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**Svetli jekleni izdelki - Tehnični dobavni pogoji**

Bright steel products - Technical delivery conditions

Blankstahlerzeugnisse - Technische Lieferbedingungen

Produits en acier transformés à froid - Conditions techniques de livraison

**Ta slovenski standard je istoveten z: prEN 10277**

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EN 10277-5:2008

English Version

## Bright steel products - Technical delivery conditions

Produits en acier transformés à froid - Conditions  
techniques de livraison

Blankstahlerzeugnisse - Technische Lieferbedingungen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee ECISS/TC 105.

If this draft becomes a European Standard, 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.

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

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## European foreword

This document (prEN 10277:2017) has been prepared by Technical Committee ECISS/TC 105 “Steels for heat treatment, alloy steels, free-cutting steels and stainless steels”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 10277-1:2008, EN 10277-2:2008, EN 10277-3:2008, EN 10277-4:2008 and EN 10277-5:2008.

This standard is the result of the work on ISO 683-1. Since the bright stainless steel products are to be found in EN 10088-3 they are excluded here. In addition, there are adaptations to the European references (see Clause 2).

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## 1 Scope

This European Standard specifies the technical delivery requirements for bright steel bars in the drawn or peeled/turned condition and they are intended for mechanical purposes, for example for machine parts. The bright bars are subdivided into the following steel types:

- a) non-alloy general engineering steels;
- b) non-alloy free-cutting steels;
- c) non-alloy and alloy case-hardening steels;
- d) non-alloy and alloy steels for quenching and tempering.

Bright steel products of stainless steels are to be found in EN 10088-3.

In addition to this standard, the general technical delivery requirements of EN 10021 are applicable.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 10021:2006, *General technical delivery conditions for steel products*

EN 10025-2, *Hot rolled products of structural steels - Part 2: Technical delivery conditions for non-alloy structural steels*

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

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

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

EN 10079, *Definition of steel products*

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

EN 10247, *Micrographic examination of the non-metallic inclusion content of steels using standard pictures*

CEN/TR 10261, *Iron and steel - European standards for the determination of chemical composition*

EN ISO 148-1, *Metallic materials - Charpy pendulum impact test - Part 1: Test method (ISO 148-1)*

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

EN ISO 643, *Steels - Micrographic determination of the apparent grain size (ISO 643)*

EN ISO 683-1, *Heat-treatable steels, alloy steels and free-cutting steels - Part 1: Non-alloy steels for quenching and tempering*

EN ISO 683-2, *Heat-treatable steels, alloy steels and free-cutting steels - Part 2: Alloy steels for quenching and tempering*

EN ISO 683-3, *Heat-treatable steels, alloy steels and free-cutting steels - Part 3: Case-hardening steels*

EN ISO 683-4, *Heat-treatable steels, alloy steels and free-cutting steels - Part 4: Free-cutting steels*

EN ISO 3887, *Steels - Determination of depth of decarburization (ISO 3887)*

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

EN ISO 6892-1, *Metallic materials - Tensile testing - Part 1: Method of test at room temperature (ISO 6892-1)*

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

ISO 286-2, *Geometrical product specifications (GPS) - ISO code system for tolerances on linear sizes - Part 2: Tables of standard tolerance classes and limit deviations for holes and shafts*

ISO 4967, *Steel - Determination of content of non-metallic inclusions - Micrographic method using standard diagrams*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 10020, EN 10027-1, EN 10027-2, EN 10052, EN 10079, EN ISO 377, EN ISO 14284 and the following apply.

#### 3.1

##### **bright steel products**

drawn or peeled/turned bars with smoother surface quality and better dimensional accuracy in comparison with hot-rolled bars

#### 3.2

##### **drawn products**

products of various cross-sectional shapes obtained, after descaling, by cold drawing of hot-rolled bars or rod, on a drawing bench (cold deformation without removing material)

Note 1 to entry: This operation gives the product special features with respect to shape, dimensional accuracy and surface finish. Products in lengths are delivered straightened, products of small cross-section may also be supplied in coils.

