

Cold formed welded structural hollow sections of non-alloy and fine grain steels

Part 1. Technical delivery requirements

The European Standard EN 10219-1 : 1997 has the status of a British Standard

ICS 77.140.75

National foreword

This British Standard is the English language version of EN 10219-1 : 1997.
The UK participation in its preparation was entrusted to Technical Committee ISE/12, Structural steels, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled 'International Standards Correspondence Index', or by using the 'Find' facility of the BSI Standards Electronic Catalogue.

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Summary of pages

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English version

Cold formed welded structural hollow sections of non-alloy and fine grain steels — Part 1: Technical delivery requirements

Profils creux pour la construction formés à froid en aciers de construction non alliés et à grains fins —
Partie 1: Conditions techniques de livraison

Kaltgefertigte geschweißte Hohlprofile für den Stahlbau aus unlegierten Baustählen und aus Feinkornbaustählen — Teil 1: Technische Lieferbedingungen

This European Standard was approved by CEN on 1997-06-22. 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 Central Secretariat or to any CEN member.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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Foreword

This European Standard has been prepared by Technical Committee ECISS/TC 10, Structural steels — Qualities, the secretariat of which is held by NNI.

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 February 1998, and conflicting national standards shall be withdrawn at the latest by February 1998.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

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1 Scope

This Part of this European Standard specifies the technical delivery requirements for cold formed welded structural hollow sections of circular, square or rectangular form and applies to structural hollow sections formed cold without subsequent heat treatment.

The specified requirements apply to non-alloy quality steel, fine grain non-alloy quality steel and fine grain alloy special steels as defined in EN 10020.

The grades, chemical composition and mechanical properties for the non-alloy quality steels are given in annex A.

The grades, chemical composition and mechanical properties for the fine grain non-alloy quality and alloy special steels are given in annex B.

The products specified in this Part of this European Standard are intended for use in construction.

NOTE. A range of steel grades is specified in this European Standard and the user should select the grade appropriate to the intended use and service conditions. The grades and mechanical properties of the finished hollow sections are compatible with those in EN 10025 and EN 10113 and some of those in EN 10149.

Requirements for tolerances, dimensions and sectional properties are contained in Part 2 of this European Standard (EN 10219-2).

This European standard does not apply to products covered by the following European Standards:

- EN 10025 *Hot-rolled products of non-alloy structural steels — Technical delivery conditions*
- EN 10113 *Hot-rolled products in weldable fine grain structural steels*
- EN 10149 *Hot-rolled flat products made of high yield strength steels for cold forming*
- EN 10155 *Structural steels with improved atmospheric corrosion resistance — Technical delivery conditions*
- EN 10210 *Hot finished structural hollow sections of non-alloy and fine grain structural steels*
- EN 10225 *Weldable structural steels for fixed offshore structures*

2 Normative references

This Part of this European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this part of this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

- EN 287-1 *Approval testing of welders — Fusion welding — Part 1: Steels*
- EN 288-1 *Specification and approval of welding procedures for metallic materials — Part 1: General rules for fusion welding*
- EN 288-2 *Specification and approval of welding procedures for metallic materials — Part 2: Welding procedure specification for arc welding*
- EN 288-3 *Specification and approval of welding procedures for metallic materials — Part 3: Welding procedure tests for arc welding of steels*
- EN 10002-1 *Metallic materials — Tensile testing — Part 1: Method of test (at ambient temperature)*
- EN 10020 *Definition and classification of grades of steel*
- EN 10021 *General technical delivery requirements for steel and iron products*
- EN 10027-1 *Designation systems for steel — Part 1: Steel names, principal symbols*
- EN 10027-2 *Designation systems for steel — Part 2: Steel numbers*
- EN 10045-1 *Metallic materials — Charpy impact test — Part 1: Test method*
- EN 10052 *Vocabulary of heat treatment terms for ferrous products*
- 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*
- EN 10246-3¹⁾ *Non-destructive testing of steel tubes — Part 3: Automatic eddy current testing of seamless and welded (except submerged arc welded) steel tubes for the detection of imperfections*
- EN 10246-5¹⁾ *Non-destructive testing of steel tubes — Part 5: Automatic full peripheral magnetic transducer/flux leakage testing of seamless and welded (except submerged arc welded) ferromagnetic steel tubes for the detection of longitudinal imperfections*

¹⁾ In preparation, until this document is published as a European Standard, a corresponding national standard should be agreed at the time of enquiry and order.

EN 10246-8 ¹⁾	<i>Non-destructive testing of steel tubes — Part 8: Automatic ultrasonic testing of the weld seam of electric resistance and induction welded steel tubes for the detection of longitudinal imperfections</i>
EN 10246-9 ¹⁾	<i>Non-destructive testing of steel tubes — Part 9: Automatic ultrasonic testing of the weld seam of submerged arc-welded steel tubes for the detection of longitudinal and/or transverse imperfections.</i>
EN 10246-10 ¹⁾	<i>Non-destructive testing of steel tubes — Part 10: Radiographic testing of the weld seam of submerged arc-welded steel tubes for the detection of imperfections</i>
EN 10266 ¹⁾	<i>Steel tubes, fittings and steel structural hollow sections — Symbols and definitions of terms for use in product standards</i>
EN ISO 377	<i>Selection and preparation of samples and test pieces for steel and iron products</i> (ISO 377 : 1997)
EN ISO 9001	<i>Quality systems — Model for quality assurance in design/development, production, installation and servicing</i> (ISO 9001 : 1994)
EN ISO 9002	<i>Quality systems — Model for quality assurance in production, installation and servicing</i> (ISO 9002 : 1994)
EURONORM 103 ²⁾	<i>Micrographic determination of ferritic or austenitic grain size of steel</i>
EURONORM 168 ²⁾	<i>Iron and steel products — Inspection documents — Contents</i>
<i>Information Circular No. 2 : Weldable fine-grained structural steels — Recommendations for processing, in particular for welding</i>	
<i>CR 10260 : Designation system for steel: Additional symbols for steel names</i>	
ISO 2566-1	<i>Steel — Conversion of elongation values — Part 1: Carbon and low alloy steels</i>
ISO 14284	<i>Steel and iron — Sampling and preparation of samples for the determination of chemical composition</i>

3 Definitions

For the purpose of this European Standard, the following definitions apply in addition to or where different from those in EN 10020, EN 10021, EN 10052, EN 10204 and EN 10266.

3.1 cold forming

A process where the main forming is done at ambient temperature.

3.2 normalizing rolling

A 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.

3.3 thermomechanical rolling

A 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. Subsequent heating above 580 °C may lower the strength values.

