



BSI Standards Publication

Cold formed welded steel structural hollow sections

Part 3: Technical delivery conditions for high strength and weather resistant steels

National foreword

This British Standard is the UK implementation of EN 10219-3:2020.

The UK participation in its preparation was entrusted to Technical Committee ISE/103, Structural Steels Other Than Reinforcements.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Part 1 of this series, EN 10219-1:2006, is published in the Official Journal of the European Union (OJEU) under the Construction Products Regulation (CPR Regulation (EU) No. 305/2011) and therefore allows the CE marking of all the products included in it.

The European technical committee responsible for the development of EN 10219-3 (CEN/TC 459/SC 3) tried to revise EN 10219-1:2006 to extend its scope to include not only higher-strength steel grades and weather-resistant steels but also other new processes, such as quenched and tempered steels (feedstock condition). Unfortunately, a draft revised standard was never published, due to difficulties with it complying with the Regulation.

The European technical committee decided to incorporate these additions to Part 1 into a new Part 3, which is not under the Construction Products Regulation. This new standard, EN 10219-3:2020, is therefore a voluntary standard that can be used if the covered products are to be used in mechanical engineering applications. It will not be possible to CE mark them under the Construction Products Regulation. A comparison between both parts is presented below.

Products	Grades included in EN 10219-1:2006 (products CE marked under the CPR)	Grades included in EN 10219-3:2020 (products not CE marked under the CPR)
Non-alloy quality steels (Annex A)	S235JRH, S275J0H, S275J2H, S355J0H, S355J2H, S355K2H	Not included (annex is only informative)
Fine grain steels – feedstock condition N (Annex B)	S275NH, S275NLH, S355NH, S355NLH, S460NH, S460NLH	S420NH, S420NLH
Thermomechanical formed steels – feedstock condition M	S275MH, S275MLH, S355MH, S355MLH, S420MH, S420MLH, S460MH, S460MLH (Annex B)	S500MH, S500MLH, S550MH, S550MLH, S600MH, S600MLH, S650MH, S650MLH, S700MH, S700MLH, S900MH, S960MH (Annex C)

Products	Grades included in EN 10219-1:2006 (products CE marked under the CPR)	Grades included in EN 10219-3:2020 (products not CE marked under the CPR)
Quenched and tempered steels – feedstock condition QT (Annex D)	Not included	S460QH, S460QLH, S460QL1H, S500QH, S500QLH, S500QL1H, S550QH, S550QLH, S550QL1H, S620QH, S620QLH, S620QL1H, S690QH, S690QLH, S690QL1H, S770QH, S770QLH, S770QL1H, S890QH, S890QLH, S890QL1H, S960QH, S960QLH, S960QL1H
Steels with improved atmospheric corrosion resistance (Annex E)	Not included	S355J0WH, S355J2WH, S355K2WH, S420K2WH, S460K2WH, S500K2WH

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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English Version

Cold formed welded steel structural hollow sections - Part 3: Technical delivery conditions for high strength and weather resistant steels

Profils creux de construction en acier, soudés et formés
à froid - Partie 3 : Conditions techniques de livraison
des aciers à haute limite élastique et des aciers à
résistance améliorée à la corrosion atmosphérique

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

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This European Standard was corrected and reissued by the CEN-CENELEC Management Centre on 23 September 2020.

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.

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 10219-3:2020) 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 10219 consists of the following parts:

- EN 10219-1, Cold formed welded steel structural hollow sections - Part 1: Technical delivery conditions
- EN 10219-2, Cold formed welded steel structural hollow sections - Part 2: Tolerances, dimensions and sectional properties
- EN 10219-3, Cold formed welded 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 10210-1 to EN 10210-3.

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 the technical delivery conditions for high strength and weather resistant electric welded and submerged arc welded cold formed steel structural hollow sections of circular, square, rectangular or elliptical forms and formed cold without subsequent heat treatment other than the heat treatment of the weld line.

NOTE 1 The requirements for tolerances, dimensions and sectional properties can be found in EN 10219-2.

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

NOTE 3 A range of steel 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, but not the final supply condition of cold formed hollow sections are generally comparable with those in EN 10025-3, EN 10025-4, EN 10025-5, EN 10025-6, EN 10149-2 and EN 10149-3.

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 10219-1, *Cold formed welded structural hollow sections of non-alloy and fine grain steels - Part 1: Technical delivery conditions*

EN 10219-2, *Cold formed welded 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 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 14284, *Steel and iron - Sampling and preparation of samples for the determination of chemical composition (ISO 14284)*

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 15614-1)*

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 purposes of this document, the following 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

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 $D/T \geq 20$ may be classified as hot-finished hollow sections.

