

Hot rolled products of structural steels —

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

The European Standard EN 10025-5:2004 has the status of a
British Standard

ICS 77.140.10; 77.140.50

National foreword

This British Standard is the official English language version of EN 10025-5:2004. BS EN 10025-5:2004 together with BS EN 10025-1:2004 supersedes BS EN 10155:1993, which is withdrawn.

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 international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
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Foreword

This document (EN 10025-5:2004) has been prepared by Technical Committee ECISS/TC 10 "Structural steels - Grades and qualities", the secretariat of which is held by NEN.

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of an identical text or by endorsement, at the latest by May 2005, and conflicting national standards shall be withdrawn at the latest by May 2005.

This document supersedes together with EN 10025-1:2004, EN 10155:1993, *Structural steels with improved atmospheric corrosion resistance - Technical delivery conditions*.

The titles of the other parts of this document are:

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 6: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition.

This document has been prepared under Mandate M/120 given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of the EU Construction Products Directive (89/106/EEC). For relationship with the EU Construction Products Directive, see informative Annex ZA of EN 10025-1:2004.

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, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

Part 5 of this document, in addition to part 1, specifies requirements 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 may be supplied are given in Table 1.

In addition to EN 10025-1:2004 the steels specified in this document are especially intended for use in welded, bolted and riveted components which shall have enhanced resistance to atmospheric corrosion, for service at ambient temperatures (subject to the restrictions described in 7.4.1).

The steels specified in this Part 5 are not intended to be heat treated except products delivered in the delivery condition +N. Stress relief annealing is permitted (see also the NOTE in 7.3.1.1 of EN 10025-1:2004). Products delivered in +N condition can be hot formed and/or normalized after delivery (see Clause 3).

2 Normative references

The following referenced documents are indispensable for the application 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.

2.1 General standards

EN 10020, *Definition and classification of grades of steel.*

EN 10025-1:2004, *Hot rolled products of structural steels - Part 1: General technical delivery conditions.*

EN 10027-1, *Designation systems for steels - Part 1: Steel names, principal symbols.*

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

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: Plates 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 10221, *Surface quality classes for hot-rolled bars and rods - Technical delivery conditions.*

CR 10260, *Designation systems for steels - Additional symbols.*

2.2 Standards on dimensions and tolerances (see 7.7.1)

EN 10017, *Non-alloy steel rod for drawing and/or cold rolling – Dimensions and tolerances.*

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

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

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 uncoated plate, sheet and 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 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 10162, *Cold rolled steel sections - Technical delivery conditions - Dimensional and cross-sectional tolerances.*

EN 10279, *Hot rolled steel channels - Tolerances on shape and dimensions.*

2.3 Standards on testing

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

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 ISO 643, *Steels – Micrographic determination of the apparent grain size (ISO 643:2003).*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 10025-1:2004 and the following apply.

3.1 normalizing rolling

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

The abbreviated form of this delivery condition is +N.

NOTE 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

delivery condition without any special rolling and/or heat treatment condition

The abbreviated form of this delivery condition is +AR.

3.3 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 Steel with improved atmospheric corrosion resistance is often called weathering steel.

NOTE 2 Additional information for the use of steel with improved atmospheric corrosion resistance is given in Annex C.

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 the steel grades S235 and S355 (see Table 5), which differ in their mechanical properties.

The steel grades may be supplied in qualities J0, J2 and K2. The qualities differ in specified impact energy requirements.

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 The designation shall be in accordance with EN 10025-1.

NOTE For a list of corresponding former designations and the former designations from EURONORM 155 (1980) and EN 10155:1993 see Annex A, Table A.1.

4.2.2 The designation shall consist of:

- number of this document (EN 10025-5);
- steel name or the steel number; the steel name consisting of:

EN 10025-5:2004 (E)

- symbol S (for structural steel);
- indication of the minimum specified yield strength for thickness ≤ 16 mm expressed in MPa¹);
- 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 or +AR", when the products are ordered and delivered in the condition +N or +AR (see 3.1, 3.2 and 6.3). The indication "+N or +AR" 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 ambient temperature of 355 MPa¹), with a minimum impact energy value of 27 J at 0 °C (J0) and delivery condition normalized rolled (or as rolled):

Steel EN 10025-5 - S355J0W+N (or +AR)

or

Steel EN 10025-5 - 1.8959+N (or +AR)

5 Information to be supplied by the purchaser

5.1 Mandatory information

The information that shall be supplied by the purchaser at the time of the order is specified in EN 10025-1.

