BS EN 13604:2013

BSI Standards Publication

Copper and copper alloys — Semiconductor devices, electronic and vacuum products made from high conductivity copper

bsi.

...making excellence a habit.™

National foreword

This British Standard is the UK implementation of EN 13604:2013. It supersedes BS EN 13604:2002 which is withdrawn.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.

ISBN 978 0 580 74206 4

ICS 29.050; 77.150.30

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 2013.

Amendments issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 13604

June 2013

ICS 77.150.30

Supersedes EN 13604:2002

English Version

Copper and copper alloys - Semiconductor devices, electronic and vacuum products made from high conductivity copper

Cuivre et alliages de cuivre - Produits en cuivre de haute conductivité pour application dans les tubes électroniques, semi-conducteurs et vide

Kupfer und Kupferlegierungen - Produkte aus hochleitfähigem Kupfer für Elektronenröhren, Halbleiterbauelemente und für die Anwendung in der Vakuumtechnik

This European Standard was approved by CEN on 25 April 2013.

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, 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 United Kingdom.

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

Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Page

Figures

Tables

Foreword

This document (EN 13604:2013) 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 2013, and conflicting national standards shall be withdrawn at the latest by December 2013.

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

This document supersedes EN 13604:2002.

In comparison with EN 13604:2002, the following changes have been made:

— Normative references have been updated.

— Editorial modifications have been made.

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

EN 13604:2002, *Copper and copper alloys — Products of high conductivity copper for electronic tubes, semi-conductor devices and vacuum applications.*

The two copper grades Cu-OFE (CW009A) and Cu-PHCE (CW022A) specified in this European Standard are those which are especially suitable for electronic, semiconductor and vacuum applications.

Annex A (normative) is the reference for microscopic examination.

Annex B (informative) gives guidance on the characteristics of coppers for electrical purposes.

This is one of a series of European Standards for copper products for electrical purposes. Other copper products are specified as follows:

— EN 13599, *Copper and copper alloys — Copper plate, sheet and strip for electrical purposes*

— EN 13600, *Copper and copper alloys — Seamless copper tubes for electrical 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*

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.

1 Scope

This European Standard specifies the composition, property requirements including electrical properties and tolerances on dimensions and form of semiconductor devices, electronic and vacuum products in two copper grates Cu-OFE (CW009A) and Cu-PHCE (CW022A), in the form of wrought products, e.g. plate, sheet, strip, seamless tube, rod, bar, wire, profiles.

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

This European Standard applies to the wrought copper products as delivered to the device manufacturer, i.e. for further fabrication.

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

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

EN 10204, *Metallic materials — Types of inspection documents*

EN 13599, *Copper and copper alloys — Copper plate, sheet and strip for electrical purposes*

EN 13600, *Copper and copper alloys — Seamless copper tubes for electrical 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*

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

EN ISO 2626, *Copper — Hydrogen embrittlement test (ISO 2626)*

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 7438, *Metallic materials — Bend test (ISO 7438)*

IEC 60468, *Method of measurement of resistivity of metallic materials*

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

ISO 4746, *Oxygen-free copper — Scale adhesion test*

ISO 7801, *Metallic materials — Wire — Reverse bend test*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13599, EN 13600, EN 13601, EN 13602 and EN 13605 apply.

4 Designations

4.1 Material

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

4.2 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.

4.3 Number

The material number designation is in accordance with the system given in EN 1412.

4.4 Material condition

The material condition depends on the product and is fully described in the corresponding standards:

— EN 13599 for plate, sheet and strip;

— EN 13600 for tube;

— EN 13601 for rod and bar;

— EN 13602 for wire;

— EN 13605 for profile and profiled wire.

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;

D Material condition for the product as drawn without specified mechanical properties;

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

R... Material condition designated by the minimum value of tensile strength requirement for the product with mandatory tensile strength requirement (and other tensile property requirements, dependent on product);

A... Material condition designated by the minimum value of elongation requirement for the product with mandatory elongation requirements.

Products in the H... condition may be specified to Vickers or Brinell hardness, dependent on the product. The material condition designation H... is the same for both hardness test methods.

Exact conversion between the material conditions designated H... and R..., or R... and A..., dependent on the product, is not possible.

Material condition is designated by only one of the above designations.

4.5 Product

The product designation provides a standardised 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 (Plate, Sheet, Strip, Tube, Rod, Bar, Wire, Profile or Profiled wire);

— number of this European Standard (EN 13604);

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

— other information dependent on copper product for electrical purposes (see 6.2).

