
**Nevarjene jeklene cevi za tlačne posode - Tehnični dobavni pogoji - 2. del:
Nelegirane in legirane jeklene cevi s specificiranimi lastnostmi za delo pri
povišanih temperaturah**

Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties

Nahtlose Stahlrohre für Druckbeanspruchungen - Technische Lieferbedingungen - Teil 2: Rohre aus unlegierten und legierten Stählen mit festgelegten Eigenschaften bei erhöhten Temperaturen

Tubes sans soudure en acier pour service sous pression - Conditions techniques de livraison - Partie 2: Tubes en acier non allié et allié avec caractéristiques spécifiées à température élevée

Ta slovenski standard je istoveten z: EN 10216-2:2013+A1:2019

ICS:

23.020.32	Tlačne posode	Pressure vessels
77.140.75	Jeklene cevi in cevni profili za posebne namene	Steel pipes and tubes for specific use

SIST EN 10216-2:2014+A1:2020 **en,fr,de**

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EUROPEAN STANDARD

EN 10216-2:2013+A1

NORME EUROPÉENNE

EUROPÄISCHE NORM

December 2019

ICS 23.040.10; 77.140.75

Supersedes EN 10216-2:2013

English Version

Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties

Tubes sans soudure en acier pour service sous pression - Conditions techniques de livraison - Partie 2:
Tubes en acier non allié et allié avec caractéristiques spécifiées à température élevée

Nahtlose Stahlrohre für Druckbeanspruchungen - Technische Lieferbedingungen - Teil 2: Rohre aus unlegierten und legierten Stählen mit festgelegten Eigenschaften bei erhöhten Temperaturen

This European Standard was approved by CEN on 17 August 2013 and includes Amendment 1 approved by CEN on 23 September 2019.

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 10216-2:2013+A1:2019) has been prepared by Technical Committee CEN/TC 459 SC/10 "Steel tubes, and iron and steel fittings", 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of an identical text or by endorsement, at the latest by June 2020, and conflicting national standards shall be withdrawn at the latest by June 2020.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document includes Amendment 1 approved by CEN on 23 September 2019.

This document supersedes A1 EN 10216-2:2013 A1.

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1.

For the list of the most significant technical changes that A1 were made in EN 10216-2:2013 A1, see Annex B.

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.

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This European Standard consists of the following parts, under the general title "Seamless steel tubes for pressure purposes – Technical delivery conditions":

- *Part 1: Non-alloy steel tubes with specified room temperature properties*
- *Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties (the present document)*
- *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 – Technical delivery conditions*

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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1 Scope

This European Standard specifies the technical delivery conditions in two test categories for seamless tubes of circular cross section, with specified elevated temperature properties, made of non-alloy and alloy steel.

This Part of EN 10216 may also be applied for tubes of non-circular cross section; necessary modification should be agreed at the time of enquiry and order.

NOTE Once this standard is published in the Official Journal of the European Union (OJEU) under Directive 2014/68/EU, presumption of conformity to the Essential Safety Requirements (ESR) of Directive 2014/68/EU is limited to technical data of materials in this standard and does not presume adequacy of the material to a specific item of equipment. Consequently, the assessment of the technical data stated in this material standard against the design requirements of this specific item of equipment to verify that the ESRs of the Pressure Equipment Directive are satisfied, needs to be done by the designer or manufacturer of the pressure equipment, taking also into account the subsequent manufacturing processes which may affect properties of the base materials.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

