BS EN 12449:2023

BSI Standards Publication

Copper and copper alloys — Seamless, round tubes for general purposes

Documents
Document Sharing Hub

Full document details: BS EN 12449:2023

National foreword

This British Standard is the UK implementation of EN 12449:2023. It supersedes BS EN 12449:2016+A1:2019, which is withdrawn.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 committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2023
Published by BSI Standards Limited 2023

ISBN 978 0 539 19408 1

ICS 23.040.15; 77.120.30

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

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 June 2023.

Amendments/corrigenda issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: BS EN 12449:2023

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12449

June 2023

ICS 23.040.15; 77.120.30

Supersedes EN 12449:2016+A1:2019

English Version

Copper and copper alloys - Seamless, round tubes for general purposes

Cuivre et alliages de cuivre - Tubes ronds sans soudure pour usages généraux

Kupfer und Kupferlegierungen - Nahtlose Rundrohre zur allgemeinen Verwendung

This European Standard was approved by CEN on 13 February 2023.

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

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

CEN members are the national standards bodies of 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, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and United Kingdom.

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

© 2023 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members.

Ref. No. EN 12449:2023 E

Documents
Document Sharing Hub

Full document details: BS EN 12449:2023

Contents

Page

European foreword 3
Introduction 4
1 Scope 5
2 Normative references 5
3 Terms and definitions 6
4 Designations 6
4.1 Material 6
4.2 Material condition 7
4.3 Product 7
5 Ordering information 8
6 Requirements 9
6.1 Composition 9
6.2 Mechanical properties 9
6.3 Dimensions and tolerances 9
6.4 Surface quality 10
6.5 Technological requirements 10
7 Sampling 11
7.1 General 11
7.2 Analysis 11
7.3 Mechanical tests and stress corrosion resistance test 11
8 Test methods 12
8.1 Analysis 12
8.2 Tensile test 12
8.3 Hardness test 12
8.4 Technological tests 12
8.5 Freedom from defects tests 12
8.6 Retests 13
8.7 Rounding of results 13
9 Declaration of conformity and inspection documentation 13
9.1 Declaration of conformity 13
9.2 Inspection documentation 13
10 Marking, packaging, labelling 14
Bibliography 51

Documents
Document Sharing Hub
Full document details: BS EN 12449:2023

European foreword

This document (EN 12449:2023) 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 2023, and conflicting national standards shall be withdrawn at the latest by December 2023.

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 12449:2016+A1:2019.

The main changes compared to the previous edition are listed below:

a) update of normative references;

b) addition of the material CuCr1Zr (CW106C) in Table 2 and Table 9;

c) modification of the lead content for CuZn39Pb3 (CW614N) and CuZn40Pb2 (CW617N) in Table 7;

d) correction of hardness values for CuSi3Zn2P (CW124C) of material conditions R650 and H170 in Table 9;

e) modification of 9.1 “Declaration of conformity” and 9.2 “Inspection documentation;

f) editorial amendments.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

AVA Documents
Document Sharing Hub

Full document details: BS EN 12449:2023

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 CuSi3Zn2P (CW124C) 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 they are 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.

For CuSi3Zn2P (CW124C) information may be obtained from:

VIEGA GmbH and Co. KG

Ennester Weg 9

57439 Attendorn

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 (https://www.cencenelec.eu/european-standardization/ipr-and-patents/patents/). Users are encouraged to consult the lists for the most up to date information concerning patents.

Documents
Document Sharing Hub

Full document details: BS EN 12449:2023

1 Scope

This document specifies the composition, property requirements and tolerances on dimensions and form for seamless round drawn copper and copper alloy tubes for general purposes supplied in the size range from 3 mm up to and including 450 mm outside diameter and from 0,3 mm up to and including 20 mm wall thickness.

