

**Jekla za poboljšanje - 3. del: Tehnični dobavni pogoji za legirana jekla**

Steels for quenching and tempering - Part 3: Technical delivery conditions for alloy steels

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English Version

## Steels for quenching and tempering - Part 3: Technical delivery conditions for alloy steels

Aciers pour trempe et revenu - Partie 3: Conditions techniques de livraison des aciers alliés

Vergütungsstähle - Teil 3: Technische Lieferbedingungen für legierte Stähle

This European Standard was approved by CEN on 30 June 2006.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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

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## Foreword

This document (EN 10083-3:2006) has been prepared by Technical Committee ECISS/TC 23 “Steels for heat treatment, alloy steels and free-cutting steels - Qualities and dimensions”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2007, and conflicting national standards shall be withdrawn at the latest by February 2007.

This document supersedes EN 10083-3:1995.

Together with Part 1 and Part 2 of this standard this part 3 is a revision of the following European Standards:

EN 10083-1:1991 +A1:1996, *Quenched and tempered steels – Part 1: Technical delivery conditions for special steels*

EN 10083-2:1991 +A1:1996, *Quenched and tempered steels – Part 2: Technical delivery conditions for unalloyed quality steels*

EN 10083-3:1995, *Quenched and tempered steels – Part 3: Technical delivery conditions for boron steels*

and of

EURONORM 86-70, *Flame and induction hardening steels – Quality specifications*

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

## 1 Scope

This part of EN 10083, in addition to Part 1, specifies the technical delivery requirements for:

- semi-finished products, hot formed, e.g. blooms, billets, slabs (see NOTES 2 and 3 in EN 10083-1:2006, Clause 1),
- bars (see NOTE 2 in EN 10083-1:2006, Clause 1),
- rod,
- wide flats,
- hot-rolled strip and sheet/plate,
- forgings (see NOTE 2 in EN 10083-1:2006, Clause 1),

manufactured from the direct hardening alloy steels for quenching and tempering and the alloy flame and induction hardening steels and supplied in one of the heat treatment conditions given for the different types of products in Table 1, lines 2 to 6, and in one of the surface conditions given in Table 2.

The steels are generally intended for the fabrication of quenched and tempered, flame or induction hardened machine parts.

The requirements for mechanical properties given in this document are restricted to the sizes given in Table 8.

NOTE This document does not apply for bright steel products. For bright steel products EN 10277-1 and EN 10277-5 apply.

In special cases, variations in these technical delivery requirements or additions to them may be agreed at the time of enquiry and order (see Annex A).

## 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.

EN 10002-1, *Metallic materials – Tensile testing – Part 1: Method of test at ambient temperature*

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

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

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

EN 10045-1, *Metallic materials – Charpy impact test – Part 1: Test method*

EN 10083-1:2006, *Steels for quenching and tempering – Part 1: General technical delivery conditions*

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

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

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

EN 10221, *Surface quality classes for hot-rolled bars and rods – Technical delivery conditions*

CR 10261, *ECISS Information Circular 11 – Iron and steel – Review of available methods of chemical analysis*

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

EN ISO 377, *Steel and steel products – Location and preparation of samples and test pieces for mechanical testing (ISO 377:1997)*

EN ISO 642, *Steel – Hardenability test by end quenching (Jominy test) (ISO 642:1999)*

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

EN ISO 3887, *Steels – Determination of depth of decarburization (ISO 3887:2003)*

EN ISO 6506-1, *Metallic materials – Brinell hardness test – Part 1: Test method (ISO 6506-1:2005)*

EN ISO 6508-1:2005, *Metallic materials – Rockwell hardness test – Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T) (ISO 6508-1:2005)*

EN ISO 14284, *Steel and iron – Sampling and preparation of samples for the determination of chemical composition (ISO 14284:1996)*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 10083-1:2006 apply.

### 4 Classification and designation

#### 4.1 Classification

All steel grades are classified according to EN 10020 as alloy special steels.

#### 4.2 Designation

##### 4.2.1 Steel names

For the steel grades covered by this document, the steel names as given in the relevant tables are allocated in accordance with EN 10027-1.

##### 4.2.2 Steel numbers

For the steel grades covered by this document, the steel numbers as given in the relevant tables are allocated in accordance with EN 10027-2.

### 5 Information to be supplied by the purchaser

#### 5.1 Mandatory information

See EN 10083-1:2006, 5.1.

## **5.2 Options**

A number of options are specified in this document and listed below. If the purchaser does not indicate his wish to implement any of these options, the supplier shall act in accordance with the basic specification.

