given in EN ISO 6509-1 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;

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 Clause 5 list entry i)].

8.6 Retests

8.6.1 Analysis, tensile, hardness and dezincification resistance tests

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.

NOTE If an inspection lot of alloy of dezincification resistant alloys fails the dezincification resistance test when tested or retested, the supplier has the option to heat treat, or to further heat treat, the inspection lot and resubmit it for all the tests called for on the order, except for analysis.

8.6.2 Stress corrosion resistance test

If a test piece fails the test, 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.

8.7 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 EN ISO 80000-1. It shall be rounded in one step to the same number of figures used to express the specified limit in this European Standard. Except for tensile strength and the 0,2 % proof strength the rounding interval shall be 10 N/mm^2 [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 Clause 5 list entry m)] 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 Clause 5 list entry n)] 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 Clause 5 list entry o)].

1) 1 N/mm^2 is equivalent to 1 MPa.

Table 1 — Composition of low alloyed copper alloys

Material designation		Composition % (mass fraction)												Density[a] g/cm^3
Symbol	Number	Element	Cu	Be	Co	Cr	Fe	Mn	Ni	Pb	Si	Zr	Others total	approx.
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	
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	
CuZr	CW120C	min.	Rem.	—	—	—	—	—	—	—	—	0,1	—	8,9
		max.	—	—	—	—	—	—	—	—	—	0,2	0,1	

[a] For information only.

Table 2 — Composition of copper-aluminium alloys

Material designation		Composition % (mass fraction)											Density[a] g/cm^3
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-zinc alloys

Material designation		Composition % (mass fraction)									Density[a] g/cm^3
Symbol	Number	Element	Cu	Fe	Mn	Ni	Pb	Sn	Zn	Others total	approx.
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	
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	
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	

[a] For information only.

Table 4 — 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.	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	

[a] For information only.

Table 5 — Composition of copper-zinc alloys

Material designation		Composition[b] % (mass fraction)											Density[a] g/cm^3
Symbol	Number	Element	Cu	As	Al	Fe	Mn	Ni	Pb	Sn	Zn	Others total	approx.
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	
CuZn40	CW509L	min.	59,0	—	—	—	—	—	—	—	Rem.	—	8,4
		max.	61,5	—	0,05	0,2	—	0,3	0,2	0,2	—	0,2	
CuZn42	CW510L	min.	57,0	—	—	—	—	—	—	—	Rem.	—	8,4
		max.	59,0	—	0,05	0,3	—	0,3	0,2	0,3	—	0,2	
CuZn38As	CW511L	min.	61,5	0,02	—	—	—	—	—	—	Rem.	—	8,4
		max.	63,5	0,15	0,05	0,1	—	0,3	0,2	0,1	—	0,2	

[a] For information only.

[b] For drinking water applications, restrictions to the chemical composition of some materials listed in this table may apply according to national regulations/laws, e.g. as specified in the 4 MS Common Composition List.

Table 6 — Composition of copper-zinc-lead alloys

Material designation		Composition[b] % (mass fraction)											Density[a] g/cm^3
Symbol	Number	Element	Cu	Al	As	Fe	Mn	Ni	Pb	Sn	Zn	Others total	approx.
Group A alloys													
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	
CuZn37Pb1	CW605N	min.	61,0	—	—	—	—	—	0,8	—	Rem.	—	8,5
		max.	62,5	0,05	—	0,3	—	0,3	1,6	0,3	—	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	
CuZn38Pb1	CW607N	min.	60,0	—	—	—	—	—	0,8	—	Rem.	—	8,4
		max.	61,0	0,05	—	0,2	—	0,3	1,6	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	
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	—	0,3	—	0,3	1,6	0,3	—	0,2	
CuZn39Pb2	CW612N	min.	59,0	—	—	—	—	—	1,6	—	Rem.	—	8,4

