SLOVENSKI STANDARD
SIST EN 10225-3:2019

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Nadomešča:
SIST EN 10225:2009

Konstrukcijska jekla za varjene konstrukcije naftnih ploščadi - Tehnični dobavni pogoji - 3. del: Vroče izdelani votli profili

Weldable structural steels for fixed offshore structures - Technical delivery conditions - Part 3: Hot finished hollow sections

Schweißgeeignete Baustähle für feststehende Offshore-Konstruktionen - Technische Lieferbedingungen - Teil 3: Warmgefertigte Hohlprofile

Aciers de construction soudables destinés à la fabrication de structures marines fixes - Conditions techniques de livraison - Partie 3 : Profils creux finis à chaud

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ICS:

75.180.10	Oprema za raziskovanje, vrtanje in odkopavanje	Exploratory, drilling and extraction equipment
77.140.10	Jekla za toplotno obdelavo	Heat-treatable steels
77.140.70	Jekleni profili	Steel profiles

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EUROPEAN STANDARD
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English Version

Weldable structural steels for fixed offshore structures - Technical delivery conditions - Part 3: Hot finished hollow sections

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This European Standard was approved by CEN on 23 December 2018.

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 10225-3:2019) has been prepared by Technical Committee CEN/TC 459 “ECISS - European Committee for Iron and Steel Standardization”[1], the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by November 2019, and conflicting national standards shall be withdrawn at the latest by November 2019.

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, together with EN 10225-1:2019, EN 10225-2:2019, and EN 10225-4:2019, supersedes EN 10225:2009.

This European Standard consists of the following parts, under the general title *'Weldable structural steels for fixed offshore structures – Technical delivery conditions*':

— Part 1: Plates

— Part 2: Sections

— Part 3: Hot finished hollow sections

— Part 4: Cold formed welded hollow sections

In comparison to the previous edition following technical changes were made:

— split of the standard in four parts;

— the steel names were adapted to EN 10027-1;

— former grades of group 3 are no longer listed, new options with the same enhanced properties have been introduced (*Options 2* and *3*);

— an informative Annex E was added for the prequalification of steels for fixed offshore structures in arctic areas.

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, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Through its subcommittee SC 3 “Structural steels other than reinforcements” (secretariat: DIN)

1 Scope

This document specifies requirements for weldable structural steels made of hot finished seamless and high frequency welded hollow sections to be used in the fabrication of fixed offshore structures.

The following thickness limitations are given in this standard:

— for seamless hollow sections up to and including 65 mm;

— for HFW hollow sections up to and including 25,4 mm.

Greater thicknesses can be agreed, provided the technical requirements of this European Standard are maintained.

This European Standard is applicable to steels for offshore structures, designed to operate in the offshore sector but not to steels supplied for the fabrication of subsea pipelines, risers, process equipment, process piping and other utilities. It is primarily applicable to the North Sea Sector, but may also be applicable in other areas provided that due consideration is given to local conditions e.g. design temperature.

NOTE This document has an informative Annex E on the prequalification of steels for fixed offshore structures in arctic areas.

Minimum yield strengths up to 770 MPa are specified together with impact properties at temperatures down to –40 °C.

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 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 10079, *Definition of steel products*

EN 10164, *Steel products with improved deformation properties perpendicular to the surface of the product — Technical delivery conditions*

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

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

EN 10210-2, *Hot finished structural hollow sections of non-alloy and fine grain steels — Part 2: Tolerances, dimensions and sectional properties*

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

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 4063, *Welding and allied processes — Nomenclature of processes and reference numbers (ISO 4063)*

EN ISO 4136, *Destructive tests on welds in metallic materials — Transverse tensile test (ISO 4136)*

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

EN ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method (ISO 6507-1)*

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

EN ISO 6947, *Welding and allied processes — Welding positions (ISO 6947)*

EN ISO 8492, *Metallic materials — Tube — Flattening test (ISO 8492)*

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 10893-5, *Non-destructive testing of steel tubes — Part 5: Magnetic particle inspection of seamless and welded ferromagnetic steel tubes for the detection of surface imperfections (ISO 10893-5)*

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 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 15614-1)*

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

ISO 12135, *Metallic materials — Unified method of test for the determination of quasistatic fracture toughness*

ISO 15653, *Metallic materials — Method of test for the determination of quasistatic fracture toughness of welds*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 10020, EN 10021, EN ISO 4885, EN 10079 and EN ISO 14284 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 http://www.iso.org/obp

3.1
continuous casting process route (concast)
steel produced by a continuous casting process route

3.2
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.

