BRITISH STANDARD

BS EN
10217-4:2002

Welded steel tubes for pressure purposes — Technical delivery conditions —

Part 4: Electric welded non-alloy steel tubes with specified low temperature properties

The European Standard EN 10217-4:2002 has the status of a British Standard

ICS 23.040.10; 77.140.75

National foreword

This British Standard is the official English language version of EN 10217-4:2002. Together with BS EN 10216-4:2002 it supersedes BS 3603:1991 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee ISE/73, Steels for pressure purposes, to Subcommittee ISE/73/1, Steel tubes for pressure purposes, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled "International Standards Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

This publication does not purport to include all the necessary provisions of a contract. Users of this publication are responsible for their correct application.

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This British Standard, having been prepared under the direction of the Engineering Sector Policy and Strategy Committee, was published under the authority of the Standards Policy and Strategy Committee on 26 June 2002

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English version

Welded steel tubes for pressure purposes - Technical delivery conditions - Part 4: Electric welded non-alloy steel tubes with specified low temperature properties

Tubes soudés en acier pour service sous pression - Conditions techniques de livraison - Partie 4: Tubes soudés électriquement en acier non allié avec caractéristiques spécifiées à basse température

Geschweißte Stahlrohre für Druckbeanspruchungen - Technische Lieferbedingungen - Teil 4: Elektrisch geschweißte Rohre aus unlegierten Stählen mit festgelegten Eigenschaften bei tiefen Temperaturen

This European Standard was approved by CEN on 25 April 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
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Contents

Foreword

This document (EN 10217-4:2002) has been prepared by Technical Committee ECISS/TC 29, "Steel tubes and fittings for steel tubes", the secretariat of which is held by UNI.

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 November 2002, and conflicting national standards shall be withdrawn at the latest by November 2002.

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(s).

For relationship with EU Directive(s), see informative annex ZA, which is an integral part of this document.

Other parts of EN 10217 are:

Part 1: Non-alloy steel tubes with specified room temperature properties.

Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties.

Part 3: Alloy fine grain steel tubes.

Part 5: Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties.

Part 6: Submerged arc welded non-alloy steel tubes with specified low temperature properties.

Part 7: Stainless steel tubes.

Another European Standard series covering tubes for pressure purposes is:

EN 10216: Seamless steel tubes for pressure 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.

1 Scope

This Part of EN 10217 specifies the technical delivery conditions in two test categories of electric welded tubes of circular cross section, with specified low temperature properties, made of non-alloy steel.

2 Normative references

This European Standard incorporates by date 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 date 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).

The requirements of this European Standard rule when they differ from those in the standards and documents referred to below:

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

EN 10020, *Definitions and classification of grades of steel*

EN 10021, *General technical delivery requirements for steel and iron products*

EN 10027-1, *Designation systems for steels - Part 1: Steel names, principle symbols.*

EN 10027-2, *Designation systems for steels - Part 2: Numerical systems*

EN 10045-1, *Metallic materials - Charpy impact test - Part 1: Test method*

EN 10052, *Vocabulary of heat treatment terms for ferrous products*

prEN 10168 [1)], *Iron and steel products - Inspection documents - List of information and description*

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

ENV 10220, *Seamless and welded steel tubes - Dimensions and masses per unit length*

EN 10233, *Metallic materials - Tubes - Flattening test*

EN 10234, *Metallic materials - Tubes - Drift expanding test*

EN 10236, *Metallic materials - Tubes - Ring expanding test*

EN 10237, *Metallic materials - Tubes - Ring tensile test*

EN 10246-1, *Non-Destructive Testing of steel tubes Part 1 : Automatic electromagnetic testing of seamless and welded (except submerged arc welded) ferromagnetic steel tubes for verification of hydraulic leak-tightness*

EN 10246-3, *Non-Destructive Testing of steel tubes - Part 3 :Automatic eddy current testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of imperfections*

EN 10246-5, *Non-Destructive Testing of steel tubes – Part 5: Automatic full peripheral magnetic transducer/flux leakage testing of seamless and welded (except submerged arc-welded) ferromagnetic steel tubes for the detection of longitudinal imperfections*

EN 10246-6, *Non-Destructive Testing of steel tubes - Part 6 : Automatic full peripheral ultrasonic testing of seamless steel tubes for the detection of transverse imperfections*

EN 10246-7, *Non-Destructive Testing of steel tubes - Part 7 : Automatic full peripheral ultrasonic testing of seamless and welded (except submerged arc welded) steel tubes for the detection of longitudinal imperfections*

EN 10246-8, *Non-Destructive Testing of steel tubes – Part 8: Automatic ultrasonic testing of the weld seam of electric welded tubes for the detection of longitudinal imperfections*

EN 10246-14, *Non-Destructive Testing of steel tubes - Part 7 : Automatic ultrasonic testing of seamless and welded (except submerged arc welded) steel tubes for the detection of laminar imperfections*

EN 10256, *Non-Destructive Testing of steel tubes - Qualification and competence of level 1 and level 2 NDT personnel*

prEN 10266 [1)], *Steel tubes, fittings and structural hollow sections - Symbols and definition of terms for use in product standards*

CR 10260, *Designation systems for steel - Additional symbols*

CR 10261, *ECISS Information Circular IC 11 - Iron and steel - Review of available methods of chemical analysis.*

EN ISO 377*, Steel and steel products - Location and preparation of samples and test pieces for mechanical testing (ISO 377:1997)*

EN ISO 2566-1, *Steel - Conversion of elongation values – Part 1: Carbon and low-alloy steels (ISO 2566-1:1984)*

ISO 14284, *Steel and iron - Sampling and preparation of samples for the determination of chemical composition*

3 Terms and definitions

For the purposes of this Part of EN 10217, the terms and definitions given in EN 10020, EN 10021, EN 10052, prEN 10266 and the followings apply:

3.1
test category
classification that indicates the extent and level of inspection and testing.

