

# Hot rolled products of structural steels —

## Part 3: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels

The European Standard EN 10025-3:2004 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 10025-3:2004. BS EN 10025-3:2004 together with BS EN 10025-1:2004 and BS EN 10025-4:2004 supersedes BS EN 10113-1:1993, and BS EN 10025-3:2004 together with BS EN 10025-1:2004 supersedes BS EN 10113-2:1993, which are withdrawn.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;
- monitor related international and European developments and promulgate them in the UK.

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

## Cross-references

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

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English version

**Hot rolled products of structural steels - Part 3: Technical  
delivery conditions for normalized/normalized rolled weldable  
fine grain structural steels**

Produits laminés à chaud en aciers de construction - Partie  
3: Conditions techniques de livraison pour les aciers de  
construction soudables à grains fins à l'état  
normalisé/laminage normalisé

Warmgewalzte Erzeugnisse aus Baustählen - Teil 3:  
Technische Lieferbedingungen für  
normalgeglühte/normalisierend gewalzte schweißgeeignete  
Feinkornbaustähle

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## Foreword

This document (EN 10025-3:2004) 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of an identical text or by endorsement, at the latest by May 2005, and conflicting national standards shall be withdrawn at the latest by May 2005.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 10113-1:1993, *Hot-rolled products in weldable fine grain structural steels - Part 1: General delivery conditions* and EN 10113-2:1993 *Hot-rolled products in weldable fine grain structural steels - Part 2: Delivery conditions for normalized/normalized rolled steels*.

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 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.*

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 3 of this document, in addition to part 1, specifies requirements for flat and long products of hot rolled weldable fine grain structural steels in the normalized/normalized rolled delivery condition in the grades and qualities given in Tables 2 to 4 (chemical composition) and Tables 5 to 7 (mechanical properties) in thickness  $\leq 250$  mm for grades S275, S355 and S420 and in thickness  $\leq 200$  mm for grade S460.

In addition to EN 10025-1:2004 the steels specified in this document are especially intended for use in heavily loaded parts of welded structures such as, bridges, flood gates, storages tanks, water supply tanks, etc., for service at ambient and low temperatures.

## 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 1011-2, *Welding – Recommendations for welding of metallic materials - Part 2: Arc welding of ferritic steels.*

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

EN 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

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****fine grained steels**

steels with fine grain structure with an equivalent index of ferritic grain size  $\geq 6$  determined in accordance with EN ISO 643

**4 Classification and designation****4.1 Classification****4.1.1 Main quality classes**

The steel grades S275 and S355 specified in this document shall be classified as non-alloy quality steels and the steel grades S420 and S460 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 S275, S355, S420 and S460.

All the steel grades may be supplied in the following qualities as specified at the time of the enquiry and order:

- with specified minimum values of impact energy at temperatures not lower than  $-20\text{ }^{\circ}\text{C}$ , designated as N;
- with specified minimum values of impact energy at temperatures not lower than  $-50\text{ }^{\circ}\text{C}$ , designated as NL.

**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 EN 10113-2:1993 see Annex A, Table A.1.

**4.2.2** The designation shall consist of:

- number of this document (EN 10025-3);
- 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  $\leq 16\text{ mm}$  expressed in  $\text{MPa}^{1)}$ ;

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1)  $1\text{ MPa} = 1\text{ N/mm}^2$ .

- delivery condition N;
- capital letter L for the quality with specified minimum values of impact energy at temperatures not lower than -50 °C.

EXAMPLE Normalized structural steel (S) with a specified minimum yield strength at ambient temperature of 355 MPa<sup>1)</sup>, and with a specified minimum value of impact energy at -50 °C:

Steel EN 10025-3 - S355NL

or

Steel EN 10025-3 - 1.0546

## **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) the type of inspection document (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.

### **6.2 Grain structure**

The steels shall have a fine grain structure containing sufficient amounts of nitrogen binding elements (see Table 2).

### **6.3 Delivery conditions**

The products shall be supplied normalized or in an equivalent condition obtained by normalizing rolling as defined in Clause 3.

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1) 1 MPa = 1 N/mm<sup>2</sup>.

