BS EN 10263-1:2017

BSI Standards Publication

Steel rod, bars and wire for cold heading and cold extrusion

Part 1: General technical delivery conditions

bsi.

National foreword

This British Standard is the UK implementation of EN 10263-1:2017. It supersedes BS EN 10263-1:2001, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee ISE/106, Wire Rod and Wire.

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Walzdraht, Stäbe und Draht aus Kaltstauch- und Kaltfließpreßstählen - Teil 1: Allgemeine technische Lieferbedingungen

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European foreword

This document (EN 10263-1:2017) has been prepared by Technical Committee ECISS/TC 106 "Wire rod and wires", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2018, and conflicting national standards shall be withdrawn at the latest by May 2018.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 10263-1:2001.

This European Standard EN 10263 is subdivided as follows:

— *Part 1: General technical delivery conditions*

— *Part 2: Technical delivery conditions for steels not intended for heat treatment after cold working*

— *Part 3: Technical delivery conditions for case hardening steels*

— *Part 4: Technical delivery conditions for steels for quenching and tempering*

— *Part 5: Technical delivery conditions for stainless steels*

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1 Scope

1.1 This part of EN 10263 specifies the general technical delivery conditions for round rod, round bars and wire for cold heading and cold extrusion made of:

a) non alloy steels not intended for heat treatment after cold working, as specified in EN 10263-2;

b) non alloy and alloy steels for case hardening, as specified in EN 10263-3;

c) non alloy and alloy steels for quenching and tempering, as specified in EN 10263-4;

d) stainless steels, as specified in EN 10263-5.

1.2 Parts 2, 3 and 4 of this EN 10263 cover products having a diameter up to and including 100 mm.

Part 5 covers products having a diameter up to and including:

— 25 mm for ferritic and austenitic-ferritic steels;

— 50 mm for austenitic steels;

— 100 mm for martensitic steels.

1.3 In special cases supplementary requirements or deviations with respect to this European Standard may be agreed between the purchaser and the supplier at the time of enquiry and order (See Annex A).

1.4 The general technical delivery conditions in EN 10021 also apply to products supplied in accordance with this European Standard

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, *General technical delivery conditions for steel products*

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

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

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

EN 10060, *Hot rolled round steel bars for general purposes — Dimensions and tolerances on shape and dimensions*

EN 10079, *Definition of steel products*

EN 10108, *Round steel rod for cold heading and cold extrusion — Dimensions and tolerances*

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

EN 10218-2, *Steel wire and wire products — General — Part 2: Wire dimensions and tolerances*

EN 10221:1995, *Surface quality classes for hot-rolled bars and rods — Technical delivery conditions*

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

EN 10263-2:2017, *Steel rod, bars and wire for cold heading and cold extrusion — Part 2: Technical delivery conditions for steels not intended for heat treatment after cold working*

EN 10263-3:2017, *Steel rod, bars and wire for cold heading and cold extrusion — Part 3: Technical delivery conditions for case hardening steels*

EN 10263-4:2017, *Steel rod, bars and wire for cold heading and cold extrusion — Part 4: Technical delivery conditions for steels for quenching and tempering*

EN 10263-5:2017, *Steel rod, bars and wire for cold heading and cold extrusion — Part 5: Technical delivery conditions for stainless steels*

EN 10277-1:2008, *Bright steel products — Technical delivery conditions — Part 1: General*

EN 10278, *Dimensions and tolerances of bright steel products*

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 377:2017)*

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 643:2012)*

EN ISO 3651-2, *Determination of resistance to intergranular corrosion of stainless steels — Part 2: Ferritic, austenitic and ferritic-austenitic (duplex) stainless steels — Corrosion test in media containing sulfuric acid (ISO 3651-2:1998)*

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

EN ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method (ISO 6508-1:2016)*

EN ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature (ISO 6892-1:2016)*

EN ISO 9934-1, *Non-destructive testing — Magnetic particle testing — Part 1: General principles (ISO 9934-1:2016)*

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

ISO 4967, *Steel — Determination of non-metallic inclusions — Microscopic method using standard diagrams*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 10020, EN 10021, EN ISO 4885, EN 10079, EN ISO 377 and EN ISO 14284 apply.

4 Classification and Designation

4.1 Classification

The classification of the steel grades covered by this European Standard according to EN 10020 is indicated in 4.1 of parts 2, 3, 4 and 5 of this standard for the corresponding steel grades.

4.2 Designation

4.2.1 Steel names

For the steel grades covered by this European Standard, the steel names as given in the relevant tables of Parts 2, 3, 4 and 5 of this standard series 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 the relevant tables of Parts 2, 3, 4 and 5 of this standard 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, to enable the supplier to comply satisfactorily with the requirements of this European Standard:

a) quantity to be delivered;

b) product denomination (rod or bar or wire);

c) the nominal diameter and the dimensional tolerances on dimensions and shape of the products with a reference to the relevant European Standard (see Clause 8);

d) length for bars and tolerances on length or dimensions and mass for the coils;

e) reference to this European Standard including the number of the relevant Part(s);

f) the designation of the steel grade (see 4.2);

g) the symbol of the required treatment condition (see 7.4 and Table 1);

h) the symbol of the required surface condition (see 7.10 and Table 2);

i) if applicable, indication of the symbol for hardenability requirements (see 7.7);

j) type of inspection document in accordance with EN 10204 (see 9.1);

k) requirements concerning packaging (see Clause 12).