3.1.2

normalizing rolling for 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 subsequent normalizing

3.1.3

thermomechanical rolling for 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: Thermomechanical rolling 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 for feedstock material

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 for feedstock material

process which consists of the following two steps:

- first quenching, where the steel is heated up above the A_{c3} 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

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

Note 1 to entry: For the determination of grain sizes, 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 B, C and D seven qualities N, NL, 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 10219-3);
- 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) normalized/normalized rolled structural steels:
 - i) capital letter N to indicate normalized or normalized rolled with specified impact properties at -20 °C (see 6.4);
 - ii) capital letters NL for qualities with specified impact properties at -50 °C; or
 - 2) thermomechanical rolled structural steels:
 - i) capital letter M to indicate thermomechanical rolled with specified impact properties at -20 °C (see 6.4);
 - ii) capital letters ML for qualities with specified impact properties at -50 °C; or
 - 3) 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 6.4);
 - ii) capital letters QL or QL1 for qualities with specified impact properties at -40 or -50 °C; or
 - 4) steels with improved atmospheric corrosion resistance:
 - ii) 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 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 10219-3 — S460QH

or

EN 10219-3 — 1.8608

EXAMPLE 2 Hollow section made of structural steel (S) with a specified minimum yield strength for 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 10219-3 — S355J2WH

or

EN 10219-3 — 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) CFCHS = cold formed circular hollow section;
 - 2) CFRHS = cold formed square or rectangular hollow section;
 - 3) CFEHS = cold formed elliptical hollow section;
- c) the name of the standard for dimensions and tolerances (EN 10219-2);
- d) the dimensions and the type of length, length range or length (see EN 10219-2);
- e) the steel designation (see 4.2).

5.2 Options

A number of options are specified in EN 10219-2 and this document. These 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 6.5.2);
- 3.2 Other surface condition than as rolled (see 6.6);
- 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 the circular tube 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

10 t cold formed welded square hollow sections in accordance with EN 10219-2 with specified outside dimensions 100 mm × 100 mm and wall thickness of 8 mm of 12 m approximate lengths, grade S460QH according to this document and chemical composition for hot-dip zinc coating (Option 3.8) and supplied with inspection certificate 3.1:

EXAMPLE 10 t - CFRHS - EN 10219-2 — 100 × 100 × 8 - approximate length 12 m
EN 10219-3 — S460QH - Option 3.8

6 Manufacturing process

6.1 General

Structural welded cold formed hollow sections of normalized/normalized rolled, thermomechanical rolled and quenched and tempered steels shall conform to Annexes B to 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 B.1, C.1, D.1 and E.1.

6.3 Grain structure

The steel grades given in Annexes B to 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 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 for steels of qualities N and NL according to Annex B;
- thermomechanical rolled for steels of quality M and ML according to Annex C;
- quenched and tempered for steels of qualities Q, QL and QL1 according to Annex D;
- as rolled or normalized/normalized rolled or thermomechanical formed for steels with improved atmospheric corrosion resistance W according to Annex E.

6.5 Structural hollow section manufacturing process

6.5.1 Structural hollow sections shall be manufactured by electric welding or submerged arc welding without subsequent heat treatment (see 6.6). Hollow 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

that for helically welded submerged arc-welded (SAW) hollow sections, such welds shall be permitted when tested in accordance with 10.4.3.

6.5.2 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 1.1 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.

6.5.3 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.

6.6 Delivery condition

The hollow sections shall be delivered cold formed without subsequent heat treatment except that the weld seam may be in the as welded or heat treated condition.

NOTE For SAW hollow sections, it could be necessary to perform a warm shaping operation, which does not affect the mechanical properties, in order to meet the out-of-roundness tolerance requirements.

The surface of the hollow sections shall be typical of the feedstock employed and manufacturing method used.

Option 3.2 Other possible surface conditions are:

- a) S2 pickled feedstock;
- b) S3 pickled hollow section;
- c) S4 hot-dip-zinc coated feedstock;
- d) S5 hot-dip-zinc coated hollow section (There shall also be an agreement on the coating of the weld seam).

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 B.1, C.1, D.1 or E.1.