3.2
employer
organisation for which a person works on a regular basis.

NOTE The employer may be either the tube manufacturer or supplier or a third party organisation providing Non-Destructive Testing(NDT) services.

4 Symbols

For the purposes of this Part of EN 10217, the symbols given in prEN 10266 and the following apply:

— C1, C2 category conformity indicators (see 7.3.1 and 7.3.3.)

— TC test category.

1) In preparation; until this document is published as a European standard, a corresponding national standard should be agreed at the time of enquiry and order.

5 Classification and designation

5.1 Classification

In accordance with the classification system in EN 10020, the steel grade given in Tables 2 and 4 are classified as non-alloy quality steels.

5.2 Designation

5.2.1 For the tubes covered by this Part of EN 10217 the steel designation consists of:

— the number of this Part of EN 10217;

plus either:

— the steel name in accordance with EN 10027-1 and CR 10260;

or:

— the steel number allocated in accordance with EN 10027-2.

5.2.2 The steel name is designated by

— the capital letter P for pressure purposes;

— the indication of the specified minimum yield strength expressed in MPa, given in Table 4;

— the symbol of the delivery condition for the steel grade concerned (see Table 1);

— the symbol L for low temperature.

6 Information to be supplied by the purchaser

6.1 Mandatory information

The following information shall be supplied by the purchaser at the time of enquiry and order:

a) the quantity (mass or total length or number);

b) the term "tube";

c) the dimensions (outside diameter D and wall thickness T) (see Table 6);

d) the designation of the steel grade in accordance with this Part of EN 10217 (see 5.2);

e) the test category (see 9.3).

6.2 Options

A number of options are specified in this Part of EN 10217 and these are listed below. In the event that the purchaser does not indicate a wish to implement any of these options at the time of enquiry and order, the tubes shall be supplied in accordance with the basic specification (see 6.1).

1) Tube manufacturing route (see 7.3.2).

2) Restriction on copper and tin content (see Table 2).

3) Product analysis (see 8.2.2).

4) Specification of leak-tightness test method (see 8.4.3.1).

5) Non-Destructive Testing for test category 2 tubes for the detection of transverse imperfections (see 8.4.3.2).

6) Non-Destructive Testing for test category 2 tubes for the detection of laminar imperfections (see 8.4.3.2)

7) Special end preparation (see 8.6).

8) Exact lengths (see 8.7.3).

9) The type of inspection document other than the standard document (see 9.2.1).

10) Transverse weld tensile test (see Table 9).

11) Test pressure for hydrostatic leak-tightness test (see 11.9.1).

12) Wall thickness measurement away from the ends (see 11.10).

13) Non-Destructive Testing method for the inspection of the weld seam (see 11.12.1).

14) Non-Destructive Testing method for the inspection of the tube body (see 11.12.2)

15) Additional marking (see 12.2).

16) Protection (see 13).

6.3 Example of an order

500 m of electric welded tube with an outside diameter of 168,3 mm, a wall thickness of 4,5 mm in accordance with EN 10217-4, made of steel grade P265NL, test category 1, with a 3.1.C inspection certificate in accordance with EN 10204:

500 m - Tube - 168,3 x 4,5 - EN 10217-4 - P265NL - TC 1 - Option 9: 3.1.C

7 Manufacturing process

7.1 Steelmaking process

The steelmaking process is at the discretion of the manufacturer.

7.2 Deoxidation process

Steels shall be fully killed.

7.3 Tube manufacture and delivery conditions

7.3.1 All NDT activities shall be carried out by qualified and competent level 1,2 and/or 3 personnel authorised to operate by the employer.

The qualification shall be in accordance with EN 10256 or, at least, an equivalent to it.

It is recommended that the level 3 personnel be certified in accordance with EN 473 or, at least, an equivalent to it.

The operating authorisation issued by the employer shall be in accordance with a written procedure.

NDT operations shall be authorised by a level 3 NDT individual approved by the employer.

NOTE The definition of level 1,2 and 3 can be found in appropriate Standards, e.g. EN 473 and EN 10256.

For pressure equipment in categories III and IV (of Directive 97/23-EC) the personnel shall be approved by a recognised third-party organisation. Tubes not conforming to this requirement shall be marked “C 2”, unless a requirement to mark "C1" (see 7.3.3) applies.

7.3.2 The tubes shall be manufactured by high frequency welding (HFW), minimum frequency 100 kHz, by the manufacturing process and routes as specified in Table 1.