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

EXAMPLE 1 Rod for electrical purposes conforming to this standard, in material designated either Cu-OFE or CW009A, in material condition R250, round, nominal diameter 15 mm, tolerance Class A, will be designated as follows:

Rod EN 13604 — Cu-OFE —R250 — RND15A

or

Rod EN 13604 — CW009A —R250 — RND15A

Denomination

Number of this European Standard

Material designation

Material condition designation

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

EXAMPLE 2 Strip for electrical purposes conforming to this standard, in material designated either Cu-PHCE or CW022A, in material condition R290, nominal thickness 2 mm, nominal width 1 000 mm, will be designated as follows:

Strip EN 13604 — Cu-PHCE — R290 — 2 x 1 000

or

Strip EN 13604 — CW022A — R290 — 2 x 1 000

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 ordering information for the relevant copper product for electrical purposes from:

— plate, sheet and strip in EN 13599;

— seamless tubes in EN 13600;

— rod, bar and wire in EN 13601;

— drawn, round wire in EN 13602;

— profiles and profiled wire in EN 13605;

except that the number of this European standard (EN 13604) shall be substituted, or if there is no corresponding product standard, the details shall be agreed between the purchaser and the supplier. For material conditions other than annealed, the electrical properties shall be agreed between the purchaser and the supplier (see 6.3).

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

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

b) whether scale adhesion test is required for Cu-OFE (CW009A) (see 6.5);

c) whether a grain size determination is required (see 6.6);

d) whether special surface conditions are required (see 6.8);

e) the inspection lot size if different from the sampling rate for mechanical and electrical tests for the relevant copper product from the standards listed above (see 7.3);

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

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

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

EXAMPLE Ordering details for 500 kg rod for electrical purposes conforming to EN 13604, in material designated either Cu-OFE or CW009A, in material condition R250, round, nominal diameter 15 mm, tolerance Class A, fixed length 3 000 mm:

500 kg Rod EN 13604 — Cu-OFE — R250 — RND15A — fixed length 3 000 mm

or

500 kg Rod EN 13604 — CW009A — R250 — RND15A — 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.

NOTE For characteristics of coppers for electrical purposes, see Annex B.

6.2 Mechanical properties

Mechanical properties of wrought products made from Cu-OFE (CW009A) and Cu-PHCE (CW022A) shall conform to the mechanical properties specified for:

— plate, sheet and strip in EN 13599;

— seamless tubes in EN 13600;

— rod, bar and wire in EN 13601;

— drawn, round wire in EN 13602;

— profiles and profiled wire in EN 13605.

In case of hardness requirements, the purchaser shall specify which hardness test (Brinell or Vickers) is mandatory.

If there is no corresponding product standard, the properties shall be agreed between the purchaser and the supplier.

The tests shall be carried out in accordance with either 8.2 (tensile test) or 8.3 (hardness test) or 8.4 (bend test).

6.3 Electrical properties

The electrical properties in the annealed material condition shall conform to the appropriate requirements given in Table 2.

For other material conditions, the electrical properties shall be agreed between the purchaser and the supplier.

The tests shall be carried out in accordance with 8.5.

6.4 Freedom from hydrogen embrittlement

6.4.1 General

Products shall be tested for freedom from hydrogen embrittlement in accordance with 8.6.

6.4.2 Microscopic examination

Microscopic examination of test pieces shall show neither evidence of cracks, voids, holes, fissures or inclusions, nor shall porosity be present in amounts greater than, or distribution dissimilar from, that shown in Classes 1 and 2 for Types A to C in Annex A. Class 3 for all types are examples of unacceptable material.

Unless otherwise specified, evidence of surface oxidation shall be confined to a depth of not more than 1 % of the thickness of the specimen or 0,5 mm, whichever is the smaller. For material hot rolled, only the oxidised region shall be not greater than 1 mm depth.

6.4.3 Reverse bending

The test piece shall withstand a minimum of 10 reverse bends without any evidence of cracking, when tested and examined with the unaided eye, corrected to normal vision if necessary, in accordance with 8.4.

6.5 Scale adhesion

If agreed between the purchaser and the supplier [see Clause 5 list entry b)], the test pieces of Cu-OFE (CW009A) shall be visually examined after testing in accordance with 8.7.

The black oxide film shall remain substantially unbroken and firmly adherent to the test pieces, neglecting slight loss of adherence at the edges of the test piece. No blistering or loss of oxide film shall be apparent and the colorations shall be even.