## 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. On special request of the purchaser the manufacturer shall inform the purchaser at the time of the enquiry and order which of the alloying elements appropriate to the steel grade required will be deliberately added to the material to be delivered.

See option 29.

**7.2.2** The limits applicable for the product analysis are given in Table 3. The manufacturer shall inform the purchaser at the time of the enquiry and order which of the alloying elements appropriate to the steel grade required will be deliberately added to the material to be delivered. The product analysis shall be carried out when specified at the time of the order.

See option 2.

**7.2.3** The maximum carbon equivalent values based on the ladle analysis, given in Table 4 shall apply. For the carbon equivalent value formula see 7.2.3 of EN 10025-1:2004.

**7.2.4** When products are supplied with a control on Si e.g. for hot-dip zinc-coating so that there could be a need to increase the content of other elements like C and Mn to achieve the required tensile properties, the maximum carbon equivalent values of Table 4 shall be increased as follows:

- for  $\text{Si} \leq 0,030 \%$ , increase CEV by 0,02 %;
- for  $\text{Si} \leq 0,25 \%$ , increase CEV by 0,01 %.

### 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 as well as after normalizing by heat treatment after delivery the mechanical properties shall comply with the values given in Tables 5 to 7.

**7.3.1.2** 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.

Furthermore the verification of the impact energy value shall be carried out, unless otherwise agreed (see 7.3.2.2 and 7.3.2.3) with longitudinal test pieces for:

- N at -20 °C;
- NL at -50 °C.

**7.3.2.2** Another temperature (given in Tables 6 and 7) may be agreed at the time of the order.

See option 3.

**7.3.2.3** If agreed at the time of the enquiry and order transverse impact energy values as given in Table 7 shall apply instead of longitudinal values.

See option 30.

### **7.3.3 Improved deformation properties perpendicular to the surface**

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

See option 4.

## **7.4 Technological properties**

### **7.4.1 Weldability**

The steels specified in this document shall be suitable for welding.

General requirements for arc welding of the steels specified in this document shall be as 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;
- a brittle structure of the heat affected zone;
- significant tensile stress concentrations in the welded joint.

### **7.4.2 Formability**

**NOTE** Recommendations regarding hot and cold forming are laid down in ECSC IC 2.

#### **7.4.2.1 Hot forming**

The products shall comply with the requirements of Tables 5 to 7 if hot forming is carried out after delivery (see 7.3.1.1).

#### **7.4.2.2 Cold formability**

##### **7.4.2.2.1 General**

**NOTE** Cold forming leads to reduction in the ductility. Furthermore it is necessary to draw the attention to the risk of brittle fracture in connection with hot-dip zinc-coating.

##### **7.4.2.2.2 Flangeability**

If specified at the time of the order plate, sheet, strip and wide flats ordered and supplied in the normalized condition with a nominal thickness  $\leq 16$  mm shall be suitable for flanging without cracking with the following minimum bend radii:

- 2 times the nominal thickness with the axis of the bend in transverse direction and 2,5 times the nominal thickness in longitudinal direction for the steel grades S275 and S355;

- 4 times the nominal thickness with the axis of the bend in transverse direction and 5 times the nominal thickness in longitudinal direction for the steel grades S420 and S460.

See option 11a.

#### 7.4.2.2.3 Roll forming

If specified at the time of the order plate, sheet and strip with a nominal thickness  $\leq 8$  mm shall be suitable for the production of sections by cold rolling (for example according to EN 10162), with the same minimum bend radii as given in 7.4.2.2.1.

See option 12.

NOTE The products suitable for roll forming are also suitable for the manufacture of cold-finished square and rectangular hollow sections.

#### 7.4.3 Suitability for hot-dip zinc-coating

Hot-dip zinc-coating requirements shall be agreed between manufacturer and purchaser.

EN ISO 1461 and EN ISO 14713 should be used to set these coating requirements. The definition of suitability classes based upon chemical analysis limitations as laid down in Table 1 can be used for guidance purposes.

