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**Cementacijska jekla - Tehnični dobavni pogoji**

Case hardening steels - Technical delivery conditions

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English Version

## Case hardening steels - Technical delivery conditions

Aciers pour cémentation - Conditions techniques de  
livraison

Einsatzstähle - Technische Lieferbedingungen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee ECISS/TC 23.

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COMITÉ EUROPÉEN DE NORMALISATION  
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## Foreword

This document (prEN 10084:2006) 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 document is currently submitted to the CEN Enquiry.

This document will supersede EN 10084:1998.

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## 1 Scope

1.1 This European Standard gives the technical delivery requirements for

- semi-finished products, hot formed, for example blooms, billets, slabs (see NOTES 2 and 3)
- bars (see NOTE 2)
- rod
- wide flats, quarto plates
- hot-rolled sheet/plate and strip
- hammer and drop forgings (see NOTE 2)

manufactured from the case hardening non alloyed or alloyed steels (see NOTE 4) listed in Table 3 and supplied in one of the heat treatment conditions given for the different types of products in Table 1, lines 2 to 7 and in one of the surface conditions given in Table 2.

The steels are in general intended for the fabrication of case-hardened (see clause 3) machine parts.

NOTE 1 European Standards relating to steels complying with the requirements for the chemical composition in Table 3 but which are supplied in other product forms or treatment conditions than given above or are intended for special applications, and European Standards for similar steel grades are listed in the bibliography.

NOTE 2 Hammer-forged semi-finished products (blooms, billets, slabs, etc.), seamless rolled rings and hammer-forged bars are included under semi-finished products or bars and not under the term "hammer and drop forgings".

NOTE 3 Special agreements shall be made when ordering undeformed continuously cast semi-finished products.

NOTE 4 In accordance with EN 10020, the steels covered by this European Standard are special steels.

1.2 In special cases variations in these technical delivery requirements or additions to them may form the subject of an agreement at the time of enquiry and order (see annex A).

1.3 In addition to the specifications of this European Standard, the general technical delivery requirements of EN 10021 are applicable, unless otherwise specified.

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

EN 10021, *General technical delivery requirements for steel and iron products*

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

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

EN 10052, *Vocabulary of heat treatment terms for ferrous products*

EN 10079, *Definition of steel products*

EN 10160, *Ultrasonic testing of steel flat product of thickness equal to 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: Plates 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*

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 6506-1, *Metallic materials - Brinell hardness test - Part 1: Test method (ISO 6506-1:1999)*

EN ISO 6508-1, *Metallic materials - Rockwell hardness test (scales A, B, C, D, E, F, G, H, K, N, T) - Part 1: Test method (ISO 6508-1:1999)*

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 European Standard the terms and definitions given in EN 10020, EN 10021, EN 10052, EN 10079, EN ISO 377 and EN ISO 14284 and the following apply.

#### 3.1

##### case-hardening steels

Steels with a relatively low carbon content which are intended for carburising or carbonitriding and subsequent hardening. Such steels, after treatment, are characterised by a high hardness surface layer and a tough core

### 4 Classification and designation

#### 4.1 Classification

All steels covered by this European Standard are classified according to EN 10020. Steel grades C10E, C10R, C15E, C15R, C16E and C16R are non alloy special steels. All other steels covered by this European Standard are alloy special steels.

#### 4.2 Designation

##### 4.2.1 Steel names

For the steel grades covered by this European Standard, the steel names as given in Tables 3, 5 and 6 are allocated in accordance with EN 10027-1.

##### 4.2.2 Steel numbers

For the steel grades covered by this European Standard, the steel numbers as given in Tables 3, 5 and 6 are allocated in accordance with EN 10027-2.

## 5 Information to be supplied by the purchaser

### 5.1 Mandatory information

The following information shall be supplied by the purchaser at the time of enquiry and order:

- a) the quantity to be delivered;
- b) the designation of the product form (e.g. round bar or square bar);
- c) the number of the dimensional standard (see 7.6);
- d) the dimensions and tolerances on dimensions and shape and, if applicable, letters denoting relevant special tolerances;
- e) the number of this European Standard (EN 10084);
- f) steel name or steel number (see 4.2);
- g) the standard designation for a test report (2.2) or, if required, any other type of inspection document in accordance with EN 10204 (see 8.1).