Material designation			Composition[b] % (mass fraction)										Density[a] g/cm^3
Symbol	Number	Element	Cu	Al	As	Fe	Mn	Ni	Pb	Sn	Zn	Others total	approx.
		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	
Group B alloys													
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	
CuZn35Pb1,5AlAs	CW625N	min.	62,0	0,5	0,02	—	—	—	1,2	—	Rem.	—	8,4
		max.	64,0	0,7	0,15	0,3	0,1	0,2	1,6	0,3	—	0,2	
CuZn33Pb1,5AlAs	CW626N	min.	64,0	0,8	0,02	—	—	—	1,2	—	Rem.	—	8,4
		max.	66,0	1,0	0,15	0,3	0,1	0,2	1,7	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	
CuZn41Pb1Al	CW620N	min.	57,0	0,05	—	—	—	—	0,8	—	Rem.	—	8,3
		max.	59,0	0,5	—	0,3	—	0,3	1,6	0,3	—	0,2	
CuZn43Pb2Al	CW624N	min.	55,0	0,05	—	—	—	—	1,6	—	Rem.	—	8,4
		max.	57,0	0,5	—	0,3	—	0,3	3,0	0,3	—	0,2	

[a] For information only.

[b] For drinking water applications, restrictions to the chemical composition of some materials listed in this table may apply according to national regulations/laws, e.g. as specified in the 4 MS Common Composition List.

Table 7 — Composition of complex copper-zinc alloys

Material designation		Composition[b] % (mass fraction)												Density[a] g/cm^3
Symbol	Number	Element	Cu	Al	Fe	Mn	Ni	P	Pb	Si	Sn	Zn	Others total	approx.
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	
CuZn37Mn3Al2PbSi	CW713R	min.	57,0	1,3	—	1,5	—	—	0,2	0,3	—	Rem.	—	8,1
		max.	59,0	2,3	1,0	3,0	1,0	—	0,8	1,3	0,4	—	0,3	
CuZn39Sn1	CW719R	min.	59,0	—	—	—	—	—	—	—	0,5	Rem.	—	8,4
		max.	61,0	—	0,1	—	0,2	—	0,2	—	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	
CuZn40Mn1Pb1AlFeSn	CW721R	min.	57,0	0,3	0,2	0,8	—	—	0,8	—	0,2	Rem.	—	8,3
		max.	59,0	1,3	1,2	1,8	0,3	—	1,6	—	1,0	—	0,3	
CuZn40Mn1Pb1FeSn	CW722R	min.	56,5	—	0,2	0,8	—	—	0,8	—	0,2	Rem.	—	8,3
		max.	58,5	0,1	1,2	1,8	0,3	—	1,6	—	1,0	—	0,3	
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	
CuZn33Pb1AlSiAs	CW725R	min.	64,0	0,1	0,05	—	—	—	—	0,4	0,1	Rem.	—	8,5
		max.	67,0	0,4	0,08	0,3	0,1	0,2	0,02	0,9	0,3	—	0,3	

[a] For information only.

[b] For drinking water applications, restrictions to the chemical composition of some materials listed in this table may apply according to national

Material designation		**Composition**[b] % (mass fraction)											**Density**[a] g/cm^3
Symbol	Number	Element	Cu	Al	Fe	Mn	Ni	P	Pb	Si	Sn	Zn	Others total	approx.
regulations/laws, e.g. as specified in the 4 MS Common Composition List.														

Table 8 — Mechanical properties of low alloyed copper alloys

Designations			Nominal cross-sectional dimension				Tensile strength	0,2 % proof strength	Elongation			Hardness	
Material		Material condition	profile	Bar thickness mm			R_m N/mm² (MPa)	$R_{p\,0,2}$ N/mm² (MPa)	$A_{100\ mm}$ %	$A_{11,3}$ %	A %	HBW	
Symbol	Number			from	over	up to and including	min.	min.	min.	min.	min.	min.	max.
CuBe2	CW101C	M	All	All			As manufactured						
		R1150	—	3	—	30	1 150	1 000	—	—	2	—	—
		H340	—	3	—	30	—	—	—	—	—	340	410
		R1300	—	3	—	30	1 300	1 100	—	—	2	—	—
		H350	—	3	—	30	—	—	—	—	—	350	430
CuCo1Ni1Be CuCo2Be	CW103C CW104C	M	All	All			As manufactured						
		R680	—	30	—	100	680	550	—	—	10	—	—
		H220	—	30	—	100	—	—	—	—	—	220	270
		R730	—	3	—	30	730	610	2	4	8	—	—
		H230	—	3	—	30	—	—	—	—	—	230	310
CuCr1Zr	CW106C	M	All	All			As manufactured						
		R370	—	30	—	100	370	250	—	—	16	—	—
		H120	—	30	—	100	—	—	—	—	—	120	160
		R430	—	3	—	50	430	350	3	6	10	—	—
		H135	—	3	—	50	—	—	—	—	—	135	175
		R470	—	3	—	30	470	420	2	5	8	—	—

