

# Hot rolled products of structural steels —

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

The European Standard EN 10025-6:2004 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 10025-6:2004. BS EN 10025-6:2004 together with BS EN 10025-1:2004 supersedes BS EN 10137-1:1996 and BS EN 10137-2:1996, which are withdrawn.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.

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## Hot rolled products of structural steels - Part 6: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition

Produits laminés à chaud en aciers de construction - Partie 6: Conditions techniques de livraison pour produits plats des aciers à haute limite d'élasticité à l'état trempé et revenu

Warmgewalzte Erzeugnisse aus Baustählen - Teil 6: Technische Lieferbedingungen für Flacherzeugnisse aus Stählen mit höherer Streckgrenze im vergüteten Zustand

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## Contents

Page

Foreword.....	4
<b>1</b> <b>Scope</b> .....	<b>5</b>
<b>2</b> <b>Normative references</b> .....	<b>5</b>
2.1 <b>General standards</b> .....	5
2.2 <b>Standards on dimensions and tolerances (see 7.7.1)</b> .....	6
2.3 <b>Standards on testing</b> .....	6
<b>3</b> <b>Terms and definitions</b> .....	<b>6</b>
<b>4</b> <b>Classification and designation</b> .....	<b>6</b>
4.1 <b>Classification</b> .....	6
4.1.1 <b>Main quality classes</b> .....	6
4.1.2 <b>Grades and qualities</b> .....	6
4.2 <b>Designation</b> .....	7
<b>5</b> <b>Information to be supplied by the purchaser</b> .....	<b>7</b>
5.1 <b>Mandatory information</b> .....	7
5.2 <b>Options</b> .....	7
<b>6</b> <b>Manufacturing process</b> .....	<b>8</b>
6.1 <b>Steel making process</b> .....	8
6.2 <b>Deoxidation or grain size</b> .....	8
6.3 <b>Delivery conditions</b> .....	8
<b>7</b> <b>Requirements</b> .....	<b>8</b>
7.1 <b>General</b> .....	8
7.2 <b>Chemical composition</b> .....	8
7.3 <b>Mechanical properties</b> .....	9
7.3.1 <b>General</b> .....	9
7.3.2 <b>Impact properties</b> .....	9
7.3.3 <b>Improved deformation properties perpendicular to the surface</b> .....	9
7.4 <b>Technological properties</b> .....	9
7.4.1 <b>Weldability</b> .....	9
7.4.2 <b>Formability</b> .....	10
7.4.3 <b>Suitability for hot-dip zinc-coating</b> .....	10
7.5 <b>Surface properties</b> .....	11
7.6 <b>Internal soundness</b> .....	11
7.7 <b>Tolerances on dimensions and shape, mass</b> .....	11
<b>8</b> <b>Inspection</b> .....	<b>11</b>
8.1 <b>General</b> .....	11
8.2 <b>Type of inspection and inspection document</b> .....	11
8.3 <b>Frequency of testing</b> .....	11
8.3.1 <b>Sampling</b> .....	11
8.3.2 <b>Test units</b> .....	12
8.3.3 <b>Verification of chemical composition</b> .....	12
8.4 <b>Tests to be carried out for specific inspection</b> .....	12
<b>9</b> <b>Preparation of samples and test pieces</b> .....	<b>12</b>
9.1 <b>Selection and preparation of samples for chemical analysis</b> .....	12
9.2 <b>Location and orientation of samples and test pieces for mechanical tests</b> .....	13
9.2.1 <b>General</b> .....	13
9.2.2 <b>Preparation of samples</b> .....	13
9.2.3 <b>Preparation of test pieces</b> .....	13

9.2.4	Impact test pieces .....	13
9.3	Identification of samples and test pieces .....	13
10	Test methods .....	13
10.1	Chemical analysis .....	13
10.2	Mechanical tests .....	13
10.3	Ultrasonic testing .....	13
10.4	Retests .....	14
11	Marking, labelling, packaging .....	14
12	Complaints .....	14
13	Options (see 5.2).....	14
Annex A (informative) List of corresponding former designations .....		21
Annex B (informative) List of national standards which correspond with ECSC IC 2 referenced .....		22
Annex C (informative) Minimum recommended inside bend radii for flanging.....		23
Bibliography.....		24

## Foreword

This document (EN 10025-6:2004) 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 10137-1:1995, *Plates and wide flats made of high yield strength structural steels in the quenched and tempered or precipitation hardened conditions – Part 1: General delivery conditions* and EN 10137-2:1995, *Plates and wide flats made of high yield strength structural steels in the quenched and tempered or precipitation hardened conditions - Part 2: Delivery conditions for quenched and tempered steels*.