The maximum carbon equivalent value (CEV) for all grades, based on the cast analyses, given in Tables B.2, C.2, D.2 or 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 B.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 given in Tables B.1, C.1, D.1 and E.1

Element	Permissible maximum content in the cast analysis	Permissible deviation of the product analysis from specified limits for the cast analysis
	% by mass	% by mass
C	≤ 0,20	+ 0,02
	> 0,20	+ 0,03
Si	≤ 0,60	+ 0,05
	> 0,60	+ 0,06
Mn	normalized ≤ 1,70	- 0,05 / + 0,10
	thermomechanical rolled ≤ 2,20	+ 0,10
	quenched and tempered ≤ 1,70	+ 0,10
	weather ≤ 1,50	- 0,05 / + 0,10
P	normalized/thermomechanical rolled ≤ 0,030, quenched and tempered ≤ 0,025	+ 0,005
	weather ≤ 0,035	+ 0,010
S	normalized/ thermomechanical rolled ≤ 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	normalized/thermomechanical rolled, weather ≤ 0,35	±0,04
	normalized/thermomechanical rolled, weather 0,35 < Cu ≤ 0,55	+ 0,07
	quenched and tempered ≤ 0,50	+ 0,05
N	normalized/thermomechanical rolled, weather ≤ 0,025	+ 0,002
	quenched and tempered ≤ 0,020	+ 0,001
Al _{total}	≥ 0,020	- 0,005
B	≤ 0,005 0	+ 0,000 5
Zr	≤ 0,15	+ 0,02

7.2 Mechanical properties

7.2.1 Under the inspection and testing conditions as specified in Clause 8 and in the delivery condition as specified in 6.5, the mechanical properties of the finished hollow section shall conform to the relevant requirements of Tables B.3, B.4, C.3, C.4, D.3, D.4 or E.3.

Any heat treatment at more than 580 °C and any heat treatment not processed in the normalizing temperature range could result in a reduction in the mechanical properties and is therefore not recommended.

NOTE Flame straightening can be applied in accordance with CEN/TR 10347.

The following option can be specified by the purchaser at the time of enquiry and order:

Option 3.5 Longitudinal test pieces for the tensile test shall be taken from the centre of the corner, but remote from the weld (see Annex F).

7.2.2 Another temperature as given in the Tables B.4, C.4, D.4 and E.3 may be agreed at the time of the order.

If a Charpy test is performed at a lower temperature than specified in the document and the impact energy values obtained meet the requirements at the higher temperature, then the material is deemed to conform to the document.

The following option can be specified by the purchaser at the time of enquiry and order:

Option 3.6 Longitudinal test pieces for the impact test shall be taken from the centre of the corner but remote from the weld with the notch orientated through the material thickness.

7.2.3 Subject to limitations to 7.2.2:

- a) the impact properties of structural hollow sections of steel qualities J2, K2, N, NL, M, ML, Q, QL and QL1 shall be verified;
- b) the impact properties of structural hollow sections of steel quality J0 need not be verified unless Option 3.7 is specified by the purchaser at the time of enquiry and order.

Option 3.7 For products in quality J0 supplied with specific inspection and testing (see Options 3.12 and 3.13), the verification of the impact properties is specified.

7.2.4 The following requirement for fine grain steel hollow sections can be specified:

- For fine grain steel hollow sections in thicknesses which do not permit impact test pieces of width ≥ 5 mm to be taken, the ferritic grain size (see 6.3) shall be verified by the method as described in EN ISO 643.
- When aluminium is used as the grain refining element, the grain size requirement shall be deemed to be fulfilled if the cast analysis shows the aluminium content to be $\geq 0,020$ % total aluminium or alternatively $\geq 0,015$ % soluble aluminium. In these cases, verification of the grain size is not required.

7.3 Technological properties

7.3.1 Weldability

The steels specified in this document are weldable as given in Annexes B to E. General requirements for welding the products in accordance with this document are given in EN 1011-1 and EN 1011-2.

NOTE 1 When welding hollow sections, as product thickness, strength level and CEV increase, the occurrence of cold cracking in the welded zone forms the main risk. Cold cracking is caused by a combination of the following factors:

- high levels of diffusible hydrogen in the weld metal;
- a brittle structure in the heat affected zone;
- significant tensile stress concentrations in the welded joint.

NOTE 2 By using guidelines, specified for example in EN 1011-1, EN 1011-2 or any other relevant welding standard, the recommended welding conditions and the various welding ranges for the steel grades can be determined. These will vary depending on the product thickness, the applied welding energy, the design requirements, the electrode efficiency, the welding process and the weld metal properties.