5.2 Options

Several options are specified and listed below. If the purchaser does not indicate any of these options at the time of enquiry and order, all decisions regarding them shall be left to the manufacturer's discretion (see 5.1 and Table1)

1) special surface treatment (see 7.4.3);

2) any requirement for the product analysis (see 7.5.2 and A.2);

3) any requirement for the hardenability (+H, +HH, +HL) or any requirement for core hardening (see Tables 7 and 8 of EN 10263-3:2017 and Tables 8 to 11 of EN 10263-4:2017 (see 7.7);

4) any requirement for the verification of hardenability (see 10.2);

5) any requirement for the verification of the fine grain structure (see 7.8.1 and A.3);

6) carbide spheroidization (see 7.8.2) and any requirement for the verification of the carbide spheroidization (see A.4);

7) any requirement for the verification of the non-metallic inclusions in steels specified in EN 10263-3:2017 and EN 10263-4:2017 (see A.5 and Annex B);

8) internal soundness and any requirements for non-destructive testing (see 7.9.2 and A.6);

9) surface quality (see 7.10.1 to 7.10.3) and any requirements for upsetting tests (see 9.3.5.1 and 10.3.1), for magnetic particle inspection (see 9.3.5.2 and 10.3.2) or for other inspection methods (see 9.3.5.3 and 10.3.3) ;

10) removal of surface defects and imperfections (see 7.10.4);

11) depth of decarburisation (see 7.11) and any requirements for testing the depth of decarburisation (see 10.4 and A.7);

12) corrosion resistance of stainless steel products (see 7.12) and any requirements for resistance to intergranular corrosion (see A.8);

13) statistical evaluation (see 7.1);

14) calculation of hardenability (see 10.2);

15) requirements on surface protection (see Clause 13);

16) surface quality E for rod for certain applications (see 7.10.2.1).

5.3 Example of an order

100 t round bars in accordance with Part 4 of this European Standard, with a diameter of 50 mm with normal diameter tolerances (N) and fixed length of 6 000 mm in accordance with EN 10060, made of steel grade 32CrB4 (1.7076) spheroidized and cold drawn, with a 3.1. inspection certificate in accordance with EN 10204.

100 t – round bars – EN 10060 50 **mm N x 6000 mm fixed length**

Steel grade EN 10263-4 — 32**CrB4+AC+C**

Inspection document EN 10204 3.1

6 Production process

Unless otherwise agreed at the time of enquiry and order, the production process is left to the discretion of the manufacturer.

7 Requirements

7.1 General

Suppliers are responsible, using the means they think fit, for inspecting their product in accordance with various quality criteria specified. In view of the practical difficulties in inspecting a coil of wire rod along its entire length, it cannot be proved that no value greater than the specified limits is to be found in the coil as a whole. Statistical evaluation of performances applicable to all coils may be agreed between the purchaser and the manufacturer at the time of ordering.

7.2 Quality management system

If agreed between the supplier and purchaser at the time of enquiry and order, the wire rod supplied shall be produced under a mutually acceptable quality system.

7.3 Form of delivery

The delivery shall consist of one cast or a fraction thereof. Each product shall be traceable to the cast analysis, see Clause 11.

7.4 Delivery condition

7.4.1 Basic delivery condition

Rod, bars and wire shall be supplied in one of the delivery conditions, that has been agreed at the time of ordering, as indicated in Table 1 of EN 10263-2:2017 and Tables 1 and 2 of EN 10263-3:2017 to EN 10263-5:2017.

7.4.2 Summary of combinations of delivery conditions, product forms and corresponding requirements

A summary of customary delivery conditions and product forms and of the corresponding requirements concerning chemical composition, mechanical properties and, where applicable, hardenability is given in Table 1 of EN 10263-2:2017 and Tables 1 and 2 of EN 10263-3:2017 to EN 10263-5:2017.

7.4.3 Surface treatment

Any surface treatment that can facilitate subsequent cold heading and cold extrusion or partially delay any formation of rust shall be subject of an agreement at the time of ordering.

The above treatment can include, e.g. descaling, treatment with lime and-or phosphate.

7.5 Chemical composition

7.5.1 Cast analysis

7.5.1.1 The chemical composition of steel on cast analysis shall be in conformity with the values specified in Table 2 of EN 10263-2:2017, in Table 3 of EN 10263-3:2017, in Tables 3 and 4 of EN 10263 -4:2017 and in Table 3 of EN 10263-5:2017, as appropriate to the steel grade concerned.

7.5.1.2 In cases where steels for case hardening or for quenching and tempering are ordered in accordance with Tables 8 and 9 of EN 10263-3:2017 and in Tables 9 to 12 of EN 10263-4:2017, which involves conformity with hardenability requirements according to the Jominy or core hardening tests, such hardenability requirements shall be considered as the governing criterion for acceptance.

In such cases a deviation of the cast analysis with respect to the values indicated in Table 3 of EN 10263-3:2017 and in Tables 3 and 4 of EN 10263-4:2017 is admissible, taking into account the prescriptions given in footnote b) of those tables. In any case however, the deviations in the product analysis in relation to the specified limits of cast analysis shall not exceed the values indicated in Table 4 of EN 10263-3:2017 and in Table 5 of EN 10263-4:2017.

7.5.2 Product analysis

The purchaser can specify at the time of enquiry and order that the chemical composition on product analysis be verified. In this case reference should be made to A.2.

The permissible deviations in the product analysis in relation to the specified limits of cast analysis (see 7.5.1) are indicated in Table 3 of EN 10263-2:2017, in Table 4 of EN 10263-3:2017, in Table 5 of EN 10263-4:2017 and in Table 4 of EN 10263-5:2017.

