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European standard

NF EN 12735-1

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French standard

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Copper and copper alloys

Seamless, round copper tubes for air conditioning and refrigeration

Part 1: Tubes for piping systems

F : Cuivre et alliages de cuivre — Tubes ronds sans soudure en cuivre pour l'air conditionné et la réfrigération — Partie 1 : Tubes pour canalisations

D : Kupfer und Kupferlegierungen — Nahtlose Rundrohre aus Kupfer für die Kälte- und Klimatechnik — Teil 1: Rohre für Leitungssysteme

French standard approved

by decision of the Director General of AFNOR on March 16, 2011 taking effect on April 16, 2011.

Replaces the approved standard NF EN 12735-1 of October 2001 and its amendment A1 of July 2005.

Correspondence

The European standard EN 12735-1:2010 has the status of French standard.

Analysis

This document specifies the requirements, sampling, test methods and conditions of delivery for seamless round copper tubes used for refrigeration and air-conditioning piping systems.

Descriptors

Technical International Thesaurus: non ferrous semi-finished products, copper tubes, refrigerating, definitions, designation, specifications, chemical composition, dimensions, dimensional tolerances, surface condition, sampling, tests, tension tests, hardness tests, drift expanding tests, defects, Eddy current tests, packing, marking, delivery condition.

Modifications

With respect to the replaced document, revision of the standard.

Corrections



EUROPEAN STANDARD

EN 12735-1

NORME EUROPÉENNE

EUROPÄISCHE NORM

July 2010

ICS 23.040.15

Supersedes EN 12735-1:2001

English Version

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

Cuivre et alliages de cuivre - Tubes ronds sans soudure en
cuivre pour l'air conditionné et la réfrigération - Partie 1:
Tubes pour canalisations

Kupfer und Kupferlegierungen - Nahtlose Rundrohre aus
Kupfer für die Kälte- und Klimatechnik - Teil 1: Rohre für
Leitungssysteme

This European Standard was approved by CEN on 12 June 2010.

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 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 Management Centre has the same status as the official versions.

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COMITÉ EUROPÉEN DE NORMALISATION
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EN 12735-1:2010 (E)

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Foreword

This document (EN 12735-1:2010) 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 2011, and conflicting national standards shall be withdrawn at the latest by January 2011.

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 12735-1:2001.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 97/23/EC Pressure Equipment Directive (PED).

For relationship with EU Directive 97/23/EC, see informative Annex ZA, which is an integral part of this document.

Within its programme of work, Technical Committee CEN/TC 133 requested CEN/TC 133/WG 3 "Copper tubes (installation and industrial)" to revise EN 12735-1:2001.

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

In comparison with the first edition of EN 12735-1:2001 the following significant technical changes were made:

- a) The size range has been increased (108 mm to 133 mm);
- b) EN 10002-1 replaced by EN ISO 6892-1;
- c) EN 10232 replaced by EN ISO 8491;
- d) EN 10234 replaced by EN ISO 8493.

This European Standard "*Copper and copper alloys — Seamless, round copper tubes for air conditioning and refrigeration*" consists of two parts:

- *Part 1: Tubes for piping systems;*
- *Part 2: Tubes for equipment.*

This is one of a series of European Standards for copper and copper alloy tubes. Other products are 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 12450, *Copper and copper alloys — Seamless, round copper capillary tubes*

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- 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 12735-2, *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*

According to the CEN/CENELEC Internal Regulations, the national standards organizations 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, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

It is recommended that tubes manufactured to this European Standard are certified as conforming to the requirements of this standard based on continuing surveillance which should be coupled with an assessment of a supplier's quality management system against EN ISO 9001.

NOTE Appropriate precautions should be taken if applying insulating material because it could be detrimental to the copper tube.

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1 Scope

This European Standard specifies the requirements, sampling, test methods and conditions of delivery for seamless round copper tubes used for refrigeration and air-conditioning piping systems (i.e. piping, connections, repairs).

It is applicable to tubes with an outside diameter from 3 mm up to and including 133 mm.

These tubes are supplied in straight lengths in the material conditions hard or half-hard, or in coils in the annealed material condition.

