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English version

Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 1: Non-alloy steel tubes with specified room temperature properties

(includes amendment A1:2004)

Tubes sans soudure en acier pour service sous pression -
Conditions techniques de livraison - Partie 1: Tubes en
acier non allié avec caractéristiques spécifiées à
température ambiante
(inclut l'amendement A1:2004)

Nahtlose Stahlrohre für Druckbeanspruchungen -
Technische Lieferbedingungen - Teil 1: Rohre aus
unlegierten Stählen mit festgelegten Eigenschaften bei
Raumtemperatur
(enthält Änderung A1:2004)

This European Standard was approved by CEN on 25 April 2002, and amendment A1 was approved by CEN on 2 January 2004.

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.

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

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

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Foreword

This document (EN 10216-1:2002) 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of an identical text or by endorsement, at the latest by November 2002, and conflicting national standards shall be withdrawn at the latest by November 2002.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 10216 are:

Part 2 : Non-alloy and alloy steels tubes with specified elevated temperature properties

Part 3 : Alloy fine grain steel tubes

Part 4 : Non-alloy and alloy steel tubes with specified low temperature properties

Part 5 : Stainless steel tubes

Another European Standard series covering tubes for pressure purposes is:

EN 10217: Welded 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.

Foreword to amendment A1

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1 Scope

This Part of EN 10216 specifies the technical delivery conditions for two qualities TR1 and TR2 of seamless tubes of circular cross section with specified room temperature properties made of non-alloy quality 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, *Definition 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*.

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

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

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 10246-7, *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 10256, *Non-Destructive Testing of steel tubes - Qualification and competence of level 1 and level 2 NDT personnel*.

prEN 10168¹⁾, *Iron and steel products - Inspection documents - List of information and description*

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

prEN 10266¹⁾, *Steel tubes, fittings and structural hollow sections - Symbols and definition of terms for use in product standards*

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*

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.*

3 Terms and definitions

For the purposes of this Part of EN 10216, the terms and definitions given in EN 10020, EN 10021, EN 10052, prEN 10266 and the following apply:

3.1

employer

organization for which a person works on a regular basis

NOTE The employer may be either the tube manufacturer or a third party organization providing non-destructive testing (NDT) services.

4 Symbols

For the purpose of this Part of EN 10216 the symbols given in prEN 10266 apply.

5 Classification and designation

5.1 Classification

According to the classification system in EN 10020, the steels are classified as non-alloy quality steels.

5.2 Designation

5.2.1 For the tubes covered by this Part of EN 10216 the steel designation consists of:

— the number of this Part of EN 10216;

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 for thickness ≤ 16 mm, expressed in MPa (see Table 4);
- plus either:
 - the alphanumeric TR1 for qualities without specified aluminium content, impact properties and specific inspection and testing requirements (see 9.1);

or:

- the alphanumeric TR2 for qualities with specified aluminium content, impact properties and specific inspection and testing requirements.

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 5);
- d) the designation of the steel grade in accordance with this Part of EN 10216 (see 5.2).

6.2 Options

A number of options are specified in this Part of EN 10216 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) delivery condition normalized or normalizing-formed (see 7.3.2);
- 2) restriction on copper and tin contents (see Table 2);
- 3) product analysis (see 8.2.2);
- 4) longitudinal impact testing at -10 °C for quality TR2 (see Table 4);
- 5) selection of leak-tightness test method (see 8.4.2.1);
- 6) Non-Destructive Testing for quality TR2 (see 8.4.2.2);
- 7) special end preparation (see 8.6);
- 8) exact lengths (see 8.7.3);
- 9) specific inspection for quality TR1 (see 9.1);
- 10) type of inspection document other than the standard document (see 9.2.1);
- 11) test unit restriction for tubes with $D \leq 76,1$ mm of quality TR2 (see 10.1.1);

- 12) wall thickness measurement away from the ends (see 11.5);
- 13) additional marking (see 12.2);
- 14) protection (see 13).

6.3 Example of an order

100 t of seamless tube with an outside diameter of 168.3 mm, a wall thickness of 4,5 mm, in accordance with EN 10216-1, made of steel grade P235TR2 with a 3.1.C inspection certificate in accordance with EN 10204.