#### 3.3

##### **peeled/turned products**

steel bars of circular cross-section having the same features of drawn products concerning shape, dimensional accuracy and bright surface finish but without work hardening

Note 1 to entry: They are produced by peeling on a peeling machine usually followed by straightening and by polishing. The removal of metal by peeling is carried out in such a way that the bright product is generally free from surface defects and decarburization coming from the hot-rolling process.

#### 3.4

##### **ground products**

drawn or peeled/turned round bars given an improved surface quality and dimensional accuracy by grinding or by grinding and polishing

**prEN 10277:2017 (E)****3.5****thickness**

nominal dimension of the product

Note 1 to entry: That means:

- a) the diameter in the case of rounds;
- b) the lateral length in the case of squares;
- c) the width over flats in the case of hexagons;
- d) the shorter lateral length in the case of flats (rectangular bars) and wide-flats.

For special sections, 'thickness' has to be defined at the time of enquiry and order.

**3.6****out-of round**

difference between the smallest and largest dimension measured across the pairs of opposing points at a common cross-section

**3.7****ruling section**

section for which the specified mechanical properties shall apply

Note 1 to entry: Independent of the actual shape and dimensions of the cross-section of the product, the size of its ruling section is always given by a diameter. This corresponds to the diameter of an "equivalent round bar". That is a round bar which will show the same cooling rate as the actual ruling section of the product concerned at its position for taking the test pieces, when being cooled from austenitizing temperature.

**4 Classification and designation****4.1 Classification**

The classification of the relevant steel grades is allocated in accordance with EN 10020. The general engineering and the free cutting steels are quality steels. The steels for case hardening, for quenching and tempering and the stainless steels are special steels.

**4.2 Designation**

For the steel grades covered by this document, the steel names and numbers given in the relevant tables are allocated in accordance with EN 10027-1 and EN 10027-2.

**5 Information to be supplied by the purchaser****5.1 Mandatory information**

The manufacturer shall obtain the following information from the purchaser at the time of enquiry and order:

- a) quantity (mass, number of bars) to be delivered;
- b) shape of the product (e.g. round, hexagon, square, flat);
- c) the dimensions and tolerances of the product, see 7.7 and Tables 2 and 11 to 13;
- d) reference to this European Standard, i.e. EN 10277;



- e) the designation of the steel grade and the delivery condition (see Tables 4 to 10);
- f) standard designation for a test report 2.2 or, if required, any other type of inspection document in accordance with EN 10204.

## 5.2 Options/Supplementary or special requirements

A number of options are specified in this European standard and listed below. If the purchaser does not indicate the wish to implement any of these options, the products will be supplied in accordance with the basic specifications of this standard (see 5.1).

- a) Reference testing for products used in the quenched and tempered condition (for steels for quenching and tempering only, see Table 1, footnote d and C.2);
- b) any fine grain requirement and verification of fine grain size (see 7.3 and C.3);
- c) non-destructive testing (see 7.5 and C.4);
- d) the disposition of tolerances in accordance with 7.7 and C.5;
- e) end conditions may be specified at the time of enquiry and order in accordance with C.6;
- f) product analysis (see 7.1.2, Table 15 and C.7);
- g) for a minimum reduction ratio or minimum thickness deformation (see 6.1 and C.8)
- h) temporary corrosion protection (see 6.2.1 and C.9);
- i) any requirement to special marking (see Clauses 10 and C.10)
- j) any additional requirement concerning the surface condition, i.e. ground surface +G or polished surface +PL for round bars (see 6.2.2 and Table 2);
- k) surface quality class if another than the standard class is requested (see 7.8 and Table 3);
- l) verification of the straightness (see 7.7, Table 14 and Annex D);
- m) any requirement to the hardenability (+H, +HH, +HL), for special steels only (see 7.1.4);
- n) any requirement regarding the permissible depth of decarburization (see 7.6);
- o) impact test at a temperature lower than room temperature (see 9.2.2).

## 5.3 Ordering examples

### EXAMPLE

2 t round bars with nominal diameter 20 mm, tolerance h9, stock length 6000 mm made of steel grade C45 according to this standard in delivery condition +C, surface quality class 1 and a test report 2.2 as specified in EN 10204.