- a) any particular heat treatment condition (see 6.3.2);
- b) any particular surface condition (see 6.3.3);
- c) any verification of the product analysis (see 7.1.2.2 and A.5);
- d) any requirement to the hardenability (+H, +HH, +HL) (see 7.1.3) and if agreed the information about calculation of the hardenability (see 10.3.2);
- e) any verification of mechanical properties of reference test pieces in the quenched and tempered (+QT) condition (see A.1);
- f) any verification of fine grain size (see 7.4 and A.2);
- g) any requirements for the verification of non-metallic inclusion content (see 7.4 and A.3);
- h) any requirement for internal soundness (see 7.5 and A.4);
- i) any requirement relating to surface quality (see 7.6.3);
- j) any requirement regarding the permissible depth of decarburization (see 7.6.4);
- k) suitability of bars and rod for bright drawing (see 7.6.5);
- l) any requirement relating to removal of surface defects (see 7.6.6);
- m) inspection of surface condition and dimensions shall be carried out by the purchaser at the manufacturer's works (see 8.1.4);
- n) any requirement concerning special marking of the products (see 11 and A.6).

### **EXAMPLE**

20 round bars with the nominal diameter 20 mm and the nominal length of 8000 mm according to EN 10060 made of steel grade 25CrMo4 (1.7218) according to EN 10083-3 in the heat treatment condition +A, inspection certificate 3.1 as specified in EN 10204.

20 round bars EN 10060 - 20x8000

EN 10083-3 – 25CrMo4+A

EN 10204 - 3.1

or

20 round bars EN 10060 - 20x8000

EN 10083-3 – 1.7218+A

EN 10204 - 3.1

## **6 Manufacturing process**

### **6.1 General**

The manufacturing process of steel and of the products is left to the discretion of the manufacturer with the restrictions given by the requirements in 6.2 to 6.4.



## 6.2 Deoxidation

All steels shall be killed.

## 6.3 Heat treatment and surface condition at delivery

### 6.3.1 Untreated condition

Unless otherwise agreed at the time of enquiry and order, the products shall be delivered in the untreated, i.e. hot worked, condition.

NOTE Depending on the product shape and dimensions, not all steel grades can be delivered in the hot worked untreated condition (e.g. steel grade 30CrNiMo8).

### 6.3.2 Particular heat treatment condition

If so agreed at the time of enquiry and order, the products shall be delivered in one of the heat-treatment conditions given in Table 1, lines 3 to 6.

### 6.3.3 Particular surface condition

If so agreed at the time of enquiry and order, the products shall be delivered with one of the particular surface conditions given in Table 2, lines 3 to 7.

## 6.4 Cast separation

The products shall be delivered separated by cast

## 7 Requirements

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### 7.1 Chemical composition, hardenability and mechanical properties

#### 7.1.1 General

Table 1 shows the combinations of usual heat-treatment conditions at delivery, product forms and requirements as specified in Tables 3 to 8.

Except where the steels are ordered in the quenched and tempered condition, the steels may be supplied with or without hardenability requirements (see Table 1, columns 8 and 9).

#### 7.1.2 Chemical composition

7.1.2.1 The chemical composition determined by cast analysis shall comply with the values in Table 3.

7.1.2.2 Permissible deviations between the limiting values for cast analysis and the values for product analysis are given in Table 4.

The product analysis shall be carried out when specified at the time of the order (see A.5).

#### 7.1.3 Hardenability

Where the steel is ordered by using the symbols for normal (+H) or restricted (+HL, +HH) hardenability requirements, the hardenability values given in Table 5 or Table 6 shall apply.

#### 7.1.4 Mechanical properties

Where the steel is ordered without hardenability requirements, the requirements for mechanical properties specified in Table 8 for the quenched and tempered condition apply.

In this case the hardenability values given in Table 5 are for guidance purposes only.

The mechanical property values given in Table 8 apply to test pieces in the quenched and tempered condition which have been taken and prepared in accordance with EN 10083-1:2006, Figure 1 or Figures 2 and 3 (see also footnote a in Table 1).

### **7.1.5 Surface hardness**

For the hardness of surface hardened zones of steels intended for flame and induction hardening the specifications in Table 9 apply.

## **7.2 Machinability**

All steels delivered in the soft annealed (+A) condition are machinable. Where improved machinability is required, the grades with a specified sulphur range should be ordered and/or with a specific treatment to improve machinability (e.g. Ca treatment), see also Table 3, footnote c.

