

# NF A51-126-2, NF EN 12735-2

Mai 2011

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# European standard

**NF EN 12735-2**

**May 2011**

## French standard

Classification index: **A 51-126-2**

**ICS: 23.040.15; 27.200; 77.150.30; 91.140.30**

Copper and copper alloys

## Seamless, round copper tubes for air conditioning and refrigeration

### Part 2: Tubes for equipment

F : Cuivre et alliages de cuivre — Tubes ronds sans soudure en cuivre  
pour l'air conditionné et la réfrigération — Partie 2 : Tubes pour le matériel  
D : Kupfer und Kupferlegierungen — Nahtlose Rundrohre aus Kupfer  
für die Kälte- und Klimatechnik — Teil 2: Rohre für Apparate

### **French standard approved**

by decision of the Director General of AFNOR on April 13, 2011 taking effect  
on May 13, 2011.

Replaces the approved standard NF EN 12735-2 of October 2001 and its amendment  
A1 of August 2005.

### **Correspondence**

The European standard EN 12735-2:2010 has the status of French standard.

### **Analysis**

This document specifies the requirements, sampling, test methods and conditions of  
delivery for seamless round copper tubes, smooth or inner finned, used for heat  
exchangers and their internal connecting pipes in the manufacturing of refrigeration  
and air conditioning equipment.

### **Descriptors**

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

### **Modifications**

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

### **Corrections**





EUROPEAN STANDARD

**EN 12735-2**

NORME EUROPÉENNE

EUROPÄISCHE NORM

July 2010

ICS 23.040.15

Supersedes EN 12735-2:2001

English Version

## Copper and copper alloys - Seamless, round copper tubes for air conditioning and refrigeration - Part 2: Tubes for equipment

Cuivre et alliages de cuivre - Tubes ronds sans soudure en cuivre pour l'air conditionné et la réfrigération - Partie 2: Tubes pour le matériel

Kupfer und Kupferlegierungen - Nahtlose Rundrohre aus Kupfer für die Kälte- und Klimatechnik - Teil 2: Rohre für Apparate

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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## EN 12735-2:2010 (E)

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## EN 12735-2:2010 (E)

### Foreword

This document (EN 12735-2:2010) 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 12735-2:2001.

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 12735-2:2001.

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

In comparison with the first edition of EN 12735-2:2001, the following significant technical changes were made:

- a) the size range of the outer diameter for smooth tubes has been increased from (7 to up to and including 64) mm to (6 to up to and including 133) mm;
- b) wall thickness, addition of two thicknesses (2,50 and 3,00) mm;
- c) the term "temper" replaced by "material condition" (only in the English wording);
- d) the material conditions R250 and R290 have been additionally incorporated;
- e) EN 10002-1 replaced by EN ISO 6892-1;
- f) EN 10234 has been 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*
- 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 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.



## **EN 12735-2:2010 (E)**

### **Introduction**

It is recommended that tubes manufactured to this 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.

## 1 Scope

This European Standard specifies the requirements, sampling, test methods and conditions of delivery for seamless round copper tubes, smooth or inner finned, used for heat exchangers and their internal connecting pipes in the manufacturing of refrigeration and air conditioning equipment.

It is applicable to tubes with an outside diameter from 6 mm up to and including 133 mm.

The tubes are supplied in straight length in the material conditions hard, half-hard or skin hard or as coils in the material conditions light annealed or soft annealed.

## 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, *Metallic products — Types of inspection documents*

EN ISO 2624, *Copper and copper alloys — Estimation of average grain size (ISO 2624:1990)*

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*

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### 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]

### 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.

Y... Material condition designated by the minimum value of 0,2 % proof strength requirement for the product with mandatory 0,2 % proof strength, tensile strength, elongation and grain size 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.