**Table 1 - Classes for the suitability for hot-dip zinc-coating based on the ladle analysis (for guidance)**

| Classes                                                    | Elements % by mass              |              |              |
|------------------------------------------------------------|---------------------------------|--------------|--------------|
|                                                            | Si                              | Si + 2,5 P   | P            |
| Class 1                                                    | $\leq 0,030$                    | $\leq 0,090$ | -            |
| Class 2 <sup>a</sup>                                       | $\leq 0,35$                     | -            | -            |
| Class 3                                                    | $0,14 \leq \text{Si} \leq 0,25$ | -            | $\leq 0,035$ |
| <sup>a</sup> Class 2 applies only for special zinc alloys. |                                 |              |              |

For class 1 the maximum carbon equivalent value of Table 4 shall be increased by 0,02. For class 3 the maximum carbon equivalent value of Table 4 shall be increased by 0,01 (see 7.2.4).

See option 5.

NOTE Product shape, composition of the zinc bath, other hot-dip treatment settings and other factors should be considered when agreeing upon hot-dip zinc-coating requirements.

### 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. Class A, subclass 1 of EN 10163-2 shall apply. Class B regarding grinding or subclasses 2 or 3 regarding repair by welding can be 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. Class C, subclass 1 of EN 10163-3 shall apply. Class D regarding grinding or subclasses 2 or 3 regarding repair by welding can be 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. 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 documents 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 with specific inspection and testing to indicate compliance with the order and this document.

## 8.2 Type of inspection and inspection document

The type of inspection document 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 of the same thickness range as specified in Table 5 for the yield strength.

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

- 40 tonnes or part thereof.

**8.3.2.2** If specified at the time of the order for flat products 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 the impact test.

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

- a) for all products the impact test at another temperature or on transverse test pieces (see 7.3.2.2 and 7.3.2.3);

See option 3.

See option 30.

- 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 any product of the test unit.

#### **9.2.3 Preparation of test pieces**

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

#### **9.2.4 Impact test pieces**

In addition to EN 10025-1 the following requirement applies:

- impact test pieces shall be taken from  $\frac{1}{4}t$  position for plates with nominal thickness  $\geq 40$  mm.

### **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.

### **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 be in accordance with EN 10025-1.

See option 10.

In addition to EN 10025-1 if specified at the time of the enquiry and order there shall be either no die stamping or only die stamping in positions indicated by the purchaser.

See option 31.

## 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) At which temperature the impact properties shall be verified (see 7.3.2.2 and 8.4.2).
- 4) Products shall comply with one of the improved properties perpendicular to the surface of EN 10164 (see 7.3.3).
- 5) The product shall be suitable for hot-dip zinc-coating (see 7.4.3).
- 6) For flat products in thickness  $\geq 6$  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 10025-3:

- 11a) Sheet, plate, strip and wide flats with a nominal thickness  $\leq 16$  mm shall be suitable for flanging without cracking (see 7.4.2.2.1).
- 12) Plate, sheet and strip with nominal thickness  $\leq 8$  mm shall be suitable for the production of sections by cold rolling with bend radii given in 7.4.2.2.1 (see 7.4.2.2.2).

- 13) For flat products out of each parent plate or coil the impact properties only shall be verified (see 8.3.2.2).
- 14) For flat products 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).
- 29) The manufacturer shall inform the purchaser at the time of the enquiry and order which of the alloying elements appropriate to the steel grade required will be deliberately added to the material to be delivered (see 7.2.1).
- 30) The impact properties shall be verified on transverse V-notch test pieces (see 7.3.2.3 and 8.4.2).
- 31) Die stamping is not allowed or the position for die stamping shall be as indicated by the purchaser (see Clause 11).
- 32) For railway applications a maximum S content of 0,010 % for ladle analysis and 0,012 % for product analysis is required (see Tables 2 and 3, footnote <sup>b</sup>).