**2 t round bars 20 h9 × stock 6000**

**steel grade EN 10277 —+C C45**

**Inspection document EN 10204 — 2.2**

## 6 Manufacturing process

### 6.1 General

The manufacturing process of the steel and of the products is with the restrictions given by the requirements in 6.2 and 6.3 left to the discretion of the manufacturer.

For minimum reduction ratio or minimum thickness deformation ratio of rolled and forged products, see C.8.

### 6.2 Treatment and surface condition at delivery

#### 6.2.1 Treatment condition

The treatment and heat-treatment condition (if any) at the time of delivery must comply with the condition agreed in the order and shall be one of the conditions indicated in Table 1.

Bright steel products in cold drawn or peeled/turned condition are coated with a light film of grease from processing, for bright steel products in a finally heat treated condition the manufacturer chooses the rust protection after heat treatment.

The usual light application of ordinary grease or oil does not afford positive protection against rusting, particularly in the presence of condensation water. The use of a selected rust inhibitor or a special type of packing shall, if required, be agreed at the time of enquiry and order, see C.9.

#### 6.2.2 Particular surface conditions

Table 2 shows the possible surface conditions and tolerance classes according to ISO 286-2 at delivery.

### 6.3 Traceability of the cast

Each product shall be traceable to the cast, see Clause 10.

## 7 Requirements

### 7.1 Chemical composition, mechanical properties and hardenability

#### 7.1.1 General

Combination of usual treatment conditions at the time of delivery and requirements concerning chemical composition and mechanical properties are shown in Tables 1.

#### 7.1.2 Chemical composition

The chemical composition of the steels determined by the cast analysis, shall comply to EN 10025-2, EN ISO 683-1, EN ISO 683-2, EN ISO 683-3 and EN ISO 683-4. The grades and the chemical composition of the steels are listed for information in Annex A for EN 10025-2, EN ISO 683-1, EN ISO 683-2, EN ISO 683-3 and EN ISO 683-4.

Permissible deviations between the limiting values for cast analysis and the values for product analysis are given in the corresponding tables of EN 10025-2, EN ISO 683-1, EN ISO 683-2, EN ISO 683-3 and EN ISO 683-4. The product analysis shall be carried out when specified at the time of enquiry and order (see C.7).

If steels for case hardening or for quenching and tempering are ordered with hardenability requirements according to EN ISO 683-1, EN ISO 683-2 and EN ISO 683-3, such hardenability requirements shall be considered as the governing criteria for acceptance. In such cases, the cast analysis may deviate by the values given in EN ISO 683-1, EN ISO 683-2 and EN ISO 683-3, Table 3, footnote b.

**WARNING** Due to hazardous effects to health and environmental problems of Pb, it is recommended to use instead steels only with sulphur and other innocuous free-cutting element additions.

### 7.1.3 Mechanical properties

For steels ordered in one of the treatment conditions in Tables 1 and 2, the requirements for mechanical properties specified in Tables 4 to 10 apply. The mechanical property values given in Tables 4 to 10 apply to test pieces which have been taken and prepared in accordance with Figure 1.

In this case, the normal and narrowed hardenability values given in EN ISO 683-1, EN ISO 683-2 for special steels and the narrowed hardenability values in EN ISO 683-3 for alloy special steels are for guidance purposes only.

**NOTE** In Tables 4 to 10, grades alloyed with further elements for better machinability are not explicitly mentioned, but the mechanical properties are also valid for them (see Tables A.1 to A.4).

### 7.1.4 Hardenability

Unless otherwise agreed for alloy case-hardening steels, the hardenability requirements given in EN ISO 683-3, Table 5 apply. If agreed at the time of enquiry and order, alloy case-hardening steels with restricted hardenability scatterbands given in EN ISO 683-3, Table 6 shall be supplied and these values apply in addition to Table 1, columns 6 and 7.

If special steels for quenching and tempering are ordered by using the designations to normal or to narrowed hardenability scatterbands, the values of hardenability given in EN ISO 683-1 or EN ISO 683-2 apply in addition to Table 1, columns 8 and 9.

**NOTE** In Tables 8 to 10, grades alloyed with further elements for better machinability are not explicitly mentioned, but the mechanical properties are also valid for them (see Tables A.3 and A.4).