### 5.2 Options

A number of options are specified in this European Standard and listed below. If the purchaser does not indicate his wish to implement one of these options, the supplier shall supply in accordance with the basis specification of this European Standard (see 5.1).

- a) any particular heat-treatment condition at delivery (see 6.4.2 and Table 1);
- b) any particular surface condition at delivery (see 6.4.3 and Table 2);
- c) any requirement concerning minimum reduction ratio of rolled and forged products (see 6.3 and A.5),
- d) any verification of fine grain size (see 7.3.1, 8.2.2 and A.4),
- e) any requirement for the verification of non-metallic inclusion content (see 7.3.2, A.1 and annex C),
- f) any requirement for restricted hardenability scatter bands for alloy steels (+HH, +HL-grades, see 7.1.2 and Table 6),
- g) any verification of hardenability and if agreed the information about calculation of the hardenability (see 8.2.1),
- h) any requirement for internal soundness (see 7.4 and A.2),
- i) any requirement relating to surface quality (see 7.5.3),
- j) any requirement concerning suitability of bars and rod for bright drawing (see 7.5.4),
- k) any requirement relating to removal of surface defects (see 7.5.5),
- l) any requirement concerning special marking of the products (see clause 9 and A.6),
- m) any verification of the product analysis (see Table 9 and A.3).



**EXAMPLE**

20 round bars with nominal diameter 40 mm and the nominal length of 8000 mm according to EN 10060 made of steel grade 20MnCr5 (1.7147) according to EN 10084 in the heat treatment condition +A with surface condition +BC, test report 2.2 as specified in EN 10204

20 round bars EN 10060 - 40x8000  
 EN 10084 - 20MnCr5+A+BC  
 EN 10204 -2.2

or

20 round bars EN 10060 - 40x8000  
 EN 10084 - 1.7147+A+BC  
 EN 10204 - 2.2

## 6 Manufacturing process

### 6.1 Melting process

The type of melting process is left to the discretion of the manufacturer.

### 6.2 Deoxidation

All steels shall be killed.

### 6.3 Manufacture of the product

The manufacturing process route of the product shall be at the manufacturer's discretion.

For minimum reduction ratio respectively minimum thickness deformation ratio of rolled and forged products see A.5.

### 6.4 Heat-treatment condition and surface finish at the time of delivery

#### 6.4.1 Normal condition at delivery

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

#### 6.4.2 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 8.

#### 6.4.3 Particular surface condition

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

### 6.5 Cast separation

The products shall be delivered separated by cast.

## 7 Requirements

### 7.1 Chemical composition, hardness and hardenability

**7.1.1** Table 1 gives a survey on combinations of usual heat-treatment conditions at delivery, product forms and requirements according to Tables 3 to 7 (chemical composition, hardenability, maximum hardness, hardness range).

**7.1.2** Unless otherwise agreed (see 5.2 d) for alloy steels the hardenability requirements given in Table 5 apply. If agreed at the time of enquiry and order alloy steels with restricted hardenability scatter bands given in Table 6 can be supplied.

### 7.2 Technological properties

#### 7.2.1 Machinability

All steels are machinable in the conditions "annealed to maximum hardness requirements", "treated to hardness range", "treated to ferrite/pearlite structure and hardness range" and "normalized".

Where improved machinability is required, the grades with a specified sulphur range should be ordered. (See also Table 3, footnote c).

#### 7.2.2 Shearability of semi-finished products and bars

**7.2.2.1** Under suitable shearing conditions (preheating, application of blades with a profile adapted to that of the product, etc.) all steels are shearable in the condition "annealed to maximum hardness requirements".

**7.2.2.2** The steel types 28Cr4, 28CrS4, 20MnCr5, 20MnCrS5, 22CrMoS3-5, 20MoCr3, 20MoCrS3, 20MoCr4, 20MoCrS4, 16NiCr4, 16NiCrS4, 18NiCr5-4, 17CrNi6-6, 15NiCr13, 17NiCrMo6-4, 17NiCrMoS6-4, 20NiCrMoS6-4 and 18CrNiMo7-6 and the corresponding grades with requirements on hardenability (see Tables 5 and 6), are, under suitable conditions, also shearable when supplied in the "treated to improve shearability" condition with the hardness requirements given in Table 7.

**7.2.2.3** The non alloyed steels and the steels 17Cr3, 17CrS3, 16MnCr5, 16MnCrS5, 16MnCrB5, 18CrMo4, 18CrMoS4, 10NiCr5-4, 20NiCrMo2-2, 20NiCrMoS2-2 and the corresponding grades with requirements on hardenability (see Tables 5 and 6) are shearable in the untreated condition under suitable conditions.