Table 2 - Chemical composition of the ladle analysis for normalized steel

| Designation                                |                         | C<br>%<br>max. | Si<br>%<br>max. | Mn<br>%     | P<br>%<br>max.<br><sub>a</sub> | S<br>%<br>max.<br><sub>a b</sub> | Nb<br>%<br>max. | V<br>%<br>max. | Al <sub>total</sub> .<br>%<br>min.<br><sub>c</sub> | Ti<br>%<br>max. | Cr<br>%<br>max. | Ni<br>%<br>max. | Mo<br>%<br>max. | Cu<br>%<br>max.<br><sub>d</sub> | N<br>%<br>max. |
|--------------------------------------------|-------------------------|----------------|-----------------|-------------|--------------------------------|----------------------------------|-----------------|----------------|----------------------------------------------------|-----------------|-----------------|-----------------|-----------------|---------------------------------|----------------|
| According<br>EN 10027-1<br>and<br>CR 10260 | According<br>EN 10027-2 |                |                 |             |                                |                                  |                 |                |                                                    |                 |                 |                 |                 |                                 |                |
|                                            |                         |                |                 |             |                                |                                  |                 |                |                                                    |                 |                 |                 |                 |                                 |                |
|                                            | S275N                   | 0,18           | 0,40            | 0,50 - 1,50 | 0,030                          | 0,025                            | 0,05            | 0,05           | 0,02                                               | 0,05            | 0,30            | 0,30            | 0,10            | 0,55                            | 0,015          |
|                                            | S275NL                  | 0,16           |                 |             | 0,025                          | 0,020                            |                 |                |                                                    |                 |                 |                 |                 |                                 |                |
|                                            | S355N                   | 0,20           | 0,50            | 0,90 - 1,65 | 0,030                          | 0,025                            | 0,05            | 0,12           | 0,02                                               | 0,05            | 0,30            | 0,50            | 0,10            | 0,55                            | 0,015          |
|                                            | S355NL                  | 0,18           |                 |             | 0,025                          | 0,020                            |                 |                |                                                    |                 |                 |                 |                 |                                 |                |
| S420N                                      | 1.8902                  | 0,20           | 0,60            | 1,00 - 1,70 | 0,030                          | 0,025                            | 0,05            | 0,20           | 0,02                                               | 0,05            | 0,30            | 0,80            | 0,10            | 0,55                            | 0,025          |
| S420NL                                     | 1.8912                  |                |                 |             | 0,025                          | 0,020                            |                 |                |                                                    |                 |                 |                 |                 |                                 |                |
| S460N <sup>e</sup>                         | 1.8901 <sup>e</sup>     | 0,20           | 0,60            | 1,00 - 1,70 | 0,030                          | 0,025                            | 0,05            | 0,20           | 0,02                                               | 0,05            | 0,30            | 0,80            | 0,10            | 0,55                            | 0,025          |
| S460NL <sup>e</sup>                        | 1.8903 <sup>e</sup>     |                |                 |             | 0,025                          | 0,020                            |                 |                |                                                    |                 |                 |                 |                 |                                 |                |

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

<sup>b</sup> For railway applications a maximum S content of 0,010 % may be agreed at the time of enquiry and order.

See option 32.

<sup>c</sup> If sufficient other N-binding elements are present the minimum total Al content does not apply.

<sup>d</sup> Cu content above 0,40 % may cause hot shortness during hot forming.

<sup>e</sup> V + Nb + Ti ≤ 0,22 % and Mo + Cr ≤ 0,30 %.