100 t - Tube – 168,3 × 4,5 - EN 10216-1 - P235TR2 - Option 10: 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 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

7.3.2 The tubes shall be manufactured by a seamless process. The forming operations and delivery conditions are shown in Table 1.

Table 1 — Forming operations and delivery conditions

| Forming operation | Quality | Delivery condition |
|--|-------------|--|
| Hot formed | TR1 | As formed or normalized or normalising-formed ^a |
| | TR2 | Normalized or normalising-formed |
| Hot formed + cold finished | TR1 and TR2 | Normalized |
| ^a At the discretion of the manufacturer unless option 1 is specified. | | |

Option 1 : *The tube shall be supplied in normalized or normalising-formed delivery condition.*

8 REQUIREMENTS

8.1 General

When supplied in a delivery condition indicated in 7.3 and inspected in accordance with clauses 9, 10 and 11, the tubes shall conform to the requirements of this Part of EN 10216.

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 10216, 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.

Table 2 — Chemical composition (cast analysis) ^a in % by mass

| Steel grade | | Steel name | C max. | Si max. | Mn max. | P Max. | S max. | Cr ^b max. | Mo ^b max. | Ni ^b max. | Al ^{tot} min. | Cu ^{b,c} max. | Nb ^b max. | Ti ^b max. | V ^b max. | Cr+Cu+Mo+Ni ^b max. |
|--------------|--------------|------------|-----------|------------|------------|-----------|-----------|-------------------------|-------------------------|-------------------------|---------------------------|---------------------------|-------------------------|-------------------------|------------------------|----------------------------------|
| Steel number | Steel number | | | | | | | | | | | | | | | |
| P195TR1 | 1.0107 | | 0,13 | 0,35 | 0,70 | 0,025 | 0,020 | 0,30 | 0,08 | 0,30 | - | 0,30 | 0,010 | 0,04 | 0,02 | 0,70 |
| P195TR2 | 1.0108 | | 0,13 | 0,35 | 0,70 | 0,025 | 0,020 | 0,30 | 0,08 | 0,30 | 0,02 ^d | 0,30 | 0,010 | 0,04 | 0,02 | 0,70 |
| P235TR1 | 1.0254 | | 0,16 | 0,35 | 1,20 | 0,025 | 0,020 | 0,30 | 0,08 | 0,30 | - | 0,30 | 0,010 | 0,04 | 0,02 | 0,70 |
| P235TR2 | 1.0255 | | 0,16 | 0,35 | 1,20 | 0,025 | 0,020 | 0,30 | 0,08 | 0,30 | 0,02 ^d | 0,30 | 0,010 | 0,04 | 0,02 | 0,70 |
| P265TR1 | 1.0258 | | 0,20 | 0,40 | 1,40 | 0,025 | 0,020 | 0,30 | 0,08 | 0,30 | - | 0,30 | 0,010 | 0,04 | 0,02 | 0,70 |
| P265TR2 | 1.0259 | | 0,20 | 0,40 | 1,40 | 0,025 | 0,020 | 0,30 | 0,08 | 0,30 | 0,02 ^d | 0,30 | 0,010 | 0,04 | 0,02 | 0,70 |

^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 steelmaking process.

^b The content of these elements need not be reported unless intentionally added to the cast.

^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.

^d This requirement is not applicable provided the steel contains a sufficient amount of other nitrogen binding elements which shall be reported.

8.2.2 Product analysis

Option 3 : A product analysis for tubes of quality TR2 shall be supplied. For tubes with outside diameter less than or equal to 76, 1 mm this option applies only in combination with option 11.

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

Table 3 — Permissible deviations of 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 | $\leq 0,20$ | + 0,02 |
| Si | $\leq 0,40$ | + 0,05 |
| Mn | $\leq 1,40$ | + 0,10 |
| P | $\leq 0,025$ | + 0,005 |
| S | $\leq 0,020$ | + 0,005 |
| Al | $\geq 0,020$ | - 0,005 |
| Cr | $\leq 0,30$ | + 0,05 |
| Cu | $\leq 0,30$ | + 0,05 |
| Mo | $\leq 0,08$ | + 0,02 |
| Nb | $\leq 0,010$ | + 0,005 |
| Ni | $\leq 0,30$ | + 0,05 |
| Ti | $\leq 0,04$ | + 0,01 |
| V | $\leq 0,02$ | + 0,01 |

8.3 Mechanical properties

The mechanical properties of the tubes shall conform to the requirements of Table 4.