In addition to EN 10025-1 the following information shall be supplied by the purchaser at the time of the order:

- g) whether products have to be submitted to specific or non-specific inspection and testing and which inspection document is required (see 8.2);

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.

6 Manufacturing process

6.1 Steel making process

The steel making process shall be in accordance with EN 10025-1. If specified at the time of the order the steel making process shall be reported to the purchaser.

See option 1.

¹) 1 MPa = 1 N/mm².

6.2 Deoxidation

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

6.2.2 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 shall be reported in the inspection document.

6.3 Delivery conditions

The delivery condition of long products and continuous mill flat products is at the manufacturer's discretion. The delivery condition of quarto mill products can only be +AR or +N at the manufacturer's discretion.

The delivery condition +AR or +N can be agreed at the time of the order.

See option 19a.

If an inspection document is required (see 8.2) the delivery condition shall be indicated in it with its specific symbol (+N, +AR or +M). In case the products are ordered in the delivery condition +N or +AR the specific symbol (+N or +AR) shall be added to the designation (see 4.2.2).

7 Requirements

7.1 General

The following requirements apply when sampling, preparation of test pieces and testing specified in Clauses 8, 9 and 10 are carried out.

7.2 Chemical composition

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

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.

7.2.3 For steel grade S235 a maximum carbon equivalent value of 0,44 % and for steel grade S355 a maximum carbon equivalent value of 0,52 % based on the ladle analysis shall apply for all thicknesses. For the carbon equivalent value formula see 7.2.3 of EN 10025-1:2004.

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.

7.3.1.2 For products ordered and supplied in the normalized or normalized rolled condition (see 6.3) the mechanical properties shall comply with Tables 4 and 5 in the normalized or normalized rolled condition as well as after normalizing by heat treatment after delivery.

7.3.1.3 For products of quality J2 and K2 supplied as-rolled for normalizing by the purchaser the samples shall be normalized, if requested at the time of the order. The values obtained from the normalized samples shall comply with this document. The results shall be reported in the inspection document.

See option 19b (deals with +AR).

NOTE The results of these tests do not represent the properties of the supplied products but indicate the properties which can be achieved after correct normalizing.

7.3.1.4 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 of EN 10025-1:2004).

7.3.2 Impact properties

7.3.2.1 The verification of the impact energy value shall be carried out in accordance with EN 10025-1.

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

See option 3.

7.3.2.3 For products of quality J2 and K2 with nominal thickness < 6 mm the ferritic grain size shall be ≥ 6 , verified by the method as described in EN ISO 643, if specified at the time of the order.

See option 21.

When aluminium is used as the grain refining element, the grain size requirement shall be deemed to be fulfilled if on ladle analysis the aluminium content is not less than 0,020 % total aluminium or alternatively, 0,015 % acid soluble aluminium. In this case verification of the grain size is not required, but the aluminium content shall be indicated in the inspection document.

7.3.3 Improved deformation properties perpendicular to the surface

If agreed at the time of the order products of qualities J2 and K2 shall comply with one of the requirements of EN 10164.

See option 4.

7.4 Technological properties

7.4.1 Weldability

7.4.1.1 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.

7.4.1.2 In Annex D more information on weldability may be found.

7.4.2 Formability

7.4.2.1 General

NOTE Recommendations regarding hot and cold forming are laid down in ECSC IC 2. Although ECSC IC2 is specially meant for fine grain steels, these recommendations can also apply for the steel grades of EN 10025-5.

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).

7.4.2.3 Flangeability

If specified at the time of the order plate, sheet, strip, wide flats and flats (width < 150 mm) with a nominal thickness ≤ 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 11c.