7.6 Mechanical properties

The mechanical properties of products covered by this European Standard shall meet the prescriptions stated in 6.3 of EN 10263-2:2017 to EN 10263-5:2017.

7.7 Hardenability requirements

7.7.1 General

Products cannot be ordered and supplied according to both end quench test hardenability requirements and core hardening requirements

7.7.2 End quench (Jominy test) hardenability requirements

In cases where a product is ordered with reference to a steel grade the designation of which is quoted in Tables 8 and 9 of EN 10263-3:2017 or in Tables 9 to 11 of EN 10263-4:2017, the product shall meet the hardenability requirements indicated in those tables. For the verification, see 10.2.1.

7.7.3 Core hardening requirements

In cases where a product is ordered with reference to a steel grade the designation of which is quoted in Table 12 of EN 10263-4:2017, core hardening properties shall meet the requirements indicated in the relevant tables.

At least 90 % of the structure shall be martensite.

In cases of dispute regarding supplies of products with diameters larger than those quoted in Table 12 of EN 10263-4:2017, samples to be tested shall be brought to the corresponding dimensions indicated in that table by hot working or forging, taking into account the requirements of EN ISO 642.

7.7.4 Hardenability by calculation

See 10.2.

7.8 Microstructure

7.8.1 Austenitic grain size

Steels of EN 10263-3:2017 and of EN 10263-4:2017 shall show a fine grain structure with an austenitic grain size of 5 or finer, when tested in accordance with EN ISO 643. For verification, see A.3.

Concerning steels of EN 10263-2:2017 and EN 10263-5:2017, unless otherwise specified at the time of enquiry and order, the choice of the austenitic grain size is left to the manufacturer's discretion.

7.8.2 Carbide spheroidization

For steels covered by Parts 2, 3 and 4 of this European Standard, in cases where carbide spheroidization is requested reference shall be made to A.4.

7.8.3 Non-metallic inclusions

The steels of EN 10263-3:2017 and EN 10263-4:2017 shall have a certain degree of cleanness, however verification of the non-metallic inclusion content requires a special agreement at the time of enquiry and order (see A.5).

7.9 Internal soundness

7.9.1 Rod, bars and wire shall be free from internal defects which may cause an adverse effect on the product during cold heading or cold extrusion or during heat treatment.

7.9.2 Requirements concerning internal soundness can be agreed at the time of enquiry and order, e.g. with reference to non-destructive tests (see A.6).

7.10 Surface quality

7.10.1 General

The surface quality requirements for steels of Parts 2, 3 and 4 of this European Standard are as follows. Those for steels of Part 5 are given in that Part.

7.10.2 Hot rolled products

7.10.2.1 Rod shall meet surface quality requirements according to EN 10221:1995, class D. For certain applications surface quality E according EN 10221:1995 is appropriate and may be agreed at time of enquiry and order (see Option 16).

7.10.2.2 Bars shall meet surface quality requirements according to EN 10221:1995 class D. Compliance with surface quality according to EN 10221:1995 class E may be agreed at the time of enquiry and order. When the diameter of the product is greater than the maximum diameter specified in EN 10221, for the surface quality class concerned, the maximum permissible depth of surface defects on the product shall not be greater than that specified for this maximum diameter.

7.10.3 Bright products

For wire the permissible depth of surface discontinuities shall be in proportion to the reduction of the diameter during cold drawing. Depending on the starting material for cold drawn products the same requirements apply as specified in 7.10.2.1 respectively.

Bright bars shall comply with the surface quality class 3 of EN 10277-1:2008, Table 1.

7.10.4 Removal of surface defects and imperfections

Removal of surface defects and imperfections is permitted only after approval from the purchaser.

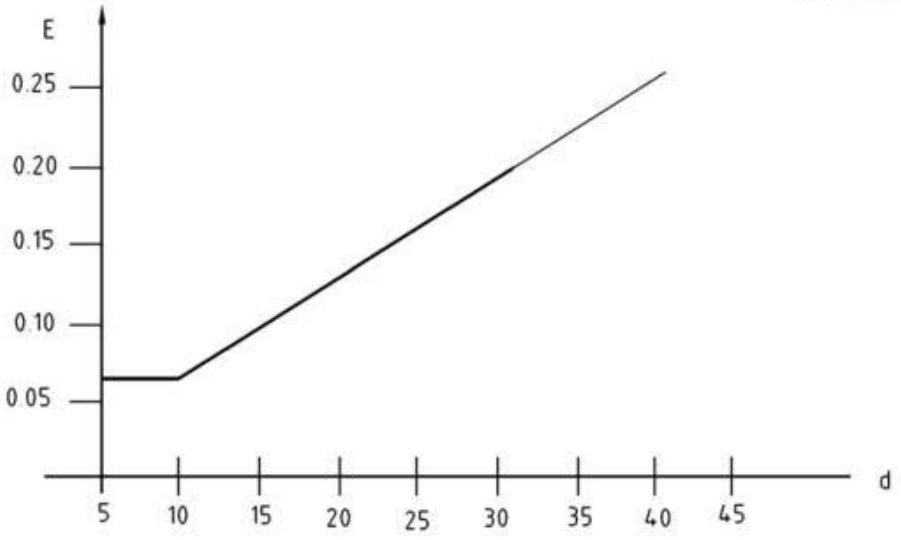
7.11 Decarburisation

Independently of their heat treatment condition, rod and bars with as-rolled surface of steels specified in Table 3 of EN 10263-3:2017 and in Tables 3 and 4 of EN 10263-4:2017 and wire shall be free from zones of total decarburisation.

