SLOVENSKI STANDARD
SIST EN 10225-1:2019

01-julij-2019

Nadomešča:
SIST EN 10225:2009

Konstrukcijska jekla za varjene konstrukcije naftnih ploščadi - Tehnični dobavni pogoji - 1. del: Plošče

Weldable structural steels for fixed offshore structures - Technical delivery conditions - Part 1: Plates

Schweißgeeignete Baustähle für feststehende Offshore-Konstruktionen - Technische Lieferbedingungen - Teil 1: Bleche

Aciers de construction soudables destinés à la fabrication de structures marines fixes - Conditions techniques de livraison - Partie 1 : Tôles

Ta slovenski standard je istoveten z: **EN 10225-1:2019**

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
77.140.50	Ploščati jekleni izdelki in polizdelki	Flat steel products and semi-products

SIST EN 10225-1:2019 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 10225-1

May 2019

ICS 77.140.10

Supersedes EN 10225:2009

English Version

Weldable structural steels for fixed offshore structures - Technical delivery conditions - Part 1: Plates

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

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 CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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

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European foreword

This document (EN 10225-1:2019) 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 10225-2:2019, EN 10225-3:2019, 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 hollow sections

In comparison to the previous edition the 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 F 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, in the form of plates, to be used in the fabrication of fixed offshore structures.

The following thickness limitations are given in this standard:

— S355NLO up to and including 200 mm;

— S355MLO, S420MLO, S460MLO, S500MLO up to and including 120 mm;

— S420QLO, S460QLO, S500QLO, S550QLO, S620QLO, S690QLO up to and including 150 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, including plate for structural hollow sections (see EN 10225-4). It does not apply to plates 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 F on the prequalification of steels for fixed offshore structures in arctic areas.

Minimum yield strengths up to 690 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 10029, *Hot-rolled steel plates 3 mm thick or above — Tolerances on dimensions and shape*

EN 10051, *Continuously hot-rolled strip and plate/sheet cut from wide strip of non-alloy and alloy steels — Tolerances on dimensions and shape*

EN 10079, *Definition of steel products*

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

EN 10163-1, *Delivery requirements for surface condition of hot-rolled steel plates, wide flats and sections — Part 1: General requirements*

EN 10163-2, *Delivery requirements for surface condition of hot-rolled steel plates, wide flats and sections — Part 2: Plate and wide flats*

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*

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 3452-1, *Non-destructive testing — Penetrant testing — Part 1: General principles (ISO 3452-1)*

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

EN ISO 9934-1, *Non-destructive testing — Magnetic particle testing — Part 1: General principles (ISO 9934-1)*

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 for steel grades with ferritic/perlitic microstructure or with an equivalent index of former austenitic grain size ≥ 5 for steel grades with martensitic/bainitic microstructure

Note 1 to entry: For the determination of grain sizes see EN ISO 643.

3.3
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

3.4
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

3.5
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.

3.6
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

3.7
parent product
product rolled from one ingot or slab

3.8
purchaser
purchaser or their representative

3.9
quenching
operation which consists of cooling a ferrous product more rapidly than in still air

Note 1 to entry: Quenching includes direct quenching.

3.10
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.

3.11
thermomechanical rolling
rolling process in which the final deformation is carried out in a certain temperature range leading to a material condition with certain properties which cannot be achieved or repeated by heat treatment alone

Note 1 to entry: Hot forming or post weld heat treatment at a temperature above 580 °C may lower the strength values and it is not recommended to be performed. Flame straightening can be applied in accordance with CEN/TR 10347.

Note 2 to entry: Thermomechanical rolling can include processes with an increasing cooling rate with or without tempering including self-tempering but excluding direct quenching and quenching and tempering.

Note 3 to entry: In some publications the word TMCP (Thermomechanical Control Process) is also used.

4 Classification and designation

4.1 Classification

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

NOTE The steel grades in this European Standard are substantially modified from steel grades in EN 10025-2, -3, -4, and -6.

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 10225-1);

— 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 NL - letter N to indicate normalized or normalized rolled, letter L to indicate specified impact properties at –40 °C (see 6.3); or

  — thermomechanical rolled structural steels: capital letters ML - letter M to indicate thermomechanical rolled, letter L to indicate specified impact properties at –40 °C (see 6.3); 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 6.3); 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/normalized rolled condition with a minimum impact energy value of 50 J at –40 °C, for offshore application:

EN 10225–1 — S355NLO

or

EN 10225–1 — 1.8808

NOTE For a transition period the old steel names and numbers are given in Tables 3 to 11 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 plates or mass);

b) details of the product form: plate;

c) the name of the standard for dimensions and tolerances and the dimensions and tolerances: EN 10029 (or EN 10051);

d) the name of this standard (EN 10225-1) 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 (for a full list of the options see Annex G, Table G.1).

