SLOVENSKI STANDARD
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Vroče izdelani votli konstrukcijski profili iz jekla - 3. del: Tehnični dobavni pogoji za jekla z visoko trdnostjo in vodoodporna

Hot finished steel structural hollow sections - Part 3: Technical delivery conditions for high strength and weather resistant steels

Warmgefertigte Hohlprofile für den Stahlbau - Teil 3: Technische Lieferbedingungen für Anwendungen im Maschinenbau

Profils creux de construction finis à chaud en aciers - Partie 3 : Conditions techniques de livraison pour des applications de construction mécanique

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Hot finished steel structural hollow sections - Part 3: Technical delivery conditions for high strength and weather resistant steels

Profils creux de construction finis à chaud en aciers - Partie 3 : Conditions techniques de livraison des aciers à haute limite élastique et des aciers à résistance améliorée à la corrosion atmosphérique

Warmgefertigte Hohlprofile für den Stahlbau - Teil 3: Technische Lieferbedingungen für höher- und wetterfeste Stähle

This European Standard was approved by CEN on 10 August 2020.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN 10210-3:2020) has been prepared by Technical Committee CEN/TC 459/SC 3 “Structural steels other than reinforcements”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2021, and conflicting national standards shall be withdrawn at the latest by March 2021.

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.

EN 10210 consists of the following parts:

— EN 10210-1, Hot finished steel structural hollow sections - Part 1: Technical delivery conditions

— EN 10210-2, Hot finished steel structural hollow sections - Part 2: Tolerances, dimensions and sectional properties

— EN 10210-3, Hot finished steel structural hollow sections - Part 3: Technical delivery conditions for high strength and weather resistant steels

It forms part of a series of standards on hollow sections together with EN 10219-1 to EN 10219-3.

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.

1 Scope

This document specifies technical delivery conditions for high strength and weather resistant hot-finished seamless, electric welded and submerged arc welded steel structural hollow sections of circular, square, rectangular or elliptical forms.

It applies to hollow sections formed hot, with or without subsequent heat treatment, or formed cold with subsequent heat treatment above 580 °C to obtain equivalent mechanical properties to those obtained in the hot formed product.

NOTE 1 The requirements for tolerances, dimensions and sectional properties are specified in EN 10210-2.

NOTE 2 The attention of users is drawn to the fact that whilst cold formed grades in EN 10219-3 can have equivalent mechanical properties to hot-finished grades in this document the sectional properties of square and rectangular hollow sections in EN 10210-2 and EN 10219-2 are not equivalent.

NOTE 3 A range of material grades is specified in this document and the user can select the grade most appropriate to the intended use and service conditions. The grades and mechanical properties of the finished hollow sections are generally comparable with those in EN 10025-4, EN 10025-5 and EN 10025-6.

NOTE 4 The requirements for seamless and welded steel structural hollow sections for use in offshore structures are covered in the EN 10225 series.

NOTE 5 Spiral welded hollow sections are expected to be used with caution in applications involving dynamic behaviour (fatigue stress) as, up to now, there is insufficient data regarding their performance.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1011-1, *Welding - Recommendations for welding of metallic materials - Part 1: General guidance for arc welding*

EN 1011-2, *Welding - Recommendations for welding of metallic materials - Part 2: Arc welding of ferritic steels*

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

EN 10021, *General technical delivery conditions for steel products*

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

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

EN 10160, *Ultrasonic testing of steel flat product of thickness equal or greater than 6 mm (reflection method)*

EN 10168, *Steel products - Inspection documents - List of information and description*

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

EN 10210-2, *Hot finished steel structural hollow sections - Part 2: Tolerances, dimensions and sectional properties*

CEN/TR 10261, *Iron and steel - European standards for the determination of chemical composition*

EN 10266, *Steel tubes, fittings and structural hollow sections - Symbols and definitions of terms for use in product standards*

EN ISO 148-1, *Metallic materials - Charpy pendulum impact test - Part 1: Test method (ISO 148-1)*

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

EN ISO 643, *Steels - Micrographic determination of the apparent grain size (ISO 643)*

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

EN ISO 4885, *Ferrous materials - Heat treatments - Vocabulary (ISO 4885)*

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

EN ISO 9606-1, *Qualification testing of welders - Fusion welding - Part 1: Steels (ISO 9606-1)*

EN ISO 9712, *Non-destructive testing - Qualification and certification of NDT personnel (ISO 9712)*

