



BSI Standards Publication

## Hot rolled products of structural steels

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Part 5: Technical delivery conditions for structural steels  
with improved atmospheric corrosion resistance

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## National foreword

This British Standard is the UK implementation of EN 10025-5:2019. It supersedes BS EN 10025-5:2004, which is withdrawn.

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 secretary.

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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EUROPEAN STANDARD

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English Version

## Hot rolled products of structural steels - Part 5: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance

Produits laminés à chaud en aciers de construction -  
Partie 5 : Conditions techniques de livraison pour les  
aciers de construction à résistance améliorée à la  
corrosion atmosphérique

Warmgewalzte Erzeugnisse aus Baustählen - Teil 5:  
Technische Lieferbedingungen für wetterfeste  
Baustähle

This European Standard was approved by CEN on 16 June 2019.

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

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## European foreword

This document (EN 10025-5:2019) 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of an identical text or by endorsement, at the latest by February 2020 and conflicting national standards shall be withdrawn at the latest by February 2020.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 10025-5:2004.

This document consists of the following parts, under the general title *Hot rolled products of structural steels*:

- *Part 1: General technical delivery conditions*
- *Part 2: Technical delivery conditions for non-alloy structural steels*
- *Part 3: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels*
- *Part 4: Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels*
- *Part 5: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance*
- *Part 6: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition*

For a short transition period there will be a coexistence of EN 10025-1:2004 with EN 10025-2:2019 to - EN 10025-6:2019, since the new EN 10025-1 has to fulfil the requirements of the CPR and will therefore be published later. For this short transition period up-to-the publication of the next edition of part 1 the following is to be taken into account for EN 10025-1:2004:

- a) all dated and undated references to EN 10025-1:2004 to EN 10025-6:2004 are unchanged to this version with following exception: In 9.2.2.1 the references are 8.3.1 and 8.3.2 instead of 8.4.1 and 8.4.2;
- b) Clauses 5, 12 and 13 of EN 10025-1:2004 are no longer relevant.

The main changes with respect to the previous edition are listed below:

- a) part 5 is now a stand-alone standard for technical delivery conditions including the preparation of samples and test pieces, the test methods, the marking, labelling and packaging and the drawings;
- b) for applications under the CPR this document and part 1 are to be used together;
- c) requirements for elements not defined were added to 7.2.1 and 7.2.2;
- d) Option 33 were added, Options 9 and 21 were deleted;
- e) key to Figure A.1 was updated;

- f) steel grades S355J4, S420J0W, S420J2W, S420J4W, S460J0W, S460J2W and S460J4W were added to Tables 1 to 5;
- g) Annex B concerning the corresponding EURONORMS deleted;
- h) references were updated and document editorial revised.

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

Botop Steel

## 1 Scope

This document specifies technical delivery conditions for flat and long products of hot rolled steels with improved atmospheric corrosion resistance in the grades and qualities given in Tables 2 and 3 (chemical composition) and Tables 4 and 5 (mechanical properties) in the usual delivery conditions as given in 6.3.

The thicknesses in which products of the steel grades and qualities specified in this document can be supplied are given in Table 1.

**Table 1 — Product forms for the different steel grades with improved atmospheric corrosion resistance depending on their thickness**

Designation		Flat products		Long products		
				Sections	Bars	Rods
Steel name	Steel number	Nominal thickness		Nominal thickness or diameter		
		mm		mm		
		≤ 12	≤ 150	≤ 63	≤ 150	≤ 60
S235J0W	1.8958		x	x	x	x
S235J2W	1.8961		x	x	x	x
S355J0WP	1.8945	x				
S355J2WP	1.8946	x				
S355J0W	1.8959		x	x	x	x
S355J2W	1.8965		x	x	x	x
S355K2W	1.8967		x	x	x	x
S355J4W	1.8787		x	x	x	x
S355J5W	1.8991		x			
S420J0W	1.8943		x	x		
S420J2W	1.8949		x	x		
S420K2W	1.8997		x	x		
S420J4W	1.8954		x			
S420J5W	1.8992		x			
S460J0W	1.8966		x	x		
S460J2W	1.8980		x	x		
S460K2W	1.8990		x	x		
S460J4W	1.8981		x			
S460J5W	1.8993		x			

The steels specified in this document are not intended to be heat treated except products delivered in the delivery condition +N. Stress relieving is accepted. Products delivered in +N condition can be hot formed and/or normalized after delivery (see Clause 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 10017, *Steel rod for drawing and/or cold rolling — Dimensions and tolerances*

EN 10020:2000, *Definition and classification of grades of steel*

EN 10021, *General technical delivery conditions for steel products*

EN 10024, *Hot rolled taper flange I sections — Tolerances on shape and dimensions*

EN 10025-1, *Hot rolled products of structural steels — Part 1: General technical delivery conditions*

EN 10027-1, *Designation systems for steels — Part 1: Steel names*

EN 10027-2, *Designation systems for steels — Part 2: Numerical system*

EN 10029, *Hot-rolled steel plates 3 mm thick or above — Tolerances on dimensions and shape*

EN 10034, *Structural steel I and H sections — Tolerances on shape and dimensions*

EN 10048, *Hot rolled narrow steel strip — Tolerances on dimensions and shape*

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

EN 10055, *Hot rolled steel equal flange tees with radiused root and toes — Dimensions and tolerances on shape and dimensions*

EN 10056-1, *Structural steel equal and unequal leg angles — Part 1: Dimensions*

EN 10056-2, *Structural steel equal and unequal leg angles — Part 2: Tolerances on shape and dimensions*

EN 10058, *Hot rolled flat steel bars and steel wide flats for general purposes — Dimensions and tolerances on shape and dimensions*

EN 10059, *Hot rolled square steel bars for general purposes — Dimensions and tolerances on shape and dimensions*

EN 10060, *Hot rolled round steel bars for general purposes — Dimensions and tolerances on shape and dimensions*

EN 10061, *Hot rolled hexagon steel bars for general purposes — Dimensions and tolerances on shape and dimensions*

EN 10067, *Hot rolled bulb flats — Dimensions and tolerances on shape, dimensions and mass*

EN 10079, *Definition of steel products*

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

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

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

EN 10163-3, *Delivery requirements for surface condition of hot-rolled steel plates, wide flats and sections — Part 3: Sections*

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

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

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

EN 10279, *Hot rolled steel channels — Tolerances on shape, dimensions and mass*

EN 10306, *Iron and steel — Ultrasonic testing of H beams with parallel flanges and IPE beams*

EN 10308, *Non destructive testing — Ultrasonic testing of steel bars*

EN 10315, *Routine method for analysis of high alloy steel by X-ray Fluorescence Spectrometry (XRF) by using a near by technique*

CR 10320, *Optical emission analysis of low alloy steels (routine method) — Method for determination of C, Si, S, P, Mn, Cr, Ni and Cu*

CEN/TR 10347, *Guidance for forming of structural steels in processing*

EN 10363, *Continuously hot-rolled patterned steel strip and plate/sheet cut from wide strip — Tolerances on dimensions and shape*

EN 10365, *Hot rolled steel channels, I and H sections — Dimensions and masses*

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 2566-1, *Steel — Conversion of elongation values — Part 1: Carbon and low alloy steels (ISO 2566-1)*

EN ISO 6892-1:2016, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature (ISO 6892-1:2016)*

EN ISO 9443, *Surface quality classes for hot-rolled bars and wire rod (ISO 9443)*

EN ISO 14284, *Steel and iron — Sampling and preparation of samples for the determination of chemical composition (ISO 14284)*

EN ISO 15350, *Steel and iron — Determination of total carbon and sulfur content — Infrared absorption method after combustion in an induction furnace (routine method) (ISO 15350)*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 10079 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

#### 3.1

##### **normalized rolled**

**+N**

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

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

#### 3.2

##### **as-rolled**

**+AR**

conventional hot rolling without any normalized rolling or thermomechanical rolling and/or heat treatment condition like normalizing or quenching

#### 3.3

##### **thermomechanical rolling**

**+M**

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 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.