NOTE. Thermomechanical rolling leading to the delivery condition M can include processes with an increasing cooling rate with or without tempering including self-tempering but excluding direct quenching and quenching and tempering.

4 Classification and designation

4.1 Classification

4.1.1 Within the strength grades of the non-alloy steels given in annex A, three qualities JR, J0 and J2 are specified. These differ in respect of specified impact requirements, limits on values of various elements with particular reference to sulfur and phosphorus and the inspection and testing requirements.

In accordance with the classification system in EN 10020, S235 is a non-alloy base steel all other steel grades in annex A are non-alloy quality steels.

4.1.2 Within the strength grades of the fine grain steels given in annex B, four qualities N, NL, M and ML are specified. These differ in respect of the carbon, sulfur and phosphorus content and low temperature impact properties.

In accordance with the classification system in EN 10020 steel grades S275 and S355 are non-alloy quality steels and steel grades S420 and S460 are alloy special steels.

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 and CR 10260; the steel numbers are allocated in accordance with EN 10027-2.

NOTE. For a list of corresponding former national designations, see annex E, table E.1.

²⁾ Until these EURONORMS are transformed into European Standards, they can either be implemented or reference made to the corresponding national standards, the list of which is given in annex D to this part of this European Standard.

4.2.2 For non-alloy steel structural hollow sections the designation shall consist of:

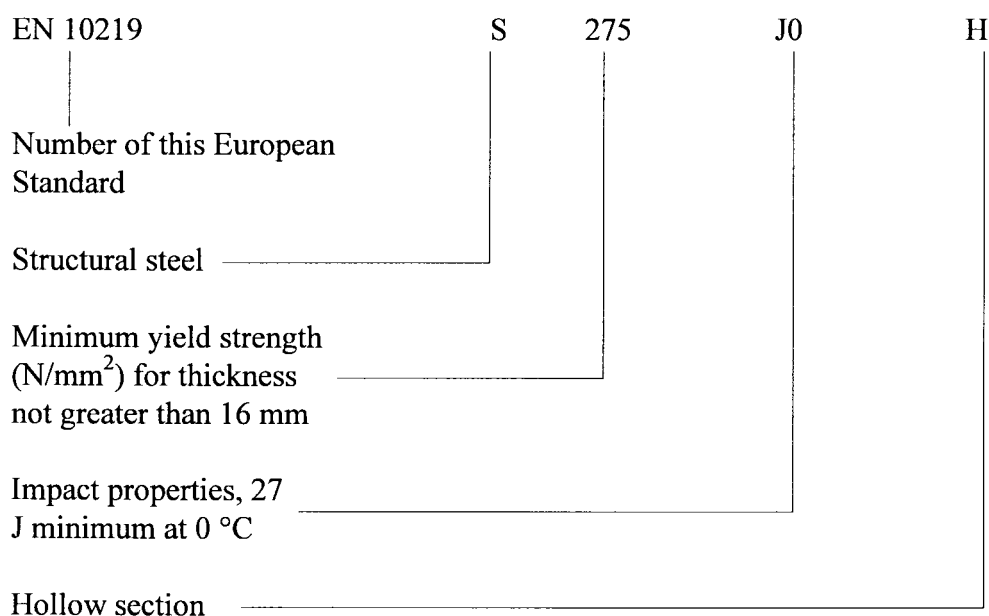
- the number of this European Standard (EN 10219);
- the capital letter S for structural steel;
- the indication of the minimum specified yield strength for thicknesses ≤ 16 mm expressed in N/mm^2 ;
- the capital letters JR for the qualities with specified impact properties at room temperature; or
- the capital letter J and a number 0 or 2 for the qualities with specified impact properties at 0°C and -20°C respectively;
- the capital letter H to indicate hollow sections.

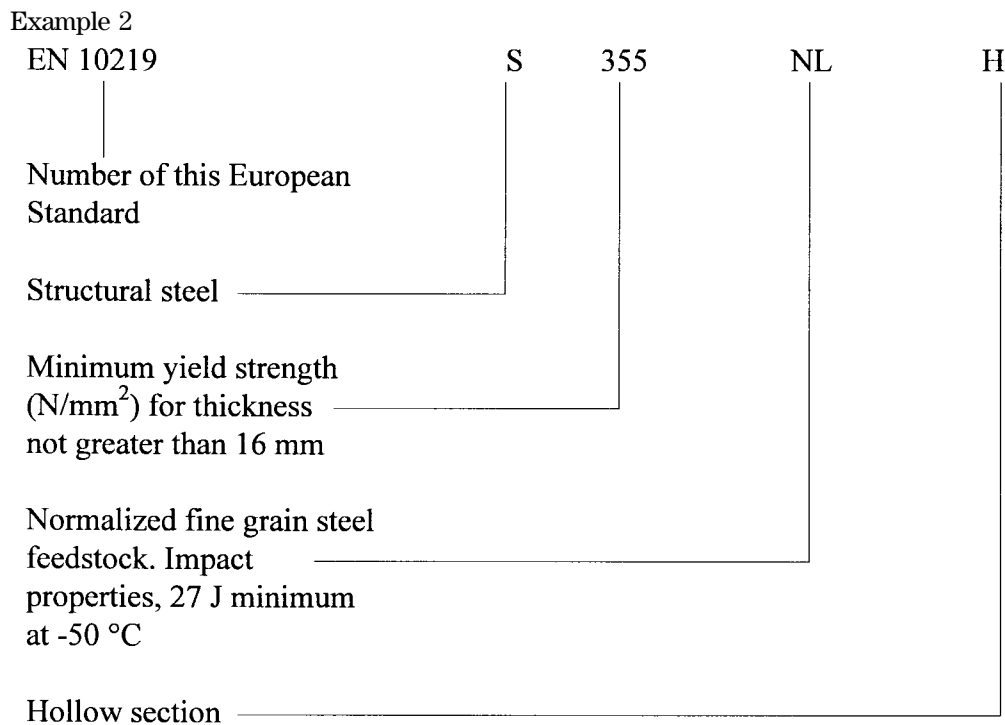
4.2.3 For fine grain steel structural hollow sections the designation shall consist of:

- the number of this European Standard (EN 10219);
- the capital letter S for structural steel;
- the indication of the minimum specified yield strength for thicknesses ≤ 16 mm expressed in N/mm^2 ;
- the capital letter N to indicate normalized or normalized rolled feedstock material (see 6.3);
- the capital letter M to indicate thermomechanically rolled feedstock material (see 6.3);
- the capital letter L for the qualities with specified minimum values of impact energy at a temperature of -50°C ;
- the capital letter H to indicate hollow sections.