Unless Option 1 is specified the manufacturing route is at the discretion of the manufacturer.

Option 1: *The manufacturing route is specified by the purchaser.*

The finished tubes shall not include welds used for joining together lengths of the strip prior to forming.

7.3.3 Welding shall be carried out by suitably qualified personnel in accordance with suitable operating procedures.

For pressure equipment in categories II, III, and IV, (of Directive 97/23 EC) the operating procedures and the personnel shall be approved by a competent third-party. Tubes not conforming to this requirement shall be marked “C 1”.

7.3.4 The delivery conditions of tubes covered by this Part of EN 10217 are shown in Table 1.

Table 1 — Tube manufacturing route and delivery condition

Route N°	Routes		Delivery condition
	Starting material	Forming operation	
1	Normalising rolled or Normalised strip	Cold formed (+welded)	Normalising weld zone or Normalising (entire tube)
2a	As (hot) rolled or normalising rolled strip	Cold formed (+welded)	Normalising (entire tube)
2b		Cold formed (+welded) + hot stretch reduced	Normalising (entire tube)
2c		Cold formed (+ welded) + hot stretch reduced at a controlled temperature to give a normalised condition	Normalised rolled

8 REQUIREMENTS

8.1 General

When supplied in a delivery condition indicated in clause 7.3 and inspected in accordance with clauses 9, 10 and 11, the tubes shall conform to the requirements of this Part of EN 10217.

Tubes shall be suitable for hot and cold bending provided the bending is carried out in an appropriate manner.

In addition, the general technical delivery requirements specified in EN 10021 shall apply.

8.2 Chemical composition

8.2.1 Cast analysis

The cast analysis reported by the steel producer shall apply and conform to the requirements of Table 2.

NOTE When welding tubes produced in accordance with this Part of EN 10217, account should be taken of the fact that the behaviour of the steel during and after welding is dependent not only on the steel, but also on the applied heat treatment and the conditions of preparing for and carrying out the welding.

8.2.2 Product analysis

Option 3: *Product analysis for the tube shall be supplied.*

Table 3 specifies the permissible deviations of the product analysis from the specified limits on cast analysis given in Table 2.

8.3 Mechanical properties

The mechanical properties of the tubes shall conform to the requirements in Tables 4 and 5 and in clauses 11.4, 11.5, 11.6 and 11.7.

Table 2 — Chemical composition (cast analysis) [a], in % by mass

Steel grade		C	Si	Mn		P	S	Cr	Mo	Ni	Al_{total} [b]	Cu [c]	Nb	Ti	V
Steel name	Steel number	max	max	min	max	max	max	max	max	max	Min	max	max	max	max
P215NL	1.0451	0,15	0,35	0,40	1,20	0,025	0,020	0,30	0,08	0,30	0,020	0,30	0,010	0,03	0,02
P265NL	1.0453	0,20	0,40	0,60	1,40	0,025	0,020	0,30	0,08	0,30	0,020	0,30	0,010	0,03	0,02

a Elements not included in this Table shall not be intentionally added to the steel without the agreement of the purchaser, except for elements which may be added for finishing the cast. All appropriate measures shall be taken to prevent the addition of undesirable elements from scrap or other materials used in the steel making process.

b $Al/N \geq 2$, if nitrogen is fixed by niobium, titanium or vanadium the requirement for Al_{tot} and Al/N do not apply.

c Option 2: In order to facilitate subsequent forming operation, an agreed maximum copper content lower than indicated and an agreed specified maximum tin content shall apply.

Table 3 — Permissible deviations in the product analysis from specified limits on cast analysis given in Table 2

Element	Limiting value for the cast analysis in accordance with Table 2 % by mass	Permissible deviation of the product analysis % by mass
C	≤ 0,20	+ 0,02
Si	≤ 0,40	+ 0,05
Mn	≤ 1,40	+ 0,10 - 0,05
P	≤ 0,025	+ 0,005
S	≤ 0,020	+ 0,005
Al	≥0,020	- 0,005
Cr	≤ 0,30	+ 0,05
Cu	≤ 0,30	+ 0,05
Mo	≤ 0,08	+ 0,02
Nb	≤ 0,010	+ 0,005
Ni	≤ 0,30	+ 0,05
Ti	≤ 0,03	+ 0,01
V	≤ 0,02	+ 0,01

Table 4 — Mechanical properties at room temperature for wall thickness T up to and including 16 mm

Steel grade		Tensile properties			
Steel name	Steel number	Upper yield strength or proof strength R_{eH} or $R_{p0,2}$ min MPa *	Tensile strength R_m MPa *	Elongation [a] A min % l	 t
P215NL [b]	1.0451	215	360 to 480	25	23
P265NL	1.0453	265	410 to 570	24	22

[a] l = longitudinal t = transverse

[b] For wall thikness T ≤ 10 mm

\+ 1 MPa = 1 N/mm^2

Table 5 — Impact properties at for wall thickness T up to and including 16 mm

Steel grade		Orientation of test pieces with respect to tube axis	Minimum average absorbed energy KV J at a temperature of°C		
Steel name	Steel number		-40	-20	+20
P215NL [a]	1.0451	Longitudinal	40	45	55
P265NL	1.0453	Longitudinal	40	45	50
		Transverse	27	30	35
[a] For wall thickness T ≤ 10 mm					

8.4 Appearance and internal soundness

8.4.1 General

The weld area shall be free from cracks and lack of fusion.