## 7.2 Machinability

All non-stainless steels are machinable in the conditions 'soft annealed' (+A) and treated to ferrite/pearlite structure (+FP).

Where improved machinability is required the grades with a specified sulphur or lead range should be ordered and/or with a specific treatment to improve machinability (see also footnote b in Tables A.1, A.3 and A.4).

Free-cutting steels with low carbon content have their best machinability in the cold drawn condition.

**NOTE** Non-leaded steels with comparable chemical composition generally have identical mechanical properties but often lower machinability than leaded steels.

## 7.3 Grain size

Unless otherwise agreed at the time of enquiry and order the grain size of the general engineering, free-cutting steels, the non-alloy steels for quenching and tempering and the stainless steels shall be left to the discretion of the manufacturer. If a fine grain structure is required for non-alloy steels for quenching and tempering or for case-hardening or quenched and tempered free-cutting steels, Annex C, Option C.3 shall be ordered.

If direct hardening treatment is used for free-cutting case-hardening steels, a fine grain structure should be ordered.

The case-hardening and the alloy steels for quenching and tempering shall have a fine grain structure with an austenite grain size of 5 or finer, when tested in accordance with EN ISO 643. Only for verification see C.3.

**prEN 10277:2017 (E)****7.4 Non-metallic inclusions****7.4.1 Microscopic inclusions**

The special steels shall have a certain degree of cleanness, however, verification of the non-metallic inclusion content requires a special agreement. If there is such an agreement at the time of enquiry and order the microscopically non-metallic inclusion content shall be determined to an agreed procedure and within agreed limits (see ISO 4967 or EN 10247).

For grades with specified minimum sulphur content, the agreement should only concern the oxides.

**7.4.2 Macroscopic inclusions**

This requirement is applicable for the verification of the macroscopic inclusions in special steels. If verification is agreed then the method and acceptance limits shall be agreed at the time of enquiry and order.

**7.5 Internal soundness**

Where appropriate, requirements relating to the internal soundness of the products shall be agreed at the time of enquiry and order (see C.4).

**7.6 Decarburization**

For non-stainless steels for quenching and tempering, 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.

**7.7 Shape, dimensions and tolerances**

The tolerance class on thickness (and width for flats) shall comply with the requirements agreed at the time of enquiry and order and shall be in accordance with Table 2. If there is no agreement on the tolerance class the bright products are delivered with the standard tolerance class given in Table 2. The tolerance class and the corresponding tolerances are given in Table 11 for rounds, squares and hexagons and in Table 12 for drawn flats. Where specified by the purchaser at the time of enquiry and order the disposition tolerances specified in Table 11 shall be in accordance with C.5.

Unless otherwise agreed at the time of enquiry and order, the length and the tolerance on length shall be as specified in Table 13.

Maximum deviation from 'out of roundness' shall be not more than half the specified tolerance range in any case never above the upper limit of the tolerance.

Where specified at the time of enquiry and order and in cases of dispute, an agreed number of bars shall be evaluated for straightness in accordance with one of the methods specified in Annex D and the tolerances specified in Table 14 shall apply.

Non-round bars (i.e. square, hexagon and flat) in widths  $\leq 150$  mm may have an undefined profile within a distance of 0,2 mm of the hypothetical edge, flats in widths  $> 150$  mm within a distance of 0,5 mm, unless otherwise agreed. For widths  $> 150$  mm, the corner profile may be undefined within a distance of 0,5 mm of the hypothetical edge, unless sharp corners have specifically been ordered.

**7.8 Surface quality**

Bright products shall have a smooth, scale free surface. Bright products in the final heat treated condition shall be free from loose surface scale; their surface might be discoloured or darker. For hexagons, squares, flats and profiles with special cross-sections, one cannot achieve – for manufacturing reasons – the same quality of surface finish as for round cross-sections.

