



# SLOVENSKI STANDARD

## SIST EN 13604:2004

01-januar-2004

---

**Baker in bakrove zlitine – Izdelki iz visoko prevodnega bakra za elektronske cevi, polprevodniške sklope in uporabo v vakuumu**

Copper and copper alloys - Products of high conductivity copper for electronic tubes, semiconductor devices and vacuum applications

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

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

<https://standards.iteh.ai/catalog/standards/sist/3a1cdea1-6070-4ffc-af55-4bdc63fff47/sist-en-13604-2004>

**Ta slovenski standard je istoveten z: EN 13604:2002**

---

**ICS:**

77.150.30      Bakreni izdelki      Copper products

**SIST EN 13604:2004**      en

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST EN 13604:2004](#)

<https://standards.iteh.ai/catalog/standards/sist/3a1cdea1-6070-4ffe-af55-4bdc63fff47/sist-en-13604-2004>

EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN 13604**

July 2002

ICS 77.150.30

English version

**Copper and copper alloys - Products of high conductivity copper  
for electronic tubes, semiconductor devices and vacuum  
applications**

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 14 March 2002.

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 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 Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.



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

**Management Centre: rue de Stassart, 36 B-1050 Brussels**

## Contents

	page		page
<b>Foreword</b> .....	3	8.3 Hardness test .....	10
<b>1 Scope</b> .....	4	8.4 Bend test .....	10
<b>2 Normative references</b> .....	4	8.5 Electrical test .....	10
<b>3 Terms and definitions</b> .....	5	8.6 Hydrogen embrittlement test .....	11
<b>4 Designations</b> .....	5	8.7 Scale adhesion test .....	11
4.1 Material .....	5	8.8 Estimation of average grain size .....	11
4.2 Material condition .....	5	8.9 Retests .....	11
4.3 Product .....	5	8.10 Rounding of results .....	11
<b>5 Ordering information</b> .....	6	<b>9 Declaration of conformity and inspection documentation</b> .....	11
<b>6 Requirements</b> .....	7	9.1 Declaration of conformity .....	11
6.1 Composition .....	7	9.2 Inspection documentation .....	12
6.2 Mechanical properties .....	7	<b>10 Marking, labelling, packaging</b> .....	12
6.3 Electrical properties .....	8	<b>Annex A (normative) Reference chart for microscopic examination at magnification 100x</b> .....	15
6.4 Freedom from hydrogen embrittlement .....	8	<b>Annex B (informative) Characteristics of coppers for electrical purposes</b> .....	16
6.5 Scale adhesion .....	8	<b>Bibliography</b> .....	18
6.6 Grain size .....	8	<b>Tables</b>	
6.7 Tolerances of dimensions and form .....	8	Table 1 — Composition of Cu-OFE and Cu-PHCE .....	13
6.8 Surface condition .....	9	Table 2 — Electrical properties (at 20 °C) ...	14
<b>7 Sampling</b> .....	9	Table B.1 — Particular characteristics of coppers for electrical purposes .....	17
7.1 General .....	9		
7.2 Analysis .....	9		
7.3 Mechanical, electrical and other tests .....	9		
<b>8 Test methods</b> .....	10		
8.1 Analysis .....	10		
8.2 Tensile test .....	10		

iTeH STANDARD PREVIEW  
(standards.iteh.ai)

SIST EN 13604:2004  
<https://standards.iteh.ai/catalog/standards/sist/3a1c10d1-6976-4b5c-8571-4bdc63f1147/sist-en-13604-2004>

## Foreword

This document EN 13604:2002 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 2003, and conflicting national standards shall be withdrawn at the latest by January 2003.

Within its programme of work, Technical Committee CEN/TC 133 requested CEN/TC 133/WG 5 "Copper for electrical purposes" to prepare the following standard:

EN 13604, *Copper and copper alloys — Products of high conductivity copper for electronic tubes, semiconductor 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 organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

**EN 13604:2002 (E)****1 Scope**

This European Standard specifies the composition, property requirements including electrical properties and tolerances on dimensions and form of two copper grades Cu-OFE (CW009A) and Cu-PHCE (CW022A), for electronic and semiconductor devices as well as for vacuum applications, 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 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**

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies (including amendments).