Table 4 — Mechanical properties ^a

| Steel grade | | Tensile properties | | | | | | Impact properties | | |
|----------------------|--------------|--|-------------|-------------|----------------------------------|-------------------------------------|----|---|-----------------|----|
| Steel name | Steel number | Upper yield strength R_{eH}^b min. for Wall Thickness T mm | | | Tensile Strength R_m | Elongation A min. % b^c | | Minimum average absorbed energy KV J at a temperature of °C ^c | | |
| | | T ≤ 16 | 16 < T ≤ 40 | 40 < T ≤ 60 | | l | t | 0 | -10 | 0 |
| | | Mpa * | Mpa * | Mpa * | Mpa * | | | | | |
| P195TR1 ^e | 1.0107 | 195 | 185 | 175 | 320 to 440 | 27 | 25 | - | - | - |
| P195TR2 | 1.0108 | 195 | 185 | 175 | 320 to 440 | 27 | 25 | 40 | 28 ^d | 27 |
| P235TR1 ^e | 1.0254 | 235 | 225 | 215 | 360 to 500 | 25 | 23 | - | - | - |
| P235TR2 | 1.0255 | 235 | 225 | 215 | 360 to 500 | 25 | 23 | 40 | 28 ^d | 27 |
| P265TR1 ^e | 1.0258 | 265 | 255 | 245 | 410 to 570 | 21 | 19 | - | - | - |
| P265TR2 | 1.0259 | 265 | 255 | 245 | 410 to 570 | 21 | 19 | 40 | 28 ^d | 27 |

^a For wall thickness greater than 60 mm the mechanical properties are subject to agreement.

^b See 11.2.

^c l = longitudinal t = transverse

^d **Option 4:** Additionally, longitudinal impact strength shall be verified at - 10 °C

^e Tubes made to these material grades are unlikely to support the essential requirements of Directive 97/23/EC unless other criteria are taken into account, see Annex I section 7.5 of this Directive

* 1 MPa = 1 N/mm²

8.4 Appearance and internal soundness

8.4.1 Appearance

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

8.4.1.2 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.

8.4.1.3 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.

8.4.1.4 Surface imperfections which encroach on the specified minimum wall thickness shall be considered defects and tubes containing these shall be deemed not to conform to this Part of this EN 10216.

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8.4.2 Internal soundness

8.4.2.1 Leak-tightness

The tubes shall pass a hydrostatic test (see 11.4.1) or electromagnetic test (see 11.4.2) for leak-tightness.

Unless the Option 5 is specified the choice of the test method is at the discretion of the manufacturer.

Option 5: The test method for verification of leak-tightness in accordance with 11.4.1 or 11.4.2 is specified by the purchaser.

8.4.2.2 Non-Destructive Testing

Option 6: The tubes of quality TR2 shall pass a non-destructive test for the detection of longitudinal imperfections in accordance with 11.7.

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 $30^{\circ} \begin{smallmatrix} +5^{\circ} \\ 0^{\circ} \end{smallmatrix}$ with a root face C of $1,6 \text{ mm} \pm 0,8 \text{ mm}$, except that for wall thickness T greater than 20 mm, an agreed alternative bevel may be specified.

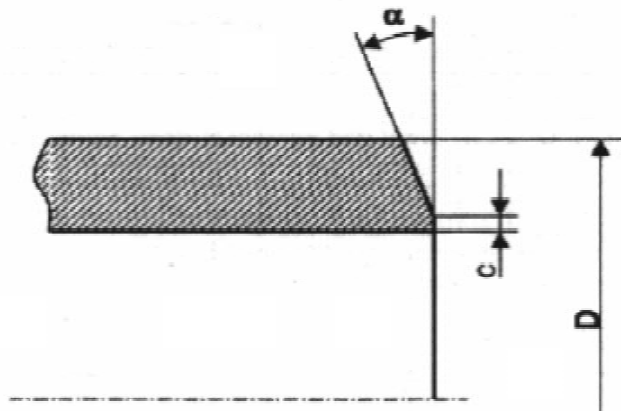


Figure 1 — Tube end bevel

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 5.

NOTE Dimensions which are different from those in Table 5 may be agreed.

8.7.2 Mass

For the mass per unit length the provisions of ENV 10220 apply.