4.2.4 The product shall be designated as illustrated by the following examples:

Example 1





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 (mass or total length);
- the type of length and length range or length (see EN 10219-2);
- details of the product form:
 - CFCHS = cold formed welded circular hollow section;
 - CFRHS = cold formed welded square or rectangular hollow section;
- the designation (see 4.2);
- the dimensions (see EN 10219-2);
- the options required (see 5.2);
- the type of inspection document required (see 7.2 and tables 2 and 3).

5.2 Options

A number of options are specified in this part of this European Standard which are listed below with appropriate clause references. In the event that the purchaser does not indicate his wish to implement any of these options at the time of enquiry and order the tubes shall be supplied in accordance with the basic specification.

1.1 Product analysis shall be carried out (see 6.6.1).

1.2 A maximum carbon equivalent value in accordance with table A.2 shall be provided for non-alloy grades (see 6.6.2).

1.3 The Cr, Cu, Mo, Ni, Ti and V cast analysis contents shall be reported in the inspection certificate or inspection report for non-alloy grades (see 6.6.2).

1.4 A maximum carbon equivalent value in accordance with table B.3 shall be provided for fine grain steels S275, S355 and S420 (see 6.6.3).

1.5 The ladle analysis limits for grade S460 (see 6.6.3) shall be:

$$V + Nb + Ti \leq 0,22 \%$$

and

$$Mo + Cr \leq 0,30 \%$$

1.6 Impact properties of quality J0 and JR shall be verified. This option applies only when products are ordered with specific inspection and testing (see 6.7.4).

1.7 The material shall be suitable for hot dipped galvanized coating (see 6.8.2).

1.8 Weld repairs to the body of non-alloy structural steel hollow sections shall not be permitted (see 6.9.4).

1.9 Specific inspection and testing for non-alloy grades of qualities JR and J0 shall be applied (see 7.1.1).

5.3 Example

10 t, 9-10 Random lengths - CFRHS - EN 10219 - S355NH - 100 × 100 × 8 - Options 1.1, 1.4 - 3.1.B

Quantity and type
of length
(see EN 10219-2)

Product form

Number of this
European Standard

Steel grade
designation

Size and thickness
(see EN 10219-2)

Options 1.1 and 1.4

Type of inspection
document selected
from EN 10204

6 Requirements

6.1 General

Structural hollow sections of non-alloy steels shall comply with the requirements of annex A. Structural hollow sections of fine grain steels shall comply with the requirements of annex B.

6.2 Steel manufacturing process

6.2.1 The steel manufacturing process shall be at the discretion of the steel producer.

6.2.2 For the non-alloy structural steels given in annex A, the method of deoxidation shall be as given in table A.1.

6.2.3 For the fine grain steels given in annex B the method of deoxidation shall be as given in table B.1 or table B.2.

6.2.4 The fine grain steels given in annex B shall have a ferritic grain size equal to or finer than 6 when measured in accordance with EURONORM 103 (see 6.7.3).

6.3 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:

- as rolled or normalized/normalized rolled (N) for steels of qualities JR, J0 and J2 according to annex A;

- normalized/normalized rolled (N) for steels of qualities N and NL according to annex B;
- thermomechanically rolled (M) for steels of quality M and ML according to annex B.

6.4 Delivery conditions

6.4.1 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 above 508 mm outside diameter it may 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.

6.4.2 For quality assurance requirements see EN 10021. If the purchaser specifies quality assurance the appropriate standard is EN ISO 9002.

NOTE. This requirement is also fulfilled by a quality system in accordance with EN ISO 9001.

6.5 Structural hollow section manufacturing process

6.5.1 Structural hollow sections shall be manufactured by electric resistance welding or submerged arc welding without subsequent heat treatment (see 6.4.1). Hollow sections manufactured by a continuous process shall not include welds used for joining lengths of the flat rolled 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 9.4.3.

6.5.2 Electric resistance welded hollow sections are normally delivered without trimming the internal weld bead.

6.6 Chemical composition

6.6.1 The cast analysis reported by the steel producer shall apply and shall comply with the requirements of table A.1 of annex A or tables B.1 or B.2 of annex B.

Option 1.1 (see **5.2**). The purchaser may request a product analysis at the time of enquiry and order for products supplied with specific inspection and testing.

The permissible deviations of the product analysis from the specified limits of cast analysis are given in table 1.

When a carbon equivalent value (CEV) is required it shall be determined from the cast analysis using the formula:

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

6.6.2 For non-alloy steel products the following additional requirements can be requested at the time of enquiry and order for products supplied with specific inspection and testing (see **7.1**).

Option 1.2 (see **5.2**). The CEV shall be in accordance with table A.2.

Option 1.3 (see **5.2**). The recording on the inspection certificate or inspection report of the Cr, Cu, Mo, Ni, Ti and V content (cast analysis).

6.6.3 For fine grain steel products the following additional requirements can be requested at the time of enquiry and order.

Option 1.4 (see **5.2**). The CEV for steel grades S275, S355 and S420 shall be in accordance with table B.3.

Option 1.5 (see **5.2**). For steel grade S460 the following limits for the cast analysis.

$$V + Nb + Ti \leq 0,22 \%$$

and

$$Mo + Cr \leq 0,30 \%$$

NOTE. A maximum CEV may be agreed between the purchaser and manufacturer as an alternative to this option.

6.7 Mechanical properties

6.7.1 Under the inspection and testing conditions as specified in clause **7** and in the delivery condition specified in **6.4** the mechanical properties shall comply with the relevant requirements of tables A.3, B.4 and B.5.

NOTE. Stress relief annealing at more than 580 °C or for over one hour may lead to deterioration of the mechanical properties. If the purchaser intends to stress relief anneal the products at higher temperatures or for longer times, the minimum values of the mechanical properties after such a treatment should be agreed at the time of the enquiry and order.