EN ISO 10893-2, *Non-destructive testing of steel tubes - Part 2: Automated eddy current testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of imperfections (ISO 10893-2)*

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 10893-6, *Non-destructive testing of steel tubes - Part 6: Radiographic testing of the weld seam of welded steel tubes for the detection of imperfections (ISO 10893-6)*

EN ISO 10893-7, *Non-destructive testing of steel tubes - Part 7: Digital radiographic testing of the weld seam of welded steel tubes for the detection of imperfections (ISO 10893-7)*

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 10893-9, *Non-destructive testing of steel tubes - Part 9: Automated ultrasonic testing for the detection of laminar imperfections in strip/plate used for the manufacture of welded steel tubes (ISO 10893-9)*

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 10893-11, *Non-destructive testing of steel tubes - Part 11: Automated ultrasonic testing of the weld seam of welded steel tubes for the detection of longitudinal and/or transverse imperfections (ISO 10893-11)*

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

EN ISO 14713-2:2009, *Zinc coatings - Guidelines and recommendations for the protection against corrosion of iron and steel in structures - Part 2: Hot dip galvanizing (ISO 14713-2:2009)*

EN ISO 15607, *Specification and qualification of welding procedures for metallic materials - General rules (ISO 15607)*

EN ISO 15609-1, *Specification and qualification of welding procedures for metallic materials - Welding procedure specification - Part 1: Arc welding (ISO 15609-1)*

EN ISO 15614-1, *Specification and qualification of welding procedures for metallic materials - Welding procedure test - Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys (ISO 15614-11)*

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

SNT TC-1A, *Personnel Qualification and Certification in Nondestructive Testing*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purpose of this document, the terms and definitions given in EN 10020, EN 10021, EN 10266 and EN ISO 4885 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1.1
hot finished
hollow sections formed hot, with or without subsequent heat treatment, or formed cold with subsequent heat treatment above 580 °C to obtain equivalent metallurgical conditions to those obtained in the hot formed product

3.1.2
cold forming
process where the forming to final shape of the welded hollow section is carried out at ambient temperature

Note 1 to entry: Circular hollow sections produced from normalized strip with a normalized weld seam and with a cold forming ratio of D/T ≥ 20 may be classified as hot-finished hollow sections.

3.1.3
thermomechanical forming
simultaneously performed forming process and heat treatment in which the final deformation from round to rectangular/square/elliptical hollow sections is carried out in a certain temperature range above 580 °C leading to a material condition with certain properties which cannot be achieved or repeated by heat treatment alone

Note 1 to entry: Thermomechanical rolling leading to the delivery condition M can include processes with an increased cooling rate with or without tempering including self-tempering but excluding direct quenching as well as quenching and tempering.

Note 2 to entry: In some publications, the word TMCP (Thermomechanical Control Process) is also used.

3.1.4
steel with improved atmospheric corrosion resistance
steel in which a certain number of alloying elements has been added in order to increase its resistance to atmospheric corrosion, by forming an auto-protective oxide layer on the base metal under the influence of weather conditions

Note 1 to entry: Steel with improved atmospheric corrosion resistance is often called weathering steel.

Note 2 to entry: Additional information for the use of steel with improved atmospheric corrosion resistance is given in Annex E.

3.1.5
quenching and tempering
process which consists of the following two steps:

— first quenching, where the steel is heated up above the AC3 temperature and then rapidly cooled down in liquids to create a process specific grain structure;

— afterwards tempering, during which the steel is heated up to a certain temperature to adjust the desired properties and cooled down in air afterwards

3.1.6
fine grain steel
steels with fine grain structure with an equivalent index of ferritic grain size ≥ 6

Note 1 to entry: For the determination of grain sizes except for +QT steels, see EN ISO 643.

3.1.7
hot-dip zinc coating
application of a zinc coating by immersing the prepared strip or hollow section in a molten bath containing a zinc content of at least 98%

3.2 Symbols

For the purposes of this document, the symbols defined in EN 10266 apply.

4 Classification and designation

4.1 Classification

4.1.1 Within the grades of steels given in Annex C and D five qualities M, ML, Q, QL and QL1 are specified. These differ in respect of the carbon, sulphur and phosphorus content, low temperature impact properties, production process, heat treatment and grain size.

In accordance with the classification system in EN 10020, all steel grades are alloy special steels.

4.1.2 Within the grades of steels given in Annex E, three qualities J0, J2 and K2 are specified. These differ in respect of specified impact requirements and limits on values of various elements.

In accordance with the classification system in EN 10020, all steel grades in Annex E are alloy special steels.