Note 2 to entry: In some publications the word TMCP (Thermomechanical Control Process) is also used.

#### 3.4

##### **normalizing**

**+N**

heat treatment consisting of austenitizing followed by air cooling

#### 3.5

##### **steel with improved atmospheric corrosion resistance**

steel in which a certain number of alloying elements, such as P, Cu, Cr, Ni, Mo, 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 B.

## 4 Classification and designation

### 4.1 Classification

#### 4.1.1 Main quality classes

The steel grades specified in this document shall be classified as alloy special steels according to EN 10020.

#### 4.1.2 Grades and qualities

This document specifies four steel grades S235, S355, S420 and S460.

The steel grades may be supplied in different qualities. The qualities differ in specified impact energy requirements (see Table 5).

Grade S355 is subdivided into the classes W and WP, which differ mainly in their carbon and phosphorus contents (see Tables 2 and 3) and availability (see Table 1).

### 4.2 Designation

**4.2.1** For the steel grades covered by this document the steel names shall be allocated in accordance with EN 10027-1; the steel numbers shall be allocated in accordance with EN 10027-2.

**4.2.2** The designation shall consist of:

- the number of this document (EN 10025-5);
- the steel name or the steel number; the steel name consisting of:
  - symbol S (for structural steel);
  - indication of the minimum specified yield strength for thickness  $\leq 16$  mm expressed in MPa;
  - quality designation (see 4.1.2) in respect of specified impact energy values;
  - letter W indicating that the steel has an improved atmospheric corrosion resistance;
  - if applicable, the letter P for the class with a greater phosphorus content (only in the case of grade S355);
- the indication "+N", "+AR" or "+M", when the products are ordered and delivered in the condition +N, +AR or +M (see 3.1, 3.2, 3.3, 3.4 and 6.3). The indication "+N", "+AR" or "+M" shall be added to the steel name or steel number.

**EXAMPLE** Structural steel (S) with improved atmospheric corrosion resistance (W), with a specified minimum yield strength at room temperature of 355 MPa with a minimum impact energy of 27 J at 0 °C (J0), delivery condition +N:

EN 10025-5 - S355J0W+N

Or

EN 10025-5 - 1.8959+N

## 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 the order:

- a) quantity to be delivered;
- b) product form and the number of the standard for dimensions and tolerances (see 2.2);
- c) nominal dimensions and tolerances on dimensions and shape (see 7.7.1);
- d) steel designation (see 4.2.2);
- e) additional requirements of inspection and testing and all required options (see 5.2 and Clause 13);
- f) type of inspection document according to EN 10204 (see 8.1);

### 5.2 Options

A number of options are specified in Clause 13. In the event that the purchaser does not indicate his wish to implement any of these options, the supplier shall supply in accordance with the basic specification, see 5.1 a) to d) and f).

## 6 Manufacturing process

### 6.1 Steel making process

The steel making process is at the discretion of the manufacturer with the exclusion of the open hearth (Siemens-Martin) process.

See **Option 1**, Clause 13 (details of manufacturing process).

### 6.2 Deoxidation

The deoxidation methods are designated as follows:

- a) FN Rimming steel not permitted;
- b) FF Fully killed steel containing nitrogen binding elements in amounts sufficient to bind the available nitrogen (for example min. 0,020 % total aluminium). The usual guideline is a minimum aluminium to nitrogen ratio of 2:1, when no other nitrogen binding elements are present. Such other elements and their content (% mass) shall be reported in the inspection document.

The method of deoxidation shall be as given in Table 2.

### 6.3 Delivery conditions

Unless otherwise agreed upon the delivery condition of products can be +AR, +N or +M at the manufacturer's discretion.

See **Option 19**, Clause 13 (delivery condition +AR, +N or +M).

If an inspection document is required (see 8.1) the delivery condition shall be indicated in it with its specific symbol (+AR, +N or +M). In case the products are ordered in the delivery condition +AR, +N or +M the specific symbol (+AR, +N or +M) shall be added to the designation (see 4.2.2).

**NOTE** The requirements on the mechanical properties of the steel grades according to this document are not depending on the delivery condition.

## 7 Requirements

### 7.1 General

The requirements in 7.2 and 7.3 apply for sampling, preparation of test pieces and testing specified in Clauses 9 and 10.

### 7.2 Chemical composition

**7.2.1** The chemical composition determined by heat analysis shall comply with the specified values of Table 2.

For elements not defined in the table for the chemical composition for heat analysis, limit values of Table 1 of EN 10020:2000 shall apply as maximum values.

**7.2.2** The limits applicable for the product analysis are given in Table 3.

The product analysis shall be carried out when specified at the time of the order.

See **Option 2**, Clause 13 (product analysis).

For elements not defined in table for the chemical composition for product analysis, limit values of Table 1 of EN 10020:2000 shall apply as maximum values.

**7.2.3** The maximum carbon equivalent values based on the heat analysis given in Table 2 shall apply.

For determining the carbon equivalent value the following IIW (International Institute of Welding) formula shall be used:

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

### 7.3 Mechanical properties

#### 7.3.1 General

**7.3.1.1** Under the inspection and testing conditions as specified in Clauses 8, 9 and 10 and in the delivery condition as specified in 6.3 the mechanical properties shall comply with the values given in Tables 4 and 5.

Stress relieving at more than 580 °C or for over 1 h can lead to a deterioration of the mechanical properties of the steel grade. For normalized and normalized rolled flat products the maximum stress relief temperature should be 560 °C. If the purchaser intends to stress relief the products at higher temperatures or for longer times than mentioned above the minimum values of the mechanical properties after such a treatment should be agreed upon at the time of the order.

**7.3.1.2** For flat and bar products ordered and supplied in the normalized or normalized rolled condition (delivery condition +N) the mechanical properties shall comply with the relevant tables for mechanical properties in the normalized or normalized rolled condition or after normalizing by heat treatment after delivery or after hot forming if the provisions of CEN/TR 10347 are satisfied.

Products can be susceptible to a deterioration in mechanical strength if they are subjected to incorrect heat treatment processes at higher temperature such as flame straightening, rerolling, etc. Products in the +N delivery condition are less sensitive than other delivery conditions, but it is recommended that guidance is sought from the manufacturer if any higher temperature processing is required.

**7.3.1.3** For flat products the nominal thickness applies. For long products of irregular section the nominal thickness of that part from which the samples are taken applies (see Annex A).