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

| Designation                                |                         | C<br>%<br>max. | Si<br>%<br>max. | Mn<br>%     | P<br>%<br>max.<br><sub>a</sub> | S<br>%<br>max.<br><sub>a b</sub> <sup>1</sup> | Nb<br>%<br>max. | V<br>%<br>max. | Al <sub>total</sub> .<br>%<br>min.<br><sub>c</sub> | Ti<br>%<br>max. | Cr<br>%<br>max. | Ni<br>%<br>max. | Mo<br>%<br>max. | Cu<br>%<br>max.<br><sub>d</sub> | N<br>%<br>max. |
|--------------------------------------------|-------------------------|----------------|-----------------|-------------|--------------------------------|-----------------------------------------------|-----------------|----------------|----------------------------------------------------|-----------------|-----------------|-----------------|-----------------|---------------------------------|----------------|
| According<br>EN 10027-1<br>and<br>CR 10260 | According<br>EN 10027-2 |                |                 |             |                                |                                               |                 |                |                                                    |                 |                 |                 |                 |                                 |                |
|                                            |                         |                |                 |             |                                |                                               |                 |                |                                                    |                 |                 |                 |                 |                                 |                |
| S275N                                      | 1.0490                  | 0,20           |                 |             | 0,035                          | 0,030                                         |                 |                |                                                    |                 |                 |                 |                 |                                 |                |
| S275NL                                     | 1.0491                  | 0,18           | 0,45            | 0,45 - 1,60 | 0,030                          | 0,025                                         | 0,06            | 0,07           | 0,015                                              | 0,06            | 0,35            | 0,35            | 0,13            | 0,60                            | 0,017          |
| S355N                                      | 1.0545                  | 0,22           |                 |             | 0,035                          | 0,030                                         |                 |                |                                                    |                 |                 |                 |                 |                                 |                |
| S355NL                                     | 1.0546                  | 0,20           | 0,55            | 0,85 - 1,75 | 0,030                          | 0,025                                         | 0,06            | 0,14           | 0,015                                              | 0,06            | 0,35            | 0,55            | 0,13            | 0,60                            | 0,017          |
| S420N                                      | 1.8902                  |                |                 |             | 0,035                          | 0,030                                         |                 |                |                                                    |                 |                 |                 |                 |                                 |                |
| S420NL                                     | 1.8912                  | 0,22           | 0,65            | 0,95 - 1,80 | 0,030                          | 0,025                                         | 0,06            | 0,22           | 0,015                                              | 0,06            | 0,35            | 0,85            | 0,13            | 0,60                            | 0,027          |
| S460N <sup>e</sup>                         | 1.8901 <sup>e</sup>     |                |                 |             | 0,035                          | 0,030                                         |                 |                |                                                    |                 |                 |                 |                 |                                 |                |
| S460NL <sup>e</sup>                        | 1.8903 <sup>e</sup>     | 0,22           | 0,65            | 0,95 - 1,80 | 0,030                          | 0,025                                         | 0,06            | 0,22           | 0,015                                              | 0,06            | 0,35            | 0,85            | 0,13            | 0,60                            | 0,027          |

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

<sup>b</sup> For railway applications a maximum S content of 0,012 % may be agreed at the time of enquiry and order.

See option 32.

<sup>c</sup> If sufficient other N-binding elements are present the minimum total Al content does not apply.

<sup>d</sup> Cu content above 0,45 % may cause hot shortness during hot forming.

<sup>e</sup> V + Nb + Ti ≤ 0,26 % and Mo + Cr ≤ 0,38 %.

Table 4 - Maximum CEV based on the ladle analysis for normalized steel

| Designation                                                                           |                                            | Maximum CEV in % for nominal product thickness in mm |               |                |
|---------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------------------------|---------------|----------------|
| According<br>EN 10027-1<br>and CR 10260                                               | According<br>EN 10027-2                    | ≤ 63                                                 | > 63<br>≤ 100 | > 100<br>≤ 250 |
| S275N <sup>a</sup><br>S275NL <sup>a</sup>                                             | 1.0490 <sup>a</sup><br>1.0491 <sup>a</sup> | 0,40                                                 | 0,40          | 0,42           |
| S355N <sup>a</sup><br>S355NL <sup>a</sup>                                             | 1.0545 <sup>a</sup><br>1.0546 <sup>a</sup> | 0,43                                                 | 0,45          | 0,45           |
| S420N<br>S420NL                                                                       | 1.8902<br>1.8912                           | 0,48                                                 | 0,50          | 0,52           |
| S460N<br>S460NL                                                                       | 1.8901<br>1.8903                           | 0,53                                                 | 0,54          | 0,55           |
| <sup>a</sup> For the optional increase of elements which influence the CEV see 7.4.3. |                                            |                                                      |               |                |