- EN 10020:2000 ^(A1), *Definitions and classification of grades of steel*
- EN 10021:2006 ^(A1), *General technical delivery requirements for steel products*
- EN 10027-1, *Designation systems for steels - Part 1: Steel names*
- <https://standards.iteh.ai/catalog/standards/sist/93bb9132-bd07-4477-82fe-2014a1-2020>
- EN 10027-2, *Designation systems for steels - Part 2: Numerical system*
- EN 10168:2004, *Steel products - Inspection documents - List of information and description*
- EN 10204:2004, *Metallic products - Types of inspection documents*
- EN 10220, *Seamless and welded steel tubes - Dimensions and masses per unit length*
- EN 10266:2003 ^(A1), *Steel tubes, fittings and structural hollow sections - Symbols and definitions of terms for use in product standards*
- CEN/TR 10261, *Iron and steel - Review of available methods of chemical analysis*
- EN ISO 148-1:2010, *Metallic materials - Charpy pendulum impact test - Part 1: Test method (ISO 148-1:2009)*
- EN ISO 377:2013, *Steel and steel products - Location and preparation of samples and test pieces for mechanical testing (ISO 377:2013)*
- EN ISO 2566-1, *Steel - Conversion of elongation values - Part 1: Carbon and low-alloy steels (ISO 2566-1)*
- EN ISO 4885:2018, *Ferrous materials - Heat treatments - Vocabulary (ISO 4885:2018)* ^(A1)
- EN ISO 6892-1:2009, *Metallic materials - Tensile testing - Part 1: Method of test at room temperature (ISO 6892-1:2009)*

EN ISO 6892-2:2011, *Metallic materials - Tensile testing - Part 1: Method of test at elevated temperature (ISO 6892-2:2011)*

EN ISO 8492:2013 ^{A1}, *Metallic materials - Tube - Flattening test (ISO 8492)*

EN ISO 8493:2004 ^{A1}, *Metallic materials - Tube - Drift expanding test (ISO 8493)*

EN ISO 8495:2013 ^{A1}, *Metallic materials - Tube - Ring expanding test (ISO 8495)*

EN ISO 8496:2013 ^{A1}, *Metallic materials - Tube - Ring tensile test (ISO 8496)*

EN ISO 10893-1, *Non-destructive testing of steel tubes - Part 1: Automated electromagnetic testing of seamless and welded (except submerged arc-welded) steel tubes for the verification of hydraulic leak-tightness (ISO 10893-1)*

EN ISO 10893-3, *Non-destructive testing of steel tubes - Part 3: Automated full peripheral flux leakage testing of seamless and welded (except submerged arc-welded) ferromagnetic steel tubes for the detection of longitudinal and/or transverse imperfections (ISO 10893-3)*

EN ISO 10893-8, *Non-destructive testing of steel tubes - Part 8: Automated ultrasonic testing of seamless and welded steel tubes for the detection of laminar imperfections (ISO 10893-8)*

EN ISO 10893-10, *Non-destructive testing of steel tubes - Part 10: Automated full peripheral ultrasonic testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of longitudinal and/or transverse imperfections (ISO 10893-10)*

EN ISO 14284:2002, *Steel and iron - Sampling and preparation of samples for the determination of chemical composition (ISO 14284:1996)*

ISO 11484:2009, *Steel products - Employer's qualification system for non-destructive testing (NDT) personnel*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 10020, EN 10021, ^{A1} EN ISO 4885 ^{A1} and EN 10266 and the following apply.

3.1

test category

classification that indicates the extent and level of inspection and testing

3.2

employer

organization for which a person works on a regular basis

Note 1 to entry: The employer may be either the tube manufacturer or supplier or a third party organization providing Non-Destructive Testing (NDT) services.

4 Symbols

For the purposes of this document, the symbols given in EN 10266 and the following apply:

- d specified inside diameter
- d_{min} specified minimum inside diameter
- T_{min} specified minimum wall thickness
- D_c calculated outside diameter
- d_c calculated inside diameter
- T_c calculated wall thickness
- TC test category

5 Classification and designation

5.1 Classification

In accordance with the classification system in EN 10020, the steel grades P195GH, P235GH and P265GH are classified as non-alloy quality steels and the other steel grades are classified as alloy special steels.

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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;

or:

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

5.2.2 The steel name of non-alloy steel grades is designated by:

- the capital letter P for pressure purposes;
- the indication of the specified minimum yield strength at room temperature for wall thickness less than or equal to 16 mm, expressed in MPa (see Table 4);
- the symbols GH for elevated temperature.

5.2.3 The steel name of alloy steel grades is designated by the chemical composition (see Table 2) and the symbols for the heat treatment, where specified in column 3 and footnote c of Table 1.

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 or a set of dimensions covered by Option 11) (see Table 6);
- d) the designation of the steel grade in accordance with this Part of EN 10216 (see 5.2);
- e) the test category (TC) for non-alloy steel (see 9.3).