### 7.3.2 Impact properties

**7.3.2.1** The impact properties, except for steel grade S355 class WP, shall be verified by test at the temperature given in Table 5, unless otherwise agreed upon at the time of the order.

The impact properties of steel grade S355 class WP are verified only when specified at the time of the order.

See **Option 3**, Clause 13 (Verification of impact properties for qualities S355 class WP).

**7.3.2.2** If specified at the time of the order for flat products of quality J2, J4, J5 and K2 out of each parent plate or coil the impact properties only or the impact properties and the tensile properties shall be verified.

See **Option 13**, Clause 13 (For flat products on each parent plate or coil impact properties only to be verified).

See **Option 14**, Clause 13 (For flat products on each parent plate or coil impact and tensile properties to be verified).

### 7.3.3 Improved deformation properties perpendicular to the surface

If agreed upon at the time of the order products shall comply with one of the requirements of EN 10164.

See **Option 4**, Clause 13 (Deformation properties perpendicular to the surface).

## 7.4 Technological properties

### 7.4.1 Weldability

The steels specified in this document do not have unlimited suitability for the various welding processes, since the behaviour of a steel during and after welding depends not only on the material but also on the dimensions and shape and on the manufacturing and service conditions of the components.

In Annex C, more information on weldability may be found.

### 7.4.2 Formability and flame straightening

#### 7.4.2.1 General

Recommendations regarding hot forming, cold forming and flame straightening are laid out in CEN/TR 10347.

#### 7.4.2.2 Hot forming

Only products ordered and supplied in the normalized or normalized rolled condition shall comply with the requirements of Tables 4 and 5 if hot forming is carried out after delivery (see 7.3.1.2).

NOTE The products ordered and supplied in the thermomechanical rolled and as-rolled condition are not suitable for hot forming.

#### 7.4.2.3 Cold formability

##### 7.4.2.3.1 General

NOTE Cold forming leads to reduction in the ductility.

#### 7.4.2.3.2 Flangeability

If specified at the time of the order, plate, sheet, strip, wide flats and flats (width < 150 mm) with a nominal thickness  $\leq 20$  mm shall be suitable for flanging without cracking with the minimum recommended bend radii given in Table 6. The grades and qualities to which this applies are given in Table 6.

See **Option 11**, Clause 13 (Flangeability without cracking).

### 7.5 Surface properties

#### 7.5.1 Strip

The surface condition should not impair an application appropriate to the steel grade if adequate processing of the strip is applied.

#### 7.5.2 Plates and wide flats

EN 10163-1 and EN 10163-2 shall apply for the permissible surface discontinuities and for the repair of surface defects by grinding and/or welding. Class A, subclass 1 of EN 10163-2 shall apply, unless otherwise agreed upon at the time of the order.

See **Option 15**, Clause 13 (Other surface class for plates and wide flats).

#### 7.5.3 Sections

EN 10163-1 and EN 10163-3 shall apply for the permissible surface discontinuities and for the repair of surface defects by grinding and/or welding. Class C, subclass 1 of EN 10163-3 shall apply, unless otherwise agreed upon at the time of the order.

See **Option 16**, Clause 13 (Other surface class for sections).

#### 7.5.4 Bars and rods

EN ISO 9443 applies for the permissible surface discontinuities and for the repair of surface defects by grinding and/or welding. Class A of EN ISO 9443 shall apply, unless otherwise agreed upon at the time of the order.

See **Option 17**, Clause 13 (Other surface class for bars and rods).

### 7.6 Internal soundness

Ultrasonic testing may be agreed upon at the time of the order and shall comply with 10.3.

See **Option 6**, Clause 13 (Ultrasonic testing for flat products).

See **Option 7**, Clause 13 (Ultrasonic testing for H beams with parallel flanges and IPE beams).

See **Option 8**, Clause 13 (Ultrasonic testing for bars).



## 7.7 Dimensions, tolerances on dimensions and shape, mass

**7.7.1** Dimensions, tolerances on dimensions and shape shall be in accordance with the requirements given in the order by reference to following standards: EN 10017, EN 10024, EN 10029, EN 10034, EN 10048, EN 10051, EN 10055, EN 10056-1, EN 10056-2, EN 10058, EN 10059, EN 10060, EN 10061, EN 10067, EN 10279, EN 10363 and EN 10365.

For hot rolled plate tolerances the basic requirements shall be in accordance with EN 10029, including thickness tolerances to class A, unless otherwise agreed upon at the time of the order.

See **Option 18**, Clause 13 (For plates other thickness tolerance than class A).

For plates cut from continuously hot rolled strip, the thickness tolerances shall be in accordance with EN 10051, unless otherwise agreed upon at the time of order.

See **Option 34**, Clause 13 (For plates cut from strip thickness tolerances according to EN 10029).

**7.7.2** The nominal mass shall be determined from the nominal dimensions using a volumetric mass of 7 850 kg/m<sup>3</sup>.

## 8 Inspection

### 8.1 Type of inspection and inspection document

The products shall be delivered either with specific or non-specific inspection and testing to indicate compliance with the order and this document. The manufacturer shall obtain from the purchaser which of the inspection documents specified in EN 10204 is required.

NOTE Some application standards, e.g. EN 1090-2, require particular inspection documents according to EN 10204.

Unless otherwise agreed upon steel grades of this document are delivered with CE marking and they shall not only fulfil these technical delivery conditions but also the requirements of EN 10025-1.

It can be agreed upon at the time of enquiry and order to abstain from CE-marking, see Option 33, in this case EN 10025-1 does not apply.

See **Option 33**, Clause 13 (no application of CE-marking).

In case of specific inspection, testing shall be carried out according to the requirement of 8.3, Clause 9 and Clause 10.

### 8.2 Content of inspection document

The inspection document shall include, in accordance with EN 10168, the following codes and/or information, where applicable:

A	commercial transactions and parties involved;
B	description of products to which the inspection document applies;
C00-C03	identification of the sample, location of the sample, direction of the test pieces, test temperature;
C10-C13	shape of the test piece, yield or proof strength, tensile strength, elongation after fracture;
C40-C43	type of test piece, width of test piece, individual values, mean value;
C70-C92	steelmaking process, chemical composition;
D	other tests;
Z	validation.

### 8.3 Tests to be carried out for specific inspection

8.3.1 The following tests shall be carried out:

- the heat analysis;
- the tensile test;
- for products of quality J0, J2 of the steel grade S235 and for all products of quality J0, J2, J4, J5 and K2 of the steel grades S355, S420 and S460, class W, the impact test with thickness limitations as specified in 9.2.3.3.

8.3.2 At the time of the order the following additional tests can be agreed upon (see also Clause 13):

- a) the product analysis, see 7.2.2 and **Option 2**, Clause 13;
- b) for all products of steel grade S355, class WP, the impact test, see 7.3.2.1 and **Option 3**, Clause 13.

## 9 Frequency of testing and preparation of samples and test pieces

### 9.1 Frequency of testing

#### 9.1.1 Chemical analysis

The heat analysis shall be determined once per cast. If a product analysis has been agreed upon at the time of enquiry and order, the purchaser shall specify the frequency if not once per cast.

#### 9.1.2 Mechanical tests

The verification of the mechanical properties (tensile strength, yield strength, impact energy and elongation) shall be by test unit(s) from within each cast.