According to resolution ECISS/TC 10 Nr 2/1999 EN 10137-3:1995, *Plates and wide flats made of high yield strength structural steels in the quenched and tempered or precipitation hardened conditions - Part 3: Delivery conditions for precipitation hardened steels* is withdrawn because the steels from this document are hardly produced at this moment.

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

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 6 of this document, in addition to part 1, specifies requirements for flat products of high yield strength alloy special steels. The grades and qualities are given in Tables 2 to 4 (chemical composition) and Tables 5 to 7 (mechanical properties) and are supplied in the quenched and tempered condition as given in 6.3.

The steels specified in this document are applicable to hot-rolled flat products with a minimum nominal thickness of 3 mm and a maximum nominal thickness  $\leq 150$  mm for grades S460, S500, S550, S620 and S690, a maximum nominal thickness  $\leq 100$  mm for grade S890 and a maximum nominal thickness  $\leq 50$  mm for grade S960, in steels which, after quenching and tempering, have a specified minimum yield strength of 460 MPa<sup>1</sup>) to 960 MPa<sup>1</sup>).

## 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 10164, *Steel products with improved deformation properties perpendicular to the surface of the product - Technical delivery conditions.*

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

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

## 2.2 Standards on dimensions and tolerances (see 7.7.1)

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

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

## 2.3 Standards on testing

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

## 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 quenching

operation which consists of cooling a ferrous product more rapidly than in still air

### 3.2 tempering

heat treatment applied to a ferrous product generally after quench hardening or other heat treatment to bring the properties to the required level

It consists of heating to specific temperatures ( $< A_{c1}$ ) and soaking one or more times followed by cooling at an appropriate rate.

## 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 seven steel grades. They differ in their minimum yield strength at ambient temperature.

All the grades can be delivered in the following qualities as specified at the time of the enquiry and order:

- (no symbol) with specified minimum values of impact energy at temperatures not lower than  $-20\text{ }^{\circ}\text{C}$ ;
- L with specified minimum values of impact energy at temperatures not lower than  $-40\text{ }^{\circ}\text{C}$ ;



- L1 with specified minimum values of impact energy at temperatures not lower than -60 °C (with the exclusion of S960).

## 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 10137-2:1995 see Annex A, Table A.1.

**4.2.2** The designation shall consist of:

- the number of this document (EN 10025-6);
- the steel name or the steel number; the steel name consisting of:
  - the symbol S (for structural steel);
  - the indication of the minimum specified yield strength for thickness  $\leq 50$  mm expressed in MPa<sup>1</sup>);
  - the delivery condition Q;
- the capital letter L or L1 for the quality with specified minimum values of impact energy at temperatures not lower than -40 °C or -60 °C.

EXAMPLE Structural steel (S) with a specified minimum yield strength at ambient temperature of 460 MPa<sup>1</sup>), in the quenched and tempered delivery condition (Q) and of quality L:

Steel EN 10025-6 – S460QL

or

Steel EN 10025-6 - 1.8906

## 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.

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

## 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 Deoxidation or grain size

The steels specified in this document shall be fully killed. The steels shall have a fine grain structure containing nitrogen binding elements in amounts sufficient to bind the nitrogen.

### 6.3 Delivery conditions

The products shall be supplied in the quenched and tempered condition (Q) as defined in Clause 3.

NOTE Direct quenching after hot-rolling followed by tempering is considered equivalent to conventional quenching and tempering.

## 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  $Si \leq 0,030 \%$ , increase CEV by 0,02 %;
- for  $Si \leq 0,25 \%$ , 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 the mechanical properties shall comply with the values given in Tables 5, 6 and 7.

**7.3.1.2** For the products specified in this document the nominal thickness applies.

### 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:

- Q at -20 °C;
- QL at -40 °C;
- QL1 at -60 °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 the 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 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.