2 Normative references

The following referenced documents are indispensable for the application 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 723, *Copper and copper alloys — Combustion method for determination of the carbon content on the inner surface of copper tubes or fittings*

EN 1173:2008, *Copper and copper alloys — Material condition designation*

EN 1655:1997, *Copper and copper alloys — Declarations of conformity*

EN 1971, *Copper and copper alloys — Eddy current test for tubes*

EN 10204:2004, *Metallic products — Types of inspection documents*

EN ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method (ISO 6507-1:2005)*

EN ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature (ISO 6892-1:2009)*

EN ISO 8493, *Metallic materials — Tube — Drift-expanding test (ISO 8493:1998)*

ISO 1553, *Unalloyed copper containing not less than 99,90 % of copper — Determination of copper content — Electrolytic method*

ISO 4741, *Copper and copper alloys — Determination of phosphorus content — Molybdovanadate spectrometric method*

3 Terms and definitions

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

3.1

seamless round copper tube

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

[EN 1057:2006, definition 3.1]

3.2

coil

winding in which the turns either are arranged into layers parallel to its axis such that successive turns in a given layer are next to one another (LWC – Level Wound Coil) or are spirally arranged (SWC – Spiral Wound Coil)

3.3

mean diameter

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

[EN 1057:2006, definition 3.5]

3.4

deviation from circular form

difference between the maximum and minimum outside diameters measured at any one cross-section of the tube

[EN 1057:2006, definition 3.6]

3.5

deviation from concentricity

half of the difference between the maximum and minimum wall thicknesses at the same cross-section of the tube

[EN 1057:2006, definition 3.7]

3.6

production batch

definite quantity of products of the same form, the same material condition and the same cross-sectional dimensions manufactured during the same production sequence under uniform conditions

[EN 1057:2006, definition 3.8]

3.7

permanently marked

marked in such a way that the marking will remain readable up to the end of the life on the installation

EXAMPLE stamping, etching or engraving

[EN 1057:2006, definition 3.9]

3.8

durably marked

marked in such a way that the marking will remain readable up to the time of commissioning of the installation

EXAMPLE ink marking

[EN 1057:2006, definition 3.10]

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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.

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 European Standard, the following designation, which is in accordance with the system given in EN 1173, applies for the material condition (see Table 1):

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

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.

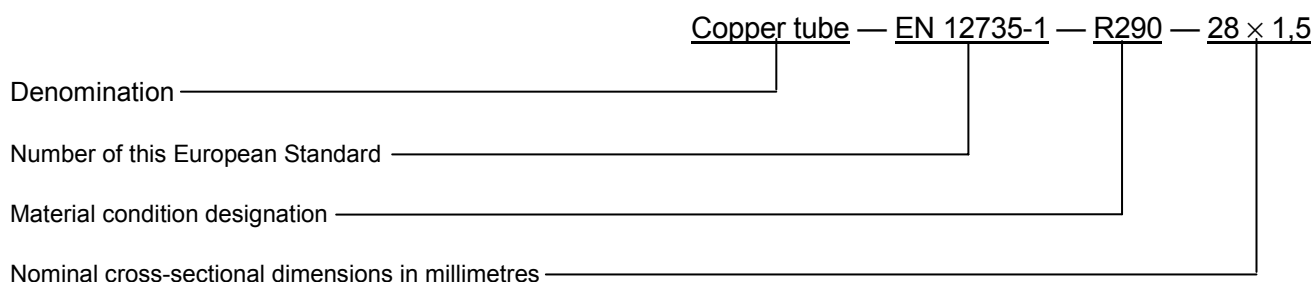
The product designation is no substitute for the full content of the standard.

The product designation for products to this European Standard shall consist of:

- denomination (Copper tube);
- number of this European Standard (EN 12735-1);
- material condition designation (see Table 1);
- nominal cross-sectional dimensions in millimetres: outside diameter \times wall thickness (see Table 2).

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

EXAMPLE Copper tube conforming to this European Standard, in material condition R290 (hard), nominal outside diameter 28 mm, nominal wall thickness 1,5 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, mass);
- b) denomination (Copper tube);
- c) reference to this European Standard (EN 12735-1);
- d) material condition designation (see 4.2 and Table 1);
- e) nominal cross-sectional dimensions: outside diameter \times wall thickness (see Table 2);
- f) nominal length (see 10.2);
- g) form of delivery (see 10.3).

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

- h) whether a declaration of conformity is required (see 9.1);
- i) whether an inspection document is required, and if so, which type (see 9.2).

NOTE 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 special requirements, if required.