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

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

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

EN 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 2624:1990).*

EN ISO 2626, *Copper — Hydrogen embrittlement test (ISO 2626:1973).*

EN ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method (ISO 6506-1:1999).*

EN ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method (ISO 6507-1:1997).*

EN ISO 7438, *Metallic materials — Bend test (ISO 7438:1985).*

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.*

NOTE Informative references to documents used in the preparation of this standard, and cited at the appropriate places in the text, are listed in the bibliography.

### 3 Terms and definitions

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

## 4 Designations

### 4.1 Material

#### 4.1.1 General

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

#### 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

**iTeh STANDARD PREVIEW**  
(standards.iteh.ai)

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.

NOTE 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.

### 4.3 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.

**EN 13604:2002 (E)**

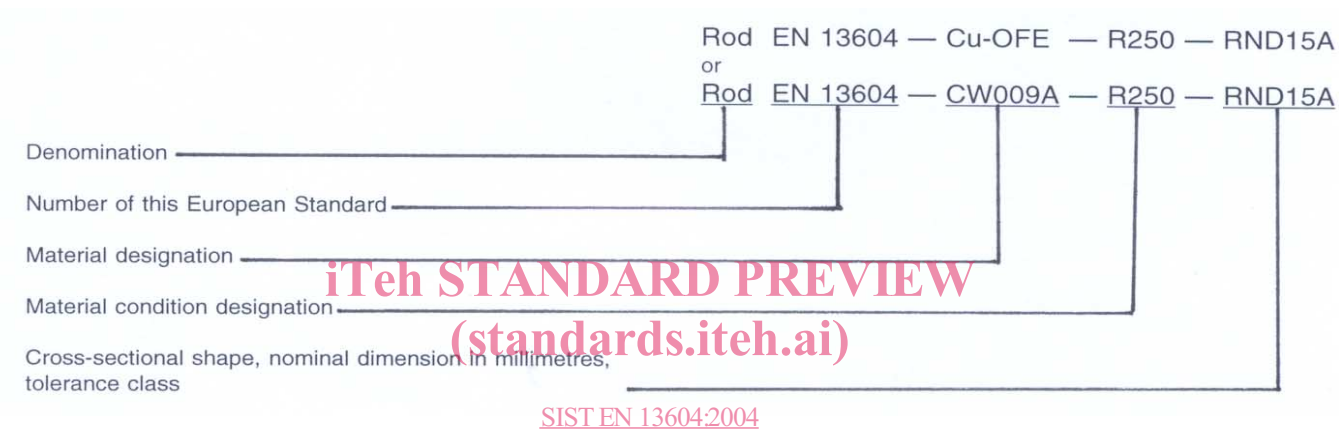
The product designation is no substitute for the full content of the standard.

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, shall be designated as follows:



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, shall 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:

<https://standards.iteh.ai/catalog/standards/sist/3a1cdea1-6070-4ffe-af55-46d009331147/sist-en-13604-2004>  
**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.

**EN 13604:2002 (E)**

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 Microscopic examination**

Microscopic examination of test piece 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.

STANDARD PREVIEW  
(standards.iteh.ai)

**6.4.2 Reverse bending**

SIST EN 13604:2004

<https://standards.iteh.ai/catalog/standards/sist/3a1cdea1-6070-4ffe-af55-46d003117788/sist-en-13604-2004>

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 5 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 5 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 5 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.

**iTeh STANDARD PREVIEW**  
(standards.iteh.ai)  
SIST EN 13604:2004  
<https://standards.iteh.ai/catalog/standards/sist/3a1cdea1-6070-4ffe-af55-4bdc63fff47/sist-en-13604-2004>

### 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.

NOTE 1 When preparing the test sample, care should be taken to avoid contaminating or overheating the test sample. Carbide tipped tools are recommended; steel tools, if used, should be made of magnetic material to assist in the subsequent removal of extraneous iron. If the test samples are in finely divided form (e.g. drillings, millings), they should be treated carefully with a strong magnet to remove any particles of iron introduced during preparation.

NOTE 2 In cases of dispute concerning the results of analysis, the full procedure given in ISO 1811-2 should be followed.

NOTE 3 Results may be used from analyses carried out at an earlier stage of manufacturing the product, e.g. at the casting stage, if the material identity is maintained and if the quality management system of the manufacturer is certified 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 5 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.