BS EN 12450:2012

BSI Standards Publication

Copper and copper alloys — Seamless, round copper capillary tubes

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National foreword

This British Standard is the UK implementation of EN 12450:2012. It supersedes BS EN 12450:1999 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee NFE/34/1, Wrought and unwrought 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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Compliance with a British Standard cannot confer immunity from legal obligations.

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Amendments issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12450

November 2012

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Supersedes EN 12450:1999

English Version

Copper and copper alloys - Seamless, round copper capillary tubes

Cuivre et alliages de cuivre - Tuyaux circulaires en cuivre, de faible diamètre, sans soudure

Kupfer und Kupferlegierungen - Nahtlose, runde Kapillarrohre aus Kupfer

This European Standard was approved by CEN on 6 October 2012.

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Foreword

This document (EN 12450:2012) 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of an identical text or by endorsement, at the latest by May 2013, and conflicting national standards shall be withdrawn at the latest by May 2013.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 12450:1999.

In comparison with EN 12450:1999, the following significant technical changes were made:

a) 6.6 "Surface quality", has been modified;

b) In 8.5 "Cleanliness test" the text regarding the determination of lubricant residue as described in EN 723 has been added.

This is one of a series of European Standards for copper and copper alloy tubes. Other products are, or will be, specified as follows:

— EN 1057, *Copper and copper alloys — Seamless, round copper tubes for water and gas in sanitary and heating applications*

— EN 12449, *Copper and copper alloys — Seamless, round tubes for general purposes*

— EN 12451, *Copper and copper alloys — Seamless, round tubes for heat exchangers*

— EN 12452, *Copper and copper alloys — Rolled, finned, seamless tubes for heat exchangers*

— EN 12735-1, *Copper and copper alloys — Seamless, round copper tubes for air conditioning and refrigeration — Part 1: Tubes for piping systems*

— EN 12735-2, *Copper and copper alloys — Seamless, round copper tubes for air conditioning and refrigeration — Part 2: Tubes for equipment*

— EN 13348, *Copper and copper alloys — Seamless, round copper tubes for medical gases or vacuum*

— EN 13349, *Copper and copper alloys — Pre-insulated copper tubes with solid covering*

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

Within its programme of work, Technical Committee CEN/TC 133 requested CEN/TC 133/WG 3 "Copper tubes (installation and industrial)" to revise the following standard:

— EN 12450:1999, *Copper and copper alloys — Seamless, round copper capillary tubes*.

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 and tolerances on dimensions and on form for seamless round copper capillary tubes for use as metering lines for liquids or gases where close controls over the smoothness and dimensions of the bore are required to ensure uniform flow characteristics.

This European Standard applies to capillary tubes in straight lengths, or in coils, in the size range up to and including 6,10 mm outside diameter and from 0,30 mm up to and including 4,45 mm inside diameter which are intended for restrictor applications.

The sampling procedures and 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 1057:2006, *Copper and copper alloys — Seamless, round copper tubes for water and gas in sanitary and heating applications*

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

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

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)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1057:2006 and the following apply.

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, 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, 3.6]

3.4
capillary tube
tube of small inside diameter with an inside surface of high quality and conforming to close diameter tolerances

Note 1 to entry: It is subject to special tests to ensure precision and uniformity of bore, having been specially cleaned.

4 Designations

4.1 Material

4.1.1 General

The material is designated either by symbol or number (see 6.1).

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

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:

R... Material condition designated by the minimum value of tensile strength requirement for the product with mandatory tensile strength and elongation requirements;

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

Exact conversion between the material conditions designated R... and H... 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.