Care should be taken when welding in corner regions of cold formed hollow sections. Eurocode 3 (EN 1993-1-8:2005, Table 4.2) includes conditions and restrictions for welding within 5t of the corner of cold formed square and rectangular hollow sections. For steel qualities J2H, K2H, MH, MLH, NH, NLH, where these limits are not satisfied, welding within 5t of the corner may be permitted, for products of nominal thickness not exceeding 12,5 mm, subject to their meeting specific analysis of $C \leq 0,18 \%$, $P < 0,020 \%$ and $S \leq 0,012 \%$. For more information, refer to EN 1993-1-8:2005, Table 4.2 and see below.

7.3.2 Hot-dip-zinc coating

EN ISO 1461 should be used to specify coating requirements. EN ISO 14713-2 provides further guidance, including information on the influence of various factors, including steel chemical composition, on the coating formation.

Option 3.8 can be used to order steels with a chemical composition required for hot-dip-zinc coating. When Option 3.8 is implemented, the purchaser and manufacturer shall agree a steel composition (cast analysis) of silicon and phosphorous according to either:

- Category A (or steels satisfying the formula $Si \leq 0,03 \%$ and $Si + 2,5 P \leq 0,09 \%$); or
- Category B (limited to $0,14 \% \leq Si \leq 0,25 \%$); or
- Category D (limited to $0,25 \% < Si \leq 0,35 \%$);

with required values as cited by the ranges given in EN ISO 14713-2:2009, Table 1, column 2.

Option 3.8 The chemical composition shall be suitable for hot dip zinc coating. If no additional information is given, the delivered category is at the discretion of the manufacturer.

NOTE EN ISO 14713-2:2009, Table 1 gives guidance on typical coating characteristics on the basis of the surface composition of silicon and phosphorous associated with certain steel compositions.

The maximum carbon equivalent shall be increased by 0,02 or by 0,01 (see 7.1.2).

7.4 Product supply condition

7.4.1 The hollow sections shall have a smooth surface corresponding to the manufacturing method used; bumps, cavities or shallow longitudinal grooves resulting from the manufacturing process are permissible, provided the remaining thickness is within tolerance, see EN 10219-2.

Surface imperfections may be removed by the manufacturer by grinding, provided that the thickness of the hollow section after the repair is not less than the minimum permissible thickness in accordance with EN 10219-2.

7.4.2 The ends of the hollow section shall be cut nominally square to the axis of the product.

7.4.3 Repair of the weld shall not be permitted for cold formed hollow sections except in the case of submerged arc welds.

7.4.4 For hollow sections repair of the body by welding shall not be permitted unless otherwise specified. The conditions under which, and the extent to which, welding repair to the body may be carried out shall be agreed between the manufacturer and the purchaser.

Option 3.9 Weld repairs to the body of structural steel hollow sections are permitted.

7.4.5 Any permitted weld repairs shall be carried out by operators qualified in accordance with EN ISO 9606-1. Welding repair procedures shall be issued in a written form and qualified in accordance with EN ISO 15607, EN ISO 15609-1 and EN ISO 15614-1.

A hollow section repaired in this way shall be considered to meet all the requirements of this document.

7.4.6 For SAW helical hollow sections where strip/plate was joined together these butt welds shall be carried out by operators qualified in accordance with EN ISO 9606-1. Welding procedures shall be issued in a written form and qualified in accordance with EN ISO 15614-1.

7.5 Non-destructive testing

The seam weld of all welded hollow sections supplied with specific inspection and testing shall be subjected to an applicable non-destructive test in accordance with 10.4.1 to 10.4.3.

Option 3.10 If agreed at the time of enquiry and order, every circular hollow section shall be full peripheral NDT-tested for imperfections according to one of the following standards: EN ISO 10893-2, EN ISO 10893-3 or EN ISO 10893-10 (see 10.4.4).

NOTE Full peripheral NDT is not possible for elliptical, square and rectangular SAW hollow sections.

Option 3.11 If agreed at the time of enquiry and order, every circular hollow section shall be tested for laminar imperfections according to EN ISO 10893-8 or testing is also possible prior to welding according to EN ISO 10893-9 or EN 10160 (see 10.4.5).

7.6 Tolerances and mass

7.6.1 Tolerances of dimensions and shape shall be as specified in EN 10219-2.

7.6.2 A density value of 7,85 kg/dm³ shall be used in mass calculations.

NOTE Dimensions, sectional properties and mass per unit length for a limited range of sizes of cold formed structural hollow sections are given in EN 10219-2. The purchaser will preferably select hollow section dimensions from this limited range of sizes.