### 7.3 Structure

**7.3.1** Unless otherwise agreed the steel shall show a fine grain structure with an austenitic grain size of 5 or finer.

**7.3.2** The steels shall have a degree of cleanliness corresponding to the special steel quality (see A.1 and C).

### 7.4 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.2).

## 7.5 Surface quality

**7.5.1** All products shall have a surface finish appropriate to the manufacturing processes applied.

**7.5.2** 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.

**7.5.3** Where appropriate, requirements relating to the surface quality of the products shall be agreed on at the time of enquiry and order, in the case of hot-rolled bars and rods with reference to EN 10221, in the case of flat products with reference to EN 10163-2.

**NOTE** It is more difficult to detect and eliminate surface discontinuities from coiled products than from cut lengths. This should be taken into account when agreements on surface quality are made.

**7.5.4** If suitability of bars, wide flats and rod for bright drawing is required, this shall be agreed at the time of enquiry and order.

**7.5.5** The removal of surface defects by welding is only permitted with the approval of the purchaser or his representative.

The method and permissible depth of defect removal, where appropriate, shall be agreed at the time of enquiry and order.

## 7.6 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 annex B).

## 8 Inspection and testing

### 8.1 Types and contents of inspection documents

**8.1.1** Products complying with this European Standard 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** If, in accordance with the agreements made at the time of enquiry and order, a test report 2.2 is to be issued, it shall contain the following information:

- a) the confirmation that the material complies with the requirements of the order;
- b) the results of the cast analysis for all the elements specified in Table 3 for the steel grade concerned.

**8.1.3** If, in accordance with the order agreements, inspection certificate 3.1 or 3.2 is to be issued, the specific tests described in 8.2 shall be carried out and the results shall be confirmed in the inspection certificate.

In addition, the inspection certificate shall include the following information:

- a) the manufacturer's results for the cast analysis of all elements specified in Table 3 for the steel grade concerned;
- b) the results of inspections and tests ordered as a result of supplementary options (see annex A);
- c) the symbol letters or numbers relating the inspection certificates, test pieces and products to each other.

## 8.2 Specific inspection and testing

### 8.2.1 Verification of hardenability

**8.2.1.1** For non alloy steels, the hardness requirements given in table 1, column 8, sub-clause 2, shall be verified.

**8.2.1.2** For alloy steels 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 for certain steel grades 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 8 of this document. The hardness values shall be determined in accordance with EN ISO 6508-1, method C.

### 8.2.2 Verification of the grain size

If the verification of fine grain structure is agreed at the time of enquiry and order, the verification of fine grain size shall be made according to annex A.4.

### 8.2.3 Visual and dimensional inspection

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

### 8.2.4 Retests

See EN 10021.

## 9 Marking

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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).

Table 1 — Combinations of usual heat-treatment conditions at delivery, product forms and requirements according to Tables 3 to 7

	1	2	3	4	5	6	7	8		9			10
1	Heat-treatment condition at delivery	Symbol	x = Applicable for					Applicable requirements for					Remarks
			Semi-finished products	Bars	Rod	Flat products	Hammer and drop forgings	Non alloy steel grades		Alloy steel grades			
								1.	2.	1.	2.	3.	
2	Untreated	None or + U	x	x	x	x	x		-				
3	Treated to improve sheatability	+ S	x	x	-	-	-			Column + S			
4	Annealed to maximum hardness requirements	+ A	x	x	x	x	x	Chemical composition according to Tables 3 and 4	Brinell hardness according to Table 7	Column + A	As in column 8 (see footnote b to Table 3)	Hardenability values according to Table 5 or 6	Observe also options given in annex A.
5	Treated to hardness range	+ TH	-	x	x	x	Column + TH						
6	Treated to ferrite-pearlite structure and hardness range	+ FP	-	x	-	-	Column + FP						
7	Normalized <sup>a</sup>	+N	-	-	-	x	Column + N						
8	Others	Other treatment conditions, for example certain annealing conditions to achieve a certain structure, may be agreed at the time of enquiry and order. The condition "annealed for spheroidal carbides (+AC) ", as required for cold heading and cold extrusion, is covered by EN 10263-4.											
<sup>a</sup> Normalizing may be replaced by normalizing forming													