8.4.2 Appearance

8.4.2.1 The tubes shall be free from external and internal surface defects that can be detected by visual examination.

8.4.2.2 The internal and external surface finish of the tubes shall be typical of the manufacturing process and, where applicable, the heat treatment employed. Normally the finish and surface condition shall be such that any surface imperfections requiring dressing can be identified.

8.4.2.3 It shall be permissible to dress only by grinding or machining surface imperfections provided that after doing so, the wall thickness in the dressed area is not less than the specified minimum wall thickness. All dressed areas shall blend smoothly into the contour of the tube.

8.4.2.4 Any surface imperfection, which is demonstrated to be deeper than 5 % of the wall thickness T or 3 mm whichever is the smaller, shall be dressed.

This requirement does not apply to surface imperfection with a depth equal or less 0,3 mm.

8.4.2.5 Surface imperfections which encroach on the specified minimum wall thickness T shall be considered defects and tubes containing these shall be deemed not to conform to this Part of EN 10217.

8.4.2.6 Repairs to the weld seam are not permitted

8.4.3 Internal soundness

8.4.3.1 Leak Tightness

The tubes shall pass a hydrostatic test (see 11.9.1) or electromagnetic test see (11.9.2) for leak-tightness.

Unless option 4 is specified, the choice of the test method is at the discretion of the manufacturer.

Option 4: *The test method for verification of leak-tightness in accordance with 11.9.1 or 11.9.2 is specified by the purchaser.*

8.4.3.2 Non-Destructive Testing

The full length of the weld seam of tubes of test category 1 shall be subjected to a Non-Destructive Testing for the detection of imperfections in accordance with 11.12.1.

The full length of the weld seam of tubes and the body of tubes of test category 2 shall be submitted to a Non-Destructive Testing for the detection of longitudinal imperfections, in accordance with 11.12.2.

Option 5: *The tubes of test category 2 shall be subjected to a Non-Destructive Testing for the detection of transverse imperfections in accordance with 11.12.3.*

Option 6: *The tubes of test category 2 shall be subjected to a Non-Destructive Testing for the detection of the laminar imperfections in accordance with 11.12.4.*

8.5 Straightness

The deviation from straightness of any tube length L shall not exceed 0,0015 L. Deviations from straightness over any one metre length shall not exceed 3 mm.

8.6 Preparation of ends

Tubes shall be delivered with square cut ends. The ends shall be free from excessive burrs.

Option 7 *:The tubes shall be delivered with bevelled ends (see figure 1). The bevel shall have an angle* α *of* $30°\ ^{+5°}_{0°}$ *with a root face C of 1,6 mm ± 0,8 mm.*

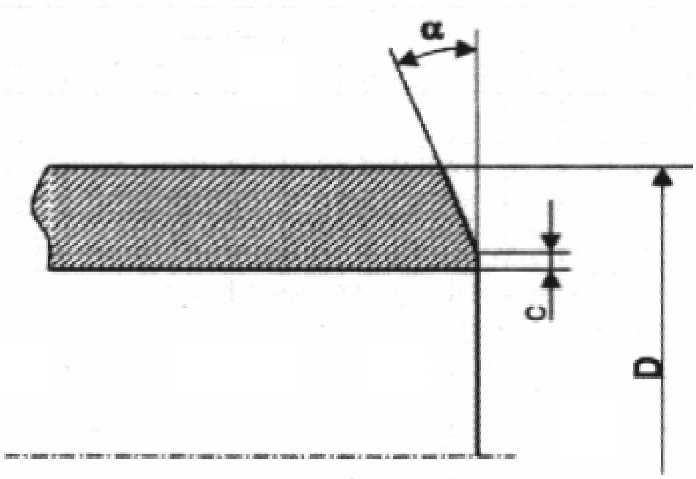

Figure 1 — Tube end bevel

8.7 Dimensions, masses and tolerances

8.7.1 Diameter and wall thickness

Tubes shall be delivered by outside diameter D and wall thickness T.

Preferred outside diameters D and wall thicknesses T have been selected from ENV 10220 and are given in Table 6.

NOTE Dimensions which are different from those in Table 6 may be agreed.

8.7.2 Mass

For the mass per unit length the provision of ENV 10220 applies.

8.7.3 Lengths

Unless option 8 is specified, the tubes shall be delivered in any random lengths. The delivery range shall be agreed at the time of enquiry and order.