4.2 Designation

4.2.1 For the products covered by this document, the steel names are allocated in accordance with EN 10027-1; the steel numbers are allocated in accordance with EN 10027-2.

4.2.2 The designation of steel hollow sections consists of:

a) the number of this document (EN 10210-3);

b) the capital letter S for structural steel;

c) the indication of the minimum specified yield strength for thicknesses ≤ 16 mm expressed in MPa;

d) further designations for either:

1) thermomechanical formed structural steels:

i) capital letter M to indicate thermomechanical rolled with specified impact properties at −20 °C (see 6.5);

ii) capital letters ML for qualities with specified impact properties at −50 °C; or

2) structural steels in the quenched and tempered condition:

i) capital letter Q to indicate the quenched and tempered condition with specified impact properties at −20 °C (see 6.5);

ii) capital letters QL or QL1 for qualities with specified impact properties at −40 or −50 °C; or

3) steels with improved atmospheric corrosion resistance:

i) the characters J0 for the qualities with specified impact properties at 0 °C;

ii) the characters J2 or K2 for the qualities with specified impact properties at −20 °C; and

iii) the letter W (weather) for improved atmospheric corrosion resistance; and

e) the capital letter H to indicate hollow sections.

EXAMPLE 1 Hollow section made of structural steel (S) with a specified minimum yield strength for a thickness not greater than 16 mm of 460 MPa, quenched and tempered condition (Q), with a minimum impact energy value of 30 J at -20 °C, hollow section (H):

EN 10210-3 — S460QH

or

EN 10210-3 — 1.8608

EXAMPLE 2 Hollow section made of structural steel (S) with a specified minimum yield strength for a thickness not greater than 16 mm of 355 MPa, with a minimum impact energy value of 27 J at −20 °C (J2), weather resistant steel (W) hollow section (H):

EN 10210-3 — S355J2WH

or

EN 10210-3 — 1.8645

5 Information to be obtained by the manufacturer

5.1 Mandatory information

The following information shall be contained in the order document at the time of enquiry and order:

a) the quantity (mass or total length);

b) details of the product form:

1) HFCHS = hot finished circular hollow sections;

2) HFRHS = hot finished square or rectangular hollow sections;

3) HFEHS = hot finished elliptical hollow sections;

c) the name of the standard for dimensions and tolerances (EN 10210-2);

d) the dimensions and the type of length, length range or length (see EN 10210-2);

e) the steel designation (see 4.2).

5.2 Options

A number of options are specified in EN 10210-2 and this document. Those relevant to this part are listed below with appropriate clause references. 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 hollow sections shall be supplied in accordance with the basic specification.

3.1 Internal weld bead trimmed (see 6.4.2);

3.2 Empty (Option for EN 10219 series)

3.3 Product analysis (see 7.1.1);

3.4 Empty;

3.5 Tensile test in corner region (see 7.2.1);

3.6 Impact test in corner region (see 7.2.2).

3.7 Verification of impact properties for quality J0 (see 7.2.3);

3.8 The product shall have a chemical composition suitable for hot-dip-zinc coating (see 7.3.2);

3.9 Weld repairs to the body of structural steel hollow sections are permitted (see 7.4.4);

3.10 Full peripheral NDT (non-destructive testing) of circular tubes for imperfections - not possible for elliptical, rectangular, square and SAW (submerged arc welded) hollow sections (see 7.5);

3.11 Ultrasonic testing for laminar imperfections (see 7.5);

3.12 Inspection certificate 3.1 for steel grade S355J0WH of Annex E instead of a test report 2.2 (see 8.1);

3.13 Inspection certificate 3.2.

5.3 Example of an order

100 t hot finished square hollow section in accordance with EN 10210-2 with specified outside dimensions 100 mm × 100 mm and wall thickness of 8 mm of 12 m approximate length, grade S460QH according to this document and supplied with inspection certificate 3.1:

EXAMPLE 100 t – HFRHS – EN 10210-2 — 100 × 100 × 8 – approximate length 12 m EN 10210-3 — S460QH

6 Manufacturing process

6.1 General

Structural hot finished hollow sections of thermomechanical rolled and quenched and tempered steels shall conform to Annexes C and D and steels with improved atmospheric corrosion resistance shall conform to the requirements of Annex E.

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

6.2 Steel manufacturing process

6.2.1 The steel manufacturing process shall be at the discretion of the hollow section manufacturer with the exception that the open hearth (Siemens-Martin) process shall not be employed.