For bars annealed in an atmosphere which is not controlled the depth of decarburisation shall be agreed at the time of enquiry and order.

Partial decarburisation (ferrite-pearlite) is admissible provided that it does not exceed the limits indicated in Figure 1. For diameters ≤ 10 mm the maximum admissible depth of decarburisation is E = 0,07 mm; for diameters greater than 10 mm the diagram corresponds to the formula E = 0,007 x d.

Dimensions in millimetres



Key

E admissible limits of depth of partial decarburisation

d diameter

Figure 1 — Admissible limits of depth of partial decarburization

For cold drawn products with diameters greater than 5 mm the limits of decarburization shall be the same as those for hot-rolled products.

For cold drawn products with diameter less than 5 mm, the permissible depth of decarburization shall be reduced in function of the reduction of the diameter during the cold drawing.

If in special cases the purchaser requests other values for partial decarburization, those values shall be agreed at the time of enquiry and order with reference to A.7.

7.12 Corrosion resistance of stainless steels

Tests for the determination of corrosion resistance of stainless steels covered by Part 5 of this European Standard may be agreed at the time of enquiry and order. In this case reference should be made to A.8.

8 Dimensions and tolerances on dimensions and shape

The nominal dimensions and the tolerances on dimensions and shape for the product shall be agreed at the time of enquiry and order, with reference to the dimensional standards as follows:

— Round bars, hot rolled: EN 10060;

— Bright bars: EN 10278;

— Rod: EN 10108;

— Wire: EN 10218-2.

9 Testing and inspection

9.1 Types and contents of inspection documents

9.1.1 Products complying with this European Standard shall be ordered and delivered with an inspection certificate 3.1 or 3.2 as specified in EN 10204. The type of document shall be agreed upon at the time of enquiry and order.

9.1.2 The inspection certificate shall contain the following information:

a) confirmation that the material complies with the requirements of the order;

b) the results of the cast analysis carried out by the manufacturer for the elements specified in the relevant tables of Parts 2,3, 4 and 5 of this European standard for the steel grade concerned;

c) the symbols, letters or numbers relating the inspection documents, test pieces and products to each other;

Additional following information shall be given if agreed at time of enquiry and order:

1) the results of inspection and tests ordered by supplementary requirements (see Annex A);

2) the results of the specific tests as agreed according to 9.2.

9.2 Extension of inspection

Unless otherwise agreed at the time of enquiry and order, cast analysis and testing of mechanical properties for products shall be carried out and confirmed in the inspection certificate, see Table 1.

Table 1 — Extension of inspection

Type of test	Products not intended for heat treatment	Products for case hardening	Products for quenching and tempering	Stainless steel products
	See EN 10263-2:2017	See EN 10263-3:2017	See EN 10263-4:2017	See EN 10263-5:2017
Cast analysis	m	m	m	m
Product analysis	o	o	o	o
Mechanical properties	m	o	o	o
End quench hardenability test	–	o	o	–
Core hardening requirements	–	–	o	–
Austenitic grain size	–	o	o	–
Carbide spheroidisation	o	o	o	–
Non-metallic inclusions	–	o	o	–
Surface defects	o	o	o	o
Surface decarburisation	–	o	o	–
Corrosion resistance	–	–	–	o
m = mandatory (to be carried out) o = optional (to be carried out only if it is agreed at the time of the ordering), – = is not carried out				

9.3 Specific inspection and testing

9.3.1 Testing of mechanical properties

Verification of mechanical properties shall only be carried out when specified, provided that the relevant requirements are applicable according to the indication given in Table 1 of EN 10263-2:2017, EN 10263-3:2017, EN 10263-4:2017 or EN 10263-5:2017.

Verification of the mechanical properties shall be carried out in the specified delivery condition (see Table 1 of EN 10263-2:2017, EN 10263-3:2017, EN 10263-4:2017 or EN 10263-5:2017).

9.3.2 Testing of hardenability by end quench test (Jominy test)

Verification of hardenability properties shall only be carried out when specified, provided that the relevant requirements are applicable according to the indication given in Table 1 of EN 10263-3:2017 or EN 10263-4:2017.

In cases where products are ordered with reference to a steel grade the designation of which includes one of the symbols +H, +HH, +HL, compliance with hardenability test requirements shall be verified by the end quench test (Jominy test) in accordance with the prescriptions given in Tables 8 and 9 of EN 10263-3:2017 and in Tables 9 to 11 of EN 10263-4:2017.

9.3.3 Testing of compliance with core hardening requirements

In cases where products are ordered with reference to a steel grade the designation of which includes the symbol +CH, compliance with core hardening requirements shall be verified in accordance with the prescriptions given in Table 12 of EN 10263-4:2017.

9.3.4 Surface inspection

9.3.4.1 General

Surface inspection is applicable to coiled products and bars. The inspection unit shall be "C+D+T" (see Table 2, Footnote a). A test piece shall be taken from each sample.

9.3.4.2 Upsetting test

The absence of cracks on the test piece after it has been submitted to the upsetting test shall be considered as evidence that the product concerned is free from surface defects. Marks appearing on the test piece after the test as a result of guide marks shall not be considered as defects.

For the test method see 10.3.1.

NOTE Normally the upsetting test is not carried out on the stainless steel products covered by Part 5 of this European standard.