For verifying the mechanical properties the following test unit shall apply:

- 60 tonnes or part thereof;
- 80 tonnes or part thereof for heavy sections with a mass > 200 kg/m;
- 80 tonnes or part thereof for all sections if the mass of the cast exceeds 200 tonnes.

The test unit shall contain products of the same form, grade and quality, delivery condition and of the same thickness range as specified in Table 4 for the yield strength.

The following samples shall be taken from one sample product of each test unit:

- one sample for tensile testing;
- one sample sufficient for one set of six impact test pieces.

### 9.2 Preparation of samples and test pieces

#### 9.2.1 Selection and preparation of samples for chemical analysis

The selection and preparation of samples for product analysis shall be in accordance with EN ISO 14284.

## 9.2.2 Location of samples and orientation and test pieces for mechanical tests

The location of samples shall be as shown in Annex A.

In addition the samples shall be taken:

- from the thickest product in the test unit;
- from any product of the test unit for products in delivery condition +N (see 3.1, 3.4).

Additionally for plates, sheet, wide strip and wide flats the samples shall be taken so that the axes of the test pieces are approximately midway between the edge and centre line of the products.

For wide strip and rod the sample shall be taken at an adequate distance from the end of the product.

For narrow strip (< 600 mm wide) the sample shall be taken at an adequate distance from the end of the coil and at one third of the width.

## 9.2.3 Preparation of test pieces for mechanical tests

### 9.2.3.1 General

The requirements of EN ISO 377 shall apply.

### 9.2.3.2 Preparation of tensile test pieces

The requirements of EN ISO 6892-1 shall apply.

For flat products of nominal thickness > 30 mm a round test piece may be used with the longitudinal axis at 1/4 thickness, if a testing machine with an adequate capacity is not available. In case of doubt or dispute, results on full thickness of the product will prevail.

NOTE For bars round test pieces are commonly used but other forms are not prohibited (see EN ISO 6892-1).

### 9.2.3.3 Preparation of impact test pieces

V-notch test pieces shall be machined and prepared in accordance with EN ISO 148-1. In addition the following requirements apply:

a) flat products and sections:

- for nominal thicknesses > 12 mm, standard 10 mm × 10 mm test pieces shall be machined in such a way that one side is not further away than 2 mm from a rolled surface;
- for nominal thicknesses ≤ 12 mm, when test pieces with reduced widths are used, the largest width possible has to be chosen;
- for nominal thickness < 6 mm no impact tests are required;

b) bars and rod:

- for nominal diameter ≥ 16 mm (round cross section) or nominal thickness ≥ 12 mm (rectangular cross section), standard 10 mm × 10 mm test pieces shall be machined;
- for nominal diameter < 16 mm (round cross section) or nominal thickness < 12 mm (rectangular cross section) no impact tests are required.

### 9.3 Identification of samples and test pieces

Samples and test pieces shall be marked so that the original products and their location and orientation in the product are known.

## 10 Test methods

### 10.1 Chemical analysis

Test methods shall be in accordance with EN 10315, EN ISO 15350 or CR 10320 depending on the elements to be analysed and their content. 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 upon taking into account CEN/TR 10261.

For the heat analysis the manufacturer shall report values of all elements defined in Table 2 for the steel grade concerned for each cast as well as of the elements for determining the carbon equivalent value.

For the product analysis, if not otherwise agreed upon, the manufacturer shall report values of all elements defined in Table 3 for the steel grade concerned, see Option 2, Clause 13.

### 10.2 Mechanical tests

#### 10.2.1 Tensile test

The tensile test shall be carried out in accordance with EN ISO 6892-1. The manufacturer may choose between method A or B specified in EN ISO 6892-1 for the tensile test.

For the specified yield strength the upper yield strength ( $R_{eH}$ ) shall be determined.

If a yield phenomenon is not present, the 0,2 % proof strength ( $R_{p0,2}$ ) shall be determined.

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.

For flat products with a nominal thickness  $< 3$  mm the test pieces shall always have a gauge length  $L_0 = 80$  mm and a width of 20 mm (test piece number 2 EN ISO 6892-1:2016, Annex B).

For normal testing, for reasons of economy, test pieces of a constant measuring length may be used provided the result obtained for elongation after fracture is converted by the formula in EN ISO 2566-1.

#### 10.2.2 Impact test

The impact test shall be carried out in accordance with EN ISO 148-1 on V-notch specimen using 2 mm striker.

The average value of the three test results shall meet the specified requirement. One individual value may be below the minimum average value specified, provided that it is not less than 70 % of that value.

Three additional test pieces shall be taken from the same sample in accordance with 9.1.2 and tested in any one of the following cases:

- if the average of three impact values is lower than the minimum average value specified;
- if the average value meets the specified requirement, but two individual values are lower than the minimum average value specified;
- if anyone value is lower than 70 % of the minimum average value specified.

The average value of the six tests shall be not less than the minimum average value specified. Not more than two of the individual values may be lower than the minimum average value specified and not more than one may be lower than 70 % of this value.

### 10.3 Ultrasonic testing

If specified at the time of the order (see 7.6), ultrasonic testing shall be carried out:

- for flat products in nominal thicknesses  $\geq 6$  mm, except for hot rolled strip and plate cut from strip in accordance with EN 10160;
- for H beams with parallel flanges and IPE beams in accordance with EN 10306;
- for bars in accordance with EN 10308.

### 10.4 Retests

The retests shall be in accordance with EN 10021.

In the case of strip and rod, retests on a rejected coil shall be carried out after the cutting of an additional longitudinal section of sufficient length to remove the coil end effect with a maximum of 20 m.

## 11 Marking, labelling, packaging

**11.1** The products shall be legibly marked using methods such as painting, stamping, laser marking, bar coding, durable adhesive labels or attached tags with the following:

- the grade, the quality and if applicable the delivery condition indicated by its abridged designation;
- a number by which the cast and if applicable the sample can be identified;
- the manufacturer's name or trademark.

The type of marking may be specified at the time of the order.

See **Option 10**, Clause 13 (special type of marking).

The mark of the external inspection representative may be marked (where applicable).

NOTE This depends on the type of inspection document (see 8.1).

**11.2** Marking shall be at a position close to one end of each product or on the end cut face at the manufacturer's discretion.

**11.3** Where products are supplied in securely tied bundles the marking shall be on a label attached to the bundle or on the top product of the bundle.

## 12 Complaints

Any complaints shall be dealt with in accordance with EN 10021.