Table 1. Permissible deviations of the product analysis from the specified limits of the cast analysis given in tables A.1, B.1 and B.2		
Element	Permissible limiting content in the cast analysis % by mass	Permissible deviation for the product analysis from specified limits for the cast analysis % by mass
C ¹⁾	≤ 0,20	+ 0,02
	> 0,20	+ 0,03
Si	≤ 0,60	+ 0,05
Mn	non-alloy ≤ 1,60	+ 0,10
	fine grain ≤ 1,70	− 0,05 + 0,10
P	non-alloy ≤ 0,045	+ 0,010
	fine grain ≤ 0,035	+ 0,005
S	non-alloy ≤ 0,045	+ 0,010
	fine grain ≤ 0,030	+ 0,005
Nb	≤ 0,050	+ 0,010
V	≤ 0,20	+ 0,02
Ti	≤ 0,05	+ 0,01
Cr	≤ 0,30	+ 0,05
Ni	≤ 0,80	+ 0,05
Mo	≤ 0,20	+ 0,03
Cu	≤ 0,35	+ 0,04
	0,35 < Cu ≤ 0,70	+ 0,07
N	≤ 0,025	+ 0,002
Al _{Total}	≤ 0,020	− 0,005

¹⁾ For S235JRH in thicknesses less than or equal to 16 mm, the permissible deviation is 0,04 % C, and for thicknesses greater than 16 mm and less than or equal to 40 mm the permissible deviation is 0,05 % C.

6.7.2 For impact tests, standard V-notch test pieces in accordance with EN 10045-1 shall be used. If the nominal product thickness is not sufficient for the preparation of standard test pieces, the test shall be carried out using test pieces of width less than 10 mm, but not less than 5 mm. The minimum average values given in tables A.3, B.4 and B.5 shall be reduced in direct proportion of the actual width of the test piece to that of the standard test piece.

Impact tests are not required for nominal thickness less than 6 mm.

6.7.3 For fine grain steel hollow sections in thicknesses which do not permit test pieces of width greater than or equal to 5 mm to be taken, the ferritic grain size (see 6.2.4) shall be verified by the method as described in EURONORM 103.

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 not less than 0,020 % total aluminium or alternatively 0,015 % soluble aluminium. In these cases, verification of the grain size is not required.

6.7.4 Subject to the limitations of 6.7.2

- a) the impact properties of structural hollow sections of steel qualities J2, M, N, ML and NL shall be verified;
- b) the impact properties of structural hollow sections of steel qualities JR and J0 are not verified.

Option 1.6 (see 5.2). The purchaser may request at the time of enquiry and order, for products supplied with specific inspection and testing (see option 1.9), that the impact properties of steel qualities JR and J0 are verified.

6.8 Technological properties

6.8.1 Weldability

The steels specified in this European Standard shall be suitable for welding by all appropriate welding processes.

NOTE.1. With increasing product thickness, increasing strength level and increasing carbon equivalent level, the occurrence of cold cracking in the welded zone forms the main risk. Cold cracking is caused by the following factors in combination:

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

NOTE.2. When using recommendations as laid down for example in Information Circular No. 2 or any other relevant standard, the recommended welding conditions and the various welding ranges of the steel grades can be determined depending on the product thickness, the applied welding energy, the design requirements, the electrode efficiency, the welding process and the weld metal properties.

6.8.2 Hot dipped galvanized coating

Option 1.7 (see 5.2). At the time of enquiry and order the purchaser may request that the products shall be suitable for hot dipped galvanized coating.

6.9 Surface condition

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

Surface defects 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. (See EN 10219-2 for thickness tolerance.)

6.9.2 The ends of the hollow section shall be cut nominally square with the axis of the product.

6.9.3 For both non-alloy and fine grain hollow sections repair of the weld shall be permitted.

6.9.4 For non-alloy hollow sections repair of the body by welding shall 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 1.8 (see 5.2). The purchaser may specify at the time of enquiry and order that repair of the body by welding shall not be carried out.

For fine grain hollow sections repair of the body by welding shall not be permitted unless otherwise agreed.

6.9.5 Welding repair shall be carried out by operators qualified in accordance with EN 287-1. Welding repair procedures shall be in accordance with EN 288, Parts 1 to 3 and shall be covered by the manufacturer's quality system.

6.9.6 The repaired hollow section shall comply with all the requirements of this European Standard.

6.10 Non-destructive testing of welds

The seam weld of all hollow sections supplied with specific inspection and testing shall be subjected to a non-destructive test.

6.11 Tolerances and mass

6.11.1 Tolerances

Tolerances for cold formed structural hollow sections shall be as specified in Part 2 of this European Standard (EN 10219-2).

6.11.2 Mass

Mass shall be determined using a density of 7,85 kg/dm³.

NOTE. Dimensions, sectional properties and mass per unit length for a range of standard sizes of cold formed hollow sections are given in Part 2 of this European Standard (EN 10219-2). The purchaser should preferably select the dimensions of the hollow sections from this range of standard sizes.

7 Inspection

7.1 Types of inspection and testing

7.1.1 Hollow sections of non-alloy steels in qualities JR and J0 (see annex A) shall be subjected to non-specific inspection and testing in accordance with EN 10021 unless otherwise specified by the purchaser at the time of enquiry and order.

Option 1.9 (see 5.2). The purchaser may request specific inspection and testing at the time of enquiry and order.

7.1.2 Hollow sections of non-alloy steel quality J2 (see annex A) and fine grain steels of qualities M, N, ML and NL (see annex B) shall be subjected to specific inspection and testing in accordance with EN 10021.

7.2 Types of inspection document

7.2.1 For products subjected to non-specific inspection and testing 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 EURONORM 168.

- A — Commercial transactions and parties involved.
- B — Description of products to which the test report applies.
- C — Information on tests as follows:
 - C11-C13 — Tensile test;
 - C71-C92 — Cast analysis.
- Z — Authentication of the test report.

7.2.2 For products subjected to specific inspection and testing an inspection certificate (3.1.A, 3.1.B or 3.1.C) or an inspection report (3.2) in accordance with EN 10204 shall be provided.

The purchaser shall indicate in the enquiry and order the type of inspection document required (see 5.1g)).

NOTE. If an inspection document 3.1.A, 3.1.C or 3.2 is specified the purchaser should notify the manufacturer of the address of the organization or person nominated by him to carry out the inspection and produce the inspection document.

The inspection certificate or inspection report shall contain the following codes and related information in accordance with EURONORM 168.

- A — Commercial transactions and parties involved.
- B — Description of products to which the inspection document applies.
- C — Information on tests as follows:
 - C01-C03 — Location of sample, 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;
 - C71-C92 — Cast analysis and if applicable, product analysis.
- Z — Authentication of the inspection document.

7.3 Product inspection and testing

7.3.1 General

The requirements for inspection and testing are given in table 2 for hollow sections of non-alloy steels and in table 3 for hollow sections of fine grain steels.