9.3.4.3 Magnetic particle inspection

The absence of detectable cracks on the test piece after it has been submitted to magnetic particle inspection shall be considered as evidence that the product concerned is free from surface defects.

For the test method see 10.3.2

9.3.4.4 Other inspection methods

Other inspection methods e.g. Eddy Current Testing may be agreed at time of enquiry and order.

For the test method see 10.3.3.

9.3.5 Number and frequency of tests

The number and frequency of tests, the conditions for sampling and sample preparation and the test methods to be used for the verification of compliance with the various requirements are given in Table 2.

9.3.6 Dimensional inspection

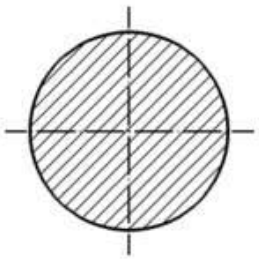
A sufficient number of products shall be inspected to ensure compliance with the relevant specifications.

10 Test methods

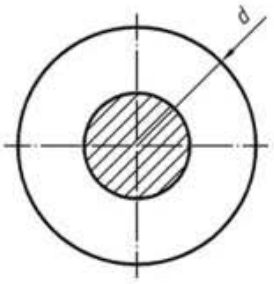
10.1 Mechanical tests

10.1.1 Tensile test

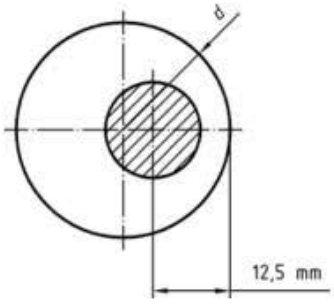
The tensile test shall be carried out as described in EN ISO 6892-1. For the location of test pieces for the tensile test see Figure 2.



a) Full section test piece



b) Round test piece where $d \leq 25$ mm



c) Round test piece where $d > 25$ mm

Figure 2 — Location of test piece for the tensile test

10.1.2 Hardness test

The Rockwell hardness test shall be carried out according to EN ISO 6508-1.

10.2 Verification of hardenability

10.2.1 General

A verification of hardenability by calculation may be agreed at the time of ordering. In this case the method of calculation should also be agreed.

10.2.2 End quench test (Jominy test)

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 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 hardening shall comply with Tables 8 and 9 of EN 10263-2:2017 and Tables 9 to 11 of EN 10263-4:2017.

The hardness values shall be determined in accordance with EN ISO 6508-1, scale C.

10.2.3 Core hardening test

For the test piece to be used, see Table 2.

The test piece shall be heated in a furnace with neutral or reducing atmosphere up to the temperatures indicated in Table 12 of EN 10263-4:2017. It shall be maintained at that temperature until complete austenitizing takes place.

It shall then be removed from the furnace and quenched immediately in a quenching oil with high cooling capacity until a full equilibrium of temperature is reached, the temperature of the quenching bath being about 50 °C and the rate of movement of the test piece being about 0,25 m/sec. The test piece shall then be notched at its midpoint in a direction perpendicular to its longitudinal axis and then broken. One of the fracture surfaces shall be polished (care should be taken to prevent excessive local heating).

The Rockwell hardness Scale C at the centre of the fracture surface shall then be determined according to EN ISO 6508-1.

10.3 Methods for surface inspection

10.3.1 Upsetting test

10.3.1.1 Non-stainless grades

Unless otherwise agreed at the time of ordering, for the upsetting test straight test pieces shall be taken from the relevant samples.

The surfaces of the end sections of the above test pieces shall be flat and parallel to each other and their initial length (height) shall be $h = 1{,}5 \times d$, where d is the test piece diameter. During the test the length (height) of the test piece shall be reduced to 1/3 of its initial value.

Supplementary for treatment condition "+AC" and diameter less than 25 mm ($d < 25$ mm) following may be agreed between the manufacturer and customer: The surfaces of the end sections of the above test pieces shall be flat and parallel to each other and their initial length (height) shall be $h = 2{,}0 \times d$, where d is the test piece diameter. During the test the length (height) of the test piece shall be reduced to 1/4 of its initial value (see Option 9).

The tests shall be carried out at room temperature. The assessment and acceptance criteria shall also be agreed at time of enquiry and order.

10.3.1.2 Stainless steel grades

The requirements given in part 5 of this European standard shall apply.

10.3.2 Magnetic particle inspection

Alternatively the magnetic particle inspection may be agreed but in this case the assessment and acceptance criteria shall also be agreed at time of enquiry and order (see Option 9).

Unless otherwise agreed at the time of ordering, the descaling of test pieces is not requested.

If magnetic particle inspection has been agreed, it shall be in accordance with EN ISO 9934-1.

10.3.3 Other inspection methods

By agreement on other inspection methods, e.g. Eddy Current Testing, the assessment and acceptance criteria shall also be agreed at time of enquiry and order (see Option 9).

10.4 Determination of the depth of decarburisation

Testing for decarburisation shall be carried out in accordance with EN ISO 3887 with the following exceptions.

Decarburisation is inspected by microscope on a transverse metallographic test piece suitably etched, with a magnification of X 200.