Designations			**Nominal cross-sectional dimension**				**Tensile strength**	**0,2 % proof strength**	**Elongation**			**Hardness**	
Material		Material condition	profile	Bar thickness mm			R_m N/mm^2 (MPa)	$R_{p\,0,2}$ N/mm^2 (MPa)	$A_{100\ mm}$ %	$A_{11,3}$ %	A %	HBW	
Symbol	Number			from	over	up to and including	min.	min.	min.	min.	min.	min.	max.
		H150	—	3	—	30	—	—	—	—	—	150	180

Designations			Nominal cross-sectional dimension				Tensile strength	0,2 % proof strength	Elongation			Hardness	
Material		Material condition	profile	Bar thickness mm			R_m N/mm^2 (MPa)	$R_{p\,0,2}$ N/mm^2 (MPa)	$A_{100\,mm}$ %	$A_{11,3}$ %	A %	HBW	
Symbol	Number			from	over	up to and including	min.	min.	min.	min.	min.	min.	max.
CuNi1Si	CW109C	M	All	All			As manufactured						
		R440	—	10	—	40	440	300	—	—	16	—	—
		H120	—	10	—	40	—	—	—	—	—	120	180
		R540	—	3	—	30	540	470	4	6	12	—	—
		H140	—	3	—	30	—	—	—	—	—	140	190
		R590	—	3	—	10	590	540	3	5	10	—	—
		H160	—	3	—	10	—	—	—	—	—	160	210
CuNi2Be	CW110C	M	All	All			As manufactured						
		R620	—	2	—	100	620	460	6	8	10	—	—
		H190	—	2	—	100	—	—	—	—	—	190	250
		R680	—	2	—	60	680	540	4	6	8	—	—
		H210	—	2	—	60	—	—	—	—	—	210	260

Designations			Nominal cross-sectional dimension				Tensile strength	0,2 % proof strength	Elongation			Hardness	
Material		Material condition	profile	Bar thickness mm			R_m N/mm^2 (MPa)	$R_{p\,0,2}$ N/mm^2 (MPa)	$A_{100\ mm}$ %	$A_{11,3}$ %	A %	HBW	
Symbol	Number			from	over	up to and including	min.	min.	min.	min.	min.	min.	max.
CuNi2Si	CW111C	M	—	All			As manufactured						
		R550	—	10	—	40	550	430	—	—	15	—	—
		H150	—	10	—	40	—	—	—	—	—	150	190
		R600	—	3	—	30	600	520	4	6	10	—	—
		H165	—	3	—	30	—	—	—	—	—	165	210
		R640	—	3	—	10	640	590	3	5	8	—	—
		H180	—	3	—	10	—	—	—	—	—	180	230
CuZr	CW120C	M	All	All			As manufactured						
		R250	—	3	—	60	250	170	12	15	20	—	—
		H075	—	3	—	60	—	—	—	—	—	75	115
		R280	—	3	—	30	280	210	10	12	15	—	—
		H090	—	3	—	30	—	—	—	—	—	90	130
		R350	—	3	—	10	350	260	8	10	12	—	—
		H120	—	3	—	10	—	—	—	—	—	120	160