### 13 Options

A list of options for parts 2 to 6 is given in Annex D for information. The following options (see 5.2) apply for this part:

- 1 The steel making process shall be indicated (see 6.1).
- 2 Product analysis shall be carried out; the number of samples shall be as agreed upon (see 7.2.2 and 9.1.1).
- 3 The impact properties of steel grade S355, class WP, shall be verified (see 7.3.2.1 and 8.3.2).
- 4 Products shall comply with one of the improved properties perpendicular to the surface of EN 10164 (see 7.3.3).
- 6 For flat products in nominal thickness  $\geq 6$  mm, except for hot rolled strip and plate cut from strip, the freedom from internal defects shall be verified in accordance with EN 10160 (see 7.6 and 10.3).
- 7 For H beams with parallel flanges and IPE beams the freedom from internal defects shall be verified in accordance with EN 10306 (see 7.6 and 10.3).
- 8 For bars the freedom from internal defects shall be verified in accordance with EN 10308 (see 7.6 and 10.3).
- 10 The type of marking required (see Clause 11).
- 11 Sheet, plate, strip, wide flats and flats (width  $< 150$  mm) with a nominal thickness  $\leq 20$  mm shall be suitable for flanging without cracking (see 7.4.2.3.2).
- 13 For flat products of quality J2, J4, J5 and K2 out of each parent plate or coil the impact properties only shall be verified (see 7.3.2.2).
- 14 For flat products of quality J2, J4, J5 and K2 out of each parent plate or coil the impact properties and the tensile properties shall be verified (see 7.3.2.2).
- 15 For plates and wide flats the permissible surface discontinuities and for the repair of surface defects by grinding and/or welding another class than class A, subclass 1 of EN 10163-2 applies (see 7.5.2).
- 16 For sections the permissible surface discontinuities and for the repair of surface defects by grinding and/or welding another class than class C, subclass 1 of EN 10163-3 applies (see 7.5.3).
- 17 For bars and rods the permissible surface discontinuities and for the repair of surface defects by grinding and/or welding another class than class A of EN ISO 9443 applies (see 7.5.4).
- 18 For hot rolled plates other tolerances than class A of EN 10029 apply (see 7.7.1).
- 19 The delivery condition +N, +AR or +M is required (see 6.3).
- 33 No application of CE-marking according to EN 10025-1, and no application of assessment and verification of constancy of performance according to EN 10025-1, for products, which are not covered by the Construction Product Regulation.
- 34 For plates cut from continuously hot rolled strip thickness tolerances according to EN 10029 apply (see 7.7.1).

Table 2 — Chemical composition of the heat analysis

Designation		Method of de-oxidation <sup>a</sup>	C % max.	Si % max.	Mn % max.	P % b.	S % max. <sup>b</sup>	N % max. <sup>f</sup>	Addition of nitrogen binding elements <sup>c</sup>	Cr % max.	Cu % max.	Others % max.	CEV % max.
Steel name	Steel number												
S235J0W	1.8958	FN	0,13	0,40	0,20 to 0,60	max. 0,035	0,035	0,012	-	0,40 to 0,80 g	0,25 to 0,55	-	0,44
S235J2W	1.8961	FF							yes				
S355J0WP	1.8945	FN	0,12	0,75	max. 1,0	0,06 to 0,15	0,035	0,012	-	0,30 to 1,25	0,25 to 0,55	-	0,52
S355J2WP	1.8946	FF							yes				
S355J0W	1.8959	FN	0,16	0,50	0,50 to 1,50	max. 0,035 max. 0,030 max. 0,030 max. 0,030 max. 0,030	0,035	0,012	-	0,40 to 0,80 g	0,25 to 0,55	-	0,52
S355J2W	1.8965	FF							yes				
S355K2W	1.8967	FF							yes				
S355J4W	1.8787	FF							yes				
S355J5W	1.8991	FF							yes				
S420J0W	1.8943	FN	0,20	0,65	0,50 to 1,35	max. 0,035 max. 0,030 max. 0,030 max. 0,030 max. 0,030	0,035	0,025	-	0,40 to 0,80 g	0,25 to 0,55	-	0,52
S420J2W	1.8949	FF							yes				
S420K2W	1.8997	FF							yes				
S420J4W	1.8954	FF							yes				
S420J5W	1.8992	FF							yes				
S460J0W	1.8966	FN	0,20	0,65	max. 1,40	max. 0,035 max. 0,030 max. 0,030 max. 0,030 max. 0,030	0,035	0,025	-	0,40 to 0,80 g	0,25 to 0,55	-	0,52
S460J2W	1.8980	FF							yes				
S460K2W	1.8990	FF							yes				
S460J4W	1.8981	FF							yes				
S460J5W	1.8993	FF							yes				

<sup>a</sup> FN = rimming steels not permitted; FF = fully killed steel (see 6.2).

<sup>b</sup> For long products the P and S content can be 0,005 % higher.

<sup>c</sup> The steels shall contain at least one of the following elements: Al total  $\geq$  0,020 %, Nb: 0,015 to 0,060 %, V: 0,02 to 0,12 %, Ti: 0,02 to 0,10 %. If these elements are used in combination, at least one of them shall be present with the minimum content indicated.

Designation		Method of de-oxidation <sup>a</sup>	C % max.	Si % max.	Mn %	P % b	S % max. <sup>b</sup>	N % max. <sup>f</sup>	Addition of nitrogen binding elements <sup>c</sup>	Cr %	Cu %	Others d e	CEV % max.
Steel name	Steel number												
<p>d The steels may show a Ni content of max. 0,65 %.</p> <p>e The steels may contain max. 0,30 % Mo and max. 0,15 % Zr.</p> <p>f The max. value for nitrogen does not apply if the chemical composition shows a minimum total Al content of 0,020 % or if sufficient other N binding are present. The N binding elements shall be mentioned in the inspection document.</p> <p>g Cr may be reduced to 0,37 % if the chemical composition shows a minimum Si content of 0,15 %.</p>													



Table 3 — Chemical composition of the product analysis based on Table 2

Designation	Method of deoxidation <sup>a</sup>	C % max.	Si % max.	Mn %	P % b	S % max. b	N % max. f	Addition of nitrogen binding elements <sup>c</sup>	Cr % g	Cu % g	Others d e
S235J0W	FN	0,16	0,45	0,15 to 0,70	max. 0,040	0,040	0,014	-	0,35 to 0,85 g	0,20 to 0,60	-
S235J2W	FF							yes			
S355J0WP	FN	0,15	0,80	max. 1,1	0,05 to 0,16	0,040	0,014	-	0,25 to 1,35	0,20 to 0,60	-
S355J2WP	FF							yes			
S355J0W	FN	0,19	0,55	0,45 to 1,60	max. 0,040	0,040	0,014	-	0,35 to 0,85 g	0,20 to 0,60	-
S355J2W	FF							yes			
S355K2W	FF							yes			
S355J4W	FF							yes			
S355J5W	FF							yes			
S420J0W	FN	0,23	0,75	0,45 to 1,45	max. 0,040	0,040	0,027	-	0,35 to 0,85 g	0,20 to 0,60	-
S420J2W	FF							yes			
S420K2W	FF							yes			
S420J4W	FF							yes			
S420J5W	FF							yes			
S460J0W	FN	0,23	0,75	max. 1,50	max. 0,040	0,040	0,027	-	0,35 to 0,85 g	0,20 to 0,60	-
S460J2W	FF							yes			
S460K2W	FF							yes			
S460J4W	FF							yes			
S460J5W	FF							yes			

Designation	Method of deoxidation <sup>a</sup>	C % max.	Si % max.	Mn %	P % b	S % max. b	N % max. f	Addition of nitrogen binding elements <sup>c</sup>	Cr %	Cu %	Others d e
Steel name	Steel number										
a	FN = rimming steels not permitted; FF = fully killed steel (see 6.2).										
b	For long products the P and S content can be 0,005 % higher.										
c	The steels shall contain at least one of the following elements: Al total $\geq 0,020$ %, Nb: 0,010 to 0,065 %, V: 0,01 to 0,14 %, Ti: 0,01 to 0,12 %. If these elements are used in combination, at least one of them shall be present with the minimum content indicated.										
d	The steels may show a Ni content of max. 0,70 %.										
e	The steels may contain max. 0,35 % Mo and max. 0,17 % Zr.										
f	The max. value for nitrogen does not apply if the chemical composition shows a minimum total Al content of 0,020 % or if sufficient other N binding elements are present. The N binding elements shall be mentioned in the inspection document.										
g	Cr may be reduced to 0,32 % if the chemical composition shows a minimum Si content of 0,15 %.										