The depth of decarburisation of the sample is considered as being the average of 8 measurements at the ends of 4 diameters located at 45° to each other, starting from the zone of maximum decarburisation and avoids starting from a defective zone. In the calculation of the above average value, any measuring point of the seven remaining situated in a local surface defect shall not be taken into account in the calculation. In cases of dispute the depth of decarburisation shall be determined by micro-hardness measurements (HV 0,3) along 4 diameters located at 45° to each other, on test pieces submitted to quenching in conformity with the indications given in the various tables regarding hardenability test, included in parts 3 and 4 of this European Standard. The depth of decarburisation is considered as being the average of the eight values e_1, e_2 ...e_8 (see Figure 3) which correspond to the distances between the surface and the nearest point on the hardness curve for which the hardness value is found to be equal to 80 % of the maximum hardness value in the zone adjacent to the decarburised zone (see Figure 3). Any measuring point situated in a local surface defect shall not be taken into consideration.

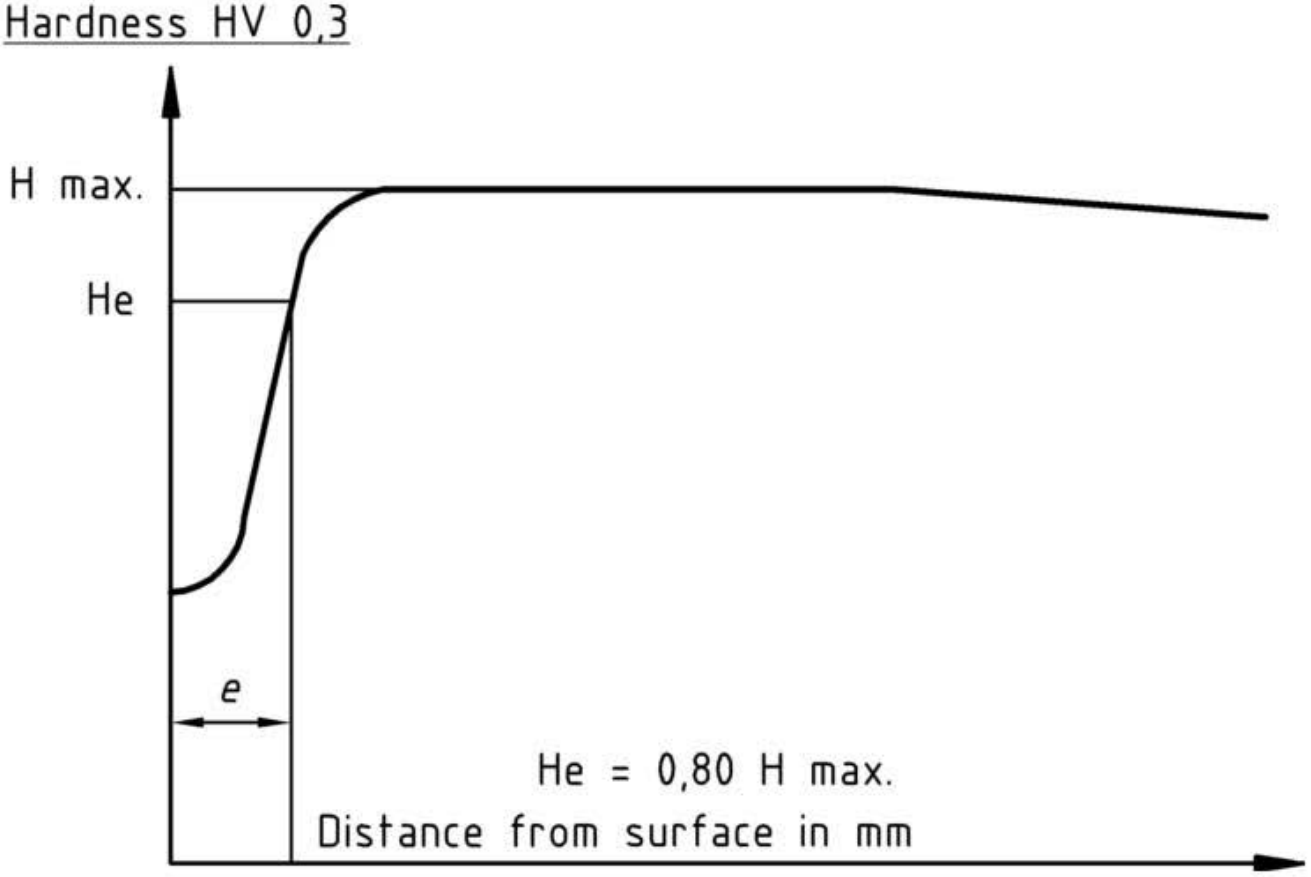


Figure 3 — Determination of the depth of decarburisation (see A.7)

10.5 Retests, sorting and reprocessing

EN 10021 shall apply.

11 Marking

The manufacturer shall mark the products or the bundles or coils in a suitable way so that it is possible to identify the manufacturer's name or symbol, the heat, the nominal diameter and the steel grade.

For any special or additional marking (see A.9).

12 Packaging

The diameter and the mass of the coil and the method of packaging of the product to be delivered shall be agreed during the ordering.

13 Protection

Any surface protection may be agreed at the time of enquiry and order.

14 Complaints after delivery

With regard to any claims and action arising there from, EN 10021 shall apply.

15 Supplementary or special requirements

See Annex A.