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

NOTE Tubes having an outside diameter less than 80 mm and/or a wall thickness greater than 2 mm in certain alloys are most frequently used for free machining purposes which are specified in EN 12168.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1971-1, *Copper and copper alloys - Eddy current test for measuring defects on seamless round copper and copper alloy tubes - Part 1: Test with an encircling test coil on the outer surface*

EN 1971-2, *Copper and copper alloys - Eddy current test for measuring defects on seamless round copper and copper alloy tubes - Part 2: Test with an internal probe on the inner surface*

EN 1976, *Copper and copper alloys - Cast unwrought copper products*

EN 16090, *Copper and copper alloys - Estimation of average grain size by ultrasound*

EN ISO 196, *Wrought copper and copper alloys - Detection of residual stress - Mercury(I) nitrate test (ISO 196)*

EN ISO 2624, *Copper and copper alloys - Estimation of average grain size (ISO 2624)*

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

EN ISO 6507-1, *Metallic materials - Vickers hardness test - Part 1: Test method (ISO 6507-1)*

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

EN ISO 8493, *Metallic materials - Tube - Drift-expanding test (ISO 8493)*

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

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

AVA Documents
Document Sharing Hub

Full document details: BS EN 12449:2023

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
seamless round tube
hollow semi-finished product, circular in cross-section, having a uniform wall thickness, which at all stages of production has a continuous periphery

3.2
mean diameter
arithmetical mean of the maximum and minimum outside diameters through the same cross-section of the tube

[SOURCE: EN 1057:2006+A1:2010, 3.5]

3.3
deviation from circular form
difference between the maximum and minimum outside diameters measured at any one cross-section of the tube

[SOURCE: EN 1057:2006+A1:2010, 3.6]

4 Designations

4.1 Material

4.1.1 General

The material is designated either by symbol or number (see Table 1 to Table 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 document 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.

Documents
Document Sharing Hub
Full document details: BS EN 12449:2023

4.2 Material condition

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

M material condition for the product as manufactured without specified mechanical properties;

R... material condition designated by the minimum value of tensile strength requirement for the product with mandatory tensile property requirements;

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

NOTE 1 Products in the H... condition can be specified to Vickers or Brinell hardness. The material 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, R... or H... condition can 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 (see 6.5.2).

Exact conversion between the 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 document.

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

— denomination (Tube);

— number of this document (EN 12449);

— material designation, either symbol or number (see Table 1 to Table 8);

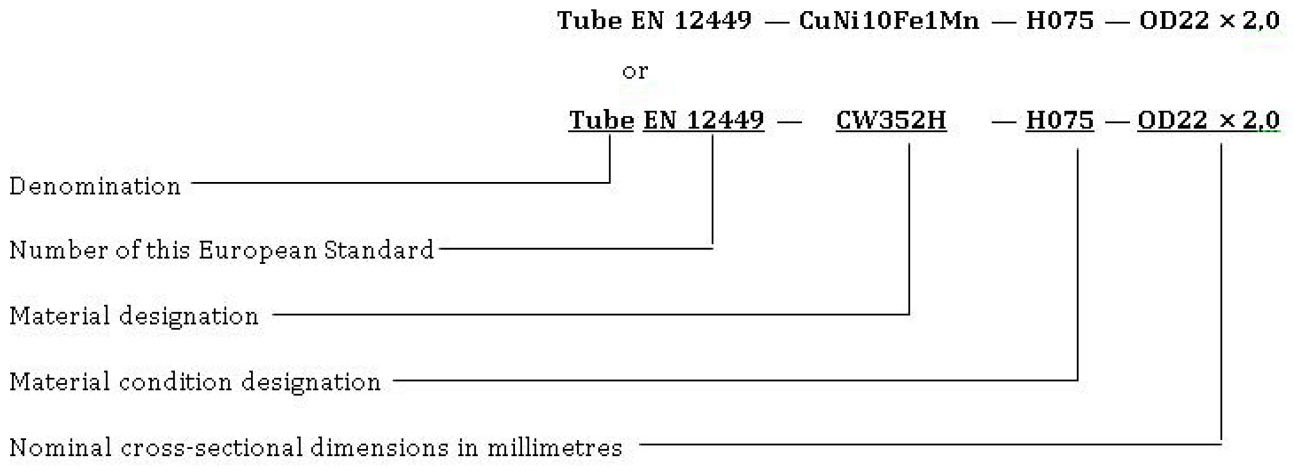
— material condition designation (see Table 9 to Table 15);

— nominal cross-sectional dimensions, either outside diameter (OD) and wall thickness or inside diameter (ID) and wall thickness (see 6.3).

The derivation of a product designation is shown in EXAMPLE 1.