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****7.4.2.1 General**

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

**7.4.2.2 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). Hot forming is only permitted up to the stress relief annealing temperature. For higher temperatures the manufacturer shall be consulted. In all cases the manufacturer shall be consulted to know the maximum stress relief annealing temperature. If higher temperatures are used an additional quenching and tempering operation shall be required in which case the manufacturer shall be consulted.

**7.4.2.3 Cold formability****7.4.2.3.1 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.

**7.4.2.3.2 Flangeability**

If specified at the time of the order plates and wide flats ordered and supplied in the quenched and tempered condition with a nominal thickness  $\leq 16$  mm are suitable for flanging without cracking with the indicative values for the inside minimum bend radii for cold forming as given in Annex C.

See option 11a.

**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 1 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.

NOTE 2 Products quenched in water may be susceptible to stress corrosion cracking after hot-dip zinc-coating.

## 7.5 Surface properties

EN 10163 parts 1 and 2 shall apply for the permissible surface discontinuities for plates and wide flats 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.

## 7.6 Internal soundness

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

See option 6 (for flat products).

## 7.7 Tolerances on dimensions and shape, mass

7.7.1 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 Unless otherwise specified (see 8.3.2.2) for verifying the mechanical properties the following test unit shall apply:

- 40 tonnes or part thereof.

The test unit shall contain products of the same form and grade and of the same thickness range for the yield strength requirement as given in Table 5. The nominal thickness of a product within the test unit shall not deviate more than 5 mm from that of the sample product.

8.3.2.2 If specified at the time of the order the impact properties only or the impact properties and the tensile properties shall be verified on each heat treatment unit.

See option 13a.

See option 14a.

### 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.

In addition to EN 10025-1 the following applies:

For the tensile test pieces either the full product thickness or half the product thickness can be used, but one product surface shall be retained. A round test piece with its axis at a quarter of the product thickness may also be used for product thicknesses over 30 mm. In cases of disputes the total thickness of the plate shall be subdivided in equal thick flat test pieces. The average of the individual results of the mechanical tests shall be valid.

### 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.

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

NOTE In the scope of EN ISO 2566-1 quenched and tempered steels are excluded. In practice the figures of EN ISO 2566-1 can be used.

### 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).
- 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 10025-6:

- 11a) Plate and wide flats with a nominal thickness  $\leq 16$  mm shall be suitable for flanging without cracking (see 7.4.2.3.2).
- 13a) For each heat treatment unit the impact properties only shall be verified (see 8.3.2.2).
- 14a) For each heat treatment unit 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).
- 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).

**Table 2 - Chemical composition of the ladle analysis for quenched and tempered steels<sup>a</sup>**

Grade	Quality	C % max.	Si % max.	Mn % max.	P % max.	S % max.	N % max.	B % max.	Cr % max.	Cu % max.	Mo % max.	Nb % max. <sub>b</sub>	Ni % max.	Ti % max. <sub>b</sub>	V % max. <sub>b</sub>	Zr % max. <sub>b</sub>
All grades	(no symbol) L L1	0,20	0,80	1,70	0,025 0,020 0,020	0,015 0,010 0,010	0,015	0,005 0	1,50	0,50	0,70	0,06	2,0	0,05	0,12	0,15

<sup>a</sup> Depending on the thickness of the product and the manufacturing conditions, the manufacturer may add to the steel one or several alloying elements up to the maximum values given in order to obtain the specified properties (see 7.2.2).

<sup>b</sup> There shall be at least 0,015 % of a grain-refining element present. Aluminium is also one of these elements. The minimum content of 0,015 % applies to soluble aluminium, this value is regarded as attained if the total aluminium content is at least 0,018 %; in case of dispute the soluble aluminium content shall be determined.

**Table 3 - Chemical composition of the product analysis based on Table 2<sup>a</sup>**

Grade	Quality	C % max.	Si % max.	Mn % max.	P % max.	S % max.	N % max.	B % max.	Cr % max.	Cu % max.	Mo % max.	Nb % max. <sub>b</sub>	Ni % max.	Ti % max. <sub>b</sub>	V % max. <sub>b</sub>	Zr % max. <sub>b</sub>
All grades	(no symbol) L L1	0,22	0,86	1,80	0,030 0,025 0,025	0,017 0,012 0,012	0,016	0,006 0	1,60	0,55	0,74	0,07	2,1	0,07	0,14	0,17

<sup>c</sup> Depending on the thickness of the product and the manufacturing conditions, the manufacturer may add to the steel one or several alloying elements up to the maximum values given in order to obtain the specified properties (see 7.2.2).