Since surface discontinuities (cracks, overlapping, scale, isolated pores, pits, grooves, etc.) cannot be completely avoided during manufacturing (hot and cold forming, heat treatments, handling and storage) and since they are retained when drawing, agreements shall be made regarding surface quality. The surface quality of the products shall be one of the classes according to Table 3. Cold drawn bars and ground/polished bars (+C, +C+QT, +C+G, +C+PL) are delivered in class 1, while peeled/turned bars as well as ground/polished bars produced from peeled/turned bars (+SH, +SH+G, +SH+PL) are delivered in class 3. Different classes may be agreed at the time of enquiry and order.

For flats, squares in sizes greater than 20 mm and hexagons in sizes greater than 50 mm, the maximum possible depth of surface discontinuities shall be agreed at the time of enquiry and order.

NOTE Where automatic testing of the surface is applied, 50 mm of each end of the bar is not normally covered.

Surface defects cannot be eliminated without removal of material. Products in the 'technically crack free by manufacture' condition are only available in the peeled/turned and/or ground conditions.

## 8 Inspection

### 8.1 Testing procedures and types of documents

**8.1.1** Products complying with this standard shall be ordered and delivered with one of the inspection documents 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 2.2 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 provided, this shall cover the following information:

- a) confirmation that the material complies with the requirements of the order;
- b) results of the cast analysis for all elements specified in Tables A.1 to A.4 for the steel grade concerned.

**8.1.3** If in accordance with the agreements in the order an inspection certificate 3.1 or 3.2 to EN 10204 is to be provided, the specific inspections and tests described in 8.3 and 9 shall be carried out and the results shall be confirmed in the inspection certificate.

In addition, the inspection certificate shall cover:

- a) confirmation that the material complies with the requirements of the order;
- b) results of the cast analysis for all elements specified in Table A.1 to A.4 for the steel grade concerned;
- c) the result of all inspections and tests ordered by supplementary requirements (see Annex C),
- d) the symbol letters or numbers relating the inspection certificate, test pieces and products to each other.

### 8.2 Frequency of testing

The amount of testing, the sampling conditions and the test methods to be applied for the verification of the requirements shall be in accordance with the prescriptions of Table 15.

### 8.3 Specific inspection and testing

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

For steels ordered in one of the treatment condition in Table 1, the hardness requirements or mechanical properties, shall, with the following exception, be verified. The requirements given in Table 1, footnote d (mechanical properties of reference test pieces), is only to be verified if supplementary requirement specified in C.2 is ordered.

For steels being ordered with the symbol +H, +HH or +HL in the designation, unless otherwise agreed, only the hardenability requirements according to EN ISO 683-1, EN ISO 683-2 and EN ISO 683-3 are to be verified.

#### 8.3.2 Visual and dimensional inspection

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

Dimensional inspection shall be carried out as follows:

- a) for round bars: not less than 150 mm from the end of the bar;
- b) for round bars cut to length: not less than 10 mm from the end of the bar;
- c) for shapes other than round: not less than 25 mm from the end of the bar.

## 9 Test methods

### 9.1 Chemical analysis

The choice of a suitable physical or chemical analytical method for the analysis shall be at the discretion of the manufacturer. In cases of dispute, the method for product analysis used shall be agreed taking into account the relevant existing European Standards.

The list of available European Standards on chemical analysis is given in CEN/TR 10261.

### 9.2 Mechanical tests

#### 9.2.1 Tensile test

The tensile test shall be carried out in accordance with EN ISO 6892-1.

For the specified yield strength in the tables on mechanical properties in this standard, the upper yield strength ( $R_{eH}$ ) shall be determined.

If a yield phenomenon is not present, the 0,2 % proof strength ( $R_{p0,2}$ ) shall be determined.

#### 9.2.2 Impact test

The Charpy-V-notch (CVN) impact test shall be carried out in accordance with EN ISO 148-1. For cold drawn bars (+C, +C+G, +C+PL), requirements on impact tests can normally not be fulfilled, impact tests can only be performed if mentioned in the tables for mechanical properties.

At the time of enquiry and order additional requirements concerning the impact energy and the verification at temperatures other than room temperature (0 °C, -20 °C and -40 °C) can be agreed.

The average values of a set of three test pieces shall be equal to or greater than the specified value. One individual value may be below the specified value, provided that it is not less than 70 % of that value.

If these conditions are not satisfied additional tests can be done according to EN 10021:2006, 8.3.4.2.