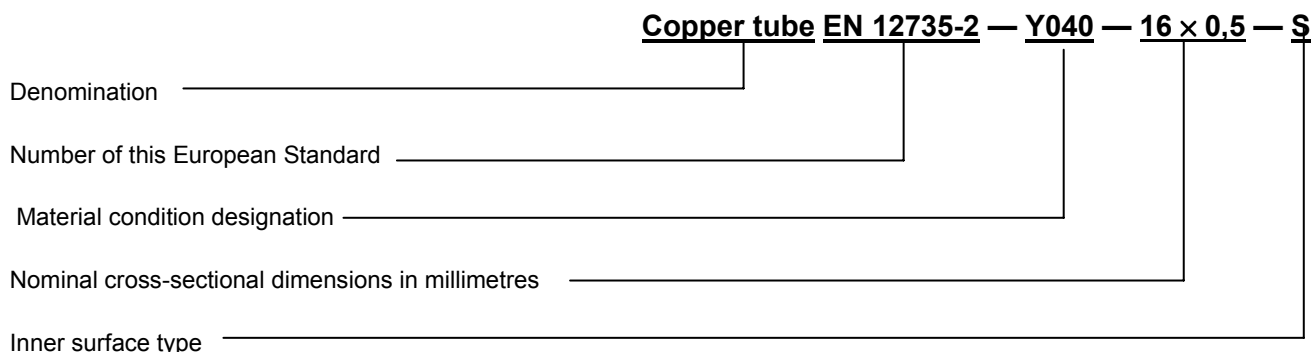
The product designation is no substitute for the full content of the standard.

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

- denomination (Copper tube);
- number of this European Standard (EN 12735-2);
- material condition designation (see Table 1);
- nominal cross-sectional dimensions in millimetres: outside diameter x wall thickness (see Tables 2 and 7);
- inner surface type (the following designations shall be used as appropriate: S for smooth, F for finned).

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

EXAMPLE Copper tube conforming to this European Standard, in material condition Y040 (light annealed), nominal outside diameter 16 mm, nominal wall thickness 0,5 mm, smooth inner surface (S), shall be designated as follows:



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### 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 12735-2);
- d) material condition designation (see 4.2 and Table 1);
- e) nominal cross-sectional dimensions,
  - for smooth tubes: outside diameter x wall thickness (see Table 2);
  - for inner finned tubes: outside diameter (see Table 7) × wall thickness at fin root and fin height, which shall be agreed between the purchaser and the supplier together with any other fin parameters agreed as necessary.
- f) inner surface type (smooth or finned);
- g) form of delivery, straight lengths, coil (LWC or SWC) (see 10.2).

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

- h) whether an other form of delivery than g) is required;
- i) whether a declaration of conformity is required (see 9.1);
- j) 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 f).

In addition, the purchaser shall also state on the enquiry and order any special requirements, if required.

EXAMPLE 1 Ordering details for 300 m copper tube conforming to EN 12735-2, in material condition Y040 (light annealed), nominal outside diameter 16 mm, nominal wall thickness 0,5 mm, smooth inner surface (S), nominal length 3 m, straight lengths:

**300 m Copper tube EN 12735-2 — Y040 — 16 × 0,5 — S  
— 3 m straight lengths**

EXAMPLE 2 Ordering details for 17 tonnes copper tube conforming to EN 12735-2, in material condition Y040 (light annealed), nominal outside diameter 9 mm, nominal wall thickness 0,28 mm, inner finned (F), 130 kg coil, level wound (LWC):

**17 tonnes Copper tube EN 12735-2 — Y040 — 9 × 0,28 — F  
— 130 kg LWC**

### 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 grade is designated either Cu-DHP or CW024A.

## 6.2 Mechanical properties and grain size

The 0,2 % proof strength, tensile strength, elongation and grain size shall conform to the requirements given in Table 1. The tests shall be carried out in accordance with 8.2, 8.3 and 8.4.

Table 1 — Mechanical properties and grain size

Material condition  designation in accordance with EN 1173:2008	common term	0,2% proof strength		Tensile strength	Elongation	Hardness (indicative)	Grain size	
		$R_{p0,2}$		$R_m$	$A$	HV 5	$\mu\text{m}$	
		MPa	MPa	MPa	%			
		min.	max.	min.	min.		min.	max.
R250 <sup>a</sup>	half-hard	—	—	250	30	(75 to 100)	—	—
R290 <sup>a</sup>	hard	—	—	290	3	(min. 100)	—	—
Y080 <sup>a</sup>	skin hard	80	140	220	40		15	40
Y040	light annealed	40	90	220	40		15	40
Y035 <sup>b</sup>	soft annealed	35	80	210	40		30	60
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 <sup>2</sup> .								
<sup>a</sup> Straight lengths only.								
<sup>b</sup> Nominal wall thickness $e \geq 0,6$ mm.								

## 6.3 Dimensions and tolerances for smooth tubes

### 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 for smooth tubes are given in Table 2. The recommended nominal dimensions of the length for straight length are indicated in 10.2.2. 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).