3.3
high frequency welded hollow section (HFW)
hollow long product, open at both ends, of circular, elliptical, square or rectangular section, made by pressure welding in a continuous or non-continuous process, in which strip is formed cold into a hollow profile and the seam weld made by heating the adjacent edges through the resistance to the passage of a high frequency current and pressing the edges together

Note 1 to entry: The electric current may be applied by direct electrode contact or by induction or conduction. After welding, the hollow section is further hot finished (see 3.4).

3.4
hot finished
for this standard: hollow sections formed hot, with or without subsequent heat treatment, or formed cold with subsequent heat treatment equal to or greater than AC3 to obtain equivalent metallurgical conditions to those obtained in the hot formed product

3.5
intermediary
organization that is supplied with products by the manufacturers and that then, in turn, supplies them without further processing or after processing without changing the properties specified in the purchase order and referenced product specification

3.6
manufacturer
organization that manufactures the respective products according to the requirements of the order and to the properties specified in the referenced product specification to the final customer

3.7
normalized rolled
rolling process in which the final deformation is carried out in a certain temperature range leading to a material condition equivalent to that obtained after normalizing so that the specified values of the mechanical properties are retained even after normalizing

Note 1 to entry: In international publications for both the normalizing rolling, as well as the thermomechanical rolling, the expression "controlled rolling" may be found. However in view of the different applicability of the products a distinction of the terms is necessary.

3.8
normalizing

heat treatment with the object of refining and eventually making uniform the grain size of a ferrous product and comprising heating it at a temperature slightly above A_3 [A_1 for hypereutectoid steels], without prolonged soaking at this temperature, followed by cooling at a suitable rate

3.9
parent product
product produced from one piece of steel

3.10
purchaser
purchaser or their representative

3.11
quenching
operation which consists of cooling a ferrous product more rapidly than in still air

Note 1 to entry: Quenching includes direct quenching.

3.12
seamless hollow section (S)
hollow long product, open at both ends, of circular, elliptical, square or rectangular section, made by piercing a solid product to obtain a tube hollow which is further hot finished into its final dimensions (see 3.4)

3.13
tempering
heat treatment applied to a ferrous product generally after quenching or other heat treatment to bring the properties to the required level

Note 1 to entry: Tempering consists of heating to specific temperatures ($<A_{C1}$) and soaking one or more times followed by cooling at an appropriate rate.

4 Classification and designation

4.1 Classification

All steel grades specified in this European Standard are classified as special steels according to EN 10020.

NOTE The steel grades in this standard are substantially modified from steel grades in EN 10210–1.

4.2 Designation

4.2.1 For the products covered by this European Standard 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 For steels for offshore structures the steel designation consists of:

— the number of this European Standard (EN 10225-3);

— the capital letter S for structural steel;

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

— further designations for either

  — normalized/normalized rolled structural steels: capital letters N - letter N to indicate normalized or normalized rolled; or

  — normalized/normalized rolled structural steels: capital letters NL - letter N to indicate normalized or normalized rolled, letter L to indicate specified impact properties at –40 °C (see 6.4); or

  — quenched and tempered structural steels: capital letters QL - capital letter Q to indicate the quenched and tempered condition, letter L to indicate specified impact properties at –40 °C (see 6.4); and

— the capital letter H for hollow sections;

— a further capital letter H for hot-finished; and

— the capital letter O for offshore structures.

EXAMPLE 1 Structural steel (S) with a specified minimum yield strength for a thickness not greater than 16 mm of 355 MPa, normalized condition (N), with a minimum impact energy value of 50 J at –40 °C (L), hollow section hot finished (HH), for offshore application (O):

EN 10225–3 — S355NLHHO

or

EN 10225–3 — 1.1182

NOTE For a transition period the old steel names and numbers are given in Tables 3 to 8 in brackets.

5 Information to be supplied by the purchaser

5.1 Mandatory information

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

a) the quantity (number of hollow sections, total length or mass);

b) details of the product form: HFCHS = hot finished circular hollow sections (or HFEHS for elliptical, HFRHS for square or rectangular);

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

d) the name of this standard (EN 10225-3) and the steel designation (steel name or steel number, see 4.2.2);

e) standard designation in accordance with EN 10204 for an inspection certificate 3.1 or, if required, inspection certificate 3.2 (see also ***Option 24***).

5.2 Options

A number of options are specified in Clause 12. In the event that the purchaser does not indicate a wish to implement any of these options, the manufacturer shall supply in accordance with the basic specification (see 5.1). The options in Clause 12 are numbered through all four parts of EN 10225, therefore some options are not available for this part.