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 (Tube);

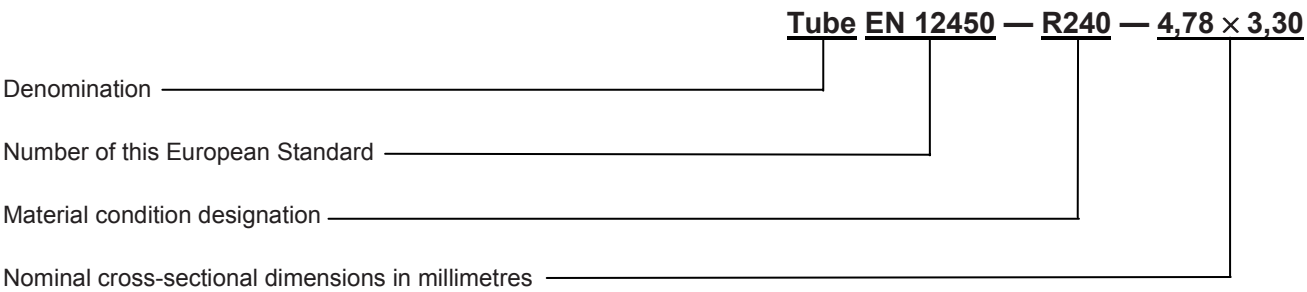
— number of this European Standard (EN 12450);

— material condition designation (see Table 1);

— nominal cross-sectional dimensions (outside diameter × inside diameter).

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

EXAMPLE Tube conforming to this standard, in material condition R240, nominal outside diameter 4,78 mm, nominal inside diameter 3,30 mm, shall be designated as follows:



5 Ordering information

In order to facilitate the enquiry, order and confirmation of order procedures between the purchaser and the supplier, the purchaser shall state on his enquiry and order the following information:

a) quantity of product required (length or mass);

b) denomination (Tube);

c) number of this European Standard (EN 12450);

d) material condition designation (see 4.2 and Table 1);

e) nominal cross-sectional dimensions (outside diameter × inside diameter);

f) for straight lengths, the length required;

g) for coils, the coil mass required;

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

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

h) whether flow requirements are to be met, and if so, the test details (see 6.5);

i) whether special internal surface quality is required (see 6.6);

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

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

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

EXAMPLE Ordering details for 1 000 m of tube conforming to EN 12450, in material condition R240, nominal outside diameter 4,78 mm, nominal inside diameter 3,30 mm, nominal length 3 000 mm.

1 000 m Tube EN 12450 – R240 – 4,78 × 3,30

– nominal length 3 000 mm

6 Requirements

6.1 Composition

The composition shall conform to the following requirements:

Cu + Ag: min. 99,90 %

0,015 % ≤ P ≤ 0,040 %

This copper is designated either Cu-DHP or CW024A.

6.2 Mechanical properties

The properties shall conform to the appropriate requirements given in Table 1. The tests shall be carried out in accordance with either 8.2 (tensile test) or 8.3 (hardness test).

Table 1 — Mechanical properties

Designations			Tensile strength		Elongation	Hardness	
			R_m		A	HV	
Material		Material condition	N/mm^2		%		
Symbol	Number		min.	max.	min.	min.	max.
Cu-DHP	CW024A	R240	240	—	15	—	—
		H050	—	—	—	50	90
		R320	320	—	5	—	—
		H095	—	—	—	95	125
		R395	395	515	—	—	—
		H110	—	—	—	110	—
NOTE 1 N/mm^2 is equivalent to 1 MPa.							

6.3 Dimensions and tolerances

6.3.1 General

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

The dimensional tolerances are applied on the outside diameter, inside diameter and length.

6.3.2 Outside diameter and inside diameter

The diameters of the tubes shall conform to the following tolerances:

— outside diameter;

— inside diameter.

The outside diameter of the tube including deviation from circular form for straight lengths, at any cross-section shall not vary from the specified value by more than ± 0,050 mm.

The mean inside diameter shall not vary from the specified value by more than ± 0,025 mm which shall be determined by the production flow test (see 8.4).

6.3.3 Length

Tubes ordered as straight lengths shall conform to the tolerances given in Table 2. The length of tube ordered in coiled form shall be agreed between the purchaser and the supplier on the basis of the coil mass.