Table 4 — Mechanical properties – Tensile test properties at room temperature a

Designation		Minimum yield strength $R_{eH}$ a				Tensile strength $R_m$ a		Orientation of test pieces a	Minimum percentage elongation after fracture a								
		MPa		Nominal thickness mm		MPa			Nominal thickness mm		%		Nominal thickness mm				
		Nominal thickness mm	Nominal thickness mm	Nominal thickness mm	Nominal thickness mm	Nominal thickness mm	Nominal thickness mm		$L_0 = 80$ mm	$L_0 = 5,65 \sqrt{S_0}$	$L_0 = 80$ mm	$L_0 = 5,65 \sqrt{S_0}$	Nominal thickness mm	Nominal thickness mm			
Steel name	Steel number	> 16 ≤ 16	> 40 ≤ 63	> 63 ≤ 80	> 80 ≤ 100	> 100 ≤ 150	< 3	≥ 3 ≤ 100	≥ 100 ≤ 150	> 1,5 ≤ 2	> 2 ≤ 2,5	> 2,5 ≤ 3	≥ 3 ≤ 40	> 40 ≤ 63	> 63 ≤ 100	> 100 ≤ 150	
S235J0W	1.8958	235	215	215	215	195	360 to 510	360 to 510	350 to 500	1	19	20	21	26	25	24	22
S235J2W	1.8961						510			t	17	18	19	24	23	22	22
S355J0WP	1.8945	355					510 to 680	470 to 630	-	l	16	17	18	22	-	-	-
S355J2WP	1.8946							b		t	14	15	16	20	-	-	-
S355J0W	1.8959									l	16	17	18	22	21	20	18
S355J2W	1.8965									t	14	15	16	20	19	18	18
S355K2W	1.8967	355	335	325	315	295	510 to 680	470 to 630	450 to 600								
S355J4W	1.8787																
S355J5W	1.8991																
S420J0W	1.8943									l	15	15	15	19	18	17	16
S420J2W	1.8949									t	13	13	13	17	16	15	14
S420K2W	1.8997	420	390	380	370	365	520 to 680	500 to 660	460 to 620								
S420J4W	1.8954																
S420J5W	1.8992																
S460J0W	1.8966									l	14	14	14	17	16	15	14
S460J2W	1.8980									t	12	12	12	15	14	13	12
S460K2W	1.8990	460	430	410	400	385	540 to 720	530 to 710	490 to 660								
S460J4W	1.8981																
S460J5W	1.8993																

Designation	Minimum yield strength $R_{eH}$ <sup>a</sup> MPa		Tensile strength $R_m$ <sup>a</sup> MPa		Orientation of test pieces <sup>a</sup>	Minimum percentage elongation after fracture <sup>a</sup> %				
	Nominal thickness mm		Nominal thickness mm			$L_0 = 80$ mm Nominal thickness mm				
Steel name Steel number	> 16	> 40	> 63	> 80	a	> 1,5	> 2	> 2,5	> 3	$L_0 = 5,65 \sqrt{S_0}$ Nominal thickness mm
	≤ 16	≤ 40	≤ 80	≤ 100		≤ 2	≤ 2,5	< 3	≤ 40	
<p>a For plate, strip and wide flats with widths ≥ 600 mm the direction transverse (t) to the rolling direction applies. For all other products the values apply for the direction parallel (l) to the rolling direction.</p> <p>b For flat products: applicable up to 12 mm.</p>										



Table 5 — Mechanical properties - Impact energy  $KV_2$  on longitudinal test pieces <sup>a</sup>

Designation		Temperature °C	Minimum energy $KV_2$ <sup>a</sup> J
Steel name	Steel number		
S235J0W	1.8958	0	27
S235J2W	1.8961	- 20	27
S355J0WP <sup>b</sup>	1.8945	0	27
S355J2WP <sup>b</sup>	1.8946	- 20	27
S355J0W	1.8959	0	27
S355J2W	1.8965	- 20	27
S355K2W	1.8967	- 20	40 <sup>c</sup>
S355J4W	1.8787	- 40	27
S355J5W	1.8991	- 50	27
S420J0W	1.8943	0	27
S420J2W	1.8949	- 20	27
S420K2W	1.8997	- 20	40
S420J4W	1.8954	- 40	27
S420J5W	1.8992	- 50	27
S460J0W	1.8966	0	27
S460J2W	1.8980	- 20	27
S460K2W	1.8990	- 20	40
S460J4W	1.8981	- 40	27
S460J5W	1.8993	- 50	27
For subsized specimens the minimum values shall be reduced in direct proportion to the cross-sectional area of the test piece.			
<sup>a</sup> Exceptions due to product size restrictions see 9.2.3.3.			
<sup>b</sup> The impact values shall be verified if agreed upon at the time of the order. See <b>Option 3</b> , Clause 13.			
<sup>c</sup> This value corresponds with 27 J at - 30 °C (see EN 1993-1-10).			

Table 6 — Cold flanging of flat products

Designation		Bending direction a	Minimum recommended inside bend radius <sup>b</sup> for nominal thicknesses mm													
Steel name	Steel number		> 1,5 ≤ 2,5	> 2,5 ≤ 3	> 3 ≤ 4	> 4 ≤ 5	> 5 ≤ 6	> 6 ≤ 7	> 7 ≤ 8	> 8 ≤ 10	> 10 ≤ 12	> 12 ≤ 14	> 14 ≤ 16	> 16 ≤ 18	> 18 ≤ 20	
S235J0W	1.8958	t	2,5	3	5	6	8	10	12	16	20	25	28	36	40	
S235J2W	1.8961	l	2,5	3	6	8	10	12	16	20	25	28	32	40	45	
S355J0WP	1.8945	t	4	5	6	8	10	12	16	-	-	-	-	-	-	
S355J2WP	1.8946	l	4	5	8	10	12	16	20	-	-	-	-	-	-	
S355J0W	1.8959															
S355J2W	1.8965	t	4	5	6	8	10	12	16	20	25	32	36	45	50	
S355K2W	1.8967															
S355J4W	1.8787	l	4	5	8	10	12	16	20	25	32	40	50	63		
S355J5W	1.8991															

a t: transverse to the rolling direction.

l: parallel to the rolling direction.