Table 2. Inspection and test programme for hollow sections of non-alloy steels					
		Inspection and test requirements		Scope of inspection and test programme and type of document	
		Type of test	Subclause reference	Non-specific inspection and testing	Specific inspection and testing
				Test report (2.2)	Inspection certificate (3.1.A, B or C) Inspection report (3.2)
Mandatory test	1	Cast analysis	6.6 9.1	One result per delivery item	One per cast
	2	Tensile test	6.7 9.2	One result per delivery item	One per test unit ¹⁾
	3	Impact test (quality J2 only)	6.7 9.2	Not applicable	One set per test unit ¹⁾
	4	Surface condition and dimensions	6.9 6.11 9.3	See 9.3	See 9.3
	5	NDT of the weld	6.10 9.4	Not applicable	All products, full length
Optional test	6	Product analysis	6.6 9.1	Not applicable	One per test unit ¹⁾
	7	Cast analysis additional elements	6.6 9.1	Not applicable	See option 1.3
	8	Impact test (qualities JR and J0 only)	6.7 9.2	Not applicable	One set per test unit ¹⁾ (only when option 1.6 is requested)

¹⁾ For test unit see 8.1.3.

Table 3. Inspection and test programme for hollow sections of fine grain steels				
		Inspection and test requirements		Scope of inspection and test programme and type of document
		Type of test	Subclause reference	Specific inspection and testing
				Inspection certificate (3.1.A, B and C) Inspection report (3.2)
Mandatory test	1	Cast analysis	6.6 9.1	One per cast
	2	Tensile test	6.7 9.2	One per test unit ¹⁾
	3	Impact test	6.7 9.2	One set per test unit ¹⁾
	4	Surface condition and dimensions	6.9 6.11 9.3	See 9.3
	5	NDT of the weld	6.10 9.4	All products, full length
Optional test	6	Product analysis	6.6 9.1	One per test unit ¹⁾
¹⁾ For test unit see 8.1.3 .				

7.3.2 Non-specific inspection and testing

When products are subjected to non-specific inspection and testing, the tests shall be carried out by the manufacturer, in accordance with his own procedures, to demonstrate that products made by the same manufacturing process meet the requirements of the order. The products tested may not necessarily be the products actually supplied.

7.3.3 Specific inspection and testing

When products are subjected to specific inspection and testing, the tests shall be carried out on the products to be supplied, or on test units of which the product to be supplied is a part, or when applicable on all hollow sections.

8 Sampling

8.1 Frequency of tests

8.1.1 For products subjected to non-specific inspection and testing see **7.3.2**.

8.1.2 For products subjected to specific inspection and testing the verification of the mechanical properties and product analysis, if applicable, shall be carried out by test unit. A test unit is defined as a quantity of hollow sections from one or more cast(s) of the same grade and dimensions manufactured by the same process (i.e. electric welding or submerged arc welding), and if applicable in the same heat treatment condition, submitted for acceptance at the same time.

From each test unit one sample shall be taken sufficient for the preparation of the following test pieces:

- 1 tensile test piece;
- 2 sets of 3 impact test pieces (see **9.2.2**);
- 1 product analysis when required (see **6.6.1**)

8.1.3 The test unit shall consist of the tonnage of sections as specified in table 4.

Table 4. Test units		
Product form		Test unit
Circular	Square or rectangular	
Outside diameter <i>D</i> mm	External perimeter mm	Mass <i>t</i> max.
≤ 114,3	≤ 400	40
> 114,3 ≤ 323,9	> 400 ≤ 800	50
> 323,9	> 800	75

8.2 Preparation of samples and test pieces

8.2.1 Selection and preparation of samples for chemical analysis

Samples for product analysis shall be taken from the test pieces or samples for mechanical testing or from the whole thickness of the hollow section at the same location as for the mechanical test samples. The preparation of samples shall be in accordance with ISO 14284.

8.2.2 Location and orientation of samples for mechanical tests

8.2.2.1 Tensile test pieces

The test pieces for tensile testing shall comply with the following:

- a) for circular, square or rectangular sections, the test piece may be the full section of the product;
- b) for circular sections, not tested in full section, the test pieces shall be taken longitudinally and shall be taken at a point remote from the weld (see annex C);

Alternatively, at the discretion of the manufacturer, transverse test pieces may be taken;

- c) for square or rectangular sections, not tested in full section, the test pieces shall be taken longitudinally, midway between the corners, from one of the sides not containing the weld (see annex C).

Alternatively, at the discretion of the manufacturer, transverse test pieces may be taken.

8.2.2.2 Impact test pieces

Test pieces for impact testing shall comply with the following:

- a) for circular sections the test pieces shall be taken longitudinally and shall be taken at a point remote from the weld (see annex C);

Alternatively, at the discretion of the manufacturer, transverse test pieces may be taken;

- b) for square or rectangular sections the test pieces shall be taken longitudinally, midway between the corners, from one of the sides not containing the weld (see annex C);

Alternatively, at the discretion of the manufacturer, transverse test pieces may be taken.

8.2.3 Preparation of test pieces for mechanical tests

The requirements of EN ISO 377 shall apply in conjunction with the test piece location specified in 8.2.2.

8.2.3.1 Tensile test pieces

The requirements of EN 10002-1 as appropriate shall apply.

Test pieces may be non-proportional, but in cases of dispute proportional test pieces having a gauge length $L_0 = 5,65 \sqrt{S_0}$ shall be used (see 9.2.1). For thicknesses less than 3 mm a gauge length of $L_0 = 80$ mm shall be used provided a test piece width of 20 mm can be achieved, otherwise a gauge length of 50 mm shall be used with a test piece width of 12,5 mm.

8.2.3.2 Impact test pieces

Impact V-notch test pieces shall be prepared and machined in accordance with EN 10045-1. In addition, the following requirements apply:

- a) for nominal thicknesses greater than 12 mm, standard test pieces shall be machined in such a way that one side is not further away than 2 mm from a rolled surface;
- b) for nominal thicknesses less than or equal to 12 mm, when test pieces with reduced sections are used, the width shall be greater than or equal to 5 mm.

NOTE. Test piece size is dependent on the actual thickness of the sample and, for circular hollow sections, allowance also needs to be made for the curvature of the section.

9 Test methods

9.1 Chemical analysis

The elements to be determined and reported shall be those given in table A.1 of annex A, unless option 1.3 is requested (see 5.2) or in table B.1 or table B.2 of annex B.

The choice of a suitable physical or chemical analytical method for the analysis shall be at the discretion of the manufacturer.

In case of dispute, the method used shall be agreed taking into account the relevant European Standards.

9.2 Mechanical tests

Tensile tests shall be carried out in the temperature range 10 °C to 35 °C. Impact tests shall be carried out at the temperatures specified in table A.3 for non-alloy steels and tables B.4 and B.5 for fine grain steels. (For retests see 9.5.)

9.2.1 Tensile tests

The tensile test shall be carried out in accordance with EN 10002-1.