Table 5 - Mechanical properties at ambient temperature for normalized steel

| Designation                                |                         | Minimum yield strength $R_{eH}^a$<br>MPa <sup>b</sup><br>Nominal thickness<br>mm |             |             |              |               |                |                |                | Tensile strength $R_m^a$<br>MPa <sup>b</sup><br>Nominal thickness<br>mm |                |                | Minimum percentage elongation after fracture <sup>a</sup><br>%<br>$L_0 = 5,65 \sqrt{S_0}$<br>Nominal thickness<br>mm |             |             |              |               |                |
|--------------------------------------------|-------------------------|----------------------------------------------------------------------------------|-------------|-------------|--------------|---------------|----------------|----------------|----------------|-------------------------------------------------------------------------|----------------|----------------|----------------------------------------------------------------------------------------------------------------------|-------------|-------------|--------------|---------------|----------------|
|                                            |                         | ≤ 16                                                                             | >16<br>≤ 40 | >40<br>≤ 63 | > 63<br>≤ 80 | > 80<br>≤ 100 | > 100<br>≤ 150 | > 150<br>≤ 200 | > 200<br>≤ 250 | ≤ 100                                                                   | > 100<br>≤ 200 | > 200<br>≤ 250 | ≤ 16                                                                                                                 | >16<br>≤ 40 | >40<br>≤ 63 | > 63<br>≤ 80 | > 80<br>≤ 200 | > 200<br>≤ 250 |
| According<br>EN 10027-1<br>and<br>CR 10260 | According<br>EN 10027-2 |                                                                                  |             |             |              |               |                |                |                |                                                                         |                |                |                                                                                                                      |             |             |              |               |                |
| S275N                                      | 1.0490                  | 275                                                                              | 265         | 255         | 245          | 235           | 225            | 215            | 205            | 370 to 510                                                              | 350 to 480     | 350 to 480     | 24                                                                                                                   | 24          | 24          | 23           | 23            | 23             |
| S275NL                                     | 1.0491                  |                                                                                  |             |             |              |               |                |                |                |                                                                         |                |                |                                                                                                                      |             |             |              |               |                |
| S355N                                      | 1.0545                  | 355                                                                              | 345         | 335         | 325          | 315           | 295            | 285            | 275            | 470 to 630                                                              | 450 to 600     | 450 to 600     | 22                                                                                                                   | 22          | 22          | 21           | 21            | 21             |
| S355NL                                     | 1.0546                  |                                                                                  |             |             |              |               |                |                |                |                                                                         |                |                |                                                                                                                      |             |             |              |               |                |
| S420N                                      | 1.8902                  | 420                                                                              | 400         | 390         | 370          | 360           | 340            | 330            | 320            | 520 to 680                                                              | 500 to 650     | 500 to 650     | 19                                                                                                                   | 19          | 19          | 18           | 18            | 18             |
| S420NL                                     | 1.8912                  |                                                                                  |             |             |              |               |                |                |                |                                                                         |                |                |                                                                                                                      |             |             |              |               |                |
| S460N                                      | 1.8901                  | 460                                                                              | 440         | 430         | 410          | 400           | 380            | 370            | -              | 540 to 720                                                              | 530 to 710     | -              | 17                                                                                                                   | 17          | 17          | 17           | 17            | -              |
| S460NL                                     | 1.8903                  |                                                                                  |             |             |              |               |                |                |                |                                                                         |                |                |                                                                                                                      |             |             |              |               |                |

<sup>a</sup> 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.

<sup>b</sup> 1 MPa = 1 N/mm<sup>2</sup>

**Table 6 - Minimum values of impact energy for impact tests on longitudinal V-notch test pieces for normalized steel**

| Designation                                                               |                                      | Minimum values of impact energy in J at test temperatures, in °C |    |      |                  |      |      |      |
|---------------------------------------------------------------------------|--------------------------------------|------------------------------------------------------------------|----|------|------------------|------|------|------|
| According<br>EN 10027-1<br>and<br>CR 10260                                | According<br>EN 10027-2              | + 20                                                             | 0  | - 10 | - 20             | - 30 | - 40 | - 50 |
| S275N<br>S355N<br>S420N<br>S460N                                          | 1.0490<br>1.0545<br>1.8902<br>1.8901 | 55                                                               | 47 | 43   | 40 <sup>a)</sup> | -    | -    | -    |
| S275NL<br>S355NL<br>S420NL<br>S460NL                                      | 1.0491<br>1.0546<br>1.8912<br>1.8903 | 63                                                               | 55 | 51   | 47               | 40   | 31   | 27   |
| <sup>a</sup> This value corresponds with 27J at - 30 °C (see Eurocode 3). |                                      |                                                                  |    |      |                  |      |      |      |

**Table 7 - Minimum values of impact energy for impact tests on transverse V-notch test pieces for normalized steel, when the impact test on transverse test pieces is agreed at the time of the order**