8 Inspection

8.1 Types of inspection

Products complying with this document shall in accordance with EN 10021 be ordered and delivered with an inspection document 2.2, 3.1 or 3.2 as specified in EN 10204. A test report 2.2 for steel grade S355J0WH of Annex E and an inspection certificate 3.1 for all other steel grades of Annexes B to E shall be issued.

Option 3.12 An inspection certificate 3.1 for steel grade S355J0WH of Annex E shall be issued if agreed at the time of enquiry and order.

Option 3.13 An inspection certificate 3.2 shall be issued if agreed at the time of enquiry and order.

8.2 Types and contents of inspection documents

8.2.1 For products supplied with non-specific inspection a test report 2.2 in accordance with EN 10204 shall be provided. The test report shall contain the following codes and relevant information in accordance with EN 10168:

- A — Commercial transactions and parties involved;
- B — Description of products to which the test report applies;
- C10-C13 — Tensile test;
- C71-C92 — Cast analysis;
- Z — Validation.

8.2.2 For products supplied with an inspection certificate 3.1 or 3.2, the following codes and relevant information in accordance with EN 10168 shall be provided:

- A — Commercial transactions and parties involved;
- B — Description of products to which the inspection certificate applies;
- C01-C03 — Location of the samples, direction of test pieces and test temperature;
- C10-C13 — Tensile test — Test piece shape and test results;
- C40-C43 — Impact test — Test piece type and test results, if applicable;
- C71-C92 — Cast analysis and, if applicable, product analysis (as a minimum all the elements referred to in Tables B.1, C.1, D.1 and E.1 as applicable and the CEV shall be reported);
- D02-D50 — if applicable, statement confirming that the NDT has been carried out and that the test results are satisfactory;
- Z — Validation.

If an inspection certificate 3.2 is specified, the purchaser shall notify the manufacturer of the address of the organization or person nominated by him to carry out the inspection and validate the inspection document.

8.3 Summary of inspection

The requirements for inspection are given in Tables 2 and 3.

Table 2 — Non-specific inspection for welded cold formed hollow sections for steel grade S355J0WH of Annex E

Inspection requirements				Inspection programme
Type of test		Subclause reference(s)		Non-specific inspection
Mandatory tests	1	Cast analysis	7.1 10.1	One result per delivery item
	2	Tensile test	7.2 10.2.2	One representative result per delivery item
	3	Impact test for quality J0 only	7.2 10.2.3	Not applicable
	4	Surface condition and dimensions	7.4 7.6 10.3	See 10.3
	5	NDT of the weld	7.5 10.4.2, 10.4.3	Not applicable
Optional tests	6	Tensile test in corner region (Option 3.5)	7.2.1 10.2	One representative result per delivery item
	7	All other optional tests		Not applicable

Table 3 — Specific inspection for welded cold formed hollow sections

Inspection requirements			Inspection programme	
Type of test		Subclause reference(s)	Specific inspection	
Mandatory tests	1	Cast analysis	7.1 10.1	One per cast
	2	Tensile test	7.2 10.2.2	One test per test unit a, b
	3	Impact test (not for quality J0)	7.2.2 10.2.3	One set of tests per test unit a, b
	4	Surface condition and dimensions	7.4, 7.6 10.3	see 10.3
	5	NDT of the weld	7.5 10.4.2, 10.4.3	Full length
Optional tests	6	Product analysis (Option 3.3)	7.1 10.1	One per cast
	7	Cast analysis additional elements only for non-alloy steels according to Annex A (Option 3.4)	7.1 10.1	One per cast
	8	Tensile test in corner region (Option 3.5)	7.2.1	One test per test unit ^a
	9	Impact test in corner region (Option 3.6)	7.2.2	One set of tests per test unit a
	10	Impact test verification for quality J0 (Option 3.7)	7.2.3 10.2	One set of tests per test unit a, b
	11	Full peripheral NDT of the tube (Option 3.10)	7.5 10.4.4	Circular products, full length
	12	Ultrasonic inspection for laminar imperfections (Option 3.11)	7.5 10.4.5	Circular products, full length
^a For test unit see, 9.1. ^b Longitudinal or transverse samples at the discretion of the manufacturer.				

9 Frequency of testing and preparation of samples and test pieces

9.1 Frequency of tests

The verification of the mechanical properties and product analysis, if applicable, shall be carried out by a test unit. A test unit is defined as a quantity of hollow sections from one manufacturing lot of same grade and sectional dimensions including hollow sections from one or more coils or bars or ingots

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