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) Cold finishing (see 7.2.2);
- 2) restriction on copper and tin content (see Table 2);
- 3) product analysis (see 8.2.2);
- 4) verification of impact energy (see Table 4);
- 5) verification of longitudinal impact energy at -10° C for non-alloy steel grades (see Table 4);
- 6) verification of elevated temperature properties (see 8.3.2);
- 7) selection test method for verification of leak-tightness (see 8.4.2.1);
- 8) Non-Destructive Testing for test category 2 tubes for detection of transverse imperfections (see 8.4.2.2);
- 9) Non-Destructive Testing for test category 2 tubes for detection of laminar imperfections (see 8.4.2.2);
- 10) special ends preparation (see 8.6);
- 11) set of dimensions other than D and T (see 8.7.1);
- 12) exact lengths (see 8.7.3);
- 13) the type of inspection certificate 3.2 other than the standard document (see 9.2.1);
- 14) test pressure for hydrostatic leak-tightness test (see 11.8.1);
- 15) wall thickness measurement away from the ends (see 11.9);

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16) Non-Destructive Testing method (see 11.11.1);

17) additional marking (see 12.2);

18) protection (see Clause 13).

6.3 Examples of an order**6.3.1 Example 1**

100 t of seamless tube with an outside diameter of 168,3 mm, a wall thickness of 4,5 mm, in accordance with EN 10216-2, made of steel grade P265GH, to test category 1 with a 3.2 inspection certificate in accordance with EN 10204:

EXAMPLE 100 t - Tube - 168,3 x 4,5 - EN 10216-2 - P265GH - TC1 - Option 13: 3.2

6.3.2 Example 2

100 m of seamless tube with a minimum inside diameter of 240 mm, a minimum wall thickness of 40 mm in accordance with $\overline{A_1}$ EN 10216-2 $\overline{A_1}$, made of steel grade 10CrMo9-10, with a 3.2 inspection certificate in accordance with EN 10204:

EXAMPLE 100 m - Tube - d_{\min} 240 x T_{\min} 40 - EN 10216-2 - 10CrMo9-10 - Option 13: 3.2

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7 Manufacturing process**7.1 Steel making process**

The steelmaking process is at the discretion of the manufacturer with the exception that the open hearth (Siemens-Martin) process shall not be employed unless in combination with a secondary steelmaking or ladle refining process.

Steels shall be fully killed.

NOTE This excludes the use of rimming, balanced or semi-killed steel.

7.2 Tube manufacture and delivery conditions

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

The qualification shall be in accordance with ISO 11484 or, at least, an equivalent to it.

It is recommended that the level 3 personnel be certified in accordance with EN ISO 9712 or, at least, an equivalent to it.

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

NDT operations shall be authorized 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 ISO 9712 and ISO 11484.

7.2.2 The tubes shall be manufactured by a seamless process.

Unless option 1 is specified, the tubes may be either hot or cold finished at the discretion of the manufacturer. The terms “ hot finished “ and “ cold finished “ apply to the condition of the tube before it is heat treated in accordance with \square_{A1} 7.2.3 \square_{A1} .

Option 1: The tubes shall be cold finished before heat treatment.