EXAMPLE 1 Ordering details for 500 m copper tube conforming to EN 12735-1, in material condition R290 (hard), nominal outside diameter 28 mm, nominal wall thickness 1,5 mm, nominal length 5 m, straight lengths:

**500 m Copper tube EN 12735-1 — R290 — 28 \times 1,5
— 5 m straight lengths**

EXAMPLE 2 Ordering details for 5 tonnes copper tube conforming to EN 12735-1, in material condition R220 (annealed), nominal outside diameter 12 mm, nominal wall thickness 1,0 mm, nominal length 25 m, in coils:

**5 tonnes Copper tube EN 12735-1 — R220 — 12 \times 1,0
— 25 m coils**

6 Requirements

6.1 Composition

The composition shall conform to the following requirements:

Cu + Ag: min. 99,90 %;
 $0,015 \% \leq P \leq 0,040 \%$.

This copper grade is designated either Cu-DHP or CW024A.

6.2 Mechanical properties

The tensile strength and elongation shall conform to the requirements given in Table 1. The test shall be carried out in accordance with 8.2.

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Table 1 — Mechanical properties

Material condition		Tensile strength	Elongation	Hardness (indicative)
designation in accordance with EN 1173:2008	common term	R_m MPa	A %	HV 5
		min.	min.	
R220	annealed	220	40	(40 to 70)
R250 ^a	half-hard	250	30	(75 to 100)
R290 ^a	hard	290	3	(min. 100)
NOTE 1 Hardness figures in parentheses are only requirements of this European Standard when they are agreed between purchaser and supplier, otherwise they are given for guidance purposes only.				
NOTE 2 1 MPa is equivalent to 1 N/mm ² .				
^a Straight lengths only.				

6.3 Dimensions and tolerances

6.3.1 General

The geometrical properties of the tubes are defined by outside diameter, wall thickness and length. The outside diameter and wall thickness shall conform to the requirements given in Table 2, Table 3 and Table 4.

In cases of dispute, the dimensions shall be measured at a temperature of $(23 \pm 5) ^\circ\text{C}$.

6.3.2 Nominal dimensions

The standardized nominal outside diameters and nominal wall thicknesses are given in Table 2. The recommended nominal lengths are given in 10.3.

Other dimensions can be supplied upon agreement between the purchaser and the supplier.

NOTE For reference purposes, if DN designation of size for components of a piping system is required, it can be calculated for tubes to this European Standard by:

$$\text{DN} = d - 2e \quad (1)$$

where

d is the nominal outside diameter in millimetres (mm);

e is the nominal wall thickness in millimetres (mm).

DN is a numerical designation of size, which is common to all components in a piping system. It is a convenient round number for reference purposes and is only loosely related to the manufacturing dimensions (see EN ISO 6708).

Table 2 — Nominal outside diameters and wall thicknesses

Nominal outside diameter <i>d</i>			Nominal wall thickness <i>e</i> mm							
metric series mm	imperial series		0,8	1,0	1,25	1,5	1,65	2,0	2,5	3,0
	3,17	1/8	•							
	3,97	5/32	•	•						
	4,76	3/16	•							
6			■ •	•						
	6,35	1/4	•	•						
	7,94	5/16	•	•						
8			■ •	•						
	9,52	3/8	•	•						
10			■ •	■ •						
12				■ •						
	12,7	1/2	•	■ •						
15				■ •						
	15,87	5/8		■ •						
18				■ •						
	19,05	3/4		•	■					
22				■ •						
	22,22	7/8		•	■					
	25,4	1		■						
28						■				
	28,57	1 1/8		■	■					
	34,92	1 3/8			■					
35						■				
	41,27	1 5/8			■					
42						■				
	53,97	2 1/8			■		■			
54								■		
64								■		
	66,67	2 5/8			■		■	■		
76,1								■		
	79,37	3 1/8					■		■	
	88,90	3 1/2						■		
	92,07	3 5/8					■		■	
	104,77	4 1/8					■		■	
108									■	
133										■

NOTE This table is a first step towards a standard including only metric values.

■ Available in straight lengths

• Available in coils

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6.3.3 Tolerances on outside diameter

The outside diameter shall conform to the tolerances given in Table 3.

Table 3 — Tolerances on outside diameter

Values in millimetres

Nominal outside diameter <i>d</i>		Tolerances on nominal diameter		
		applicable to mean diameter	applicable to any diameter ^a	
over	up to and including	all material conditions	R290 (hard) material condition	R250 (half-hard) material condition
3 ^b	18	± 0,04	± 0,04	± 0,09
18	28	± 0,05	± 0,06	± 0,10
28	54	± 0,06	± 0,07	± 0,11
54	76,1	± 0,07	± 0,10	± 0,15
76,1	88,9	± 0,07	± 0,15	± 0,20
88,9	108	± 0,07	± 0,20	± 0,30
108	133	± 0,20	± 0,70	-
^a Including deviation from circular form.				
^b Including 3.				