Option 8:*The tubes shall be delivered in exact lengths, the length to be specified at the time of enquiry and order. For tolerances see 8.7.4.3.*

Table 6 — Preferred dimensions

dimensions in mm

Outside diameters D Series [a]			Wall thicknesses, T																					
1	2	3	1,4	1,6	1,8	2	2,3	2,6	2,9	3,2	3,6	4	4,5	5	5,6	6,3	7,1	8	8,8	10	11	12,5	14,2	16
10,2																								
	12																							
	12,7																							
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		44,5																						
48,3																								
	51																							
		54																						
	57																							
60,3																								
	63,5																							
	70																							
		73																						
76,1																								

Table 6 — Continues

dimensions in mm

Outside diameters D Series [a]			Wall thicknesses, T																				
1	2	3	1,4	1,6	1,8	2	2,3	2,6	2,9	3,2	3,6	4	4,5	5	5,6	6,3	7,1	8	8,8	10	11	12,5	14,2	16
		82,5																						
88,9																								
	101,6																							
		108																						
114,3																								
	127																							
	133																							
139,7																								
		141,3																						
		152,4																						
		159																						
168,3																								
		177,8																						
		193,7																						
219,1																								
		244,5																						
273																								
323,9																								
355,6																								
406,4																								
457																								
508																								

[a] series 1 = diameters for which all the accessories needed for the construction of piping system are standardized;

series 2 = diameters for which not all the accessories are standardized;

series 3 = diameters for special application for which very few standardized accessories exist.

8.7.4 Tolerances

8.7.4.1 Tolerances on diameter and thickness

The diameter and the wall thickness of the tubes shall be within the tolerance limits given in Table 7.

Table 7 — Tolerances on outside diameter and wall thickness

dimensions in mm

Outside diameter D	Tolerance on D	Tolerance on wall thickness T [a]	
		≤ 5	5 < T ≤ 16
D ≤ 219,1	± 1% or ± 0,5 whichever is the greater	± 10% or ± 0,3 whichever is the greater	± 8%
D > 219,1	± 0,75 %		
[a] The plus tolerance excludes the weld area (see 8.7.4.2)			

8.7.4.2 Height of the weld seam

The external and internal weld seam shall be trimmed flush. The maximum height of the internal weld seam, after trimming, shall be 0,5 + 0,05·T mm.

8.7.4.3 Tolerances on exact length

The tolerances for exact lengths shall be as given in Table 8.

Table 8 — Tolerances on exact lengths

dimensions in mm

Length range L	Tolerance for outside diameter D	
	< 406,4	≥ 406,4
L ≤ 6000	+ 10 0	+ 25 0
6000 < L ≤ 12000	+ 15 0	+ 50 0
L > 12000	+ by agreement 0	

8.7.4.4 Out of roundness

The out-of-roundness (O) shall be calculated using the following equation:

$$O = \frac{D_{max} - D_{min}}{D} 100 \qquad (1)$$

where:

O = out-of-roundness in %
D = specified outside diameter in mm
D max, D min. = maximum and minimum outside diameter measured in the same plane in mm

For tubes of outside diameter D ≤ 406,4 mm, out-of-roundness, shall be included in the limits of the diameter tolerances.

For tubes of outside diameter D > 406,4 mm and with D/T ≤ 100, out-of-roundness shall not exceed 2 %.

For tubes with a D/T > 100 the values for out-of-roundness shall be agreed at the time of enquiry and order.

9 Inspection

9.1 Types of inspection

Conformity to the requirements of the order, for tubes in accordance with this Part of EN 10217, shall be checked by specific inspection.

9.2 Inspection documents

9.2.1 Types of inspection documents

Unless option 9 is specified, an inspection certificate 3.1.B, in accordance with EN 10204, shall be issued.

Option 9: *One of the inspection documents 3.1.A, 3.1.C or 3.2 in accordance with EN 10204 shall be issued.*

If an inspection document 3.1.A, 3.1.C or 3.2 is specified, the purchaser shall notify the manufacturer of the name and address of the organisation or person who is to carry out the inspection and produce the inspection document In the case of the inspection report 3.2 it shall be agreed which party shall issue the certificate.

9.2.2 Content of inspection documents

The content of the inspection document shall be in accordance with prEN 10168.

The inspection certificate or inspection report shall contain the following codes and information :

— A - commercial transactions and parties involved;

— B - description of products to which the inspection document applies;

— C01-C03 – location of the test sample and direction of the test pieces and testing temperature;

— C10-C13 - tensile test;

— C40-C43 - impact test;

— C60-C69 - other tests (e.g. flattening);

— C71-C92 - chemical composition on cast analysis (product analysis if applicable);

— D01 - marking and identification, surface appearance, shape and dimensional properties;

— D02-D99 - leak-tightness test, NDT;

— Z - validation.

9.3 Summary of inspection and testing

The tubes shall be inspected and tested in accordance with test category 1 or test category 2 as specified at the time of enquiry and in the order (see 6.1).

Inspection and testing to be carried out are summarised in Table 9.