7.2.3 The tubes shall be supplied in the relevant heat treatment conditions as specified in Table 1.

Table 1 — Heat treatment conditions

Steel grade		Heat treatment ^a	Austenitizing		Tempering	
Steel name	Steel number		Temperature °C	Cooling Medium	Temperature °C	Cooling medium
P195GH	1.0348	+N ^b	880 to 940	air	-	-
P235GH	1.0345	+N ^b	880 to 940	air	-	-
P265GH	1.0425	+N ^b	880 to 940	air	-	-
20MnNb6	1.0471	+N ^b	900 to 960	air	-	-
16Mo3	1.5415	+N ^b	890 to 950	air	-	-
8MoB5-4	1.5450	+N ^b	920 to 960	air	-	-
14MoV6-3	1.7715	+NT ^{b,c}	930 to 990	air	680 to 730	air
10CrMo5-5	1.7338	+NT ^{b,c}	900 to 960	air	650 to 750	air
13CrMo4-5	1.7335	+NT ^{b,c}	900 to 960	air	660 to 730	air
10CrMo9-10	1.7380	+NT ^{b,c}	900 to 960	air	680 to 750	air
11CrMo9-10	1.7383	+QT	900 to 960	air or liquid	680 to 750	air
25CrMo4	1.7218	+QT	860 to 900	air or liquid	620 to 680	air
20CrMoV13-5-5	1.7779	+QT	980 to 1030	air or liquid	680 to 730	air
15NiCuMoNb5-6-4	1.6368	+NT ^c	880 to 980	air	580 to 680	air
7CrWVMoNb9-6	1.8201	+NT ^d	1 040 to 1 080	air	730 to 780	air
7CrMoVTiB10-10	1.7378	+NT ^d	980 to 1 020	air	730 to 770	air
X11CrMo5+I	1.7362+I	+I	890 to 950	Furnace atmosphere	-	-
X11CrMo5+NT1	1.7362+NT 1	+NT1	930 to 980	Air	730 to 770	air
X11CrMo5+NT2	1.7362+NT 2	+NT2 ^c	930 to 980	air	710 to 750	air
X11CrMo9-1+I	1.7386+I	+I	950 to 980	Furnace atmosphere	-	-
X11CrMo9-1+NT	1.7386+NT	+NT ^c	890 to 950	air	720 to 800	air

Steel grade		Heat treatment ^a	Austenitizing		Tempering	
Steel name	Steel number		Temperature °C	Cooling Medium	Temperature °C	Cooling medium
X10CrMoVNb9-1	1.4903	+NT ^c	1 040 to 1 090	air	730 to 780	air
X10CrWMoVNb9-2	1.4901	+NT ^c	1 040 to 1 090	Air	730 to 780	air
X11CrMoWVNb9-1-1	1.4905	+NT ^c	1 040 to 1 080	Air	740 to 780	air
X20CrMoV11-1	1.4922	+NT ^c	1 020 to 1 080	air	730 to 780	air

^a +N = Normalizing, +NT = Normalizing + Tempering, +QT = Quenching + Tempering (air or liquid), +I = Isothermal Annealing.

^b Normalizing includes Normalizing Forming. Normalized Forming shall be carried out in a temperature range from 880 °C to 1 000 °C.

^c For these steel grades it may be necessary in the case of wall thickness T above 10 mm or $T/D > 0,15$ to apply quenching and tempering in order to achieve the intended structure and material properties. The decision shall be left to the discretion of the manufacturer but shall be stated to the customer at the time of enquiry and order. Steel tubes treated in such a way shall be designated by the steel name supplemented by the symbol "+QT".

^d For these steel grades it may be necessary in case of wall thickness T above 16 mm or $T/D > 0,15$ to apply quenching and tempering in order to achieve the intended structure and material properties. The decision shall be left to the discretion of the manufacturer but shall be stated to the customer at the time of enquiry and order. Steel tubes treated in such a way shall be designated by the steel name supplemented by the symbol "+QT".

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8 Requirements

8.1 General

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When supplied in a delivery condition indicated in 7.2 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.

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

When tubes are specified in the order by d , d_{min} or T_{min} the following formulae, with all terms in mm, shall apply for the calculation of outside diameter D_c , inside diameter d_c and wall thickness T_c , instead of D , d and T for the relevant requirements in 8.4.1.4, 10.2.2.2, 11.3, 11.8.1, 11.9, 11.11.4, 12.1 and Table 1, footnote c, Tables 4, 5, 8, 10, 13 and 14:

$$D_c = d + 2T \quad (1)$$

$$D_c = d_{min} + \frac{\text{tolerance} \cdot \text{of} \cdot d_{min}}{2} + 2T \quad (2)$$

$$d_c = d_{min} + \frac{\text{tolerance} \cdot \text{of} \cdot d_{min}}{2} \quad (3)$$

$$T_c = T_{min} + \frac{\text{tolerance} \cdot \text{of} \cdot T_{min}}{2} \quad (4)$$

For tolerances, see Tables 8, 9 and 10.

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.

When welding tubes produced in accordance with this Part of this 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.

8.2.2 Product analysis

Option 3: Product analysis for the tubes shall be supplied.

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

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