## **7.3 Shearability of semi-finished products and bars**

**7.3.1** Under suitable conditions (avoiding local stress peaks, pre-heating, application of blades with a profile adapted to that of the product, etc.) all steels are shearable in the soft-annealed (+A) condition (see, however, footnote f to Table 7).

**7.3.2** Steel grades without boron up to steel grade 42CrMoS4 and the boron-alloy steel grades 33MnCrB5-2 and 39MnCrB6-2 (see Table 7) and the corresponding grades with requirements on hardenability (see Tables 5 and 6) are shearable under suitable conditions, if they are supplied in the "treated to improve shearability (+S)" condition with the hardness requirements as specified in Table 7.

**7.3.3** Under suitable conditions steel grades 20MnB5, 30MnB5, 38MnB5 and 27MnCrB5-2 and the corresponding grades with requirements on hardenability (see Table 5) are shearable in the untreated condition.

## **7.4 Structure**

**7.4.1** All steels shall have a fine grain structure with an austenite grain size of 5 or finer, when tested in accordance with EN ISO 643. For verification see A.2.

**7.4.2** The steels shall have a degree of cleanness corresponding to the special steel quality (see A.3 and EN 10083-1:2006, Annex E).

## **7.5 Internal soundness**

Where appropriate, requirements relating to the internal soundness of products shall be agreed at the time of enquiry and order, if possible with reference to European standards. EN 10160 specifies requirements of ultrasonic testing of flat products of thickness equal to or greater than 6 mm and EN 10308 specifies requirements of ultrasonic testing of steel bars (see A.4).

## **7.6 Surface quality**

**7.6.1** All products shall have a smooth finish appropriate to the manufacturing processes applied, see also 6.3.3.

**7.6.2** Minor surface imperfections which may occur also under normal manufacturing conditions, such as scores originating from rolled-in scale in the case of hot-rolled products, shall not be regarded as defects.

**7.6.3** Where appropriate, requirements relating to the surface quality of the products shall be agreed upon at the time of enquiry and order, if possible with reference to European Standards.

Sheet/plate and wide flats are delivered with surface class A, subclass 1 according to EN 10163-2 unless otherwise agreed at the time of enquiry and order.

Bars and rods are delivered with surface class A according to EN 10221 unless otherwise agreed at the time of enquiry and order.

**7.6.4** Requirements relating to the permissible depth of decarburization may be agreed at the time of enquiry and order.

The depth of decarburization shall be determined in accordance with the micrographic method specified in EN ISO 3887.

**7.6.5** If suitability of bars and rods for bright drawing is required, this shall be agreed at the time of enquiry and order.

**7.6.6** The removal of surface defects by welding shall only be permitted with the approval of the customer or his representative.

If surface discontinuities are repaired, the method and maximum depth of removal shall be agreed at the time of enquiry and order.

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

The nominal dimensions, tolerances on dimensions and shape for the product shall be agreed at the time of enquiry and order, if possible, with reference to the dimensional standards applicable (see EN 10083-1:2006, Annex D).

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## **8 Inspection**

### **8.1 Testing procedures and types of documents**

**8.1.1** Products complying with this document shall be ordered and delivered with one of the inspection documents as specified in EN 10204. The type of document shall be agreed upon at the time of enquiry and order. If the order does not contain any specification of this type, a test report shall be issued.

**8.1.2** For the information to be included in a test report, see EN 10083-1:2006, 8.1.2.

**8.1.3** For the information to be included in an inspection certificate, see EN 10083-1:2006 8.1.3.

**8.1.4** Unless otherwise agreed at the time of the order, inspection of surface quality and dimensions shall be carried out by the manufacturer.

### **8.2 Frequency of testing**

#### **8.2.1 Sampling**

Sampling shall be in accordance with Table 10.

#### **8.2.2 Test units**

The test units and the extent of testing shall be in accordance with Table 10.

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

#### 8.3.1 Verification of hardenability, hardness and mechanical properties

For steels being ordered without hardenability requirements, i.e. without the symbol +H, +HH or +HL in the designation, the hardness requirements or mechanical properties given for the relevant heat-treatment condition in Table 1, Column 8, subclause 2, shall with the following exception be verified. The requirement given in Table 1, Footnote a (mechanical properties of reference test pieces), is only to be verified if supplementary requirement A.1 is ordered.

For steels being ordered with the symbol +H, +HH or +HL in the designation (see Tables 5 and 6), unless otherwise agreed, only hardenability requirements according to Table 5 or 6 shall be verified.

#### 8.3.2 Visual and dimensional inspection

A sufficient number of products shall be inspected to ensure compliance with the specification.