NOTE Cold forming leads to reduction in the ductility.

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 parts 1 and 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 at the time of the order.

See option 15.

7.5.3 Sections

EN 10163 parts 1 and 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 at the time of the order.

See option 16.

7.5.4 Bars and rods

EN 10221 applies for the permissible surface discontinuities and for the repair of surface defects by grinding and/or welding. Class A of EN 10221 shall apply, unless otherwise agreed at the time of the order.

See option 17.

7.6 Internal soundness

The permissible level of internal imperfections shall be in accordance with EN 10025-1.

See option 6 (for flat products).

See option 7 (for H beams with parallel flanges and IPE beams).

See option 8 (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 the relevant document according to 2.2 and according to 2.2 and 7.7.1 of EN 10025-1:2004.

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

See option 18.

For plates cut from continuously hot rolled strip, the thickness tolerances shall be in accordance with EN 10051.

7.7.2 The nominal mass shall comply with EN 10025-1.

8 Inspection

8.1 General

The products shall be delivered either with specific or non-specific inspection and testing to indicate compliance with the order and this document (see 5.1).

8.2 Type of inspection and inspection document

The type of inspection and inspection document required shall comply with EN 10025-1.

See option 9.

8.3 Frequency of testing

8.3.1 Sampling

The verification of the mechanical properties shall be carried out by cast.

8.3.2 Test units

8.3.2.1 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 and shall be 40 tonnes or part thereof.

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

See option 13.

See option 14.

8.3.3 Verification of chemical composition

The verification of the chemical composition shall be in accordance with EN 10025-1.

See option 2.

8.4 Tests to be carried out for specific inspection

8.4.1 The following tests shall be carried out:

- for all products the ladle analysis;
- for all products the tensile test;
- for all products of quality J0, J2 and K2 of the steel grades S235 and S355, class W, the impact test.

8.4.2 At the time of the order the following additional tests can be agreed:

- a) for all products of steel grade S355, class WP, the impact test (see 7.3.2.2);

See option 3.

- b) the product analysis (see 8.3.3.2 of EN 10025-1:2004).

See option 2.

9 Preparation of samples and test pieces

9.1 Selection and preparation of samples for chemical analysis

The preparation of samples for product analysis shall be in accordance with EN 10025-1.

9.2 Location and orientation of samples and test pieces for mechanical tests

9.2.1 General

The location and orientation of samples and test pieces for mechanical tests shall be in accordance with EN 10025-1.

9.2.2 Preparation of samples

In addition to EN 10025-1 the samples shall be taken:

- from the thickest product in the test unit except for flat products of quality J0, for which the samples are taken from any product of the test unit;
- from any product of the test unit for products of the qualities J2 and K2 and for products in delivery condition +N (see 3.1).

9.2.3 Preparation of test pieces

The preparation of test pieces for mechanical tests shall be in accordance with EN 10025-1.

9.3 Identification of samples and test pieces

The identification of samples and test pieces shall be in accordance with EN 10025-1.

10 Test methods

10.1 Chemical analysis

The chemical analysis shall be in accordance with EN 10025-1.

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10.2 Mechanical tests

The mechanical tests shall be in accordance with EN 10025-1.

10.3 Ultrasonic testing

Ultrasonic testing shall be carried out in accordance with EN 10025-1.

10.4 Retests

The retests shall be in accordance with EN 10025-1.

11 Marking, labelling, packaging

The marking, labelling and packaging shall comply with EN 10025-1.

See option 10.

12 Complaints

Any complaints shall be dealt with in accordance with EN 10025-1.

13 Options (see 5.2)

The following options of EN 10025-1:2004 apply:

- 1) The steel making process shall be indicated (see 6.1).
- 2) Product analysis shall be carried out; the number of samples and the elements to be determined shall be as agreed (see 7.2.2, 8.3.3 and 8.4.2).
- 3) The impact properties of steel grade S355, class WP, shall be verified (see 7.3.2.2 and 8.4.2).
- 4) Products of quality J2 and K2 shall comply with one of the improved properties perpendicular to the surface of EN 10164 (see 7.3.3).
- 6) For flat products in thickness ≥ 6 mm 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).
- 9) Inspection of surface condition and dimensions shall be witnessed by the purchaser at the manufacturer's works (see 8.2).
- 10) The type of marking required (see Clause 11).