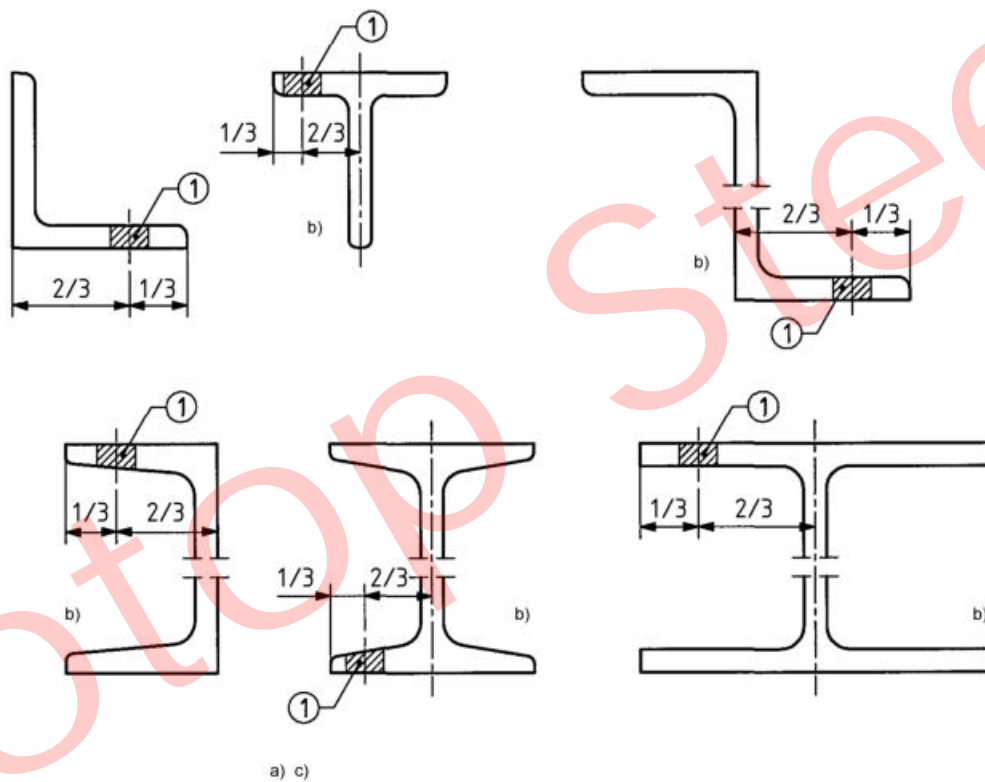
b The values are applicable for bend angles ≤ 90°.

## Annex A (normative)

### Location of samples and test pieces

The following three categories of products are covered:

- Sections (beams, channels, angles, T sections and Z sections) (Figure A.1);
- bars and rod (Figure A.2);
- flat products (Figure A.3).



#### Key

- 1 Location of the sample (s) in respect to the edge (s) of the product.c)
- a) Usually the samples shall be taken from the flange location
- b) By agreement at the time of the order, the sample may be taken from the web, at a quarter of the total height
- c) Test pieces shall be taken from the sample in respect to the surface of the product as indicated in Figure A.3. For sections with inclined flanges, machining of the inclined surface shall be permitted in order to make it parallel to the other surface

Figure A.1 — Beams, channels, angles, T sections and Z sections

Dimensions in millimetres

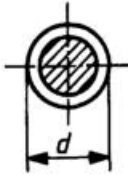
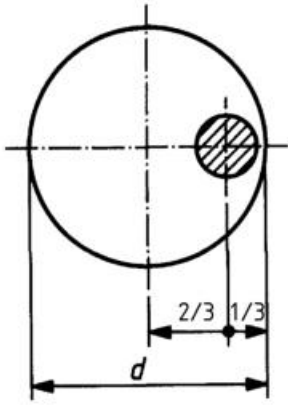
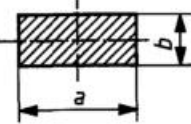
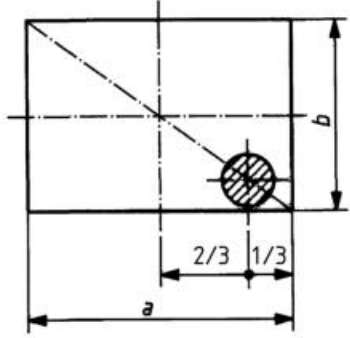
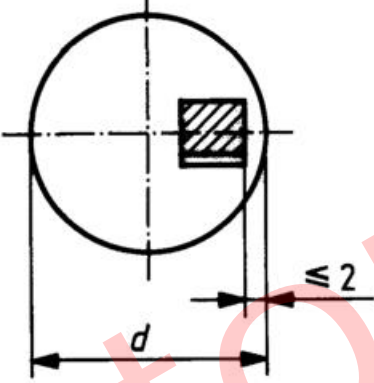
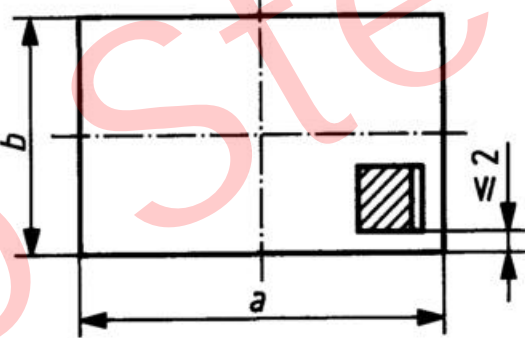
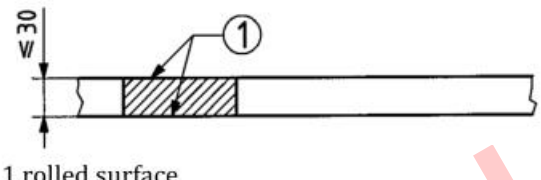
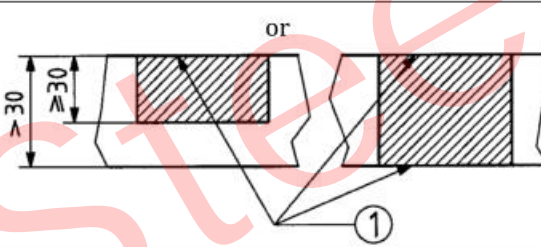
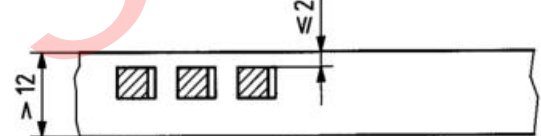
Type of test	Products with round cross-section	Products with rectangular cross-section
Tensile <sup>a</sup>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p><math>d \leq 25</math> <sup>a</sup></p>  </div> <div style="text-align: center;"> <p><math>d &gt; 25</math> <sup>b</sup></p>  </div> </div>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p><math>b \leq 25</math> <sup>a</sup></p>  </div> <div style="text-align: center;"> <p><math>b &gt; 25</math> <sup>b</sup></p>  </div> </div>
Impact <sup>c</sup>	<div style="text-align: center;"> <p><math>d \geq 16</math></p>  </div>	<div style="text-align: center;"> <p><math>b \geq 12</math></p>  </div>
<p><sup>a</sup> For products with small dimensions (<math>d</math> or <math>b \leq 25</math> mm) the test piece, if practical, shall consist of an un-machined full section of the product.</p> <p><sup>b</sup> For products of nominal diameter or thickness <math>\leq 40</math> mm the manufacturer may either apply: the rules specified for products of nominal diameter or thickness <math>\leq 25</math> mm, or take the test piece at a location nearer the centre than indicated in the figure.</p> <p><sup>c</sup> For products of round cross-section, the axis of the notch is perpendicular to axis of the product; for products with rectangular cross-section, the axis of the notch is perpendicular to the greatest rolled surface.</p>		

Figure A.2 — Bars and rod



Dimensions in millimetres

Type of test	Nominal thickness of product	Direction of the longitudinal axis of the test piece in relation to the principal direction of rolling for product nominal widths of		Distance of the test piece from the rolled surface
		< 600	≥ 600	
Tensile <sup>a</sup>	≤ 30	longitudinal	transverse	
	> 30			
Impact <sup>b</sup>	> 12 <sup>c</sup>	longitudinal	longitudinal	

<sup>a</sup> In case of dispute, for products of nominal thickness greater than or equal to 3 mm use proportional test pieces of gauge length  $L_0 = 5,65 \sqrt{S_0}$ , see 9.2.3.2 and 10.2.1.