<sup>d</sup> There shall be at least 0,010% of a grain-refining element present. Aluminium is also one of these elements. The minimum content of 0,010 % applies to soluble aluminium, this value is regarded as attained if the total aluminium content is at least 0,013 %; in case of dispute the soluble aluminium content shall be determined.

Table 4 - Maximum CEV based on the ladle analysis for quenched and tempered steel <sup>a</sup>

Designation		Maximum CEV in % for nominal product thickness in mm		
According EN 10027-1 and CR 10260	According EN 10027-2	≤ 50	> 50 ≤ 100	> 100 ≤ 150
S460Q S460QL S460QL1	1.8908 1.8906 1.8916	0,47	0,48	0,50
S500Q S500QL S500QL1	1.8924 1.8909 1.8984	0,47	0,70	0,70
S550Q S550QL S550QL1	1.8904 1.8926 1.8986	0,65	0,77	0,83
S620Q S620QL S620QL1	1.8914 1.8927 1.8987	0,65	0,77	0,83
S690Q S690QL S690QL1	1.8931 1.8928 1.8988	0,65	0,77	0,83
S890Q S890QL S890QL1	1.8940 1.8983 1.8925	0,72	0,82	-
S960Q  S960QL	1.8941  1.8933	0,82	-	-
<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 quenched and tempered steel

Designation		Minimum yield strength $R_{eH}$ MPa <sup>a</sup> Nominal thickness mm			Tensile strength $R_m$ MPa <sup>a</sup> Nominal thickness mm			Minimum percentage elongation after fracture %  $L_0 = 5,65 \sqrt{S_0}$
		$\geq 3$ $\leq 50$	$> 50$ $\leq 100$	$> 100$ $\leq 150$	$\geq 3$ $\leq 50$	$> 50$ $\leq 100$	$> 100$ $\leq 150$	
According to EN 10027-1 and CR 10260	According to EN 10027-2							
S460Q S460QL S460QL1	1.8908 1.8906 1.8916	460	440	400	550 to 720		500 to 670	17
S500Q S500QL S500QL1	1.8924 1.8909 1.8984	500	480	440	590 to 770		540 to 720	17
S550Q S550QL S550QL1	1.8904 1.8926 1.8986	550	530	490	640 to 820		590 to 770	16
S620Q S620QL S620QL1	1.8914 1.8927 1.8987	620	580	560	700 to 890		650 to 830	15
S690Q S690QL S690QL1	1.8931 1.8928 1.8988	690	650	630	770 to 940	760 to 930	710 to 900	14
S890Q S890QL S890QL1	1.8940 1.8983 1.8925	890	830	-	940 to 1 100	880 to 1 100	-	11
S960Q S960QL	1.8941 1.8933	960	--	-	980 to 1 150	-	-	10
<sup>a</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 quenched and tempered steel**

Designation		Minimum values of impact energy in J at test temperatures, in °C			
According EN 10027-1 and CR 10260	According EN 10027-2	0	- 20	- 40	- 60
S460Q S500Q S550Q S620Q S690Q S890Q S960Q	1.8908 1.8924 1.8904 1.8914 1.8931 1.8940 1.8941	40	30	-	-
S460QL S500QL S550QL S620QL S690QL S890QL S960QL	1.8906 1.8909 1.8926 1.8927 1.8928 1.8983 1.8933	50	40	30	-
S460QL1 S500QL1 S550QL1 S620QL1 S690QL1 S890QL1	1.8916 1.8984 1.8986 1.8987 1.8988 1.8925	60	50	40	30

**Table 7 - Minimum values of impact energy for impact tests on transverse V-notch test pieces for quenched and tempered 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 EN 10027-1 and CR 10260	According EN 10027-2	0	- 20	- 40	- 60
S460Q S500Q S550Q S620Q S690Q S890Q S960Q	1.8908 1.8924 1.8904 1.8914 1.8931 1.8940 1.8941	30	27	-	-
S460QL S500QL S550QL S620QL S690QL S890QL S960QL	1.8906 1.8909 1.8926 1.8927 1.8928 1.8983 1.8933	35	30	27	-
S460QL1 S500QL1 S550QL1 S620QL1 S690QL1 S890QL1	1.8916 1.8984 1.8986 1.8987 1.8988 1.8925	40	35	30	27