6.6 Grain size

If agreed between the purchaser and the supplier [see Clause 5 list entry c)], the average grain size for cross-sectional dimensions or thicknesses up to 25 mm, when tested in accordance with 8.8, shall be uniform and not greater than 0,050 mm or 0,4 % of the nominal dimension, whichever is greater. For larger dimensions, average grain size requirements shall be agreed between the purchaser and the supplier.

6.7 Tolerances of dimensions and form

Tolerances of dimensions and form of wrought products made from Cu-OFE (CW009A) and Cu-PHCE (CW022A) shall conform to the tolerances specified for:

— plate, sheet and strip in EN 13599;

— seamless tubes in EN 13600;

— rod, bar and wire in EN 13601;

— drawn, round wire in EN 13602;

— profiles and profiled wire in EN 13605.

If there is no corresponding product standard, the tolerances shall be agreed between the purchaser and the supplier.

6.8 Surface condition

The products shall be clean, sound and free from injurious defects which shall be specified by agreement between the purchaser and the supplier at the time of enquiry and order. A superficial film of residual lubricant is normally present on cold worked products and is permissible, unless otherwise specified. Slight discoloration is permissible as long as it does not impair utilisation.

Special requirements shall be agreed between the purchaser and the supplier [see Clause 5 list entry d)].

7 Sampling

7.1 General

When required (e.g. if necessary in accordance with specified procedures of a supplier's quality management 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 ISO 1811-2. 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. 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, electrical and other tests

Unless otherwise agreed between the purchaser and the supplier, the sampling rate shall be that given by the relevant copper product standard (see Clause 5). A different sampling rate may be agreed between the purchaser and the supplier at the time of enquiry and order [see Clause 5 list entry e)]. 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.

Results may be used from the resistivity test and the scale adhesion test 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.

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 8.10 shall be used.

8.2 Tensile test

The tensile test shall be carried out in accordance with EN ISO 6892-1 and with the requirements for the relevant copper product standard (see Clause 5), on test pieces prepared from the test samples obtained in accordance with 7.3.

8.3 Hardness test

8.3.1 Vickers hardness

The test shall be carried out in accordance with EN ISO 6507-1, and with the requirements for the relevant copper product standard (see Clause 5), on the test pieces prepared from the test samples obtained in accordance with 7.3.

8.3.2 Brinell hardness

The test shall be carried out in accordance with EN ISO 6506-1, and with the requirements for the relevant copper product standard (see Clause 5), on the test pieces prepared from the test samples obtained in accordance with 7.3.

8.4 Bend test

The test shall be carried out in accordance with EN ISO 7438, and with the requirements for the relevant copper product standard (see Clause 5), on the test pieces prepared from the test samples obtained in accordance with 7.3.

8.5 Electrical test

The test method used shall be left to the discretion of the supplier, e.g. eddy current method or resistance bridge, if not otherwise specified.

The electrical resistivity or conductivity shall be determined by direct measurement either at 20 °C ± 1 °C or at another temperature, when the result shall be corrected to the equivalent value at 20 °C, on the product in the as delivered condition, sampled in accordance with 7.3.

In case of dispute the volume resistivity shall be determined on a resistance bridge in accordance with IEC 60468.

8.6 Hydrogen embrittlement test

The hydrogen embrittlement test shall be carried out in accordance with EN ISO 2626, except that the test piece shall be subjected to microscopic examination at a magnification of 100× or to reverse bending in accordance with ISO 7801.

8.7 Scale adhesion test

If agreed for Cu-OFE (CW009A), the scale adhesion test shall be carried out in accordance with ISO 4746.

If the test samples and test pieces taken from the final product are not of the full cross-section, they shall retain some part of the original surface of the material.

8.8 Estimation of average grain size

The average grain size shall be estimated in accordance with the comparison procedure given in EN ISO 2624. In cases of dispute the intersect procedure shall be used.

8.9 Retests

If there is a failure of one, or more than one, of the tests in 8.1 to 8.8, two test samples from the same inspection lot shall be permitted to be selected for retesting the failed property (properties). One of these test samples shall be taken from the same sampling unit as that from which the original failed test piece was taken, unless that sampling unit is no longer available, or has been withdrawn by the supplier.

If the test pieces from both test samples pass the appropriate test(s), then the inspection lot represented shall be deemed to conform to the particular requirement(s) of this standard. If a test piece fails a test, the inspection lot represented shall be deemed not to conform to this standard.

8.10 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 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 European Standard. Except 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:

a) if the figure immediately after the last figure to be retained is less than five, 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 five, 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 f)] 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 g)] 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 h)].