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**Table 2 — Nominal outside diameters and wall thicknesses for smooth tubes**

Nominal outside diameter <i>d</i>			Nominal wall thickness																
metric series mm	imperial series		<i>e</i> mm																
	mm	in	0,28	0,30	0,35	0,40	0,45	0,50	0,63	0,70	0,80	1,00	1,25	1,50	1,65	2,00	2,50	3,00	
6																			
	6,35	¼	•	•	•	•													
7			•	•	•	•													
	7,94	5/16	•	•	•	•													
8			•	•	•	• ■													
	9,52	¾		•	•	• ■	•	•		•	■								
10				•	•	• ■	•	• ■		•	■								
12					•	•	•	•	■	•	■								
	12,7	½			•	•	• ■	• ■	• ■	•	■								
14									■		■								
15						•	•	•	•										
	15,87	5/8				•	•	• ■	•	•	■	■							
16						•	•	• ■	■	•	■	■							
18											■	■							
	19,05	¾							■			■							
20									■		■	■							
22									■		■	■							
	22,22	7/8										■							
	25,4	1										■							
28												■							
	28,57	1 ⅛										■	■						
	34,92	1 ¾											■						
35														■					
	41,27	1 ⅝											■						
42														■					
	53,97	2 ⅛											■		■				
54																■			
64																■			
	66,67	2 ⅝														■			
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																

### 6.3.3 Tolerances on mean outside diameter

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

**Table 3 — Tolerances on mean outside diameter for smooth tubes**

Values in millimetres

Nominal outside diameter		Tolerances on mean nominal outside diameter	
over	$d$ up to and including	$e \leq 0,4$	$e > 0,4$
6 <sup>a</sup>	13	$\pm 0,04$	$\pm 0,04$
13	16	$\pm 0,05$	$\pm 0,04$
16	28	—	$\pm 0,05$
28	54	—	$\pm 0,06$
54	133	—	$\pm 0,07$
<sup>a</sup> Including 6.			

### 6.3.4 Tolerances on wall thickness

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

**Table 4 — Tolerances on wall thickness for smooth tubes**

Values in millimetres

Tolerances	Nominal outside diameter		Nominal wall thickness $e$							
	over	$d$ up to and including	from 0,25 up to and including 0,30	over 0,30 up to and including 0,35	over 0,35 up to and including 0,40	over 0,40 up to and including 0,50	over 0,50 up to and including 0,63	over 0,63 up to and including 0,80	over 0,80 up to and including 1,50	over 1,50 up to and including 3,00
Maximum permissible deviation at any point <sup>a</sup>	6	133	$\pm 0,025$	$\pm 0,03$	$\pm 0,03$	$\pm 0,04$	$\pm 0,05$	$\pm 0,06$	$\pm 8 \%^b$	$\pm 15 \%^b$
Tolerances on mean wall thickness	6	9,52	$\pm 0,01$	$\pm 0,01$	$\pm 0,01$	$\pm 0,015$	$\pm 0,02$	$\pm 0,02$	—	—
	9,52	13	—	$\pm 0,01$	$\pm 0,01$	$\pm 0,015$	$\pm 0,02$	$\pm 0,02$	—	—
	13	16	—	—	$\pm 0,01$	$\pm 0,015$	$\pm 0,02$	$\pm 0,02$	—	—
	16	22	—	—	—	—	—	$\pm 0,02$	$\pm 0,05$	—
	22	40	—	—	—	—	—	$\pm 0,02$	$\pm 0,05$	—
	40	100	—	—	—	—	—	—	$\pm 0,08$	$\pm 0,10$
	100	133	—	—	—	—	—	—	—	$\pm 0,08$
<sup>a</sup> Including deviation from concentricity.										
<sup>b</sup> Value in percentage of nominal thickness.										



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### 6.3.5 Tolerances on the mass for tubes supplied in coils

Per delivery, if the order specifies the nominal mass of the coil, none of the coils shall weigh less than 50 % of the nominal mass, and not more than 20 % of the coils shall weigh less than 70 % of the nominal mass.

EXAMPLE For delivery of 10 coils, nominal mass 130 kg: No coil shall have a mass lower than 65 kg (50 % of nominal) and 2 maximum (20 %) a mass lower than 91 kg (70 % of nominal).

### 6.3.6 Tolerances on length for tubes supplied in straight lengths

Straight tubes may be delivered:

- in production approximate lengths; or
- in specified fixed lengths.

The tolerances on production approximate lengths are  $\pm 10$  % except that a proportion, maximum 10 % of the tonnage, shall be permitted to be delivered in shorter lengths of a minimum 1 m.

The tolerances on length for tubes ordered in specified fixed lengths shall conform to Table 5.