Table 9 — Summary of inspection and testing

Type of inspection and test		Frequency of testing	Refer to	Test category	
				1	2
Mandatory Tests	Cast analysis	one per cast	8.2.1 and 11.1	X	X
	Tensile test on base material at room temperature	one per sample tube	8.3.1 and 11.2.1	X	X
	Flattening test [a] for D < 600 mm and T/D ratio ≤ 0,15 but T ≤ 40 mm or [b] for D > 150 mm ring tensile test		8.3.1, 11.4 and 11.5	X	X
	Drift expanding test for D ≤ 150 mm and T ≤ 10 mm or [b] Ring expanding test for D ≤ 114,3 mm and T ≤ 12,5 mm		8.3.1, 11.6 and 11.7	X	X
	Impact test at low temperature		8.3.2 and 11.8	X	X
	Leak tightness test	each tube	8.4.3.1 and 11.9	X	X
	Dimensional inspection	8.5, 8.7 and 11.10		X	X
	Visual examination	11.11		X	X
	NDT on the weld for the detection of longitudinal imperfections	each tube	8.4.3.2 and 11.12.1	X	--
	NDT on the tube body and on the weld for the detection of longitudinal imperfections		8.4.3.2 and 11.12.2	--	X
Optional Tests	Product analysis (Option 3)	one per cast	8.2.2 and 11.1	X	X
	Tensile test on the weld at room temperature (option 10) [c]	one per sample tube	8.3 and 11.3	X	X
	Wall thickness measurement away from tube end (Option 12)	8.7 - 11.10		X	X
	NDT for the detection of transverse imperfections (Option 5)	each tube	8.4.3.2 and 11.12.3	--	X
	NDT for the detection of laminar imperfections(Option 6)		8.4.3.2 and 11.12.4	--	X

[a] For the flattening test 2 test pieces shall be tested with the weld position at 0° and 90°

[b] The choice of flattening test or ring tensile test and of drift expanding test or ring expanding test is at the discretion of the manufacturer.

[c] ***Option 10:*** *For tubes of outside diameter D greater than 219,1 a transverse tensile test on the weld shall be carried out.*

10 Sampling

10.1 Frequency of tests

10.1.1 Test unit

For tubes delivered without subsequent heat treatment or welded line heat treated, a test unit shall comprise tubes of the same specified diameter and wall thickness, the same steel grade, the same cast, the same manufacturing process.

For tubes which are furnace heat treated a test unit shall comprise tubes of the same specified diameter and wall thickness, the same steel grade, the same cast, the same manufacturing process, subjected to the same finishing treatment in a continuous furnace or heat treated in the same furnace charge in a batch-type furnace.

The number of tubes per test unit shall conform to Table 10:

Table 10 — Number of tubes per test unit

Outside diameter D (mm)	Maximum number of tubes per test unit
$D \leq 114,3$	200
$114,3 < D \leq 323,9$	100
$D > 323,9$	50

10.1.2 Number of sample tubes per test unit

The following number of samples tubes shall be selected from each test unit :

— - test category 1: one sample tube;

— - test category 2: two sample tubes; when the total number of tubes is less than 20, only one sample tube.

10.2 Preparation of samples and test pieces

10.2.1 Selection and preparation of samples for product analysis

Samples for product analysis shall be taken from the test pieces or samples for mechanical testing or from the whole wall thickness T of the tube at the same location as for the mechanical test samples, in accordance with ISO 14284.

10.2.2 Location, orientation and preparation of samples and test pieces for mechanical tests

10.2.2.1 General

Samples and test pieces shall be taken at the tube ends and in accordance with the requirements of EN ISO 377.

10.2.2.2 Test pieces for tensile tests of the base material

The test piece shall be prepared in accordance with the requirements of EN 10002-1.

At the manufacturer's discretion:

for tubes with an outside diameter $D \leq 219,1$ mm, the test piece shall be either a full tube section or a strip section and shall be taken in a direction longitudinal to the axis of the tube;

tubes with an outside diameter D > 219,1 mm the test piece shall either a machined test piece with circular cross section from an unflattened sample or a strip section and be taken in a direction either longitudinal or transverse to the axis of the tube.

Except when a full tube section is used, the test piece shall be taken diametrically opposite the weld.

10.2.2.3 Test pieces for tensile tests on the weld

The test piece shall be taken transverse to the weld with the weld at the centre of the test piece. The test piece shall be a strip section with the full thickness of the tube, the weld bead may be removed.

10.2.2.4 Test piece for the flattening test, ring tensile test, drift expanding test, ring expanding tests

The test piece for the flattening test, ring tensile test, drift expanding test, ring expanding test shall consist of a full tube section in accordance with EN 10233, EN 10237, EN 10234 or EN 10236 respectively.

10.2.2.5 Test pieces for the impact test

Three standard Charpy V-notch test pieces shall be prepared in accordance with EN 10045-1. If the wall thickness is such that standard test pieces cannot be produced without flattening of the section, then test pieces of width less than 10 mm, but not less than 5 mm shall be prepared; the largest obtainable width shall be used.

Where test pieces at least 5 mm width cannot be obtained, the tubes shall not be subjected to impact testing.

The test pieces shall be taken transverse to the tube axis unless D_{min} , as calculated by the following equation, is greater than the specified outside diameter, in which case longitudinal test pieces shall be used:

$$D_{min} = (T-5) + [\ 756{,}25 / (T-5)\ ] \qquad (2)$$

The test pieces shall be taken diametrically opposite the weld.

The test pieces shall be prepared such that the axis of the notch is perpendicular to the surface of the tube see figure 2.