Table 2 — Test conditions for the verification of the requirements given in column 2

Type of requirements			Inspection unit[a]	Number and frequency of tests		Sampling and sample preparation	Test procedure and method to be used
	see Part	see Table		Number of samples per test unit	Number of test pieces taken from each sample		
Chemical composition	2 3 4 5	2 3 3–4 3	C	The cast analysis is given by the manufacturer. For the possible product analyses see Clause A.2 of Annex A		The general conditions and preparation of samples and test pieces shall be in accordance with EN ISO 14284	
Mechanical properties in the delivery condition prescribed	2 3 4 5	4 5–6–7 6–7–8 5–6–7–8	C + D + T	1 for each 15 tons with a maximum of 3 tests		The general conditions and preparation of samples and test pieces shall be in accordance with EN ISO 377. **Products with d > 25 mm:** The sample for the tensile test shall be taken in conformity with the indication given in Figure 2. The test piece shall be prepared according to the prescriptions of EN ISO 6892-1. **Products with d ≤ 25 mm:** The sample for the tensile test shall be submitted to test without preliminary machining.	In accordance with EN ISO 6892-1

[a] The tests shall be carried out separately for each heat (indicated by "C"), for each dimension (indicated by "D") and for each treatment batch (indicated by "T").Rod, bars and wire for which the ratio of nominal section does not exceed 3:1 may be grouped in a single test unit. In cases where heat treatment is performed as a continuous process the symbol "T" denotes that the tests are to be carried out for each 25 ton or fraction thereof.

Type of requirements			Inspection unit[a]	Number and frequency of tests		Sampling and sample preparation	Test procedure and method to be used
	see Part	see Table		Number of samples per test unit	Number of test pieces taken from each sample		
End quench hardenability	3 4	8–9 9–10–11	C	1	1	For alloy steels as far as available, the manufacturer has the option to verify the hardenability by calculation The general conditions and preparation of samples and test pieces shall be in accordance with EN ISO 377. **Jominy test:** The test piece shall be obtained by machining from the samples with d ≤ 40 mm. Depending on the agreements made at the time of ordering the samples shall be taken from the product concerned, or the billet or bloom originating from the same cast. In the absence of such agreements the origin of the sample is left to the manufacturer's discretion. The sample shall be obtained by hot rolling or hot forging.	EN ISO 642
Core hardening	4	12	C	1	1	The general conditions and preparation of samples and test pieces shall be in accordance with EN ISO 377. The diameter of the test piece shall, if possible, be the maximum indicated in Table 12 of EN 10263-4. Sampling and sample preparation is left to the manufacturer's discretion, taking into account the indications concerning the test piece for the End Quench test (Jominy test) (see EN ISO 642). The length of the test piece shall be greater than or equal to four times its diameter.	See 10.2.2

[a] The tests shall be carried out separately for each heat (indicated by "C"), for each dimension (indicated by "D") and for each treatment batch (indicated by "T").Rod, bars and wire for which the ratio of nominal section does not exceed 3:1 may be grouped in a single test unit. In cases where heat treatment is performed as a continuous process the symbol "T" denotes that the tests are to be carried out for each 25 ton or fraction thereof.

Annex A
(normative)

Supplementary or special requirements

A.1 General

One or more of the following supplementary or special requirements may be agreed upon at the time of enquiry and order. The details of these requirements may be agreed upon between the manufacturer and the purchaser at the time of enquiry and order if necessary.

A.2 Product analysis

One product analysis shall be carried out per heat for the determination of elements for which values are specified for the cast analysis of the steel grade concerned in the corresponding Part of this Standard.

Sampling shall be carried out as specified in EN ISO 14284. Further details concerning sampling and sample preparation and the method of analysis to be used may be agreed at the time of enquiry and order. In cases of dispute, the method used shall be agreed if possible with reference to the corresponding European Standards.

For the European Standards which are now available in the field of chemical analysis of iron and steel see CEN/TR 10261.

A.3 Fine grain steel

A.3.1 General

This requirement is applicable to products covered by EN 10263-3:2017 and EN 10263-4:2017.

A.3.2 Case hardening steels (EN 10263-3)

Fine grain steel shall have an austenite grain size of 5 or finer. If specific testing is ordered, the grain size requirement is to be verified by determining the aluminium content or micrographically. The fine grain structure is normally achieved, when the total aluminium content is a minimum of 0,018 %. In such a case, the micrographic investigation is not necessary. The aluminium content shall be given in the inspection document. Otherwise, one test piece per cast shall be inspected for the determination of the apparent austenitic grain size.

Sampling and sample preparation shall be as specified in EN ISO 643. The steel shall be tested in accordance with the Mc-Quaid-Ehn method described in EN ISO 643 and the grain structure shall be considered satisfactory if 70 % of the area is within the specified size limits.

Unless otherwise agreed at the time of enquiry and order, the grain size shall be determined from a carburized specimen. Carburization shall be achieved by maintaining the specimen in carburizing powder at 925 ± 10 °C for 6 h. This is generally done by keeping the carburizing chamber at 925 ± 10 °C for 8 h, including a preheating period. In most cases, a carburized layer of approximately 1 mm is obtained. After carburizing, cooling of the specimen at a rate slow enough ensures the cementite precipitating on the grain boundaries of the hypoeutectoid zone of the carburized layer.

A.3.3 Steels for quenching and tempering (EN 10263-4)

When tested in accordance with EN ISO 643, the steel shall have an austenite grain size of 5 or finer.

If specific testing is ordered, it shall also be agreed whether this grain size requirement is to be verified by determining the aluminium content or micrographically.

In the first case, the fine grain structure is normally achieved, when the total aluminium content is a minimum of 0,007 %. In such a case, the micrographic investigation is not necessary. The aluminium content shall be given in the inspection document. In the second case, one test piece shall be inspected per cast for the determination of the austenitic grain size.