8.7.3 Lengths

Unless Option 8 is specified the tubes are delivered in 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 and the length shall be specified at the time of enquiry and order. For the tolerances see 8.7.4.2.

Table 5 — Preferred dimensions

dimensions in mm

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| Outside diameter D | Wall thickness T | | | | | | | | | | | | | | | | | | | | | | | | |
|--------------------|---------------------|------|---|-----|-----|---|-----|-----|-----|-----|-----|---|-----|---|-----|-----|-----|---|-----|----|----|------|------|--|--|
| | Series ^a | | | 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 | | |
| | 1 | 2 | 3 | | | | | | | | | | | | | | | | | | | | | | |
| 10,2 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 12 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 12,7 | | | | | | | | | | | | | | | | | | | | | | | | |
| 13,5 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 14 | | | | | | | | | | | | | | | | | | | | | | | |
| | 16 | | | | | | | | | | | | | | | | | | | | | | | | |
| 17,2 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 18 | | | | | | | | | | | | | | | | | | | | | | | |
| | 19 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 20 | | | | | | | | | | | | | | | | | | | | | | | | |
| 21,3 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 22 | | | | | | | | | | | | | | | | | | | | | | | |
| | 25 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 25,4 | | | | | | | | | | | | | | | | | | | | | | | | |
| 26,9 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 30 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 31,8 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 32 | | | | | | | | | | | | | | | | | | | | | | | | |
| 33,7 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 35 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 38 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 40 | | | | | | | | | | | | | | | | | | | | | | | | |
| 42,4 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | 44,5 | | | | | | | | | | | | | | | | | | | | | | | |
| 48,3 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 51 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 54 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 57 | | | | | | | | | | | | | | | | | | | | | | | | |
| 60,3 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 63,5 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 70 | | | | | | | | | | | | | | | | | | | | | | | | |
| | 73 | | | | | | | | | | | | | | | | | | | | | | | | |
| 76,1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 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 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 559 | | | | | | | | | | | | | | | | | | | | | | | | |
| 610 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 660 | | | | | | | | | | | | | | | | | | | | | | | | |
| 711 | | | | | | | | | | | | | | | | | | | | | | | | | |

^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.

Table 5. concludes

dimensions in mm

| Outside diameter D Series ^a | | | Wall thickness T | | | | | | | | | | | | | | | | | | | |
|---|-------|-------|------------------|------|----|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|--|
| 1 | 2 | 3 | 16 | 17,5 | 20 | 22,2 | 25 | 28 | 30 | 32 | 36 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 80 | 90 | 100 | |
| 10,2 | | | | | | | | | | | | | | | | | | | | | | |
| | 12 | | | | | | | | | | | | | | | | | | | | | |
| | 12,7 | | | | | | | | | | | | | | | | | | | | | |
| 13,5 | | | | | | | | | | | | | | | | | | | | | | |
| | | 14 | | | | | | | | | | | | | | | | | | | | |
| | 16 | | | | | | | | | | | | | | | | | | | | | |
| 17,2 | | | | | | | | | | | | | | | | | | | | | | |
| | | 18 | | | | | | | | | | | | | | | | | | | | |
| | 19 | | | | | | | | | | | | | | | | | | | | | |
| | 20 | | | | | | | | | | | | | | | | | | | | | |
| 21,3 | | | | | | | | | | | | | | | | | | | | | | |
| | | 22 | | | | | | | | | | | | | | | | | | | | |
| | 25 | | | | | | | | | | | | | | | | | | | | | |
| | | 25,4 | | | | | | | | | | | | | | | | | | | | |
| 26,9 | | | | | | | | | | | | | | | | | | | | | | |
| | | 30 | | | | | | | | | | | | | | | | | | | | |
| | 31,8 | | | | | | | | | | | | | | | | | | | | | |
| | 32 | | | | | | | | | | | | | | | | | | | | | |
| 33,7 | | | | | | | | | | | | | | | | | | | | | | |
| | | 35 | | | | | | | | | | | | | | | | | | | | |
| | 38 | | | | | | | | | | | | | | | | | | | | | |
| | 40 | | | | | | | | | | | | | | | | | | | | | |
| 42,4 | | | | | | | | | | | | | | | | | | | | | | |
| | | 44,5 | | | | | | | | | | | | | | | | | | | | |
| 48,3 | | | | | | | | | | | | | | | | | | | | | | |
| | 51 | | | | | | | | | | | | | | | | | | | | | |
| | | 54 | | | | | | | | | | | | | | | | | | | | |
| | 57 | | | | | | | | | | | | | | | | | | | | | |
| 60,3 | | | | | | | | | | | | | | | | | | | | | | |
| | 63,5 | | | | | | | | | | | | | | | | | | | | | |
| | 70 | | | | | | | | | | | | | | | | | | | | | |
| | | 73 | | | | | | | | | | | | | | | | | | | | |
| 76,1 | | | | | | | | | | | | | | | | | | | | | | |
| | | 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 | | | | | | | | | | | | | | | | | | | | | | |
| | | 559 | | | | | | | | | | | | | | | | | | | | |
| 610 | | | | | | | | | | | | | | | | | | | | | | |
| | | 660 | | | | | | | | | | | | | | | | | | | | |
| 711 | | | | | | | | | | | | | | | | | | | | | | |