Key

1 longitudinal test piece

2 transverse test piece

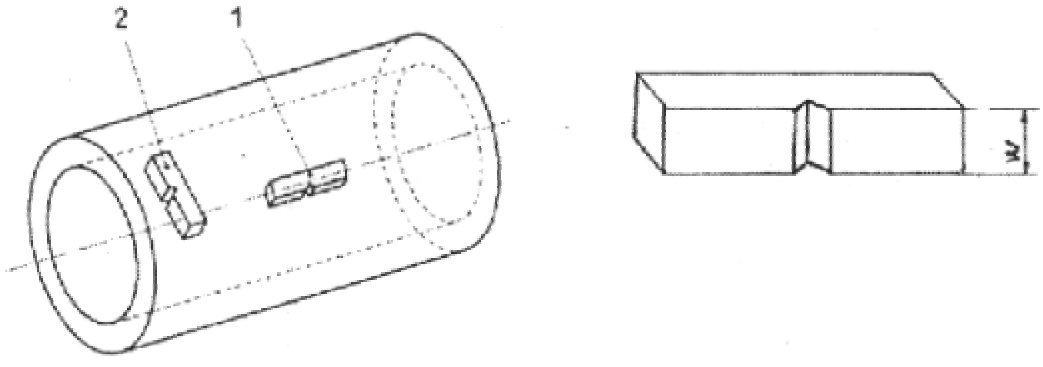

Figure 2 — Impact test piece orientation

11 Test methods

11.1 Chemical analysis

The elements to be determined and reported shall be those specified in Table 2. The choice of a suitable physical or chemical analytical method for the analysis shall be at the discretion of the manufacturer. In case of dispute the method used shall be agreed between manufacturer and purchaser taking into account CR 10261.

11.2 Tensile test on the base material

The test shall be carried out in accordance with EN 10002-1, and the following determined:

— the tensile strength (R_m);

— the upper yield strength (R_{eH}) or if a yield phenomenon is not present the 0,2 % proof strength ($R_{p0,2}$);

— the percentage elongation after fracture with a reference to a gauge length (L_0) of $5{,}65 \cdot \sqrt{So}$; if a non-proportional test piece is used, the percentage elongation value shall be converted to the value for a gauge length $Lo = 5{,}65 \cdot \sqrt{So}$ using the conversion tables in EN ISO 2566-1.

11.3 Transverse tensile test on the weld

The test shall be carried out in accordance with EN 10002-1 at room temperature and the tensile strength (Rm) shall be determined.

11.4 Flattening test

The test shall be carried out in accordance with EN 10233. The tube section shall be flattened in a press until the distance H between the platens reaches the value given by the following equation:

$$H = \frac{(1+C)}{C + (T/D)} xT \qquad (3)$$

where :

— H is the distance between platens, in mm, to be measured under load;

— D is the specified outside diameter, in mm;

— T is the specified wall thickness, in mm;

— C is the constant factor of deformation, the value of which is:

  — 0,09 for steel grade P215NL;

  — 0,07 for steel grade P265NL.

After testing, the test piece shall be free from cracks or breaks. However, slight incipient cracks at its edges shall not be regarded as justification for rejection.

11.5 Ring tensile test

The test shall be carried out in accordance with EN 10237.

The tube section shall be subjected to strain in the circumference direction until fracture occurs.

After fracture the test pieces shall not show any visible cracks without the use of magnifying aids, excluding the fracture point.

11.6 Drift expanding test

The test shall be carried out in accordance with EN 10234.

The tube section shall be expanded with a 60° conical tool until the percentage increase in outside diameter shown in Table 11 is reached.

Table 11 — Drift expanding test requirements

d/D [a]	% increase in outside diameter
≤ 0,6	8
> 0,6 ≤ 0,8	10
> 0,8	15
[a] d = D - 2T	

After testing, the test piece shall be free from cracks or breaks. However, slight incipient cracks at its edges shall not be regarded as justification for rejection.

11.7 Ring expanding test

The test shall be carried out in accordance with EN 10236.

The tube section shall be expanded with a conical tool until it breaks. The surface outside the fracture zone shall be free from cracks or breaks. However, slight incipient cracks at its edges shall not be regarded as justification for rejection.

11.8 Impact test

11.8.1 The test shall be carried out in accordance with EN 10045-1 at – 40° C.

11.8.2 The mean value of the three test pieces shall meet the requirement given in Table 5. One individual value may be below the specified value, provided that it is not less than 70 % of that value.

11.8.3 If the width (W) of the test piece is less than 10 mm, the measured impact energy (KV_p) shall be converted to impact energy(KV_c) using the following equation:

$$KV_C = \frac{10 \times KV_p}{W} \qquad (4)$$

where:

— KV_c is the calculated impact energy, in J;

— KV_p is the measured impact energy, in J;

— W is the width of the test piece, in mm.

The calculated impact energy KV_c shall conform to the requirements given in 11.8.2.

11.8.4 If the requirements of 11.8.2 are not met, then an additional set of three test pieces may be taken at the discretion of the manufacturer from the same sample and tested. To consider the test unit as conforming, after testing the second set, the following conditions shall be satisfied simultaneously:

the average value of the six tests shall be equal to or greater than the specified minimum average value;

not more than two of the six individual values may be lower than the specified minimum average value;

not more than one of the six individual values may be lower than 70 % of the specified minimum average value.

11.8.5 The dimensions in millimetres of the test pieces, the measured impact energy values and the resulting average value shall be reported.