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

Table 1 — Composition of Cu-OFE and Cu-PHCE

Material designation		Composition % (mass fraction)																	
Symbol	Number	Element	Cu	Ag	As	Bi	Cd	Fe	Mn	Ni	O	P	Pb	S	Sb	Se	Sn	Te	Zn
Cu-OFE	CW009A	min.	99,99	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		max.	—	0,002 5	0,000 5	0,000 20	0,000 1	0,001 0	0,000 5	0,001 0	--[a]	0,000 3	0,000 5	0,001 5	0,000 4	0,000 20	0,000 2	0,000 20	0,000 1
Cu-PHCE	CW022A	min.	99,99	—	—	—	—	—	—	—	—	0,001	—	—	—	—	—	—	—
		max.	—	0,002 5	0,000 5	0,000 20	0,000 1	0,001 0	0,000 5	0,001 0	--[a]	0,006	0,000 5	0,001 5	0,000 4	0,000 20	0,000 2	0,000 20	0,000 1

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

Table 2 — Electrical properties (at 20 °C)

Designations		Material condition	Volume resistivity $\frac{\Omega \times mm^2}{m}$	Mass resistivity[a] $\frac{\Omega \times g}{m^2}$	Conductivity	
Material					MS/m	% IACS[b]
Symbol	Number		max.	max.	min.	min.
Cu-OFE	CW009A	annealed	0,017 07	0,151 7	58,6	101,0
Cu-PHCE	CW022A		0,017 24	0,153 3	58,0	100,0
Cu-OFE	CW009A	other than annealed	to be agreed between the purchaser and the supplier			
Cu-PHCE	CW022A					

NOTE 1 The % IACS values are calculated as percentages of the standard value for annealed high conductivity copper as laid down by the International Electrotechnical Commission. Copper having a volume resistivity of 0,017 24 $\mu\Omega \times m$ at 20 °C, is defined as corresponding to a conductivity of 100 %.

NOTE 2 1 MS/m is equivalent to 1 $m/(\Omega \times mm^2)$.

[a] Calculated with a density of copper 8,89 g/cm^3.

[b] IACS: International Annealed Copper Standard.

Annex A
(normative)