6.3.4 Tolerances on wall thickness

The tolerance on wall thickness, expressed in percentage of the nominal thickness, as measured at any point shall conform to the requirements given in Table 4.

Table 4 — Tolerances on wall thickness

Nominal outside diameter <i>d</i> mm	Tolerances on wall thickness <i>e</i> ^a	
	<i>e</i> < 1 mm %	<i>e</i> ≥ 1 mm %
< 18	± 10	± 13
≥ 18	± 10	± 15 ^b
NOTE Concentricity (uniformity of wall thickness) is controlled by tolerance on wall thickness.		
^a Including deviation from concentricity.		
^b ±10 % for R250 (half hard) tubes of 35 mm, 42 mm and 54 mm diameter, with a wall thickness of 1,2 mm.		

6.3.5 Tolerances on length

The lengths shall be equal to or greater than those ordered.

6.3.6 Tolerances of form

6.3.6.1 Deviation from circular form

Deviation from circular form for R290 (hard) and R250 (half-hard) material condition tubes is included in the tolerances on the outside diameter given in Table 3.

Unless otherwise agreed between the purchaser and the supplier, no tolerances on deviation from circular form are applicable to R220 (annealed) material condition tubes except coiled tubes with diameters up to and including 16 mm. In this case, the maximum deviation from circular form shall be 7 % of the outside diameter.

6.3.6.2 Deviation from concentricity

The deviation from concentricity is included in the wall thickness tolerance given in Table 4.

6.3.6.3 Straightness

For tubes supplied in R290 (hard) material condition in straight lengths, a straightness tolerance may be agreed between the purchaser and the supplier.

6.4 Drift expanding

No crack, break or tearing of the metal shall be visible to the unaided eye, corrected for normal vision, if necessary, when tubes with a nominal outside diameter ≤ 18 mm in the R220 (annealed) and R250 (half-hard) material conditions are tested in accordance with 8.4.

6.5 Freedom from defects

The tubes shall be free from defects that could be detrimental to their use. Each tube shall be subjected to the eddy current test described in 8.6.

6.6 Surface quality

The outer and inner surfaces of the tubes shall be clean and smooth.

The inner 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 inner surface of the tube shall not exceed $0,38 \text{ mg/dm}^2$.

7 Sampling

For the purposes of demonstrating conformity to the dimensional requirements the sampling rate to be taken random shall be at least one sampling unit for each 3 000 kg or for each production batch whichever is the smaller.

Results may be used from analyses carried out at an earlier stage of manufacturing the product, e.g. at the casting or billets inward stage, if product identity is maintained and if the manufacturer has established and maintains a quality management system which should be at least equivalent to EN ISO 9001.

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8 Test methods

8.1 Analysis

For composition, analysis shall be carried out on the test samples obtained in accordance with Clause 7. The analytical methods used shall be chemical or spectrographic in accordance with appropriate European or International standards.

In cases of dispute the reference method shall be by chemical analysis according to ISO 1553 and ISO 4741.

8.2 Tensile test

The tensile test shall be carried out in accordance with the method given in EN ISO 6892-1 on test pieces prepared from the test samples obtained in accordance with Clause 7.

8.3 Hardness test

When required and after agreement between the purchaser and the supplier, the Vickers hardness test shall be carried out in accordance with EN ISO 6507-1.

8.4 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°.

8.5 Carbon content test

The determination of lubricant residue as total carbon content shall be carried out on the test samples obtained in accordance with Clause 7 applying the reference method described in EN 723.

NOTE For routine controls in the course of quality assurance procedures, other methods may be used as an alternative.

8.6 Freedom from defect test

Each tube shall be subjected to an eddy current test for detection of local defects, in accordance with EN 1971.

Maximum drill diameters for the production of the reference standard tube which is specified in EN 1971 are given in Table 5.

Table 5 — Maximum drill diameters for reference standard tube

Dimensions in millimetres

Nominal outside diameter <i>d</i>		Drill diameter
over	up to and including	max.
3 ^a	26	0,8
26	42	1,2
42	133	2,0
^a Including 3.		

Signals produced by reference standard tubes set the sorting limits for acceptance or rejection. Tubes containing defects which produce signals equal to or greater than the sorting limit shall be rejected.

8.7 Retests

In the event that the tube sample fails to meet the test requirements the batch represented by the tube sample or, in the case of continuous production all tubes manufactured since the previous check, shall be placed in a bond.