5.3 Example of an order

50 plates in accordance with EN 10029 with specified dimensions 25 mm × 2 000 mm × 4 500 mm, thickness tolerance class B, limited edge camber and out-of-squareness (G), special flatness tolerance S, made according to EN 10225-1 from structural steel S355NLO for offshore application, supplied with inspection certificate 3.1:

50 plates – EN 10029 B G S – 25 × 2 000 × 4 500
EN 10225-1 — S355NLO – inspection certificate 3.1

or

50 plates – EN 10029 B G S – 25 × 2 000 × 4 500
EN 10225-1 — 1.8808 inspection certificate 3.1

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 Qualification of personnel for NDT-activities

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

6.3 Delivery condition

Plates shall be supplied in the furnace normalized/normalized rolled (N), thermomechanically rolled (M) or quenched and tempered (Q) condition as shown in Tables 3 to 11.

See ***Option 4*** (furnace normalizing is mandatory)

6.4 Thickness limits

6.4.1 The maximum thickness of product from the continuous casting process shall be at the manufacturer's discretion.

6.4.2 The minimum rolling reduction ratio for plate made of steel from continuous casting process with a thickness up to and including 120 mm shall be 3:1 if all of the following limitations are met:

a) one or more of the following low hydrogen practices are used: vacuum degassing during steelmaking, controlled soaking of the slabs or plates or controlled slow cooling of the slabs or plates;

b) the sulfur content is 0,004 % or less, based upon heat analysis;

c) one or more of the following practices are used:

— electromagnetic stirring during casting;

— soft reduction during casting; or

— heavy pass reductions (min. 30 mm for min. one pass in the first rolling schedule) during plate rolling.

Otherwise a reduction ratio of minimum 4:1 is mandatory.

See ***Option 5*** (other more severe reduction ratios).

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, 6 and 9;

The deliberate addition of any elements other than those listed in Tables 3, 6 and 9 shall not be permitted. For residual element control, Boron (B) shall not be intentionally added to steel grades up to and including S500.

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, 6 and 9, 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 formulae 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, 7 and 10. 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, 8 and 11. 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 Strain age tests

Strain age testing shall not be carried out, except when ***Option 11*** is specified.

See ***Option 11*** (strain age testing)

It is recommended to specify ***Option 11***, if the plate material is to be used for the production of SAWL hollow sections according to part 4 of this standard or other critical components for offshore applications.

7.3.4 Through-thickness testing

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

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

7.3.5 Fracture mechanic testing

Data is not required except when ***Option 14*** is specified.

See ***Option 14*** (fracture mechanic testing)

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2 IIW, International Institute of Welding formula.

7.3.6 Prequalification for arctic areas

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

See informative Annex F (testing at lower temperatures as prequalification for arctic areas shall be done, e.g. for arctic area 1, 2 or 3 at −20 °C, −30 °C or −40 °C).

7.4 Technological properties

7.4.1 Cold forming characteristics of steel plate

If required at the time of enquiry and order the steel manufacturer shall make available data which characterizes the cold forming behaviour of these steels. If such data is not available or is deemed inadequate by the purchaser, additional testing may be specified (see Annex E).

See ***Option 15*** (plate cold forming procedures)

7.4.2 Hot forming procedures for steel plate

If required at the time of enquiry and order the steel manufacturer shall provide general information on the procedures and effects of hot forming on material properties.

See ***Option 16*** (plate hot forming procedures)

Materials in delivery condition M or Q are generally unsuitable for subsequent normalizing or hot forming above 580 °C. Heating above 580 °C may lower the strength values. If subsequent processing at temperatures above 580 °C is required, reference should be made to the manufacturer.

7.4.3 Weldability data

Weldability data is not required, except when ***Option 17*** is specified.

See ***Option 17*** (weldability data, this option shall already be requested at the time of enquiry)

Regardless of the revision of the standard, weldability studies performed with a former version of EN 10225 remains valid, provided chemical composition and mechanical properties comply with the current version.

This data refers only to the weldability of the material being supplied and is intended for use in development and preparation of fabrication procedures. The manufacturer does not have to fulfil the requirements of a welding procedure qualification test (WPQT), nor provide data to it.

7.5 Internal soundness and non-destructive testing

All plates shall be ultrasonically tested in accordance with EN 10160 and shall meet the requirements of EN 10160, class S_0/E_1, unless ***Option 18*** is specified.

See ***Option 18*** (Ultrasonic test according to EN 10160, class S_1/E_2 shall be met)

7.6 Surface quality

All surfaces of plates shall be 100 % visually inspected. The surface condition shall comply with EN 10163-2, Class A, sub-class 3 if not otherwise agreed at the time of enquiry and order.

Repair of defects such as cracks, shells or seams (in accordance with EN 10163-1 and EN 10163-2) shall be followed by magnetic particle inspection or dye penetrant inspection.