Reference chart for microscopic examination at magnification 100×

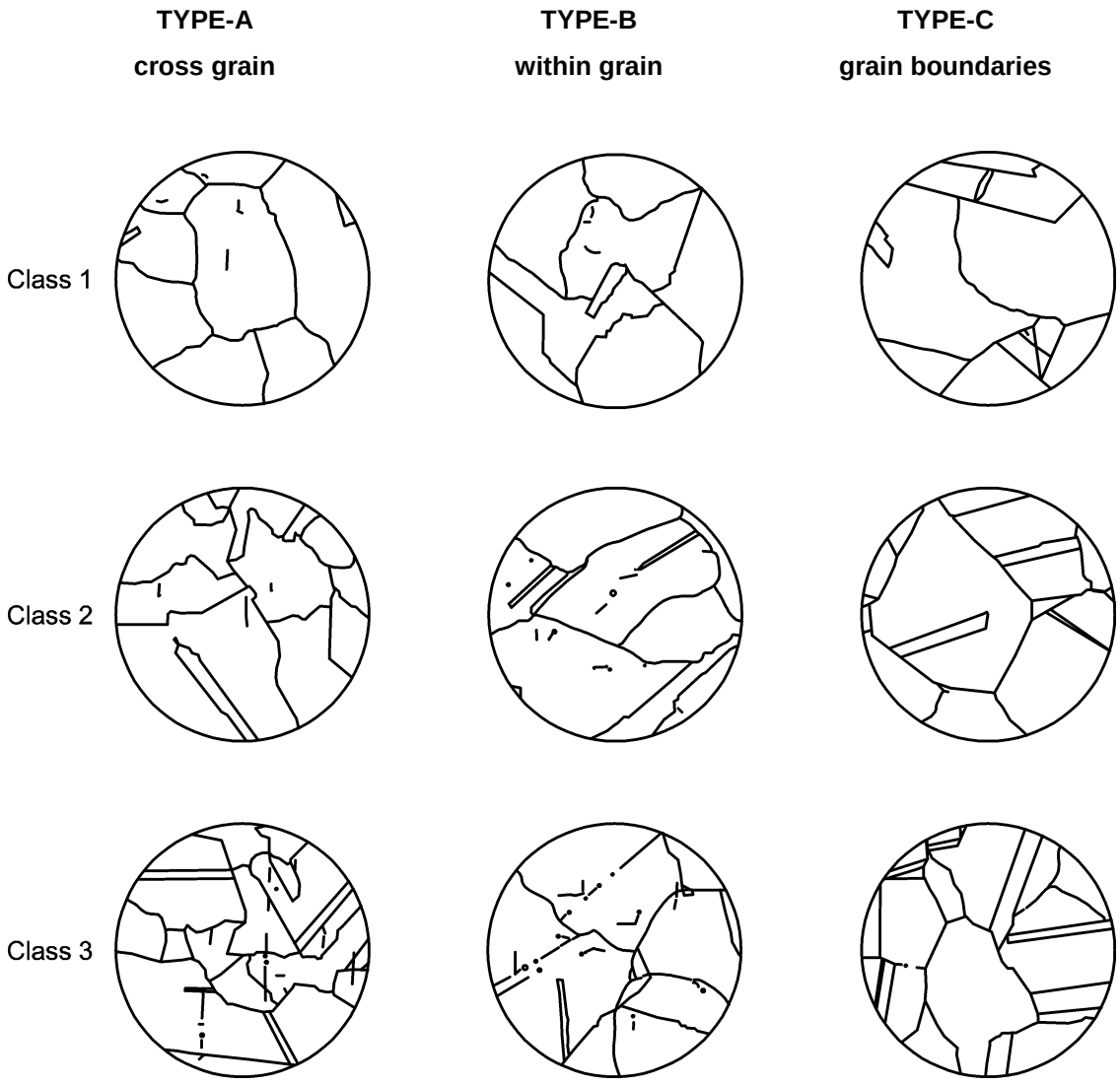

Figure A.1 — Reference chart for microscopic examination at magnification 100×

Annex B
(informative)

Characteristics of coppers for electrical purposes

B.1 General grouping of copper types

The characteristic properties of coppers depend to a considerable extent on the presence or absence of certain elements, in particular oxygen, phosphorus and silver.

The various grades of copper fall into four types:

— tough pitch coppers (i.e. oxygen-containing coppers);

— oxygen-free coppers;

— deoxidised coppers;

— silver-bearing coppers.

NOTE The classification of copper as "unrefined copper" or "refined copper", as well as specific terms and definitions for the subdivisions of these classes, are given in ISO 197-1.

B.2 General characteristics

In general, all coppers have excellent formability and solderability. Electrical conductivity and weldability both vary, depending on the purity of the copper grade.

B.3 Particular characteristics

Table B.1 describes the particular characteristics of coppers for electrical purposes. The table also indicates the material designation, i.e. symbols and numbers of the grades of copper corresponding to each type.

NOTE This standard does not necessarily specify all the grades of copper given in Table B.1.

Table B.1 — Particular characteristics of coppers for electrical purposes

Copper type	Characteristics	Material designation	
		Symbol	Number
Tough pitch coppers (oxygen-containing coppers)	Coppers of this type are produced with a controlled amount of oxygen and have high electrical conductivity. Special precautions are necessary when heat-treating, welding or brazing these coppers in atmospheres containing hydrogen to avoid hydrogen embrittlement.	Cu-ETP1 Cu-ETP Cu-FRHC	CW003A CW004A CW005A
Oxygen-free coppers	Coppers of this type are produced in an oxygen-free environment without the use of deoxidisers and have high electrical conductivity. These coppers may be heat-treated, welded or brazed without the need for special precautions to avoid hydrogen embrittlement.	Cu-OF1 Cu-OF Cu-OFE	CW007A CW008A CW009A
Deoxidised coppers	Coppers of this type are produced with the addition of a controlled amount of deoxidiser, preferably phosphorus, and contain a controlled low amount of residual deoxidiser; these coppers have high electrical conductivity. These coppers may be heat treated, welded or brazed without the need for special precautions to avoid hydrogen embrittlement.	Cu-PHC Cu-HCP Cu-PHCE	CW020A CW021A CW022A
Silver bearing coppers	Tough pitch, oxygen-free and deoxidised coppers can be produced with additions of silver, up to 0,12 % (mass fraction). The effect of the silver content is to increase the resistance of softening without significantly affecting the electrical conductivity.	CuAg0,04 CuAg0,07 CuAg0,10 CuAg0,04P CuAg0,07P CuAg0,10P CuAg0,04(OF) CuAg0,07(OF) CuAg0,10(OF)	CW011A CW012A CW013A CW014A CW015A CW016A CW017A CW018A CW019A

Bibliography

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

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

[3] EN 50149, *Railway applications — Fixed installations — Electric traction — Copper and copper alloy grooved contact wires*

[4] EN ISO 9001, *Quality management systems — Requirements (ISO 9001)*

[5] ISO 197-1, *Copper and copper alloys — Terms and definitions — Part 1: Materials*

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

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

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™