Table 9 — Mechanical properties of copper-aluminium alloys

Designations			Nominal cross-sectional dimension				Tensile strength	0,2 % proof strength	Elongation			Hardness	
Material		Material condition	profile	Bar thickness mm			R_m N/mm² (MPa)	$R_{p\,0,2}$ N/mm² (MPa)	$A_{100\ mm}$ %	$A_{11,3}$ %	A %	HBW	
Symbol	Number			from	over	up to and including	min.	min.	min.	min.	min.	min.	max.
CuAl10Fe1	CW305G	M	All	All			As manufactured						
		R530	—	—	6	30	530	290	—	8	10	—	—
		H130	—	—	6	30	—	—	—	—	—	130	170
		R630	—	3	—	6	630	490	—	4	5	—	—
		H155	—	3	—	6	—	—	—	—	—	155	—
CuAl10Ni5Fe4	CW307G	M	All	All			As manufactured						
		R680					680	320	—	8	10	—	—
		H170					—	—	—	—	—	170	210
		R740					740	400	—	6	8	—	—
		H200					—	—	—	—	—	200	—
CuAl11Fe6Ni6	CW308G	M	All	All			As manufactured						
		R740					740	420	3	4	5	—	—
		H220					—	—	—	—	—	220	260
		R830					830	550	—	2	3	—	—
		H240					—	—	—	—	—	240	—

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

Designations			Nominal cross-sectional dimension				Tensile strength	0,2 % proof strength	Elongation			Hardness	
Material		Material condition	profile	bar thickness mm			R_m N/mm² (MPa)	$R_{p\,0,2}$ N/mm² (MPa)	$A_{100\ mm}$ %	$A_{11,3}$ %	A %	HBW	
Symbol	Number			from	over	up to and including	min.	min.	min.	min.	min.	min.	max.
CuNi7Zn39Pb3Mn2	CW400J	M	All	All			As manufactured						
		R600	—	6	—	20	600	400	—	5	8	—	—
		H155	—	6	—	20	—	—	—	—	—	155	190
		R700	—	3	—	6	700	500	—	—	—	—	—
		H180	—	3	—	6	—	—	—	—	—	180	—
CuNi12Zn24	CW403J	M	All	All			As manufactured						
		R450	—	6	—	40	450	200	—	10	12	—	—
		H125	—	6	—	40	—	—	—	—	—	125	150
		R540	—	3	—	6	540	400	—	2	—	—	—
		H160	—	3	—	6	—	—	—	—	—	160	190
CuNi18Zn19Pb1	CW408J	M	All	All			As manufactured						
		R420	—	6	—	50	420	260	—	16	20	—	—
		H110	—	6	—	50	—	—	—	—	—	110	145
		R520	—	3	—	6	520	420	—	3	—	—	—
		H130	—	3	—	6	—	—	—	—	—	130	155

Designations			Nominal cross-sectional dimension				Tensile strength	0,2 % proof strength	Elongation			Hardness	
Material		Material condition	profile	bar thickness mm			R_m N/mm^2 (MPa)	$R_{p\,0,2}$ N/mm^2 (MPa)	$A_{100\ mm}$ %	$A_{11,3}$ %	A %	HBW	
Symbol	Number			from	over	up to and including	min.	min.	min.	min.	min.	min.	max.
CuNi18Zn20	CW409J	M	All	All			As manufactured						
		R480	—	6	—	40	480	250	—	9	11	—	—
		H140	—	6	—	40	—	—	—	—	—	140	175
		R580	—	3	—	6	580	400	—	—	—	—	—
		H170	—	3	—	6	—	—	—	—	—	170	210