**Table 5 — Tolerances on length for tubes supplied in straight lengths**

Values in millimetres

Specified length		Tolerance on length
over	up to and including	
—	600	+ 1,6 0
600	2 000	+ 2,0 0
2 000	4 000	+ 5,0 0
4 000	7 000	+ 8,0 0
7 000	—	by agreement between the purchaser and the supplier

### 6.3.7 Tolerances of form

#### 6.3.7.1 Deviation from circular form

The deviation from circular form shall conform to the tolerances given in Table 6.

**Table 6 — Maximum deviation from circular form expressed as percentage of the nominal outside diameter**

Form of delivery	Nominal thickness $e$ mm		Maximum deviation from circular form % for nominal outside diameter $d$ in millimetres				
	over	up to and including	over 6 up to and including 9,8	over 9,8 up to and including 13	over 13 up to and including 16	over 16 up to and including 22	over 22 up to and including 76,1
Coil	—	0,41	4,0	5,0	7,0	by agreement between the purchaser and the supplier	
	0,41	0,70	3,5	4,0	6,0		
	0,70	—	3,0	3,5	5,0		
Straight length	—	0,41	1,0	1,0	—	—	—
	0,41	0,70	1,0	1,0	1,0	—	—
	0,70	1,00	0,8	0,8	1,0	1,0	—
	1,00	3,00	0,7	0,8	0,8	0,8	1,0

#### 6.3.7.2 Deviation from concentricity

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

## 6.4 Dimensions and tolerances for inner finned tubes

### 6.4.1 General

The geometrical properties of inner finned tubes are defined by outside diameter, wall thickness at fin root, fin height, number of fins, shape of fins and spiral pitch.

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

$$DN = d - 2e - 2h_f \quad (2)$$

where

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

$e$  is the nominal wall thickness at fin root in millimetres (mm);

$h_f$  is the nominal fin height in millimetres (mm).

DN is 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).

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

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### 6.4.2 Dimensions for inner finned tubes

The recommended nominal outside diameters are indicated in Table 7.

**Table 7 — Recommended nominal outside diameters for inner finned tubes**

Nominal outside diameter <i>d</i>	
mm	in
6,0	—
6,35	1/4
7,00	—
7,94	<sup>5</sup> / <sub>16</sub>
8,00	—
9,52	<sup>3</sup> / <sub>8</sub>
10,00	—
12,00	—
12,70	<sup>1</sup> / <sub>2</sub>
15,00	—
15,87	<sup>5</sup> / <sub>8</sub>
16,00	—

### 6.4.3 Tolerances on mean outside diameter

The tolerances on the mean outside diameter shall be  $\pm 0,05$  mm for all diameters.

### 6.4.4 Tolerances on mass for tubes supplied in coils

Per delivery, if the order specifies the nominal mass of the coil, not more than 20 % of the coils shall weigh less than 50 % of the nominal mass.

### 6.4.5 Tolerances of form

The deviation from circular form shall conform to the tolerances given in Table 6.

## 6.5 Drift expanding (for smooth tubes)

On smooth tubes with dimensions and material conditions according to Table 8, no crack, break or tearing of the metal shall be visible to the unaided eye, corrected for normal vision, if necessary, when smooth tubes are tested in accordance with 8.5.

NOTE For inner finned tubes no drift expanding is specified.

Table 8 — Testing of drift expanding

Nominal outside diameter <i>d</i> mm		Material condition	Drift expanding
over	up to and including		
6 <sup>a</sup>	18		
		R250 (half hard)	M
		R290 (hard)	—
18	54		
		R250 (half hard)	A
		R290 (hard)	—
54	133		
		R250 (half hard)	—
		R290 (hard)	—
M Mandatory.			
A To be agreed upon by the purchaser and the supplier.			
<sup>a</sup> Including 6.			

## 6.6 Freedom from defects

### 6.6.1 General

The tubes shall be free from defects that could be detrimental to their use. Each tube shall be subjected to the freedom from defect test as described in 8.7.

### 6.6.2 Straight tubes

Any tube with identified defects shall be rejected.

### 6.6.3 Coiled tubes

Each defect shall be marked indelibly and visibly by a method which shall not deform the tube.

The permissible number of defects is proportional to the mass and is indicated in Table 9 for a 90 kg coil for deliveries of 10 t minimum.

NOTE For smaller deliveries, this number can be agreed between the purchaser and the supplier.

