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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

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English Version

Bright steel products - Technical delivery conditions

Produits en aciers transformés à froid - Conditions techniques de livraison

Blankstahlerzeugnisse - Technische Lieferbedinungen

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European foreword

This document (EN 10277:2018) 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 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of an identical text or by endorsement, at the latest by December 2018 and conflicting national standards shall be withdrawn at the latest by December 2018.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 10277-1:2008 to EN 10277-5:2008.

The following changes have been made in comparison to the previous edition EN 10277-1:2008 to EN 10277-5:2008:

a) the five parts of EN 10277-1 to EN 10277-5 were merged into one part;

b) the dimensional requirements for bright steel products were added to this standard;

c) for the steels for general engineering use, the steel grades E295GC, E355GC, C10, C15, C16 and C55 were deleted and the grades C25, C30 and C50 were added;

d) for the free cutting steels, the grades 9S20, 17SMn20, 35SMn20 and 35SMnPb20 were added;

e) for the case hardening steels, the grades 16MnCrB 5, 15NiCrS4, 15NiCr13 and 17NiCrMoS6-4 were deleted, the grades C10E, C15E, C16E, 16MnCr5, 20Cr4, 20CrS4, 20MnCr5, 24CrMo4, 24CrMoS4, 16NiCr4, 16NiCrS4, 20NiCrMo2-2, 17NiCrMo6-4, 17NiCrMoS6-4 and 18CrNiMo7-6 were added;

f) for the steels for quenching and hardening, the grade 39NiCrMo3 was deleted, the grades C25E. C25R. C30E, C30R, 28Mn6, 36Mn6, 42Mn6, 34Cr4, 37Cr4, 37CrS4, 41Cr4, 25CrMo4, 34CrMo4, 34CrMoS4, 42CrMo4, 50CrMo4 36CrNiMo4 and 30CrNiMo8 were added;

g) the standard was editorially revised.

This standard is the result of the work on ISO 683-18. Since the bright stainless steel products are to be found in EN 10088-3 for European standardization, they are excluded here. In addition, this standard was adapted to include the European references and some further amendments were made.

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

1 Scope

This document specifies the technical delivery requirements for bright steel bars in the drawn, peeled/turned or ground 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.

This document lists the mechanical characteristics for products up to 100 mm in thickness. For larger dimensions, the manufacturer and purchaser agree on mechanical properties at the time of enquiry and order.

It does not cover cold rolled products and cut lengths produced from strip or sheet by cutting. Bright steel products of stainless steels are to be found in EN 10088-3.

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

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 10021:2006, *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 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·(ISO 683-1)*

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

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

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

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

EN ISO 4885, *Ferrous materials - Heat treatments - Vocabulary (ISO 4885)*

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 10079, EN ISO 377, EN ISO 4885, 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 to 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 formation without removing material)

Note 1 to entry: This operation gives the product special features with respect to shape, dimensional accuracy and surface finish. In addition the process causes cold working of the product, which can be eliminated by subsequent heat treatment. Products in lengths are delivered straightened.

3.3
peeled/turned products
round bars produced by peeling or turning where the product can be further processed by straightening and polishing

Note 1 to entry: This operation gives the bar special features with respect to shape, dimensional accuracy and surface finish. The removal of metal is carried out in such a way that the bright product is generally free from rolling defects and surface decarburization

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

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

3.7
out-of shape
any deviation for the nominal section profile

3.8
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 and for quenching and tempering 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) bar 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 16 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 for non-metallic inclusions (see 7.4);

o) any requirement regarding the permissible depth of decarburization (see 7.6);

p) 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 6 000 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 —C45+C

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

Where improved machinability is required the grades with defined ranges of alloying elements, which support the machinability and/or with a specific treatment to improve machinability should be ordered (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 and the non-alloy steels for quenching and tempering 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.

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 microscopical 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

Freedom of macroscopic inclusions cannot be ensured in any steel. 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 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.

The maximum admitted ovality shall be not more than half the specified tolerance range, in any case never above the upper limit of the tolerance. Any other requirements concerning out of shape may be agreed at the time of enquiry and order.

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 ≤ 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 after 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 products are normally delivered in class 1, while turned and peeled bars as well as ground round bars 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 inspection 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 16.

8.3 Specific inspection and testing

8.3.1 Inspection on 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 the ruling section 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), there is no reference value for the impact tests; impact tests can be requested but there are no reference values, unless agreed at the time of enquiry and order

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.

9.3 Hardness and hardenability tests

9.3.1 Hardness in treatment conditions +A and +FP

For products in treatment conditions +SH (hot-rolled and peeled/turned), +A+SH (soft annealed and peeled/turned), +A+C (soft annealed and cold drawn), +FP +SH (treated to ferrite-pearlite structure and peeled/turned) and +FP+C (treated to ferrite-pearlite structure and cold drawn), the Brinell hardness tests shall be carried out in accordance with EN ISO 6506-1.

9.3.2 Verification of hardenability

For verification of hardenability, see EN ISO 683-1, EN ISO 683-2 and EN ISO 683-3.

9.4 Verification of dimensions

The ovality test has to be carried out by the two-point measuring method.

Other methods to measure the out-of-shape have be agreed at the time of enquiry and order.

9.5 Retests

Retests and criteria should be as specified in EN 10021.

10 Marking

The manufacturer shall mark the products or the bundles or boxes containing the products in a suitable way, so that the identification of the cast, the steel type and the origin of the delivery is possible (see C.10).