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Weldable structural steels for fixed offshore structures - Technical delivery conditions - Part 4: Cold formed welded hollow sections

Schweißgeeignete Baustähle für feststehende Offshore-Konstruktionen - Technische Lieferbedingungen - Teil 4: Kaltgeformte geschweißte Hohlprofile

Aciers de construction soudables destinés à la fabrication de structures marines fixes - Conditions techniques de livraison - Partie 4 : Profils creux soudés formés à froid

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Technical delivery conditions - Part 4: Cold formed welded
hollow sections**

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Konstruktionen - Technische Lieferbedingungen - Teil
4: Kaltgeformte geschweißte Hohlprofile

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (prEN 10225-4:2017) has been prepared by Technical Committee ECISS/TC 103 “Structural steels other than reinforcements”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

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:

- Welded cold formed hollow sections were only implicit mentioned in the previous version. Because of the split of the standard into four parts now a separate part with full requirements to cold formed hollow sections for offshore structures is written;
- 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);
- There is an Annex E concerning SAWH hollow sections and an Annex F concerning high strength rectangular HFW hollow sections, since the application of these hollow sections needs more practical experience;
- An Annex G was added for the prequalification of steels for fixed offshore structures in arctic areas;

1 Scope

This part of EN 10225 specifies requirements for submerged arc welded (SAW) and high frequency welded (HFW) cold formed hollow sections to be used in the fabrication of fixed offshore structures.

The thickness limit for SAWL round hollow sections is up to and including 50,8 mm, for HFW round hollow sections up to and including 25,4 mm and for HFW rectangular hollow sections up to and including 12,5 mm.

Greater thicknesses for SAWL hollow sections may be agreed provided the technical requirements of this European Standard are maintained.

NOTE 1 There is an Annex E about SAWH round hollow sections with thickness limit of 30,0 mm and an Annex F about high strength rectangular HFW hollow sections steel grades S550 to S700 for further information please refer to it.

The 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. temperature.

NOTE 2 There is an Annex G on the prequalification of steels for fixed offshore structures in arctic areas.

Minimum yield strengths up to 690 MPa are specified together with low temperature 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 10160, *Ultrasonic testing of steel flat product of thickness equal or greater than 6 mm (reflection method)*

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 10219-2, *Cold formed welded 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 5173, *Destructive tests on welds in metallic materials — Bend tests (ISO 5173:2009)*

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 9606, *Qualification testing of welders — Fusion welding (ISO 9606)*

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 10893-6, *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)*

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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 14732, *Welding personnel — Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials (ISO 14732)*

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 10079, EN ISO 4885, EN ISO 14284 and the following apply.

3.1

cold forming

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

3.2

concast

steel produced by a continuous casting process route

3.3

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 Q steels see EN ISO 643

3.4**high frequency welded hollow section (HFW)**

hollow long product, open at both ends, of circular, 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 induction or conduction. After welding, the hollow section is further cold processed into its final dimensions.

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 manufacture 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 (feedstock material)**

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 (feedstock material)**

heat treatment consisting of austenitizing followed by air cooling

3.9**parent product**

product rolled from one piece of steel

3.10**purchaser**

purchaser or his representative

3.11**Submerged arc welding (SAW)**

welding process that produces melting and coalescence of metals by heating them with an arc or arcs between a bare metal consumable electrode or electrodes and the workpiece, wherein the arc and molten metal are shielded by a blanket of granular flux

Note 1 to entry: to entry: Contact pressure is not used and part or all of the filler metal is obtained from the electrodes

[Source: EN ISO 3183:2001, 4.52]

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3.12

thermomechanical rolling (feedstock material)

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: 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 2 to entry: 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 special steels according to EN 10020.

NOTE The steel grades in this standard are substantially modified from steel grades in EN 10219-1.

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 10225-4);
- 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) and;
- the capital letter H for hollow sections;
- the capital letter C for cold formed 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, thermomechanical rolled condition (M), with a minimum impact energy value of 27 J at -40 °C (L), hollow section cold formed (HC), for offshore application (O):

EN 10225-4 – S420MLHCO

or

EN 10225-4 – 1.8xxx

NOTE For a transition period the old steel names and numbers are given in Tables 5 to 10 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:

- the quantity (number of hollow sections, total length or mass);
- the type of welding, either SAWL, SAWH or HFW;
- details of the product form: CFCHS = cold formed circular hollow section (or CFRHS for rectangular HFW hollow section);
- the name of the standard for dimensions and tolerances and the dimensions and tolerances: EN 10219-2;
- the name of this standard (EN 10225-4) and the steel designation (steel name or steel number, see 4.2.2);
- standard designation in accordance with EN 10204 for an inspection certificate 3.1 or, if required, inspection certificate 3.2 (see also Option 25).

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. 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 Examples of an order

50 submerged arc welded (SAWL) cold formed circular hollow sections (CFCHS) in accordance with EN 10219-2 with specified dimensions 200 mm × 200 mm × 10,0 mm × 6 000 mm made according to EN 10225-4 from structural steel S420MLHCO for offshore application, supplied with inspection certificate 3.1 and a product analysis:

50	SAWL-CFCHS	–	EN 10219-2	–	762 × 10,0 × 6000
EN 10225-4 – S420MLHCO – inspection certificate 3.1, Option 7					

or

50	SAWL	CFCHS	–	EN 10219-2	–	762 × 10,0 × 6000
EN 10225-4 – 1.88xx – 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.

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All steels shall be fully killed.

All steels shall be made to fine grain practice.

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

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

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

All products shall be traceable to the cast.

6.2 Condition of feedstock material

According to the designation given in the order the following delivery conditions apply for the feedstock material used for the manufacture of cold formed hollow sections:

- normalized/normalized rolled (N) for steels of qualities N and NL;
- thermomechanically rolled (M) for steels of quality M and ML;

The feedstock material for SAWL hollow sections is according to the plate material of EN 10225-1. Therefore the chemical composition of the steel grades for SAWL hollow sections is according to EN 10225-1. The feedstock material of SAWH and HFW hollow section is hot rolled coil. Since there is no standardized pre-material, the chemical composition of the steel grades for SAWH and HFW hollow sections is according to Tables 5 and 8 of this standard. Since the ranges for the elements of the chemical composition of the SAWH and HFW hollow section are broader, the chemical composition of the SAWL hollow sections is also fulfilled by the SAWL hollow sections and can therefore also be used for information. In cases of dispute for SAWL hollow sections the tables for the chemical composition of the corresponding steel grades in part 1 are mandatory.

6.3 Structural hollow section manufacturing process

Cold formed structural hollow sections shall be manufactured by a 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 an external weld bead trimmed to an essentially flush condition. They are normally supplied without trimming the internal weld bead, which is at the discretion of the manufacturer, see also 7.5.1.

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

The trained operators shall be qualified according to EN ISO 9606 and EN ISO 14732.

6.4 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 ASNT.

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.