Table 11 — Mechanical properties of copper-tin alloys

Designations			Nominal cross-sectional dimension				Tensile strength	0,2 % proof strength		Elongation			Hardness	
Material		Material condition	profile	Bar thickness mm			R_m N/mm² (MPa)	$R_{p\,0,2}$ N/mm² (MPa)		$A_{100\,mm}$ %	$A_{11,3}$ %	A %	HBW	
Symbol	Number			from	over	up to and including	min.	min.	max.	min.	min.	min.	min.	max.
CuSn6	CW452K	M	All	All			As manufactured							
		R420	—	3	—	40	420	220	—	20	25	30	—	—
		H120	—	3	—	40	—	—	—	—	—	—	120	155
		R520	—	3	—	6	520	400	—	3	5	—	—	—
		H150	—	3	—	6	—	—	—	—	—	—	150	180
CuSn8	CW453K	M	All	All			As manufactured							
		R390	—	3	—	50	390	—	280	35	40	45	—	—
		H085	—	3	—	50	—	—	—	—	—	—	85	125
		R450	—	3	—	6	450	280	—	18	22	—	—	—
		H135	—	3	—	6	—	—	—	—	—	—	135	165
		R550	—	3	—	6	550	400	—	10	12	—	—	—
		H160	—	3	—	6	—	—	—	—	—	—	160	190

Table 12 — Mechanical properties of copper-zinc alloys

Designations			Nominal cross-sectional dimension				Tensile strength	0,2 % proof strength		Elongation			Hardness	
Material		Material condition	profile	Bar thickness mm			R_m N/mm² (MPa)	$R_{p\,0,2}$ N/mm² (MPa)		$A_{100\,mm}$ %	$A_{11,3}$ %	A %	HBW	
Symbol	Number			from	over	up to and including	min.	min.	max.	min.	min.	min.	min.	max.
CuZn36 CuZn37	CW507L CW508L	M	All	All			As manufactured							
		R290	—	3	—	20	290	—	230	30	40	45	—	—
		H050	—	3	—	20	—	—	—	—	—	—	50	100
		R370	—	3	—	10	370	240	—	10	12	14	—	—
		H085	—	3	—	10	—	—	—	—	—	—	85	130
		R460	—	3	—	4	460	330	—	4	6	—	—	—
		H105	—	3	—	4	—	—	—	—	—	—	105	145
CuZn40	CW509L	M	All	All			As manufactured							
		R360	—	3	—	20	360	—	300	10	15	20	—	—
		H070	—	3	—	20	—	—	—	—	—	—	70	100
		R410	—	3	—	10	410	220		8	10	12	—	—
		H100	—	3	—	10	—	—	—	—	—	—	100	145
		R500	—	3	—	10	500	350		2	5	8	—	—
		H120	—	3	—	10	—	—	—	—	—	—	120	—

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

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

Designations			Nominal cross-sectional dimension				Tensile strength	0,2 % proof strength		Elongation			Hardness	
Material		Material condition	profile	Bar thickness mm			R_m N/mm^2 (MPa)	$R_{p\,0,2}$ N/mm^2 (MPa)		$A_{100\,mm}$ %	$A_{11,3}$ %	A %	HBW	
Symbol	Number			from	over	up to and including	min.	min.	max.	min.	min.	min.	min.	max.
		M	All	All			As manufactured							
		R280	—	3	—	20	280	—	200	20	25	30	—	—
CuZn36Pb2As	CW602N	H070	—	3	—	20	—	—	—	—	—	—	70	110
CuZn35Pb1,5AlAs	CW625N	R320	—	3	—	20	320	200		10	15	20	—	—
CuZn33Pb1,5AlAs	CW626N	H090	—	3	—	20	—	—	—	—	—	—	90	135
		R400	—	3	—	10	400	250		2	5	8	—	—
		H105	—	3	—	10	—	—	—	—	—	—	105	—
		M	All	All			As manufactured							
		R340	—	3	—	20	340	—	280	10	15	20	—	—
CuZn35Pb1 CuZn35Pb2	CW600N CW601N	H070	—	3	—	20	—	—	—	—	—	—	70	120
CuZn37Pb1	CW605N	R400	—	3	—	10	400	200	—	4	8	12	—	—
CuZn36Pb3 CuZn37Pb2	CW603N CW606N	H100	—	3	—	10	—	—	—	—	—	—	100	140
		R480	—	3	—	10	480	350		2	5	8	—	—
		H125	—	3	—	10	—	—	—	—	—	—	125	—
CuZn38Pb1 CuZn38Pb2	CW607N CW608N	M	All	All			As manufactured							
		R360	—	3	—	20	360	—	300	10	15	20	—	—