Table 9 — Permissible number of defects for coils

Nominal wall thickness <i>e</i> mm		Number of defects permitted per coil for 90 kg coils	
over	up to and including	maximum number	maximum average number per delivery of 10 t minimum
—	0,35	5	2
0,35	0,635	4	2
0,635	—	3	1

EXAMPLE Permissible number of defects for a coil, nominal weight 130 kg:  $5 \times 130/90 = 7,22$ , i.e. 7 maximum.

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### **6.7 Surface quality**

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

The inner surfaces of the tubes shall pass the test of the carbon content in accordance with 8.6.

When measured in accordance with 8.6 the lubricant residues as total content shall not exceed 0,38 mg/dm<sup>2</sup>.

## **7 Sampling**

For the purposes of demonstrating conformity to the dimensional requirements of this standard and the requirements of Clause 6, the sampling rate to be taken at 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.

## **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 Estimation of average grain size**

The average grain size shall be determined by comparison with standard images in accordance with the method given in EN ISO 2624, on test pieces prepared from the test samples obtained in accordance with Clause 7.

### **8.5 Drift expanding test**

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 the following amounts using a conical mandrel with an angle of 45°:

- for tubes with nominal outside diameter up to and including 20 mm, 40 %;
- for tubes with nominal outside diameter larger than 20 mm, 30 %.

NOTE The drift expanding does not apply for inner finned tubes.

## 8.6 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.

## 8.7 Freedom from defects test

### 8.7.1 General

The test shall be carried out in accordance with EN 1971 and the conditions given in 8.7.2 or 8.7.3.

Maximum drill diameters for the production of the reference standard tube which is specified in EN 1971 are given in Table 10.

### 8.7.2 Detection of local defects

Local discontinuities of the tubes are detected as defects with encircling coils systems in accordance with EN 1971.

The reference standard tube shall contain holes produced from the drill diameters in Table 10.

**Table 10 — Maximum drill diameters for reference standard tube**

Dimensions in millimetres

Nominal outside diameter <i>d</i>		Drill diameter
over	up to and including	max.
6 <sup>a</sup>	20	0,6
20	26	0,7
26	32	0,8
32	40	1,1
40	42	1,2
42	133	2,0
<sup>a</sup> Including 6.		

Signals produced by reference standard tubes shall set the sorting limits for acceptance or rejection. Straight lengths with discontinuities which produce signals equal to or greater than the sorting limit shall be rejected. Coils with discontinuities shall be marked according to 6.6.3.

### 8.7.3 Detection for non-local defects on coiled tubes

Non-local discontinuities of the coiled tubes shall be identified as defects by one of the methods specified for this purpose in EN 1971.

Discontinuities of the tubes (non-local defects); whose defect signals are ranging below the detection threshold of the normal sorting limit for local defects are identified with a second, selected detection threshold. The value of the lower selected detection threshold (K2) shall be smaller than 50 % of the detection threshold of the normal sorting limit. The maximum permissible frequency of defects identified with the lower selected

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detection threshold (no local defects) is 3 defects per 300 mm length of the tube. A higher number of defects within a test length are counted as 1 local defect.

Non-local defects shall be marked for their entire extent.

### **8.8 Retests**

In the event that the 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 i)] 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 j)] and agreed with the supplier, the supplier shall issue for the products the appropriate inspection document in accordance with EN 10204.

NOTE When ordering products 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**

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:

- number of this standard (EN 12735-2);
- nominal cross-sectional dimensions in millimetres: outside diameter × wall thickness;
- inner surface type (smooth or finned);
- number of defects on each coil;
- net mass;
- material condition;

- manufacturer's identification mark;
- number of production batch.

## 10.2 Form of delivery

### 10.2.1 Coils

Coils (LWC or SWC) can be delivered with or without reels.

Recommended sizes of coils and reels are given in Table 11.

**Table 11 — Coil and reel dimensions**

Form of delivery	Mass kg	Nominal outside diameter mm	Core diameter mm	Nominal width mm	Tolerance on nominal width mm	Arbor hole diameter mm
Coil	80 to 250	900 to 1 250	560 to 630	150 to 340	$\begin{smallmatrix} 0 \\ -10 \end{smallmatrix}$	—
Reel	—	900 to 1 200	—	170 to 340	$\begin{smallmatrix} 0 \\ -10 \end{smallmatrix}$	127 to 130

### 10.2.2 Straight lengths

If not specified, tubes are usually supplied in 3 m, 5 m or 6 m length.



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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**

<b>Clause(s)/ sub clause(s) of this EN</b>	<b>Subject</b>	<b>Qualifying remarks/Notes</b>
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*