5.3 Example of an order

50 hot-finished circular hollow sections in accordance with EN 10210-2 with specified dimensions 244,5 mm × 25,0 mm × 4 500 mm, made according to EN 10225-3 from structural steel S355NLHHO for offshore application, supplied with inspection certificate 3.1 and a product analysis:

50 HFCHS – EN 10210-2 — 244,5 × 25,0 × 4 500
EN 10225-3 — S355NLHHO – inspection certificate 3.1, *Option 7*

or

50 HFCHS – EN 10210-2 — 244,5 × 25,0 × 4 500
EN 10225-3 — 1.1182 inspection certificate 3.1, *Option 7*

6 Manufacturing process

6.1 Steel manufacturing process

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

All steels shall be fully killed.

All steels shall be made to fine grain practice.

See ***Option 1*** (further details of steel manufacturing process)

See ***Option 2*** (vacuum degassed and/or ladle refined)

See ***Option 3*** (reduced S-content)

All products shall be traceable to the cast.

6.2 Structural hollow section manufacturing process

Hot finished structural hollow sections shall be manufactured by a seamless or by a high frequency welding process. 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.

HFW welded hollow sections shall be supplied with the external weld bead trimmed to an essentially flush condition. Internal trimming is at the discretion of the manufacturer. Normally sections are supplied without trimming the internal weld bead unless ***Option 21*** is specified, see 7.5.1.

The ends of the hollow section shall be cut perpendicular to the axis of the product.

6.3 Qualification of personnel for NDT activities

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

The qualification shall be in accordance with ISO 11484 or ASNT TC-1A or ISO 9712.

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

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

6.4 Delivery condition

Hollow sections shall be supplied full body heat treated, either in the normalized/normalized rolled (N) or quenched and tempered (Q) condition as shown in Tables 3 to 8.

7 Requirements

7.1 General

In addition to the requirements of this European Standard, the general technical delivery requirements specified in EN 10021 apply.

7.2 Chemical composition

7.2.1 Heat analysis

The chemical composition determined by heat analysis shall comply with the values in Tables 3 and 6.

The deliberate addition of any elements other than those listed in Tables 3 and 6 shall not be permitted. For residual element control, Boron (B) shall not be intentionally added to steel grades up to and including S460.

Any further restrictions in heat analysis shall be agreed between the manufacturer and the purchaser at the time of the enquiry and order, see ***Option 6*** (restricted heat analysis).

7.2.2 Product analysis

The chemical composition determined by product analysis shall comply with the values given in Tables 3 and 6; for verification see ***Option 7*** (product analysis);

Any further restrictions in product analysis shall be agreed between the manufacturer and the purchaser at the time of enquiry and order, see ***Options 6*** and ***7*** (restricted product analysis).

7.2.3 Carbon equivalent values (CEV) and P_{cm}

CEV[2] and P_{cm} shall be calculated using the following equations where each element is expressed as a mass percentage:

$$CEV = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} \quad (1)$$

$$Pcm = C + \frac{Si}{30} + \frac{Mn + Cu + Cr}{20} + \frac{Ni}{60} + \frac{Mo}{15} + \frac{V}{10} + 5B \quad (2)$$

The maximum permissible CEV and P_{cm} values are given in Tables 4 and 7. Either the P_{cm} or/and the CEV is reported at the discretion of the manufacturer, unless otherwise agreed between manufacturer and purchaser at the time of enquiry and order. See ***Option 8*** (agreement whether to report a P_{cm} or/and CEV value).

7.3 Mechanical properties

7.3.1 General

Under the inspection and testing conditions as specified in Clause 8 and, if requested, in the simulated heat treatment conditions given in 7.3.2, the mechanical properties at the verification test temperature shall comply with the relevant requirements given in Tables 5 and 8. Samples (from which test pieces are taken) shall be tested in the delivery condition.

7.3.2 Post weld heat treatment (PWHT)

Where a requirement for PWHT is foreseen, the items concerned shall be ordered with additional testing according to ***Option 9***.

The simulated PWHT shall be at 580 °C ± 20 °C if not otherwise agreed (see ***Option 10***) for a minimum soaking time of 1 h per 25 mm thickness of product but maximum 4 h.

7.3.3 Through thickness testing

Through-thickness testing shall not be carried out, except when ***Option 12*** is specified.

See ***Option 12*** (through thickness testing)

7.3.4 Flattening test

A flattening test shall not be carried out except when ***Option 13*** is specified for circular welded hollow sections.

See ***Option 13*** (flattening test)

7.3.5 Prequalification for arctic areas

If specified at the time of enquiry and order testing at specified lower temperatures shall be carried out.

2 IIW, International Institute of Welding formula