<sup>b</sup> The axis of the notch shall be perpendicular to the surface of the product.

<sup>c</sup> For nominal thicknesses  $t \leq 12$  mm see 9.2.3.3.

Figure A.3 — Flat products

## **Annex B** (informative)

### **Additional information for the use of steel with improved atmospheric corrosion resistance**

The corrosion inhibiting effect of the auto-protective oxide layer relates to the nature of its constituents and to the particular distribution and concentration of alloying elements in it. The resistance to atmospheric corrosion depends on weather condition having a succession of dry and wet periods for the forming of the auto-protective oxide layer of the base metal. The protection afforded depends on the environmental and other conditions prevailing at the site of the structure.

Provisions should be made in the design and the fabrication of the structure for the auto-protective oxide layer on the surface to form and regenerate itself unimpeded. It is the responsibility of the designer to include corrosion of unprotected steels in his calculation and, as far as is necessary, to compensate for this by increasing the thickness of the product.

A conventional surface protection is recommended when the content of particular chemical substances in the air is significant and absolutely necessary where the structure is in contact with water for long periods, is permanently exposed to moisture, or is to be used in a marine atmosphere. Before painting, the products should be descaled. Under comparable conditions, the susceptibility to corrosion of steel with improved atmospheric corrosion resistance under painting is less than that for conventional structural steels.

The surfaces of structures which are not exposed to the elements but may be subject to the build-up of condensation, should be appropriately ventilated. Otherwise, a suitable surface protection is necessary. The extent to which these factors depend on the prevailing climatic conditions in the widest sense and on the details of the structure do not permit any generally valid statements on the corrosion process. The user should therefore consult the manufacturer of the steel regarding the suitability of the products for each individual application.

## **Annex C** (informative)

### **Notes on fabrication**

#### **C.1 Weldability**

If filler metal without improved atmospheric corrosion resistance is used ensure that the weld itself is weather resistant.

Before welding, any surface layer which has already been formed should be removed to a distance of 10 mm to 20 mm from the joint edges.

Special precautions should be taken when welding steel grades S355J0WP and S355J2WP with a high phosphorus content.

General requirements for arc welding of the steels specified in this document are given in EN 1011-2.

**NOTE** With increasing product thickness and strength level cold cracking can occur. Cold cracking is caused by the following factors in combination:

- the amount of diffusible hydrogen in the weld metal;
- the presence of hardening structures (martensite and/or bainite) in the heat affected zone;
- significant tensile stress concentrations in the welded joint.

#### **C.2 Riveting and bolting**

In case of assembling by riveting and bolting, precautions should be taken with regard to the choice of rivets and bolts to be used for assemblies in order to prevent the start of the corrosion process.

**Annex D**  
(informative)

**List of Options of EN 10025-2 to -6**

**Table D.1 — List of Options in EN 10025-2 to -6**

Number of Option	Options	Part 2	Part 3	Part 4	Part 5	Part 6
1	Details of manufacturing process	x	x	x	x	x
2	Product analysis	x	x	x	x	x
3	Verification of impact properties Part 2: for qualities JR Part 5: for qualities S355 class WP	x	-	-	x	
4	Deformation properties perpendicular to the surface	x	x	x	x	x
5	Chemical composition for hot dip zinc coating	x	x	x	-	x
6	Ultrasonic testing for flat products	x	x	x	x	x
7	Ultrasonic testing for sections	x	x	x	x	-
8	Ultrasonic testing for bars	x	x	x	x	-
9	-	-	-	-	-	-
10	Special type of marking	x	x	x	x	x
11	Flangeability without cracking Part 2: nominal thickness $\leq 30$ mm Part 3: nominal thickness $\leq 16$ mm Part 4: nominal thickness $\leq 12$ mm Part 5: nominal thickness $\leq 20$ mm Part 6: nominal thickness $\leq 16$ mm	x	x	x	x	x
12	Roll forming of flat products	x	x	x	-	-
13	For flat products out of each parent plate or coil impact properties <b>only</b> to be verified. Part 2: for qualities J2 and K2 Part 3 and 4: for all qualities Part 5: for qualities J2, J4, J5 and K2 Part 6: for each heat treatment unit and for all qualities	x	x	x	x	x
14	For flat products out of each parent plate or coil impact and tensile properties to be verified. Part 2: for qualities J2 and K2 Part 3 and 4: for all qualities Part 5: for qualities J2, J4, J5 and K2 Part 6: for each heat treatment unit and for all qualities	x	x	x	x	x
15	Other surface class for plates and wide flats	x	x	x	x	x
16	Other surface class for sections	x	x	x	x	-
17	Other surface class for bars and rods	x	x	x	x	-
18	For plates other thickness tolerance than class A	x	x	x	x	x

Number of Option	Options	Part 2	Part 3	Part 4	Part 5	Part 6
	(EN 10029)					
19	Special delivery condition: Part 2: +AR, +N or +M for long products and strip, +AR, +N for quarto plates Part 5: +AR, +N, +M	x	-	-	x	-
20	Cu alloyed	x	-	-	-	-
21	-	-	-	-	-	-
22	Drawing of bars	x	-	-	-	-
23	Certificate of compliance for S185	x	-	-	-	-
24	Agreement on another impact test temperature	-	x	x	-	x
25	Sample preparation for semi-finished products	x	-	-	-	-
26	Max. Carbon for sections thickness > 100 mm	x	-	-	-	-
27	Higher S-content for better machinability	x	-	-	-	-
28	Min. impact values for sections thickness > 100 mm	x	-	-	-	-
29	-	-	-	-	-	-
30	Impact properties verified on transverse test pieces	-	x	x	-	x
31	Die stamping not allowed or at special position	-	x	x	-	x
32	Max. S-content	-	x	x	-	-
33	No application of CE-marking	x	x	x	x	x
34	For plates cut from strip thickness tolerances according to EN 10029	x	x	x	x	x

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- [1] EN 1011-2, *Welding — Recommendations for welding of metallic materials — Part 2: Arc welding of ferritic steels*
- [2] EN 1993-1-10, *Eurocode 3: Design of steel structures — Part 1-10: Material toughness and through-thickness properties*
- [3] CEN/TR 10261, *Iron and steel — European standards for the determination of chemical composition*

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