See option 30

| Designation                                |                                      | Minimum values of impact energy in J at test temperatures, in °C |    |      |      |      |      |      |
|--------------------------------------------|--------------------------------------|------------------------------------------------------------------|----|------|------|------|------|------|
| According<br>EN 10027-1<br>and<br>CR 10260 | According<br>EN 10027-2              | + 20                                                             | 0  | - 10 | - 20 | - 30 | - 40 | - 50 |
| S275N<br>S355N<br>S420N<br>S460N           | 1.0490<br>1.0545<br>1.8902<br>1.8901 | 31                                                               | 27 | 24   | 20   | -    | -    | -    |
| S275NL<br>S355NL<br>S420NL<br>S460NL       | 1.0491<br>1.0546<br>1.8912<br>1.8903 | 40                                                               | 34 | 30   | 27   | 23   | 20   | 16   |

## Annex A

(informative)

### List of corresponding former designations

**Table A.1 - List of corresponding former designations**

| Designation according to EN 10025-3 |        | Equivalent former designations in |        |                        |                          |                                 |                                     |                        |                                                          |
|-------------------------------------|--------|-----------------------------------|--------|------------------------|--------------------------|---------------------------------|-------------------------------------|------------------------|----------------------------------------------------------|
|                                     |        | According to EN 10113-2:1993      |        | According to EU 113-72 | Germany according to DIN | France according to NF A 36-201 | United Kingdom according to BS 4360 | Italy according to UNI | Sweden according to SS 14 followed by number steel grade |
| S275N                               | 1.0490 | S275N                             | 1.0490 | Fe E 275 KG N          | StE285                   | -                               | -                                   | Fe E 275 KG N          | -                                                        |
| S275NL                              | 1.0491 | S275NL                            | 1.0491 | Fe E 275 KT N          | TStE285                  | -                               | 43EE                                | Fe E 275 KT N          | -                                                        |
| S355N                               | 1.0545 | S355N                             | 1.0545 | Fe E 355 KG N          | StE355                   | E 355 R                         | -                                   | Fe E 355 KG N          | 2134-01                                                  |
| S355NL                              | 1.0546 | S355NL                            | 1.0546 | Fe E 355 KT N          | TStE355                  | E 355 FP                        | 50EE                                | Fe E 355 KT N          | 2135-01                                                  |
| S420N                               | 1.8902 | S420N                             | 1.8902 | Fe E 420 KG N          | StE420                   | E 420 R                         | -                                   | -                      | -                                                        |
| S420NL                              | 1.8912 | S420NL                            | 1.8912 | Fe E 420 KT N          | TStE420                  | E 420 FP                        | -                                   | -                      | -                                                        |
| S460N                               | 1.8901 | S460N                             | 1.8901 | Fe E 460 KG N          | StE460                   | E 460 R                         | -                                   | Fe E 460 KG N          | -                                                        |
| S460NL                              | 1.8903 | S460NL                            | 1.8903 | Fe E 460 KT N          | TStE460                  | E 460 FP                        | 55EE                                | Fe E 460 KT N          | -                                                        |

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 <sup>a</sup>                                                                        | 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 <sup>a</sup>                                                                        | DIN 1025 T2                        | NF A 45 201 | BS 4           | UNE 36-527 | UNI 5397  | NBN 633      | NP-2117  | SS 21 27 50 | -       | NS 1907 |
|                                                                                        | DIN 1025 T3                        |             |                | UNE 36-528 |           |              |          | SS 21 27 51 |         | NS 1908 |
|                                                                                        | DIN 1025 T4                        |             |                | UNE 36-529 |           |              |          | SS 21 27 52 |         |         |
| 54 <sup>a</sup>                                                                        | 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 | -       | -       |
| <sup>a</sup> This Euronorm is formally withdrawn, but there are no corresponding EN's. |                                    |             |                |            |           |              |          |             |         |         |

## Bibliography

- [1] EN ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods (ISO 1461:1999)*.
- [2] EN ISO 14713, *Protection against corrosion of iron and steel structures – Zinc and aluminium coatings – Guidelines (ISO 14713:1999)*.
- [3] ECSC IC 2 (1983)<sup>2)</sup>, *Weldable fine-grained structural steels - Recommendations for processing, in particular for welding*.

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<sup>2)</sup> 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 document.



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