Designations			Nominal cross-sectional dimension				Tensile strength	0,2 % proof strength		Elongation			Hardness	
Material		Material condition	profile	Bar thickness mm			R_m N/mm^2 (MPa)	$R_{p\,0,2}$ N/mm^2 (MPa)		$A_{100\,mm}$ %	$A_{11,3}$ %	A %	HBW	
Symbol	Number			from	over	up to and including	min.	min.	max.	min.	min.	min.	min.	max.
CuZn39Pb0,5 CuZn39Pb1 CuZn39Pb2 CuZn39Pb2Sn	CW610N CW611N CW612N CW613N	H070	—	3	—	20	—	—	—	—	—	—	70	100
		R410	—	3	—	10	410	220	—	8	10	12	—	—
		H100	—	3	—	10	—	—	—	—	—	—	100	145
		R500	—	3	—	10	500	350	—	2	5	8	—	—
		H120	—	3	—	10	—	—	—	—	—	—	120	—
CuZn39Pb3 CuZn40Pb2	CW614N CW617N	M	All	All			As manufactured							
		R360	—	6	—	40	360	—	320	—	15	20	—	—
		H090	—	6	—	40	—	—	—	—	—	—	90	125
		R430	—	3	—	20	430	220	—	6	8	10	—	—
		H110	—	3	—	20	—	—	—	—	—	—	110	160
		R500	—	3	—	10	500	350		2	5	8	—	—
		H135	—	3	—	10	—	—	—	—	—	—	135	—
CuZn41Pb1Al CuZn43Pb2Al	CW620N CW624N	M	All	All			As manufactured							

Table 14 — Mechanical properties of complex copper-zinc alloys

Designations			Nominal cross-sectional dimension				Tensile strength	0,2 % proof strength		Elongation			Hardness	
Material		Material condition	profile	Bar thickness mm			R_m N/mm² (MPa)	$R_{p\ 0,2}$ N/mm² (MPa)		$A_{100\ mm}$ %	$A_{11,3}$ %	A %	HBW	
Symbol	Number			from	over	up to and including	min.	min.	max.	min.	min.	min.	min.	max.
CuZn35Ni3Mn2AlPb	CW710R	M	All	All			As manufactured							
		R490	—	3	—	6	490	290	—	10	15	18	—	—
		H120	—	3	—	6	—	—	—	—	—	—	120	160
CuZn36Sn1Pb	CW712R	M	All	All			As manufactured							
		R340	—	3	—	20	340	160	—	12	20	25	—	—
		H080	—	3	—	20	—	—	—	—	—	—	80	120
		R400	—	3	—	20	400	200		10	16	20	—	—
		H105	—	3	—	20	—	—	—	—	—	—	105	135
CuZn37Mn3Al2PbSi	CW713R	M	All	All			As manufactured							
		R540	—	—	10	20	540	280	—	—	—	15	—	—
		H130	—	—	10	20	—	—	—	—	—	—	130	170
		R590	—	3	—	10	590	370		5	8	10	—	—
		H150	—	3	—	10	—	—	—	—	—	—	150	220
CuZn39Sn1	CW719R	M	All	All			As manufactured							
		R340	—	3	—	20	340	140	—	10	15	20	—	—

Designations			Nominal cross-sectional dimension				Tensile strength	0,2 % proof strength		Elongation			Hardness	
Material		Material condition	profile	Bar thickness mm			R_m N/mm² (MPa)	$R_{p\ 0,2}$ N/mm² (MPa)		$A_{100\ mm}$ %	$A_{11,3}$ %	A %	HBW	
Symbol	Number			from	over	up to and including	min.	min.	max.	min.	min.	min.	min.	max.
		H080	—	3	—	20	—	—	—	—	—	—	80	120
		R400	—	3	—	20	400	180		8	10	15	—	—
		H105	—	3	—	20	—	—	—	—	—	—	105	145
		R450	—	3	—	10	450	250		4	5	10	—	—
		H120	—	3	—	10	—	—	—	—	—	—	120	160
CuZn40Mn 1Pb1	CW720R	M	All	All			As manufactured							
		R390	—	—	10	60	390	180	—	—	—	20	—	—
		H090	—	—	10	60	—	—	—	—	—	—	90	125
		R440	—	3	—	10	440	250		10	15	18	—	—
		H100	—	3	—	10	—	—	—	—	—	—	100	145
CuZn40Mn1 Pb1AlFeSn CuZn40Mn1 Pb1FeSn	CW721R CW722R	M	All	All			As manufactured							
		R440	—	—	10	30	440	180	—	—	16	20	—	—
		H100	—	—	10	30	—	—	—	—	—	—	100	140
		R500	—	3	—	10	500	270		5	10	12	—	—
		H130	—	3	—	10	—	—	—	—	—	—	130	—
CuZn21Si3P	CW724R	M	All	All			As manufactured							