^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.

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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 6.

Out-of-roundness is included in the tolerances on outside diameter and eccentricity is included in the tolerances on wall thickness.

Table 6 — Tolerances on outside diameter and on wall thickness

| Outside diameter D mm | Tolerances on D | Tolerances on T for a T/D ratio | | | |
|--------------------------|---|--|--------------------|-------------------|---------------------|
| | | ≤ 0,025 | > 0,025 ≤ 0,050 | > 0,050 ≤ 0,10 | > 0,10 |
| D ≤ 219,1 | ± 1% or ± 0,5 mm whichever is the greater | ± 12,5 % or ± 0,4 mm whichever is the greater | | | |
| D > 219,1 | | ± 20 % | ± 15 % | ± 12,5 % | ± 10 % ^a |

^a For outside diameters D ≥ 355,6 mm it is permitted to exceed the upper wall thickness locally by a further 5% of the wall thickness T

8.7.4.2 Tolerances on exact lengths

The tolerances for exact lengths shall be as given in Table 7.

Table 7 — Tolerances on exact lengths

| Length L | Tolerance on exact length |
|-------------------|---------------------------|
| L ≤ 6000 | +10 0 |
| 6000 < L ≤ 12 000 | +15 0 |
| L > 12 000 | +by agreement 0 |

dimensions in mm

9 INSPECTION

9.1 Types of inspection

Conformity to the requirements of the order, for tubes in accordance with this Part EN 10216, shall be checked by:

- non-specific inspection for quality TR1;
- specific inspection for quality TR2.

When an inspection document 3.1.B is specified for material of quality TR2, the material manufacturer shall state in the confirmation of the order whether he is operating according to a "quality-assurance system", certified by a competent Body established within the Community, and having undergone a specific assessment for materials.

NOTE See the Directive 97/23/EC Annex I section 4.3 third paragraph.

Option 9: Specific inspection shall be carried out for quality TR1.

9.2 Inspection documents

9.2.1 Types of inspection documents

The following inspection documents, in accordance with EN 10204, shall be issued;

- test report 2.2 for quality TR1;
- inspection certificate 3.1.B for quality TR2.

Option 10: One of the following inspection documents, specified by the purchaser, shall be issued:

- for quality TR1 if specific inspection is ordered, an inspection document type 3.1.A, 3.1.B, 3.1.C or 3.2;
- for quality TR2, an inspection document 3.1.A, 3.1.C or 3.2.

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.

NOTE Document 3.1.A is not acceptable for compliance with the Directive 97/23/EC.

9.2.2 Content of inspection documents

9.2.2.1 The content of the inspection document shall be in accordance with prEN 10168 as shown in **9.2.2.2** and **9.2.2.3**.

In all types of inspection documents a statement on the conformity of the products delivered with the requirements of this specification and the order shall be included.

9.2.2.2 For tubes supplied with non-specific inspection the test report shall contain the following codes and information:

- A – commercial transactions and parties involved;
- B – description of products to which the inspection document applies;
- C02 – direction of test pieces;
- C10–C13 – tensile test;
- C71–C92 – chemical composition;
- D01 – marking and identification, surface appearance, shape and dimensional properties;
- D02–D99 – leak-tightness test;
- Z – validation

9.2.2.3 For tubes supplied with specific inspection 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; |
| C02–C03 | direction of test pieces and testing temperature; |
| C10–C13 | tensile test; |
| C40–C43 | impact test, if applicable; |
| 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 if applicable; |
| Z | validation |

In addition for inspection document 3.1B the manufacturer shall state the references to the certificate (see 9.1) of the appropriate “quality-assurance system”, if applicable.