In addition to the options of EN 10025-1:2004 the following options apply to products according to EN 10025-5:

- 11c) Sheet, plate, strip, wide flats and flats (width < 150 mm) with a nominal thickness ≤ 20 mm shall be suitable for flanging without cracking (see 7.4.2.2).

- 13) For flat products of quality J2 and K2 out of each parent plate or coil the impact properties only shall be verified (see 8.3.2.2).
- 14) For flat products of quality J2 and K2 out of each parent plate or coil the impact properties and the tensile properties shall be verified (see 8.3.2.2).
- 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 10221 applies (see 7.5.4).
- 18) Other tolerances than class A of EN 10029 for hot rolled plates apply (see 7.7.1).
- 19a) The delivery condition +N or +AR is required (see 6.3).
- 19b) The delivery condition +AR is required with a verification of the mechanical properties on normalized samples (see 7.3.1.3).
- 21) The grain size shall be verified for products of quality J2 and K2 with nominal thickness < 6 mm (see 7.3.2.3).

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

Designation		Flat products		Long products		
		Nominal thickness		Sections Shapes	Bars	Rods
According EN 10027-1 and CR 10260	According EN 10027-2	mm		Nominal thickness or diameter		
		≤ 12	≤ 150	≤ 40	≤ 150	≤ 60
S235J0W	1.8958		x	x	x	x
S235J2W	1.8961		x	x	x	x
S355J0WP	1.8945	x		x		
S355J2WP	1.8946	x		x		
S355J0W	1.8959		x	x	x	x
S355J2W	1.8965		x	x	x	x
S355K2W	1.8967		x	x	x	x

Table 2 - Chemical composition of the ladle analysis of steels with improved atmospheric corrosion resistance

Designation	Method of deoxidation	C % max.	Si % max.	Mn %	P %	S % max.	N % max.	Addition of nitrogen binding elements ^c	Cr %	Cu %	Others
According to EN 10027-1 and CR 10260	^a										
According to EN 10027-2											
S235J0W	FN	0,13	0,40	0,20 - 0,60	max. 0,035	0,035	0,009 ^{d g}	-	0,40 - 0,80	0,25 - 0,55	^e
S235J2W	FF					0,030	-	yes			
S355J0WP	FN	0,12	0,75	max. 1,0	0,06 - 0,15	0,035	0,009 ^g	-	0,30 - 1,25	0,25 - 0,55	^e
S355J2WP	FF					0,030	-	yes			
S355J0W	FN	0,16	0,50	0,50 - 1,50	max. 0,035	0,035	0,009 ^{d g}	-	0,40 - 0,80	0,25 - 0,55	^{e f}
S355J2W	FF				max. 0,030	0,030	-	yes			
S355K2W	FF				max. 0,030	0,030	-	yes			

^a FN = rimming steels not permitted; FF = fully killed steel (see 6.2.2).

^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: 0,015 - 0,060 %, V: 0,02 - 0,12 %, Ti: 0,02 - 0,10 %. If these elements are used in combination, at least one of them shall be present with the minimum content indicated.

^d It is permissible to exceed the specified values provided that for each increase of 0,001 % N the P max. content will be reduced by 0,005 %; the N content of the ladle analysis, however, shall not be more than 0,012 %.

^e The steels may show a Ni content of max. 0,65 %.

^f The steels may contain max. 0,30 % Mo and max. 0,15 % Zr.

^g 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.