Sampling and sample preparation shall be as specified in EN ISO 643. The steel shall be tested in accordance with the Bechet-Beaujard method described in EN ISO 643 and the grain structure shall be considered satisfactory if 70 % of the area is within the specified size limits.

Unless otherwise agreed at the time of enquiry and order, the quenched grain size shall be determined. Hardening shall be carried out under the following conditions for the purposes of determining the quenched grain size:

— for steels with a lower carbon content limit < 0,35 %: (880 ± 10) °C, 90 min/water;

— for steels with a lower carbon content limit ≥ 0,35 %: (850 ± 10) °C, 90 min/water.

In cases of dispute, pretreatment at 1 150 °C for 30 min/air shall be carried out in order to produce a uniform starting condition.

A.4 Carbide spheroidization

This requirement is applicable to products covered by Parts 2, 3 and 4 of this European Standard, when ordered in the heat treatment conditions "+AC", "+AC+PE", "+U+AC", "+U+C+AC+", "+U+C+AC+LC", "+AC+C", as defined in Table 1 of the above Parts 2, 3 and 4.

NOTE It should be kept in mind that as the carbon content decreases it becomes more difficult to obtain spheroidized cementite.

The cross-section of each test piece shall be prepared, polished and then etched by means of a suitable solution.

The degree of spheroidization of cementite shall be verified by means of a microscopic examination of the section, normally with a magnification of X 500.

If so agreed at the time of ordering, the degree of spheroidization shall be assessed with reference to an agreed series of standard images.

A.5 Non-metallic inclusion content

This requirement is applicable to products covered by Parts 3 and 4 of this European Standard.

The microscopically determined non-metallic inclusion content shall be within agreed limits when tested according to a procedure to be agreed at the time of enquiry and order (see Annex B).

NOTE The requirements for non-metallic inclusion content apply in every case; however, proof requires a special agreement.

A.6 Internal soundness

The bar products of steel grades covered by EN 10263-2:2017, EN 10263-3:2017, EN 10263-4:2017 or EN 10263-5:2017 shall be tested ultrasonically in accordance with EN 10308.

Other products shall be non-destructively tested in accordance with a method to be agreed at the time of enquiry and order. The acceptance criteria shall also be agreed at time of enquiry and order.

A.7 Special limits for decarburisation

This requirement is applicable to products covered by EN 10263-3:2017 and EN 10263-4:2017.

Values below those indicated in Figure 3 for partial decarburization are to be agreed at the time of enquiry and order.

The inspection unit and the corresponding number of samples and test pieces are also to be agreed at the time of enquiry and order.

For the method of determination of the depth of decarburisation see 10.4.

A.8 Corrosion resistance of stainless steel products

This requirement is applicable to products covered by EN 10263-5:2017.

The resistance to intergranular corrosion shall be tested in accordance with EN ISO 3651-2. The definition of a degree of corrosion resistance for the products concerned shall be agreed at the time of enquiry and order.

The inspection unit and the corresponding number of samples and test pieces are to be agreed at the time of enquiry and order.

NOTE The corrosion resistance of stainless steels is very dependent on the type of environment and can therefore not always be clearly ascertained through laboratory tests. It is therefore advisable to draw on the available experience of the use of the steels.

A.9 Special or additional marking

The products shall be marked in a way specially agreed at the time of enquiry and order.

Annex B
(normative)

Determination and assessment of non-metallic inclusions

For the microscope determination of the non-metallic inclusions in special steels, agreement may be reached at the time of enquiry and order on a test (see Option 17), in accordance with one of the following methods:

EN 10247 **"Micrographic examination of the inclusion content of steels using standard pictures"**

In case where EN 10247 is used for testing the non-metallic inclusion content the method of assessment and the acceptance criteria shall be defined at the time of enquiry and order.

ISO 4967 **"Steel — Determination of non-metallic inclusions — Microscopic method using standard diagrams"**

The method for assessment of non-metallic inclusions and the assessment criteria shall be by the "worst field" method, as defined in ISO 4967 (method A) by using a severity rating of 0 to 5 (JK charts). The worst field for each individual inclusion type shall be recorded and a mean value calculated. Acceptance limits are shown in Table B.1.

Table B.1 — Limit values for non-metallic inclusions according to ISO 4967

Inclusion type [a]	Thin		Thick	
	Worst	Mean	Worst	Mean
A	4	2	3	1,5
B	3	2	2	1,0
C	4	2	3	1,5
D	3	2	2	1,0
DS	—	—	2,5	1,0

[a] Inclusion types according to ISO 4967.

Specification of "*K*" values for the oxide non-metallic inclusions

In case where *"K"* values are required, the method of determination shall be agreed at time of enquiry and order. The *"K"* values shall be as stated in Table B.2.

Table B.2 — Requirements for microscopic degree of purity when *K* values (method *K*) are required (valid for oxide non-metallic inclusions)

Bars diameter *d* [mm]	Total characteristic value for an individual cast *K* (oxides)
$70 < d \leq 100$	$K_4 \leq 30$
$35 < d \leq 70$	$K_4 \leq 25$
$17 < d \leq 35$	$K_3 \leq 30$
$8 < d \leq 17$	$K_3 \leq 20$
$d \leq 8$	$K_2 \leq 35$

Bibliography

[1] EN 10017, *Steel rod for drawing and/or cold rolling — Dimensions and tolerances*

[2] EN 10088-1, *Stainless steels — Part 1: List of stainless steels*

[3] EN 10168, *Steel products — Inspection documents — List of information and description*

[4] CEN/TR 10261, *Iron and steel — European standards for the determination of chemical composition*

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