EXAMPLE 1 Tube conforming to this document, in material designated either CuNi10Fe1Mn or CW352H, in material condition H075, nominal outside diameter 22 mm, nominal wall thickness 2,0 mm, will be designated as follows:

Documents
Document Sharing Hub
Full document details: BS EN 12449:2023



EXAMPLE 2 Tube conforming to this document, in material designated either CuZn37 or CW508L, in material condition M, stress relieved, nominal inside diameter 30 mm, nominal wall thickness 2,5 mm, will be designated as follows:

Tube EN 12449 — CuZn37 — MS — ID30 × 2,5

or

Tube EN 12449 — CW508L — MS — ID30 × 2,5

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 (number of pieces, length or mass);

b) denomination (Tube);

c) number of this document (i.e. EN 12449);

d) material designation (see Table 1 to Table 8);

e) material condition designation (see 4.2 and Table 9 to Table 15) if it is other than M;

f) nominal cross-sectional dimensions [either outside diameter (OD) and wall thickness or inside diameter (ID) and wall thickness] (see 6.3);

g) length, either nominal together with tolerance required, or fixed length (see 6.3.4).

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

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

h) whether the tubes are for sea water application (see Table 3). If so, the composition limits required;

i) test method to be used for the measurement of hardness, i.e. Vickers or Brinell (see 8.3);

j) where dimensional tolerances are to be applied, if not on the outside diameter and wall thickness (see 6.3.1);

Documents
Document Sharing Hub
Full document details: BS EN 12449:2023

k) whether the tubes are required to pass a drift expanding test (see 6.5.1);

l) whether the tubes are required to pass a stress corrosion resistance test (see 6.5.2);

m) whether the tubes are required to meet a grain size requirement (see 6.5.3); if so, the grain size limits required;

It is advised to agree the grain size limits between the purchaser and the supplier.

n) whether the tubes are required to pass freedom from defects tests (see 6.5.4); 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, and the acceptance criteria if they are not to be left to the discretion of the supplier;

o) whether deburring is required (see 6.4);

p) whether special surface quality is required (see 6.4);

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

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

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

EXAMPLE Ordering details for 1 000 m tube conforming to EN 12449, in material designated either CuNi10Fe1Mn or CW352H, in material condition H075, nominal outside diameter 22 mm, nominal wall thickness 2,0 mm, in 3 000 mm fixed lengths:

1 000 m Tube EN 12449 — CuNi10Fe1Mn — H075 — OD22 × 2,0

— fixed length 3 000 mm

or

1 000 m Tube EN 12449 — CW352H — H075 — OD22 × 2,0

— fixed length 3 000 mm

6 Requirements

6.1 Composition

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

6.2 Mechanical properties

The properties shall conform to the appropriate requirements given in Table 9 to Table 15. The tests shall be carried out in accordance with either 8.2 (tensile test) or 8.3 (hardness test).

Products in stress relieved condition shall conform to the same mechanical property requirements as for non stress relieved material.

6.3 Dimensions and tolerances

6.3.1 General

The geometrical properties of the tubes are defined by outside diameter or inside diameter, wall thickness and length.

Documents
Document Sharing Hub
Full document details: BS EN 12449:2023

Normally, tolerances for cross-sectional dimensions are applied on the outside diameter (see 6.3.2) and wall thickness (see 6.3.3) but other possibilities may be agreed between the purchaser and the supplier at the time of the enquiry and order [see Clause 5, list entry j)].

Normally, tubes are supplied in lengths with tolerances agreed between the purchaser and the supplier at the time of the enquiry and order [see Clause 5, list entry g)] but tubes may be ordered as "fixed lengths" (see 6.3.4).

6.3.2 Outside or inside diameter

The diameter of the tubes shall conform to the tolerances given in Table 17.

6.3.3 Wall thickness

The wall thickness, measured at any point, shall conform to the tolerances given in Table 18.

6.3.4 Fixed lengths

Tubes in straight lengths ordered as "fixed lengths" shall conform to the tolerances given in Table 19. Tubes in coiled form ordered as "fixed lengths" shall conform to the tolerances given in Table 20.

6.3.5 Tolerances on form

6.3.5.1 Deviation from circular form

For tubes in straight lengths the deviation from circular form is included in the tolerances on diameter given in Table 17.

For coiled tubes with wall thicknesses up to and including 2 mm, except for tubes with ratios of outside diameter to wall thickness greater than 20, the deviation from circular form is included in the tolerances on diameter given in Table 21.

6.3.5.2 Straightness

Tubes in straight lengths, except for those in the annealed condition (see Table 9 to Table 15) or with outside diameter equal to or less than 10 mm, shall conform to the tolerances given in Table 22.