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

Designation	Method of deoxidation ^a	C % max.	Si % max.	Mn %	P % b	S % max. b	N % max.	Addition of nitrogen binding elements ^c	Cr %	Cu %	Others
According to EN 10027-1 and CR 10260											
According to EN 10027-2											
S235J0W	FN	0,16	0,45	0,15 - 0,70	max. 0,040	0,040	0,010 ^{d g}	-	0,35 - 0,85	0,20 - 0,60	e
S235J2W	FF					0,035	-	yes			
S355J0WP	FN	0,15	0,80	max. 1,1	0,05 - 0,16	0,040	0,010 ^g	-	0,25 - 1,35	0,20 - 0,60	e
S355J2WP	FF					0,035	-	yes			
S355J0W	FN	0,19	0,55	0,45 - 1,60	max. 0,040	0,040	0,010 ^{d g}	-	0,35 - 0,85	0,20 - 0,60	e f
S355J2W	FF				max. 0,035	0,035	-	yes			
S355K2W	FF				max. 0,035	0,035	-	yes			

^a FN = rimming steels not permitted; FF = fully killed steel (see 6.2.2).
^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 - 0,065 %, V: 0,01 - 0,14 %, Ti: 0,01 - 0,12 %. If these elements are used in combination, at least one of them shall be present with the minimum content indicated.
^d It is permissible to exceed the specified values provided that for each increase of 0,001 % N the P max. content will be reduced by 0,005 %; the N content of the product analysis, however, shall not be more than 0,013 %.
^e The steels may show a Ni content of max. 0,70 %.
^f The steels may contain max. 0,35 % Mo and max. 0,17 % Zr.
^g 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.

Table 4 - Mechanical properties at ambient temperature for flat and long products of steels with improved atmospheric corrosion resistance^a

Designation	Minimum yield strength R_{eH} ^a MPa ^b			Tensile strength R_m ^a MPa ^b			Position of test pieces ^a	Minimum percentage elongation after fracture ^a %								
	Nominal thickness mm							$L_0 = 80$ mm Nominal thickness mm			$L_0 = 5,65 \sqrt{S_0}$ Nominal thickness mm					
	> 16 ≤ 16	> 40 ≤ 63	> 63 ≤ 80	> 80 ≤ 100	> 100 ≤ 150	> 100 ≤ 150		< 3	≥ 3 ≤ 100	≥ 100 ≤ 150	> 1,5 ≤ 2	> 2 ≤ 2,5	> 2,5 ≤ 3	≥ 3 ≤ 40	≥ 40 ≤ 63	> 63 ≤ 100
According to EN 10027-1 and CR 10260	235	225	215	215	195	360 to 510	l	19	20	21	26	25	24	22		
S235J0W	235	225	215	215	195	360 to 510	l	19	20	21	26	25	24	22		
S235J2W	235	225	215	215	195	360 to 510	t	17	18	19	24	23	22	22		
S355J0WP	355	345 ^c	-	-	-	510 to 680	l	16	17	18	22 ^c	-	-	-		
S355J2WP	355	345 ^c	-	-	-	470 to 630 ^c	t	14	15	16	20	-	-	-		
S355J0W	355	345	325	315	295	470 to 630	l	16	17	18	22	21	20	18		
S355J2W	355	345	325	315	295	470 to 630	t	14	15	16	20	19	18	18		
S355K2W	355	345	325	315	295	470 to 630	t	14	15	16	20	19	18	18		

^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.

^b 1 MPa = 1 N/mm².

^c - for flat products: applicable up to 12 mm.
- for long products: applicable up to 40 mm.

Table 5 - Mechanical properties - impact strength KV longitudinal for flat and long products of steels with improved atmospheric corrosion resistance^a

Designation		Temperature	Minimum energy ^a
According EN 10027-1 and CR 10260	According EN 10027-2	°C	J
S235J0W	1.8958	0	27
S235J2W	1.8961	- 20	27
S355J0WP ^b	1.8945	0	27
S355J2WP ^b	1.8946	- 20	27
S355J0W	1.8959	0	27
S355J2W	1.8965	- 20	27
S355K2W	1.8967	- 20	40 ^c

^a For nominal thicknesses ≤ 12 mm see 7.3.2.1 of EN 10025-1:2004.

^b The impact values shall be verified if agreed at the time of the order. See option 3.

^c This value corresponds with 27J at - 30 °C (see Eurocode 3).