9.3 Summary of inspection and testing

Inspection and testing shall be carried out as stated in Tables 8 and 9 for tubes of quality TR1 or TR2 respectively.

Table 8 — Summary of inspection and testing for quality TR1

| Type of inspection and test | | Frequency of testing | | Refer to |
|-----------------------------|--|---|---------------------|----------------|
| | | Non-specific inspection | Specific inspection | |
| Mandatory tests | Cast analysis | One representative result per delivery item | One per cast | 8.2.1 and 11.1 |
| | Tensile test | | One per test unit | 8.3 and 11.2 |
| | Leak-tightness test | Each tube | | 11.4 |
| | Dimensional inspection | See 11.5 | | |
| | Visual examination | See 11.6 | | |
| Optional test | Wall thickness measurement away from tube ends (Option 12) | See 11.5 | | |

Table 9 — Summary of inspection and testing for quality TR2

| Type of inspection and test | | Frequency of testing | Refer to |
|-----------------------------|--|----------------------|----------------|
| Mandatory tests | Cast analysis | One per cast | 8.2.1 and 11.1 |
| | Tensile test | One per test unit | 8.3 and 11.2 |
| | Impact test at 0 °C | | 8.3 and 11.3 |
| | Leak-tightness test | Each tube | 11.4 |
| | Dimensional inspection | See 11.5 | |
| | Visual examination | See 11.6 | |
| Optional tests | Product analysis (Option 3) | One per cast | 8.2.2 and 11.1 |
| | Longitudinal impact test at -10 °C (Option 4) | One per test unit | 8.3 and 11.3 |
| | Wall thickness measurement away from tube ends (Option 12) | See 11.5 | |
| | NDT for detection of longitudinal imperfections (Option 6) | Each tube | 11.7 |

10 SAMPLING

10.1 Frequency of tests

10.1.1 Test unit

In case of specific inspection, a test unit shall comprise :

- **Quality TR1** : Tubes of the same specified outside diameter and wall thickness, the same steel grade, the same manufacturing process and, if applicable, the same normalizing treatment in a continuous furnace or heat treated in the same furnace charge in a batch-type furnace.
- **Quality TR2** : Tubes of the same specified outside diameter and wall thickness, the same steel grade, the same cast, the same manufacturing process and, if applicable, the same normalising treatment in a continuous furnace or heat treated in the same furnace charge in a batch-type furnace. Tubes with specified outside diameter less than or equal to 76.1 mm need not be separated by cast unless option 11 is specified.

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

Option 11: Tubes with specified outside diameter less than or equal to 76,1 mm shall be separated by cast for quality TR2 .

Table 10 — Number of tubes per test unit

| Outside diameter D (mm) | Maximum number of tubes per test unit | |
|------------------------------|---------------------------------------|-------------|
| | Quality TR1 | Quality TR2 |
| $D \leq 114,3$ | 400 | 200 |
| $114,3 < D \leq 323,9$ | 200 | 100 |
| $D > 323,9$ | 100 | 50 |

10.1.2 Number of sample tubes per test unit

One sample tube shall be taken from each test unit.

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 thickness of the tube at the same location as 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 test

The test pieces for tensile test shall be prepared in accordance with 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;

for 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.

10.2.2.3 Test pieces for impact test

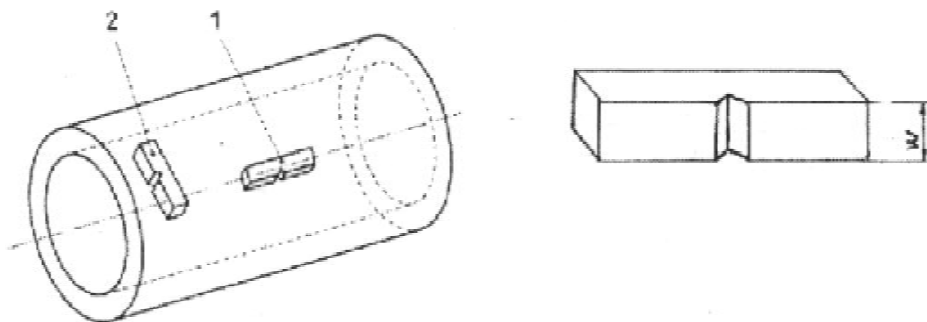
Three standard Charpy V-notch test pieces shall be prepared in accordance with EN 10045-1. If the wall thickness is such that standard test pieces cannot be produced without flattening of the section, then test pieces of width less than 10 mm, but not less than 5 mm shall be prepared; the largest obtainable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