For the specified yield strength in tables A.3, B.4 and B.5, the upper yield stress (R_{eH}) shall be determined.

If a yield phenomenon is not present, the 0,2 % proof strength $R_{p0,2}$ or the 0,5 % total extension $R_{t0,5}$ shall be determined. In cases of dispute, the 0,2 % proof strength $R_{p0,2}$ shall apply.

If a non-proportional test piece is used, the percentage elongation value obtained shall be converted to the value for a gauge length $L_0 = 5,65 \sqrt{S_0}$ using the conversion tables given in ISO 2566-1.

For thicknesses less than 3 mm the percentage elongation may be reported for a gauge length of 80 mm or 50 mm (see 8.2.3.1). In this case the values to be achieved shall be agreed between the purchaser and the manufacturer at the time of enquiry and order.

9.2.2 Impact tests

The impact test shall be carried out in accordance with EN 10045-1 and shall be assessed in accordance with EN 10021 as follows:

- a) the averaged value of a set of three test pieces shall meet the specified requirement. One individual value may be below the specified value, provided that it is not less than 70 % of that value;
- b) if the conditions under a) are not satisfied then an additional set of three test pieces shall be taken from the same sample and tested. To consider the test unit as conforming, after testing the second set, the following conditions shall be satisfied simultaneously:
 - 1) the average value of six tests shall be equal to or greater than the specified value;
 - 2) not more than two of six individual values may be lower than the specified value;
 - 3) not more than one of the six individual values may be lower than 70 % of the specified value;
- c) if these conditions are not satisfied the sample product is deemed not to comply with this standard and retests may be carried out on the remainder of the test unit (see 9.5).

9.3 Visual inspection and dimensional check

9.3.1 Visual inspection

The hollow sections shall be visually inspected for compliance with the requirements of 6.9.

9.3.2 Dimensional check

The dimensions of the hollow sections shall be checked for compliance with the requirements of Part 2 of this European Standard (EN 10219-2).

9.4 Non-destructive testing

9.4.1 General

When the welds of structural hollow sections are to be subjected to non-destructive testing the method shall be in accordance with 9.4.2 or 9.4.3. At the manufacturer's discretion the NDT may be carried out either on the circular shape prior to final forming or on the round, square or rectangular hollow sections after final forming.

9.4.2 Electric resistance welded sections

The weld seam of the hollow sections shall be tested in accordance with one of the following European Standards.

- a) EN 10246-3 to acceptance level E4 with the exception that the rotating tube/pancake coil technique shall not be permitted;
- b) EN 10246-5 to acceptance level F5 or EN 10246-8 to acceptance level U5.

The standard to be applied is at the discretion of the manufacturer.

9.4.3 Submerged arc welded sections

The weld seam of hollow sections shall be tested to level U4 in accordance with EN 10246-9 or by radiography in accordance with EN 10246-10 with an image quality class R2.

Butt welds used to join lengths of strip/plate together in the helically submerged arc weld process shall be tested full length by the same procedure and shall meet the same acceptance requirements as the main seam weld.

9.5 Retests, sorting and reprocessing

For retests, sorting and reprocessing, EN 10021 shall apply with the provision that if sorting is carried out each individual product shall be subjected to the test which failed.

10 Marking

10.1 Except as provided for in 10.2 for hollow sections which are bundled, each hollow section shall be marked by suitable and durable methods such as painting, stamping, adhesive labels or attached tags with the following:

- the abridged designation e.g. EN 10219 S275J0;
- the manufacturer's name or trademark;
- in the case of specific inspection and testing an identification number, e.g. order number, which permits the correlation of the product or delivery unit to the related document.

Examples: EN 10219 S235JR + Trademark
EN 10219 S275NL + Manufacturer's name

10.2 Where the products are supplied bundled, the marking required in 10.1 may be on a label which shall be securely attached to the bundle.

Annex A (normative)

Structural hollow sections of non-alloy steels — Chemical composition and mechanical properties

Table A.1 Chemical composition — Cast analysis for product thickness equal to or less than 40 mm ¹⁾									
Steel designation		Type of de-oxidation ²⁾	Classification ³⁾	% by mass					
According to EN 10027-1 and CR 10260	According to EN 10027-2			C max.	Si max.	Mn max.	P max.	S max.	N ⁴⁾ max.
S235JRH	1,0039	FF	BS	0,17	—	1,40	0,045	0,045	0,009
S275J0H	1,0149	FF	QS	0,20	—	1,50	0,040	0,040	0,009
S275J2H	1,0138	FF	QS	0,20	—	1,50	0,035	0,035	—
S355J0H	1,0547	FF	QS	0,22	0,55	1,60	0,040	0,040	0,009
S355J2H	1,0576	FF	QS	0,22	0,55	1,60	0,035	0,035	—
¹⁾ Only circular hollow sections available in thicknesses over 24 mm. ²⁾ The deoxidation method is designated as follows: FF: Fully killed steel containing nitrogen binding elements in amounts sufficient to bind available nitrogen (e.g. min. 0,020 % total Al, or 0,015 % soluble Al). ³⁾ BS base steel QS: quality steel. ⁴⁾ The max. value for nitrogen does not apply if the chemical composition shows a minimum total Al content of 0,020 % with a minimum Al/N ratio of 2:1, or if sufficient other N-binding elements are present. The N-binding elements shall be recorded in the inspection document.									

Table A.2 Maximum carbon equivalent value based on cast analysis		
Steel designation		Maximum CEV for nominal thicknesses equal to or less than 40 mm ¹⁾
According to EN 10027-1 and CR 10260	According to EN 10027-2	
S235JRH	1,0039	0,35
S275J0H	1,0149	0,40
S275J2H	1,0138	0,40
S355J0H	1,0547	0,45
S355J2H	1,0576	0,45
¹⁾ Only circular hollow section available in thicknesses over 24 mm.		

Table A.3 Mechanical properties of non-alloy steel hollow sections in thicknesses equal to or less than 40 mm¹⁾

Steel designation		Minimum yield strength R_{eH}		Tensile strength R_m		Minimum elongation ($L_0 = 5,65\sqrt{S_0}$) ³⁾⁴⁾	Impact properties	
According to EN 10027-1 and CR 10260	According to EN 10027-2	N/mm ²		N/mm ²		%		
		Nominal thickness mm		Nominal thickness mm		Nominal thickness mm	Test temperature °C	Minimum average absorbed energy for standard test pieces ⁵⁾ J
		≤ 16	> 16 ≤ 40	< 3	≥ 3 ≤ 40	≤ 40		
S235JRH ²⁾	1.0039	235	225	360-510	340-470	24	20	27
S275J0H ²⁾	1.0149	275	265	430-580	410-560	20	0	27
S275J2H	1.0138						-20	27
S355J0H ²⁾	1.0547	355	345	510-680	490-630	20	0	27
S355J2H	1.0576						-20	27

¹⁾ Only circular hollow sections available in thicknesses over 24 mm.