Table 6 - Minimum recommended value of the bend radius for cold flanging of flat products of steels with improved atmospheric corrosion resistance

Designation	Bending direction a	Minimum recommended inside bend radius ^b for nominal thicknesses													
		mm													
According to EN 10027-1 and CR 10260		> 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	t	2,5	3	5	6	8	10	12	16	20	25	28	36	40	
S235J2W	l	2,5	3	6	8	10	12	16	20	25	28	32	40	45	
S355J0WP	t	4	5	6	8	10	12	16							
S355J2WP	l	4	5	8	10	12	16	20							
S355J0W	t	4	5	6	8	10	12	16	20	25	32	36	45	50	
S355J2W															
S355K2W	l	4	5	8	10	12	16	20	25	32	36	40	50	63	

^a t: transverse to the rolling direction.

l: parallel to the rolling direction.

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

Annex A (informative)

List of corresponding former designations

Table A.1 – List of corresponding former designations

Designation according EN 10025-5:2004		Equivalent former designation					
		According EN 10155:1993		According EU 155-80	France	United Kingdom	Germany
S235J0W	1.8958	S235J0W	1.8958	Fe 360 C KI	E 24 W 3	-	-
S235J2W	1.8961	S235J2W	1.8961	Fe 360 D KI	E 24 W 4	-	WTSt 37-3
S355J0WP	1.8945	S355J0WP	1.8945	Fe 510 C 1 KI	E 36 W A 3	WR50A	-
S355J2WP	1.8946	S355J2WP	1.8946	Fe 510 D 1 KI	E 36 W A 4	-	-
S355J0W ^a	1.8959 ^a	S355J0W	1.8959	Fe 510 C 2 KI	E 36 W B 3	WR50B	-
		S355J2G1W	1.8963	Fe 510 D 2 KI	-	WR50C	-
S355J2W ^a	1.8965 ^a	S355J2G2W	1.8965	-	-	-	WTSt 52-3
		S355K2G1W	1.8966	-	E 36 W B 4	-	-
S355K2W	1.8967	S355K2G2W	1.8967	-	-	-	-

^a When a product is delivered in the N condition +N shall be added to the designation (see 4.2.2).

Annex B
(informative)

List of national standards which correspond with EURONORMS referenced

Until the following EURONORMS are transformed into European Standards, they may be either implemented or reference made to the corresponding national standards as listed in Table B.1.

NOTE Standards listed in Table B.1 are not supposed to be strictly similar although they deal with the same subjects.

Table B.1 — EURONORMS with corresponding national standards

EURONORM	Corresponding national standard in										
	Germany	France	United Kingdom	Spain	Italy	Belgium	Portugal	Sweden	Austria	Norway	
19 ^a	DIN 1025 T5	NF A 45 205	BS 4	UNE 36-526	UNI 5398	NBN 533	NP-2116	SS 21 27 40	M 3262	-	
53 ^a	DIN 1025 T2 DIN 1025 T3 DIN 1025 T4	NF A 45 201	BS 4	UNE 36-527 UNE 36-528 UNE 36-529	UNI 5397	NBN 633	NP-2117	SS 21 27 50 SS 21 27 51 SS 21 27 52	-	NS 1907 NS 1908	
54 ^a	DIN 1026-1	NF A 45 007	BS 4	UNE 36-525	UNI-EU 54	NBN A 24-204	NP-338	-	M 3260	-	
ECSC IC 2	SEW 088	NF A 36 000	BS 5135	-	-	-	-	SS 06 40 25	-	-	

^a This EURONORM is formally withdrawn, but there are no corresponding EN's.

Annex C **(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 D (informative)

Notes on fabrication

D.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.

D.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.

Bibliography

- [1] EN 1011-2, *Welding – Recommendations for welding of metallic materials - Part 2: Arc welding of ferritic steels.*
- [2] ECSC IC 2 (1983)²⁾, *Weldable fine-grained structural steels - Recommendations for processing, in particular for welding.*

²⁾ Until ECSC IC 2 is transformed into a CEN Technical Report, it can either be implemented or reference made to the corresponding national standards, the list of which is given in Annex B to this European Standard.

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