Further samples shall be taken from the bonded tubes at a sampling rate four times more frequent than specified in Clause 7. If any of the retest samples fail to meet the specification requirements the tubes represented by the samples shall be deemed not to meet the requirements of this European Standard and shall be rejected. If all the retest samples meet the requirements, the tubes represented by the samples shall be deemed to meet the requirements of this European Standard.

9 Declaration of conformity and inspection documentation

9.1 Declaration of conformity

When requested by the purchaser [see Clause 5, item h)] 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, item i)] and agreed with the supplier, the supplier shall issue for the products the appropriate inspection document in accordance with EN 10204:2004.

NOTE When ordering material for pressure equipment applications, the equipment manufacturer has the obligation to request appropriate inspection documentation in accordance with EN 10204:2004, Annex ZA.

10 Packaging, marking and form of delivery

10.1 Packaging and marking

Each tube shall be capped, plugged or otherwise closed at both ends so as to maintain the internal cleanliness of the tube under normal conditions of handling and storage.

NOTE Plug design should be such to prevent the plug from being forced into the tube bore beyond its depth.

The tubes shall be packaged in such a way that they are effectively protected in normal transport and handling conditions.

The tubes shall be packaged in uniform batches, i.e. of the same dimensions and material condition, and each package shall indicate at least the following information in a legible and indelible manner:

- reference to this European Standard (EN 12735-1);
- nominal cross-sectional dimensions in millimetres: outside diameter \times wall thickness;
- quantity;
- material condition;
- manufacturer's identification mark.

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10.2 Marking of tubes

Durable marking:

- reference to this European Standard (EN 12735-1);
- nominal cross-sectional dimensions in millimetres: outside diameter x wall thickness;
- identification for R250 (half hard) material condition by the following symbol: |—|—|;
- manufacturer's identification;
- date of production: year and quarter (I to IV) or year and month (1 to 12).

The marking shall not be detrimental to the use of the tube.

Durable marking shall be "capable of" passing the test defined in Annex A.

NOTE No sampling frequency for the marking durability test is given; the concept of "capable of" in this context means that the manufacturer has to satisfy himself, by a suitable frequency of in-house testing, that all such markings would satisfy the requirements of the durability test if they were subjected to it. As a minimum, initial type tests should be carried out on first off samples selected from each new combination of marking materials and methods. Tests should be repeated if material formulation of source of supply changes.

10.3 Form of delivery

Coiled tubes are usually supplied in 25 m or 50 m lengths.

Straight tubes are usually supplied in 3 m, 5 m or 6 m lengths.

Annex A (normative)

Marking durability test

A.1 Abrasion test

A specimen of marked tube, having a length of more than 600 mm shall be rubbed five times in one direction, longitudinally, with a cotton cloth under strong manual pressure.

Afterwards, the marking shall remain legible.

A.2 Climatic test

Specimens of ink-marked tube, 200 mm long, shall be placed vertically in a climatic drying cabinet.

After exposure to a temperature of $(80 \pm 3) ^\circ\text{C}$ and 100 % atmospheric humidity for 24 h and after having been rubbed five times in one direction, longitudinally, with a cotton cloth under strong manual pressure, the marking shall remain legible.

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Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Pressure Equipment Directive (PED) 97/23/EC

This European Standard has been prepared under a Mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 97/23/EC.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

For this harmonized supporting standard for materials, presumption of conformity to the Essential Requirements of the Directive is limited to technical data of the material in the standard and does not presume adequacy of the material to specific equipment. Consequently, the technical data stated in the material standard should be assessed against the design requirements of the specific equipment to verify that the Essential Requirements of the Pressure Equipment Directive (PED) are satisfied.

Table ZA.1 — Correspondence between this European Standard and Directive 97/23/EC

Clause(s)/ sub clause(s) of this EN	Subject	Qualifying remarks/Notes
6.2	Material properties	Annex I 4.1(a) of the Directive
9.2	Conformity of product and manufacturer's certified documentation	Annex I 4.3 of the Directive

NOTE Brittle fracture prevention: Copper, having a face-centred cubic crystal structure, does not suffer a transition from ductile to brittle failure like some other materials.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

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

EN ISO 6708, *Pipework components — Definition and selection of DN (nominal size) (ISO 6708:1995)*

EN ISO 9001, *Quality management systems — Requirements (ISO 9001:2008)*

ISO 857-2, *Welding and allied processes — Vocabulary — Part 2: Soldering and brazing processes and related terms*

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