Designations			Nominal cross-sectional dimension				Tensile strength	0,2 % proof strength		Elongation			Hardness	
Material		Material condition	profile	Bar thickness mm			R_m N/mm² (MPa)	$R_{p\ 0,2}$ N/mm² (MPa)		$A_{100\ mm}$ %	$A_{11,3}$ %	A %	HBW	
Symbol	Number			from	over	up to and including	min.	min.	max.	min.	min.	min.	min.	max.
		R500	—	2	—	20	500	—	450	12	13	15	—	—
		H130	—	2	—	20	—	—	—	—	—	—	130	180
		R600	—	2	—	20	600	300	—	—	11	12	—	—
		H150	—	2	—	20	—	—	—	—	—	—	150	220
		R670	—	2	—	7	670	400		8	9	10	—	—
		H170	—	2	—	7	—	—	—	—	—	—	170	—
CuZn33Pb1AlSiAs	CW725R	M	All	All			As manufactured							
		R290	—	3	—	20	290	—	200	20	25	30	—	—
		H070	—	3	—	20	—	—	—	—	—	—	70	110
		R320	—	3	—	20	320	200		10	15	20	—	—
		H090	—	3	—	20	—	—	—	—	—	—	90	135
		R400	—	3	—	10	400	250		2	5	8	—	—
		H105	—	3	—	10	—	—	—	—	—	—	105	—

Table 15 — Tolerances on width (*b*) and height of a leg (*h*) for profiles with L-, T- and U-cross-sections

Dimensions in millimetres

Nominal dimensions *b* and *h*		**Tolerance on dimensions *b* and *h* within a circumscribing circle**		
over	up to and including	up to and including 50	over 50 up to and including 120	over 120 up to and including 180
Class A tolerances[a]				
—	10	±0,18	±0,29	±0,45
10	18	±0,22	±0,35	±0,55
18	30	±0,26	±0,42	±0,65
30	50	±0,31	±0,50	±0,80
50	80	—	±0,60	±0,95
80	120	—	±0,70	±1,10
120	180	—	—	±1,25
Class B tolerances[b]				
—	10	±0,40	±0,50	±0,60
10	18	±0,50	±0,60	±0,70
18	30	±0,60	±0,70	±0,80
30	50	±0,70	±0,80	±0,90
50	80	—	±1,00	±1,10
80	120	—	±1,20	±1,50
120	180	—	—	±1,75

[a] Class A tolerances are normally intended for drawn products.

[b] Class B tolerances are normally intended for extruded products.

Table 16 — Tolerances on thickness for profiles with L-, T- and U-cross-sections

Dimensions in millimetres

Nominal thickness		**Tolerance on thickness within a circumscribing circle**	
over	up to and including	up to and including 50	over 50 up to and including 120
Class A tolerances[a]			
—	3	±0,18	±0,20
3	6	±0,20	±0,24
6	10	±0,23	±0,29
10	18	±0,28	±0,35
18	30	±0,33	±0,42
30	50	—	±0,50
Class B tolerances[b]			
—	3	±0,35	±0,40
3	6	±0,40	±0,50
6	10	±0,45	±0,60
10	18	±0,55	±0,70
18	30	±0,65	±0,80
30	50	—	±1,00

[a] Class A tolerances are normally intended for drawn products.