6.4 Surface quality

The external and internal surfaces shall be clean and smooth.

The tubes may have a superficial film of drawing lubricant or, if annealed or thermally stress relieved, a superficial, dull, iridescent oxide film, securely adherent on both the internal and external surfaces.

Discontinuous irregularities on the external and internal surfaces of the tubes 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 p)].

If deburring of the cut ends of the tubes is required it shall be agreed between the purchaser and the supplier [see Clause 5, list entry o)].

6.5 Technological requirements

6.5.1 Drift expanding

No crack shall be visible to the unaided eye, corrected for normal vision if necessary, when tubes in the annealed condition and outside diameter up to and including 100 mm and when agreed between the purchaser and the supplier [see Clause 5, list entry k)] are tested in accordance with 8.4.1.

Documents
Document Sharing Hub

Full document details: BS EN 12449:2023

6.5.2 Residual stress level

No crack shall be visible to the unaided eye, corrected for normal vision if necessary, when tubes in the stress relieved condition and when requested by the purchaser [see Clause 5, list entry l)] are tested in accordance with 8.4.2.

6.5.3 Grain size

The average grain size of tubes in the annealed condition, when requested by the purchaser, [see Clause 5, list entry m)] shall conform to the limits agreed between the purchaser and the supplier. The test shall be carried out in accordance with 8.4.3.

6.5.4 Freedom from defects

When requested by the purchaser [see Clause 5, list entry n)] tubes shall be tested in accordance with 8.5 and the acceptance criteria, unless otherwise agreed between the purchaser and the supplier, shall be at the discretion of the supplier.

7 Sampling

7.1 General

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

7.2 Analysis

The sampling rate shall be in accordance with Table 23. 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 management system of the manufacturer is certified, e.g. as conforming to EN ISO 9001.

7.3 Mechanical tests and stress corrosion resistance test

The sampling rate shall be in accordance with Table 23. 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.

AVA Documents
Document Sharing Hub

Full document details: BS EN 12449:2023

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 chemical or spectrographic according to EN or ISO standards in force. For expression of results, the rounding rules given in 8.7 shall be used.

In cases of dispute concerning the results of analysis, the method of analysis to be used should be chemical.

8.2 Tensile test

The tensile properties shall be determined in accordance with EN ISO 6892-1 on the test pieces obtained in accordance with 7.3.

8.3 Hardness test

Hardness shall be determined on test pieces prepared from the test samples obtained in accordance with 7.3. The test shall be carried out in accordance with either EN ISO 6506-1 or EN ISO 6507-1 and the impression/indentation made on the outside surface, unless otherwise agreed. For the Brinell test according to EN ISO 6506-1, a 0,102 F/D^2 ratio of 10 shall be used.

8.4 Technological tests

8.4.1 Drift expanding test

When required, the drift expanding test shall be carried out in accordance with EN ISO 8493. The outside diameter of the tube end shall be expanded by 30 % using a conical mandrel with an angle of 45°.

8.4.2 Stress corrosion resistance test

When required, the test method given in either EN ISO 196 or ISO 6957 shall be used on the test pieces prepared from the test samples obtained in accordance with 7.3. The choice of which of these tests is used shall be at the discretion of the supplier.

8.4.3 Average grain size determination

When required, the estimation of average grain size shall be carried out in accordance with EN ISO 2624 or EN 16090.

8.5 Freedom from defects tests

When required, each tube shall be subjected to one of the following tests:

— Eddy current test for detection of local defects, in accordance with EN 1971-1 or EN 1971-2;

— hydrostatic test;

— pneumatic test.

If not otherwise agreed between the purchaser and the supplier, which of the test methods to be used and the method of testing shall be at the discretion of the manufacturer.

Documents
Document Sharing Hub

Full document details: BS EN 12449:2023

8.6 Retests

8.6.1 Analysis, tensile, hardness, drift expanding and grain size tests

If there is a failure of one, or more than one, of the tests in 8.1, 8.2, 8.3, 8.4.1 or 8.4.3, 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 manufacturer.

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 document. If a test piece fails a test, the inspection lot represented shall be deemed not to conform to this document.

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 7.3.

If a test piece from the further test sample passes the test, the stress relieved material shall be deemed to conform to the requirements of this document 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 material shall be deemed not to conform to this document.