²⁾ The impact properties are verified only when specified at the time of enquiry and order for products supplied with specific inspection and testing.

³⁾ For section sizes ≤ 60 mm × 60 mm and equivalent round and rectangular sections the minimum value for elongation is 17 % for all thicknesses.

⁴⁾ For thicknesses less than 3 mm a gauge length of 80 mm or 50 mm shall be used (see 8.2.3.1); the values of percentage elongation to be achieved shall be agreed between the purchaser and the manufacturer at the time of enquiry and order (see 9.2.1).

⁵⁾ For impact properties for reduced section test pieces see 6.7.2.

Annex B (normative)
Structural hollow sections of fine grain steels — Chemical composition and mechanical properties

Table B.1 Chemical composition — Cast analyses for product thicknesses equal to or less than 40 mm, ¹⁾ feedstock condition N2															
Steel designation		Type of deoxidation ³⁾	Classification ⁴⁾	% by mass											
According to EN 10027-1 and CR 10260	According to EN 10027-2			C max.	Si max.	Mn max.	P max.	S max.	Nb max.	V max.	Al total min. ⁵⁾	Ti max.	Cr max.	Ni max.	Mo max.
				%	%	%	%	%	%	%	%	%	%	%	%
S275NH	1,0493	GF	QS	0,20	0,40	0,50-1,40	0,035	0,030	0,050	0,05	0,020	0,03	0,30	0,30	0,10
S275NLH	1,0497						0,030	0,025							0,015
S355NH	1,0539	GF	QS	0,20	0,50	0,90- 1,65	0,035	0,030	0,050	0,12	0,020	0,03	0,30	0,50	0,10
S355NLH	1,0549			0,18			0,030	0,025							0,015
S460NH	1,8953	GF	SS	0,20	0,60	1,00-1,70	0,035	0,030	0,050	0,20	0,020	0,03	0,30	0,80	0,10
S460NLH	1,8956						0,030	0,025							0,025

1) Only circular hollow sections available in thicknesses over 24 mm.

2) See 6.3.

3) The deoxidation method is designated as follows:
GF: Fully killed steel containing nitrogen binding elements in amounts sufficient to bind the available nitrogen and having a fine grained structure

4) QS: quality steel. SS: special steel.

5) If sufficient N-binding elements are present, the minimum total Al content does not apply.

6) If the copper content is greater than 0,30 % then the nickel content shall be at least half of the copper content.

Table B.2 Chemical composition — Cast analysis for product thicknesses equal to or less than 40 mm ¹⁾ — feedstock condition M ²⁾															
Steel designation		Type of deoxidation ³⁾	Classification ⁴⁾	% by mass											
According to EN 10027 and CR 10260	According to EN 10027-2			C max.	Si max.	Mn max.	P max.	S max.	Nb max.	V max.	Al total min. ⁵⁾	Ti max.	Ni max.	Mo ⁶⁾ max.	N max.
S275MH	1,8843	GF	QS	0,13	0,50	1,50	0,035	0,030	0,050	0,08	0,020	0,050	0,30	0,20	0,020
S275MLH	1,8844						0,030	0,025							
S355MH	1,8845	GF	QS	0,14	0,50	1,50	0,035	0,030	0,050	0,10	0,020	0,050	0,30	0,20	0,020
S355MLH	1,8846						0,030	0,025							
S420MH	1,8847	GF	SS	0,16	0,50	1,70	0,035	0,030	0,050	0,12	0,020	0,050	0,30	0,20	0,020
S420MLH	1,8848						0,030	0,025							
S460MH	1,8849	GF	SS	0,16	0,60	1,70	0,035	0,030	0,050	0,12	0,020	0,050	0,30	0,20	0,025
S460MLH	1,8850						0,030	0,025							
1) Only circular hollow sections available in thicknesses over 24 mm.															
2) See 6.3.															
3) The deoxidation method is designated as follows: GF: Fully killed steel containing nitrogen binding elements in amounts sufficient to bind the available nitrogen and having a fine grained structure.															
4) QS: quality steel. SS: special steel.															
5) If sufficient N-binding elements are present, the minimum total Al content does not apply.															
6) The total sum of Cr, Cu and Mo shall be not higher than 0,60 %															

Table B.3 Maximum carbon equivalent value based on cast analysis		
Steel designation		Maximum CEV for nominal thicknesses equal to or less than 40 mm ¹⁾ %
According to EN 10027-1 and CR 10260	According to EN 10027-2	
S275NH	1,0493	0,40
S275NLH	1,0497	
S275MH	1,8843	0,34
S275MLH	1,8844	
S355NH	1,0539	0,43
S355NLH	1,0549	
S355MH	1,8845	0,39
S355MLH	1,8846	
S420MH	1,8847	0,43
S420MLH	1,8848	
S460NH ²⁾	1,8953	—
S460NLH ²⁾	1,8956	
S460MH ²⁾	1,8849	—
S460MLH ²⁾	1,8850	
¹⁾ Only circular hollow sections available in thicknesses over 24 mm.		
²⁾ See 6.6.3. Option 1.5.		

Table B.4 Mechanical properties of hollow sections in thicknesses equal to or less than 40 mm ¹⁾ — feedstock material condition N							
Steel designation		Minimum yield strength R_{eH} N/mm ²		Tensile strength R_m N/mm ²	Minimum elongation $(L_0 = 5,65\sqrt{S_0})^{2) 3)}$ %	Impact properties	
According to EN 10027-1 and CR 10260	According to EN 10027-2	Nominal thickness mm		Nominal thickness mm	Nominal thickness mm	Test temperature °C	Minimum average absorbed energy (J) for standard test pieces ⁴⁾
		≤ 16	> 16 ≤ 40	≤ 40	≤ 40		
S275NH	1,0493	275	265	370-540	24	−20	40
S275NLH	1,0497					−50	27
S355NH	1,0539	355	345	470-630	22	−20	40
S355NLH	1,0549					−50	27
S460NH	1,8953	460	440	550-720	17	−20	40
S460NLH	1,8956					−50	27

¹⁾ Only circular hollow sections available in thicknesses over 24 mm.