## 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 ISO 14284.

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

#### 9.2.1 Preparation of samples

Preparation of samples shall be in accordance with Table 10 and EN 10083-1:2006, 9.2.1.

#### 9.2.2 Preparation of test pieces

Preparation of test pieces shall be in accordance with Table 10 and EN 10083-1:2006, 9.2.2.

### 9.3 Location and preparation of samples for hardness and hardenability tests

See Table 10.

### 9.4 Identification of samples and test pieces

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

## 10 Test methods

### 10.1 Chemical analysis

See EN 10083-1:2006, 10.1.

### 10.2 Mechanical tests

See Table 10 and EN 10083-1:2006, 10.2.

### 10.3 Hardness and hardenability tests

#### 10.3.1 Hardness in treatment conditions +A and +S

For products in treatment conditions +A (soft annealed) and +S (treated to improve shearability), the hardness shall be measured in accordance with EN ISO 6506-1.

#### 10.3.2 Verification of hardenability

As far as available the manufacturer has the option to verify the hardenability by calculation. The calculation method is left to the discretion of the manufacturer. If agreed at the time of enquiry and order the manufacturer shall give sufficient information about the calculation for the customer to confirm the result.

If a calculation formula is not available or in the case of dispute an end quench hardenability test shall be carried out in accordance with EN ISO 642. The temperature for quenching shall comply with table 11. The hardness values shall be determined in accordance with EN ISO 6508-1, scale C.

#### 10.3.3 Surface hardness

The surface hardness of steels after flame or induction hardening (see Table 9) shall be determined in accordance with EN ISO 6508-1, scale C.

### 10.4 Retests

See EN 10083-1:2006, 10.4.

## 11 Marking, labelling, packaging

The manufacturer shall mark the products or the bundles or boxes in a suitable way so that it is possible to determine the cast, the steel grade and the origin of the delivery (see A.6).

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**Table 1 — Combinations of usual heat-treatment conditions at delivery, product forms and requirements as specified in Tables 3 to 8**

1	2	3	4	5	6	7	8		9				
1	Heat treatment condition at delivery	Symbol	x indicates applicable for				Applicable requirements if the steel is ordered with the designation given in						
			Semi-finished products	Bars	Rod	Flat products	Hammer and drop forgings	Table 3		Table 5 or 6			
								8.1	8.2	9.1	9.2	9.3	
2	Untreated	none or +U	x	x	x	x	x	a		As in columns 8.1 and 8.2 (see footnote b in Table 3)		Hardenability values according to Table 5 or 6	
3	Treated to improve shearability	+S	x	x	-	x	-	Chemical composition according to Tables 3 and 4	Maximum hardness				Table 7 column +S <sup>a</sup>
4	Soft annealed	+A	x	x	x	x <sup>b</sup>	x						Table 7 column +A <sup>a</sup>
5	Quenched and tempered	+QT	-	x	x	x <sup>b</sup>	x	Mechanical properties according to	Table 8	Not Applicable			
6	Others	Other treatment conditions, e.g. certain annealing conditions to achieve a certain structure may be agreed at the time of enquiry and order. The treatment condition annealed for spheroidal carbide (+AC) as required for cold upsetting and cold extrusion is covered by EN 10263-4.											
<sup>a</sup> For deliveries in the untreated condition and in the "treated to improve shearability" and "soft annealed" condition, the mechanical properties specified in Table 8 shall be achievable for the ruling end cross-section after appropriate heat treatment (for verification on reference test pieces, see A.1).													
<sup>b</sup> It is not possible to deliver all dimensions of flat products in this heat-treatment condition.													

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Table 2 — Surface condition at delivery

	1	2	3	4	5	6	7	8	9	
1	Surface condition at delivery		Symbol	x indicates in general applicable for						Notes
				Semi-finished products (such as blooms, billets)	Bars	Rod	Flat products	Hammer and drop forgings (see note 2 in EN 10083-1:2006, Clause 1)		
2	Unless otherwise agreed	Hot worked	None or +HW	x	x	x	x	x	-	
3	Particular conditions supplied by agreement	Unformed continuously cast	+CC	x	-	-	-	-	-	
4		Hot worked and pickled	+PI	x	x	x	x	x	<sup>a</sup>	
5		Hot worked and blast cleaned	+BC	x	x	x	x	x	<sup>a</sup>	
6		Hot worked and rough machined	+RM	-	x	x	-	x	-	
7		Others	-	-	-	-	-	-	-	
<sup>a</sup>	In addition, it may be agreed that the products be oiled or, where appropriate, limed or phosphated.									

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