8.7 Rounding of results

For the purpose of determining conformity to the limits specified in this document, 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 ISO 80000-1:2009, Annex B. It shall be rounded in one step to the same number of figures used to express the specified limit in this document, except that for tensile strength and 0,2 % proof strength the rounding interval shall be 10 N/mm^2 [1] and for elongation the value shall be rounded to the nearest 1 %.

The following rules shall be used for rounding:

— 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;

— 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 a supplier's declaration of conformity is required [see Clause 5 list entry q)], the relevant information is available in EN ISO/IEC 17050-1 and EN ISO/IEC 17050-2.

9.2 Inspection documentation

When an inspection document is required [see Clause 5 list entry r)], the relevant information is available in EN 10204.

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

AVA Documents
Document Sharing Hub

Full document details: BS EN 12449:2023

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 s)].

Table 1 — Composition of copper

Material designation		Composition								Density [b]
		Element	Cu [a]	Bi	O	P	Pb	other elements (see NOTE)		
Symbol	Number							total	excluding	approx.
		% (mass fraction)								g/cm³
Cu-ETP	CW004A	min.	99,90	—	—	—	—	—	Ag, O	8,9
		max.	—	0,000 5	0,040 [c]	—	0,005	0,03		
Cu-FRHC	CW005A	min.	99,90	—	—	—	—	—	Ag, O	8,9
		max.	—	—	0,040 [c]	—	—	0,06 [d]		
Cu-OF	CW008A	min.	99,95	—	—	—	—	—	Ag	8,9
		max.	—	0,000 5	— [e]	—	0,005	0,03		
Cu-PHC	CW020A	min.	99,95	—	—	0,001	—	—	Ag, P	8,9
		max.	—	0,000 5	— [e]	0,006	0,005	0,03		
Cu-HCP	CW021A	min.	99,95	—	—	0,002	—	—	Ag, P	8,9
		max.	—	0,000 5	— [e]	0,007	0,005	0,03		
Cu-DHP	CW024A	min.	99,90	—	—	0,015	—	—	—	8,9
		max.	—	—	— [e]	0,040	—	— [f]		

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.

[a] Including silver, up to a maximum of 0,015 %.

[b] For information only.

[c] Oxygen content up to 0,060 % is permitted, subject to agreement between the purchaser and the supplier.

[d] Higher total impurities content is permitted, subject to agreement between the purchaser and the supplier.

[e] The oxygen content shall be such that the material conforms to the hydrogen embrittlement requirements of EN 1976.

[f] If required, the permitted total of elements, other than silver and phosphorus, should be agreed between the purchaser and the supplier.

Documents
Document Sharing Hub
Full document details: BS EN 12449:2023

Table 2 — Composition of low alloyed copper alloys

Material designation		Composition															Density [a]
Symbol	Number	Element	Cu	Al	As	Cr	Fe	Mn	Ni	P	Pb	Si	Sn	Zn	Zr	others total	approx.
		% (mass fraction)															g/cm³
CuCr1Zr	**CW106C**	min.	Rem.	—	—	**0,5**	—	—	—	—	—	—	—	—	0,03	—	8,9
		max.	—	—	—	**1,2**	0,08	—	—	—	—	0,1	—	—	0,3	0,2	
CuFe2P	**CW107C**	min.	Rem.	—	—	—	2,1	—	—	0,015	—	—	—	0,05	—	—	8,8
		max.	—	—	—	—	2,6	—	—	0,15	0,03	—	—	0,20	—	0,2	
CuNi2Si	**CW111C**	min.	Rem.	—	—	—	—	—	1,6	—	—	0,4	—	—	—	—	8,8
		max.	—	—	—	—	0,2	0,1	2,5	—	0,02	0,8	—	—	—	0,3	
CuSi3Zn2P	**CW124C**	min.	Rem.	—	—	—	—	—	—	0,01	—	2,5	—	1,0	—	—	8,6
		max.	—	—	—	—	—	0,20	0,20	0,20	0,10	3,5	—	3,0	—	0,2	
CuFe0,1Sn0,1P	**CW125C**	min.	Rem.	—	—	—	0,05	—	—	0,015	—	—	0,05	—	—	—	8,6
		max.	—	—	—	—	0,20	—	—	0,055	—	—	0,25	—	—	0,2	

[a] For information only.

Documents
Document Sharing Hub
Full document details: BS EN 12449:2023