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

Unless otherwise specified (see Option 4), 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:

$$D_{\min} = (T-5) + [756,25 / (T-5)] \quad (1)$$

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 cases of dispute the method used shall be agreed between manufacturer and purchaser taking into account CR 10261.

11.2 Tensile test

The test shall be carried out at room temperature in accordance with EN 10002-1, and the following shall be 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 $5,65 \cdot \sqrt{S_0}$; if a non-proportional test piece is used, the percentage elongation value shall be converted to the value for a gauge length $L_0 = 5,65 \cdot \sqrt{S_0}$ using the conversion Tables in EN ISO 2566-1.

11.3 Impact test

11.3.1 The test shall be carried out in accordance with EN 10045-1 at 0 °C and, if option 4 is specified, at -10 °C.

11.3.2 The mean value of the three test pieces shall meet the requirements given in Table 4. One individual value may be below the specified value, provided that it is not less than 70 % of that value.

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

$$KV_c = \frac{10 \times KV_p}{W} \quad (2)$$

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 11.3.2.

11.3.4 If the requirements of 11.3.2 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 value;
- not more than two of the six individual values may be lower than the specified minimum value;
- not more than one of the six individual values may be lower than 70 % of the specified minimum average value.

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

11.4 Leak tightness test

11.4.1 Hydrostatic test

The hydrostatic test shall be carried out at a test pressure of 70 bar²⁾ or at a test pressure P calculated using the following equation, whichever is lower:

$$P = 20 \frac{S \times T}{D} \quad (3)$$

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 specified 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 a outside diameter D less than or equal to 457 mm and for not less than 10 s for tubes with a outside diameter D greater than 457 mm.

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

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

11.4.2 Electromagnetic test

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

11.5 Dimensional inspection

Specified dimensions, including straightness, shall be verified.

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

2) 1 bar = 100 kPa.

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

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

11.6 Visual examination

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

11.7 Non-Destructive Testing

When option 6 is specified, the tubes of quality TR2 shall be subjected to a Non-Destructive testing for the detection of longitudinal imperfections in accordance with EN 10246-3, EN 10246-5 or EN 10246-7 to acceptance level 3, sub-category C, where applicable.

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

11.8 Retest, sorting and reprocessing

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

12 MARKING

12.1 Marking to be applied

The marking shall be indelibly marked on each tube at least at one end. For tubes with outside diameter $D \leq 51$ mm the marking on tubes may be replaced by the 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);

In addition in case of specific inspection

- the cast number or a code number;
- the mark of the inspection representative;
- an identification number (e.g. order or item number), which permit the correlation of the product or delivery unit to related documents.

Example of marking:

X – EN 10216-1 - P265TR2 - Y - Z₁ - Z₂

where

- X is the manufacturer's mark;
- Y is the cast number or the code number;
- Z₁ is the mark of the inspection representative;
- Z₂ is the identification number.

12.2 Additional marking

Option 13: *Additional marking, as agreed upon at the time of the enquiry and order, shall be applied.*

13 PROTECTION

The tubes shall be delivered without a temporary protective coating.

Option 14: *A temporary protective coating or durable coating and/or lining shall be applied.*

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 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 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.

Table ZA-1 — Correspondence between this European Standard and the essential requirements of the EU Directive 97/23/EC

| Clauses/sub-clauses of this EN | Essential Requirements (ERs) of the Directive 97/23/EC | Qualifying remarks/Notes |
|--------------------------------|--|--|
| 8.3 | Annex I, 4.1a | Appropriate material properties |
| 7.3 and 8.4 | Annex I, 4.1d | Suitable for the processing procedures |
| 9 and 10 | Annex I, 4.3 | Documentation |

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

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Bibliography

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