Table 2 — Tolerances on tubes in straight lengths

Tolerances on length mm		
from 150 up to and including 500	over 500 up to and including 2 000	over 2 000 up to and including 6 000
+ 1,6 0	+ 2,0 0	+ 1 ‰, but not more than 5 mm

6.4 Tolerances on form

Tubes in straight lengths shall conform to the tolerances on diameter, including deviation from circular form, given in 6.3.2. Tubes in coiled form shall conform to the tolerances on diameter, including deviation from circular form, agreed between the purchaser and the supplier.

6.5 Flow

When specified by the purchaser [see 5 h)] and agreed by the supplier, the tubes shall conform to the requirements given in Table 3. The test shall be carried out in accordance with 8.4.

Table 3 — Tolerances on flow

Values in litres per minute

Flow		Tolerance on flow
over	up to and including	
—	5	± 0,3
5	9	± 0,4
9	14	± 0,6
14	20	± 0,8
20	—	by agreement

6.6 Surface quality

The external and internal surfaces of the tubes shall be clean and smooth.

When specified by the purchaser [see 5 i)] and agreed by the supplier, the internal surface of the tubes shall be capable of passing the carbon content test as described in 8.5.

When measured in accordance with 8.5, the lubricant residue on the internal surface of the tube shall not exceed 0,310 g/m^2.

NOTE 0,1 g/m^2 is equivalent to 1,0 mg/dm^2.

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.

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.

For the purpose of demonstrating maintained material identity it is recommended to certify the quality management system of the manufacturer e.g. as conforming to EN ISO 9001.

7.2 Analysis

The sampling rate shall be in accordance with Table 4. 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.

Table 4 — Sampling rate

Size of inspection lot	Number of lengths to be tested
maximum number of tubes 1 000 or minimum mass 50 kg	0,2 %

7.3 Mechanical tests

The sampling rate shall be in accordance with Table 4. 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.

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 test pieces obtained in accordance with 7.3.

8.3 Hardness test

Hardness shall be determined on the test pieces prepared from the test samples obtained in accordance with 7.3. The test shall be carried out in accordance with EN ISO 6507-1 and the indentation made on the outside surface, unless otherwise agreed.

8.4 Flow test

When required, the flow test shall be carried out in accordance with the methods and procedures agreed between the purchaser and the supplier [see 5 h)], which may be based upon current international practice.

The flow shall be determined using dry nitrogen at a temperature of (23^{+3}_{0}) °C either at an input pressure of (0,981 ± 0,005) N/mm^2 under free flowing conditions or at another pressure which shall be agreed between the purchaser and the supplier.

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

8.5 Cleanliness test

When required, a determined quantity of a suitable solvent for oil and grease, shall be pulled through the tube into a flask, attached to an aspirator or vacuum pump, and transferred to a weighed container (crucible, evaporating dish, or beaker) for evaporation up to dryness on a low temperature hotplate or steam bath. Overheating of the container shall be avoided to prevent charring of the residue. When dry, the container shall be placed in an oven at 100 °C to 110 °C for 10 min and then transferred to a desiccator to cool before weighing.

A blank determination on the determined quantity of solvent shall be carried out and the gain in weight for the blank subtracted from the weightings of residue sample. The corrected weight to grams of residue per square metre of internal surface shall be calculated. The quantity of solvent used may vary with the size of tube being examined. A minimum of 30 ml for all sizes shall be used. The quantity of solvent used for the blank run, shall be the same as used for the actual examination of the tube sample.

For routine controls in the course of quality assurance procedures, the determination of lubricant residue as total carbon content can be carried out on the test samples obtained in accordance with Clause 7 applying the reference method described in EN 723.

8.6 Retests

If there is a failure of one, or more than one, of the tests in 8.1 to 8.5, 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 standard. If a test piece fails a test, the inspection lot represented 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 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 standard, except that for tensile 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 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 5 j)] 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 5 k)] 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 5 l)].

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

Bibliography

[1] EN 723, *Copper and copper alloys — Combustion method for determination of the carbon content on the inner surface of copper tubes or fittings*

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

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

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

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

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

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

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