²⁾ For section sizes ≤ 60 mm × 60 mm and equivalent round and rectangular section, the minimum value for elongation is 17 % for all thicknesses.

³⁾ For thicknesses less than 3 mm a gauge length of 80 mm or 50 mm shall be used (see **8.2.3.1**); the values of percentage elongation to be achieved shall be agreed between the purchaser and the manufacturer at the time of enquiry and order (see **9.2.1**).

⁴⁾ For impact properties for reduced section test pieces see **6.7.2**.

Table B.5 Mechanical properties of hollow sections in thicknesses equal to or less than 40 mm ¹⁾ — feedstock material condition M							
Steel designation		Minimum yield strength R_{eH} N/mm ²		Tensile strength R_m N/mm ²	Minimum elongation $(L_0 = 5,65\sqrt{S_0})^{2) \ 3)}$ %	Impact properties	
According to EN 10027-1 and CR 10260	According to EN 10027-2	Nominal thickness mm		Nominal thickness mm	Nominal thickness mm	Test temperature °C	Minimum average absorbed energy (J) for standard test pieces ⁴⁾
		≤ 16	> 16 ≤ 40	≤ 40	≤ 40		
S275MH	1,8843	275	265	360-510	24	−20	40
S275MLH	1,8844					−50	27
S355MH	1,8845	355	345	450-610	22	−20	40
S355MLH	1,8846					−50	27
S420MH	1,8847	420	400	500-660	19	−20	40
S420MLH	1,8848					−50	27
S460MH	1,8849	460	440	530-720	17	−20	40
S460MLH	1,8850					−50	27

¹⁾ Only circular hollow sections available in thicknesses over 24 mm.

²⁾ For section sizes ≤ 60 and equivalent round and rectangular sections, the minimum value for elongation is 17 % for all thicknesses.

³⁾ For thicknesses less than 3 mm a gauge length of 80 mm or 50 mm shall be used (see **8.2.3.1**); the values of percentage elongation to be achieved shall be agreed between the purchaser and the manufacturer at the time of enquiry and order (see **9.2.1**)

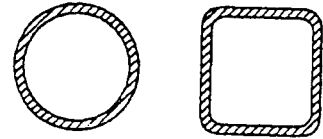
⁴⁾ For impact properties for reduced section test pieces see **6.7.2**.

Annex C (normative)

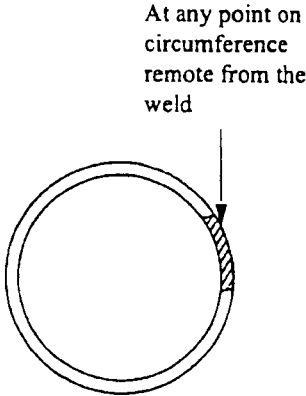
Location of samples and test pieces

This annex gives information on the location of samples and test pieces for hollow sections (see 8.2.2).

Position of test samples for tensile test

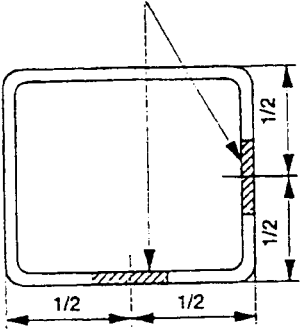


C.1 Small sections



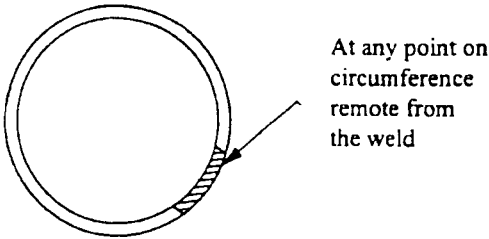
C.2 Circular sections

Alternative positions
(on any side except a
side containing the weld)



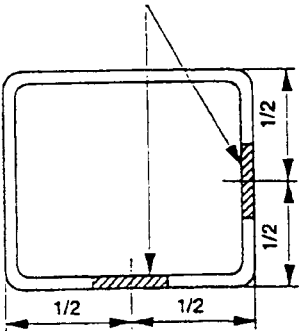
C.3 Square and
rectangular sections

Position of test samples for impact test



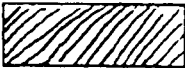
C.4 Circular sections

Alternative positions
(on any side, except a
side containing the weld)



C.5 Square and
rectangular sections

C.6



Location of samples
Note: Test pieces are taken from the samples indicated

Annex D (informative)
List of national standards which correspond with Euronorms referenced

Table D.1 Euronorms with corresponding national standards										
Euronorm	Corresponding national standard in									
	Germany	France	United Kingdom	Spain	Italy	Belgium	Portugal	Sweden	Austria	Norway
103	DIN 50 601	NF A 04 102	BS 4490	UNE 7-280	UNI EU 103	NBN A 14-101	NP- 1787	—	—	—
168	—	NF A 03 116	BS 6363	UNE 36-800	UNI EU 168	—	—	SS11 00 12	—	—
Information Circular No.2	SEW 088	NF A 36 000	BS 5135	—	—	—	—	SS06 40 25	—	—

Annex E (informative)
Designation of steel grades in this European Standard and the corresponding former national designation

Table E.1 List of corresponding former national designations												
Steel designation		Corresponding former designations in										
According to EN 10027-1 and CR 10260	According to EN 10027-2	Germany		France	United Kingdom	Spain	Italy	Belgium	Sweden	Portugal	Austria	Norway
		Steel number	Steel name									
S235JRH	1,0039	1,0037	St 37-2	E 24-2			Fe 360B	AE 235-B	13 11-00	Fe 360B		NS 12 120
S275J0H	1,0149	1,0144	St 44-3U	E 28-3	34/26	AE 275C	Fe 430C	AE 255-C		Fe 430C	St 430C	NS 12 143
S275J2H	1,0138	1,0144	St 44-3N	E 28-4		AE 275D	Fe 430D	AE 255-D	14 14-01	Fe 430D	St 430D	NS 12 143
S355J0H	1,0547	1,0570	St 52-3U	E 36-3	43/36	AE 355C	Fe 510C	AE 355-C		Fe 510C	St 510C	NS 12 153
S355J2H	1,0576	1,0570	St 52-3N			AE 355D	Fe 510	AE 355-D		Fe 510D	St 410D	NS 12 153
S275NH	1,0493	1,0486	St E 285 N		—							
S275NLH	1,0497	1,0488	TSt E 285 N									
S355NH	1,0539	1,0562	St E 355 N		—							
S355NLH	1,0547	1,0566	TSt E 355 N		—							
S460NH	1,8953	1,8905	St E 460 N		—							
S460NLH	1,8953	1,8915	TSt E 460 N									

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