11.9 Leak tightness test

11.9.1 Hydrostatic test

The hydrostatic test shall be carried out at a test pressure of 70 bar[2)] or at a test pressure P calculated using the following equation, whichever is lower:

$$P = 20\frac{SxT}{D} \qquad (5)$$

where :

— P is the test pressure, in bar;

— D is the specified outside diameter, in mm;

— T is the specified wall thickness, in mm;

— S is the stress, in MPa, corresponding to 70 % of the an minimum yield strength (see Table 4) for the steel grade concerned

The test pressure shall be held for not less than 5 s for tubes with an outside diameter D less than or equal to 457 mm and for not less than 10 s for tubes with specified outside diameter Dgreater than 457 mm.

The tube shall withstand the test without showing leakage or visible deformation.

Option 11: *A test pressure different from that specified in 11.9.1 and corresponding to stress below 90% of the specified minimum yield strength (see Table 4) for the steel grade concerned is specified.*

NOTE This hydrostatic leak-tightness test is not a strength test.

11.9.2 Electromagnetic test

The test shall be carried out in accordance with EN 10246-1.

11.10 Dimensional inspection

Specified dimensions, including straightness, shall be verified.

The outside diameter shall be measured at the tube ends. For tubes with outside diameter D ≥ 406,4 mm, the diameter may be measured using a circumference tape.

Unless option 12 is specified the wall thickness shall be measured at both tube ends.

2) 1 bar = 100 kPa

Option 12: *The wall thickness shall be measured away from the tube ends in accordance with an agreed procedure.*

11.11 Visual examination

Tubes shall be visually examined to ensure conformity to the requirements of 8.4.1 and 8.4.2.

11.12 Non-Destructive Testing

11.12.1 The full length of the weld seam of tubes of test category 1 shall be tested in accordance with either EN 10246-3 to acceptance level E3, EN10246-5 to acceptance level F3, EN 10246-7 to acceptance level U3, sub-category C or EN 10246-8 to acceptance level U3.

Unless option 13 is specified, the selection of the test inspection method is at the discretion of the manufacturer.

Option 13: *The test inspection method is specified by the purchaser.*

Weld seam at the tube ends not automatically tested shall either be subjected to manual/semi-automatic ultrasonic testing in accordance with EN 10246-8 to acceptance level U3, sub-category C or be cropped off.

11.12.2 Tubes of test category 2 shall be subjected to ultrasonic testing for the detection of longitudinal imperfections, in accordance with EN 10246-7 to acceptance level U2, sub-category C or in accordance with EN 10246-5 to acceptance level F 2,

Unless option 14 is specified, the test inspection method used shall be at the discretion of the manufacturer.

Option 14: *The test method is chosen by the purchaser*

Regions at the tube ends not automatically tested shall either be subjected to manual/semi-automatic ultrasonic testing in accordance with EN 10246-7 to acceptance level U2, sub-category C or be cropped off.

11.12.3 When option 5 (see 8.4.2.2) is specified, the tubes shall be subjected to ultrasonic testing for the detection of transverse imperfections in accordance with EN 10246-6 to acceptance level U2, sub-category C.

11.12.4 When option 6 (see 8.4.2.2) is specified, the tubes shall be subjected to ultrasonic testing for the detection of the laminar imperfections in accordance with EN 10246-14 to acceptance level U2.

11.13 Retests, sorting and reprocessing

For retest, sorting and reprocessing the requirements of EN 10021shall apply.

12 Marking

12.1 Marking to be applied

The marking shall be indelibly marked on each tubes at least at one end. For tubes with outside diameter D ≤ 51 mm the marking on tubes, may be replaced by marking on a label attached to the bundle or box.

The marking shall include the following information:

— the manufacturer's name or trade mark ;

— the number of this European standard and the steel name (see 5.2);

— the test category;

— the category conformity indicator if applicable (see , 7.3.1 and 7.3.3)

— the cast number or a code number;

— the mark of the inspection representative;

— an identification number (e.g. order or item number) which permits the correlation of the product or delivery unit to the related document.

Example of marking:

X - EN 10217-4 - P265NL - TC1 - C2 - Y - - Z_1 - Z_2

where:

— X is the manufacturer's mark;

— TC1 is the designation of the test category 1;

— C2 is the category conformity indicator, if applicable (see clause 7.3.1 and 7.3.3)

— Y is the cast number or a code number;

— Z_1 is the mark of the inspection representative;

— Z_2 is the identification number;

12.2 Additional marking

Option 15: *Additional marking, as agreed upon at the time of enquiry and order, shall be applied.*

13 protection

The tubes shall be delivered without a temporary protective coating.

Option 16: *A temporary protective coating or durable coating and/or lining shall be applied.*

Annex ZA
(informative)

Clauses of this European Standard addressing essential requirements or other provisions of EU Directives

This European Standard 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.

Warning: Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this European Standard.

The clauses of this European Standard are likely to support the essential requirements of section 4 of annex 1, “Essential safety requirements” of the Pressure Equipment Directive 97/23/EC.

Compliance with this European Standard provides one means of conforming with the specific essential requirements of the Directive concerned

Bibliography

EN 473, *Non destructive testing - Qualification and certification of NDT personnel - General principles*

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