## Annex A (informative)

### List of corresponding former designations

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

Designation according EN 10025-6		Equivalent former designations in					
		According EN 10137-2:1995		EU 137 (1983)	Germany	France	Sweden
S460Q	1.8908	S460Q	1.8908	FeE 460 V	-		
S460QL	1.8906	S460QL	1.8906	FeE 460 V KT	TStE 460 V	E460T	
S460QL1	1.8916	S460QL1	1.8916		-		
S500Q	1.8924	S500Q	1.8924	FeE 500 V	StE 500 V		2614
S500QL	1.8909	S500QL	1.8909	FeE 500 V KT	TStE 500 V	E 500T	2615
S500QL1	1.8984	S500QL1	1.8984		EstE 500 V		
S550Q	1.8904	S550Q	1.8904	FeE 550 V	StE 550 V		
S550QL	1.8926	S550QL	1.8926	FeE 550 V KT	TStE 550 V	E 550T	
S550QL1	1.8986	S550QL1	1.8986		EstE 550 V		
S620Q	1.8914	S620Q	1.8914	FeE 620 V	StE 620 V		
S620QL	1.8927	S620QL	1.8927	FeE 620 V KT	TStE 620 V	E 620T	
S620QL1	1.8987	S620QL1	1.8987		EstE 620 V		
S690Q	1.8931	S690Q	1.8931		StE 690 V		2624
S690QL	1.8928	S690QL	1.8928	FeE 690 V KT	TStE 690 V	E 690T	2625
S690QL1	1.8988	S690QL1	1.8988		EstE 690 V		
S890Q	1.8940	S890Q	1.8940		-		
S890QL	1.8983	S890QL	1.8983		TStE 890 V	-	
S890QL1	1.8925	S890QL1	1.8925		EstE 890 V		
S960Q	1.8941	S960Q	1.8941		-		
S960QL	1.8933	S960QL	1.8933		TStE 960 V	E 960T	

## Annex B (informative)

### List of national standards which correspond with ECSC IC 2 referenced

Until the following ECSC IC 2 is transformed into a CEN Technical Report, it may be either implemented or reference made to the corresponding national standards as listed in Table B.1.

**Table B.1 — ECSC IC 2 with corresponding national standards**

EURONORM	Corresponding national standard in			
	Germany	France	United Kingdom	Sweden
ECSC IC 2	SEW 088	NF A 36 000	BS 5135	SS 06 40 25



## Annex C (informative)

### Minimum recommended inside bend radii for flanging

**Table C.1 — Minimum recommended inside bend radii for flanging**

Designation		Minimum recommended inside bend radii for nominal thicknesses ( $t$ ) $3 \leq t \leq 16$ mm <sup>a</sup>	
According to EN 10027-1 and CR 10260	According to EN 10027-2	Axis of bend in transverse direction	Axis of bend in longitudinal direction
S460Q	1.8908	3,0t	4,0t
S460QL	1.8906	3,0t	4,0t
S460QL1	1.8916	3,0t	4,0t
S500Q	1.8924	3,0t	4,0t
S500QL	1.8909	3,0t	4,0t
S500QL1	1.8984	3,0t	4,0t
S550Q	1.8904	3,0t	4,0t
S550QL	1.8926	3,0t	4,0t
S550QL1	1.8986	3,0t	4,0t
S620Q	1.8914	3,0t	4,0t
S620QL	1.8927	3,0t	4,0t
S620QL1	1.8987	3,0t	4,0t
S690Q	1.8931	3,0t	4,0t
S690QL	1.8928	3,0t	4,0t
S690QL1	1.8988	3,0t	4,0t
S890Q	1.8940	3,0t	4,0t
S890QL	1.8983	3,0t	4,0t
S890QL1	1.8925	3,0t	4,0t
S960Q	1.8941	4,0t	5,0t
S960QL	1.8933	4,0t	5,0t

<sup>a</sup> The values are applicable for bend angles  $\leq 90^\circ$ .

## 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 2566-1, *Steel - Conversion of elongation values - Part 1: Carbon and low alloy steels (ISO 2566-1:1984)*.
- [3] EN ISO 14713, *Protection against corrosion of iron and steel structures – Zinc and aluminium coatings – Guidelines (ISO 14713:1999)*.
- [4] 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 European Standard.



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