[b] Class B tolerances are normally intended for extruded products.

Table 17 — Tolerances on width and thickness of bar

Dimensions in millimetres

Nominal width		Tolerance on width	Tolerance on thickness for range of thickness					
over	up to and including		from 3 up to and including 6	over 6 up to and including 10	over 10 up to and including 18	over 18 up to and including 30	over 30 up to and including 50	over 50 up to and including 60
Class A tolerances								
6[a]	18	± 0,27	± 0,18	± 0,22	± 0,27	—	—	—
18	30	± 0,33	± 0,18	± 0,22	± 0,27	± 0,33	—	—
30	50	± 0,62	± 0,22	± 0,27	± 0,33	± 0,45	± 0,62	—
50	80	± 1,20	± 0,27	± 0,33	± 0,45	± 0,52	± 0,74	± 1,00
80	120	± 2,20	± 0,33	± 0,45	± 0,52	± 0,74	± 1,00	± 1,20
Class B tolerances								
6[a]	18	± 0,15	± 0,10	± 0,12	± 0,15	—	—	—
18	30	± 0,22	± 0,10	± 0,12	± 0,15	± 0,22	—	—
30	50	± 0,30	± 0,13	± 0,15	± 0,18	± 0,22	± 0,30	—
50	80	± 0,37	± 0,16	± 0,18	± 0,22	± 0,30	± 0,37	—
80	120	± 0,45	± 0,18	± 0,22	± 0,27	± 0,35	± 0,45	—
Class C tolerances								
6[a]	18	± 0,10	± 0,07	± 0,09	± 0,10	—	—	—
18	30	± 0,15	± 0,07	± 0,09	± 0,10	± 0,15	—	—
30	50	± 0,20	± 0,09	± 0,10	± 0,12	± 0,15	± 0,20	—
50	80	± 0,25	± 0,11	± 0,12	± 0,15	± 0,20	± 0,25	—
80	120	± 0,30	± 0,12	± 0,15	± 0,18	± 0,23	± 0,35	—

NOTE Bar to Class C tolerances is normally only available for the materials given in Tables 5 and 6.

[a] Including 6.

Table 18 — Tolerances on length of bar

Dimensions in millimetres

Nominal width		Preferred (available) lengths	Tolerance on length
over	up to and including		
6[a]	18	3 000, 4 000	±50
18	30	3 000, 4 000	±100
30	50	2 000, 3 000, 4 000	±150
50	80	2 000, 3 000	±200
80	120	1 000, 2 000	±200

[a] Including 6.

Table 19 — Tolerances on straightness of bar, for widths 10 mm and over

Tolerance class	Maximum deviation from straightness (see 6.5.4.2) mm	
	localized over any 400 mm length	over whole length L of bar in metres ($L \geq 1$ m)
A	2,4	6,0 × L
B	1,6	4,0 × L
C	0,8	2,0 × L

Table 20 — Maximum twist of bar

Dimensions in millimetres

Nominal width		Maximum permitted twist V in any 1 000 mm length of bar (see Figure 2)		
over	up to and including	class A	class B	class C
6[a]	18	2,0	1,5	1,0
18	30	3,0	2,3	1,5
30	50	4,0	3,0	2,0
50	80	6,0	4,5	3,0
80	120	9,0	7,0	4,5
For bar of total length greater than 2 000 mm, the permitted twist over the total length shall be twice the appropriate maximum given in the table for "in any 1 000 mm".				
[a] Including 6.				

Table 21 — Corner radii of bar

Dimensions in millimetres

Nominal thickness		Radii of corners	
over	up to and including	Sharp max.	Rounded range
3[a]	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	40	0,7	0,7 to 2,8
40	60	0,8	0,8 to 4,0
NOTE 1 The requirements in this table for sharp corners are only applicable to materials given in Tables 5 and 6.			
NOTE 2 A bar having rounded corners of radius greater than those covered by this table is considered to be a profile.			

[a] Including 3.

Table 22 — Sampling rate

Mass per unit length kg/m		**Size 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.		

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

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