6.2.2 The method of deoxidation shall be as specified in Tables C.1, D.1 and E.1.

6.3 Grain structure

The steels grades given in Annexes C and D shall have a ferritic grain size equal to or finer than 6 when measured in accordance with EN ISO 643 (see 7.2.4).

6.4 Structural hollow section manufacturing process

6.4.1 Structural hollow sections shall be manufactured by a seamless or by a welding process (see informative Annex G, Table G.1). Welded sections manufactured by a continuous process shall not include the welds used to join the lengths of strip prior to forming the hollow section, except as permitted in 10.4.3.

6.4.2 Electric welded hollow sections shall be supplied with the external weld bead trimmed to an essentially flush condition. Trimming of the internal weld bead is at the discretion of the manufacturer unless Option 3.1 is specified.

Option 3.1 Electric welded hollow sections shall be supplied with the internal weld bead trimmed, the maximum height of the internal weld bead after trimming shall be agreed at the time of enquiry and order.

6.4.3 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 SNT TC-1A or EN ISO 9712.

It is recommended that the level 3 personnel be certified in accordance with EN ISO 9712 or ASNT.

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

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

NOTE The definition of levels 1, 2 and 3 can be found in the appropriate standards, e.g. EN ISO 9712 and ISO 11484.

6.5 Delivery condition

The products shall be delivered in the conditions indicated below:

— Qualities M and ML — thermomechanical formed,

— Qualities Q, QL and QL1 — quenched and tempered,

— Qualities J0W, J2W and K2W —improved atmospheric corrosions resistance.

7 Requirements

7.1 Chemical composition

7.1.1 The chemical composition determined by the cast analysis and reported by the steel producer shall comply with the requirements given in Tables C.1, D.1 or E.1.

The maximum carbon equivalent value (CEV) for all grades, based on the cast analyses, given in Tables C.2, D.2 and E.2 shall apply.

When determining the CEV, the following formula of the International Institute of Welding (IIW) shall be used:

$$CEV = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

In addition to the cast analysis the following option can be specified by the purchaser at the time of enquiry and order:

Option 3.3 For products supplied with specific inspection and testing, a product analysis shall be reported.

Deviations of the product analysis from the specified limits of the cast analysis shall be in accordance with Table 1.

7.1.2 When products are supplied with a control on Si e.g. for hot-dip zinc-coating there could be a need, for certain grades and thicknesses, to increase the content of other elements such as C and Mn, to achieve the required mechanical properties. In such cases, the maximum carbon equivalent values of Table C.2 to Table E.2 may be increased as follows:

— for Si ≤ 0,04 %, increase the value of the CEV by 0,02;

— for Si ≤ 0,25 %, increase the value of the CEV by 0,01.

Table 1 — Permissible deviations of the product analysis from the specified limits of the cast analysis specified in Tables C.1, D.1 and E.1

Element	Permissible maximum content in the cast analysis % by mass	Permissible deviation of the product analysis from specified limits for the cast analysis % by mass
C	≤ 0,20	+ 0,02
	> 0,20	+ 0,03
Si	≤ 0,60	+ 0,05
	> 0,60	+ 0,06
Mn	thermomechanical formed ≤ 2,10	+ 0,10
	quenched and tempered ≤ 1,70	+ 0,10
	weather ≤ 1,50	– 0,05 / + 0,10
P	thermomechanical formed ≤ 0,030, quenched and tempered ≤ 0,025	+ 0,005
	weather ≤ 0,035	+ 0,010
S	thermomechanical formed ≤ 0,025	+ 0,005
	quenched and tempered ≤ 0,015	+ 0,002
	weather ≤ 0,035	+ 0,010
Nb	≤ 0,060	+ 0,010
V	≤ 0,20	+ 0,02
Ti	≤ 0,03	+ 0,01
	> 0,03	+ 0,02
Cr	≤ 0,30	+ 0,05
	> 0,30	+ 0,10
Ni	≤ 0,80	+ 0,05
	> 0,80	+ 0,10
Mo	≤ 0,10	+ 0,03
	> 0,10	+ 0,04
Cu	thermomechanical formed, weather ≤ 0,35	±0,04
	thermomechanical formed, weather 0,35 < Cu ≤ 0,55	+ 0,07
	quenched and tempered ≤ 0,50	+ 0,05
N	thermomechanical formed, weather ≤ 0,025	+ 0,002
	quenched and tempered ≤ 0,020	+ 0,001
Al_{total}	≥ 0,020	– 0,005