

Non-alloy steel rod for drawing or cold rolling
General requirements
English version of DIN EN 10016-1

DIN
EN 10016-1

ICS 77.140.70

Descriptors: Steel rod, unalloyed steel, drawing, cold rolling, requirements.

Walzdraht aus unlegiertem Stahl zum Ziehen und/oder Kaltwalzen. Teil 1:
Allgemeine Anforderungen

This standard, together with
DIN EN 10016-2, April 1995
edition, supersedes
DIN 17140-1, March 1983
edition.

European Standard EN 10016-1:1994 has the status of a DIN Standard.

National foreword

This standard has been prepared by ECISS/TC 15.

The responsible German body involved in its preparation was the *Normenausschuß Eisen und Stahl* (Steel and Iron Standards Committee), Technical Committee *Walzdraht zum Ziehen*.

Rimmed and rimmed substitute low carbon steel rod and steel rod for use in special applications are covered in DIN EN 10016-3 and DIN EN 10016-4.

The DIN Standards corresponding to the European Standards and EURONORMs referred to in clause 2 of the EN are as follows:

EN 10204	DIN EN 10204
EURONORM 17	DIN 59110
EURONORM 104	DIN 50192
IC 10	DIN V 17006-100

Amendments

In comparison with DIN 17140-1, March 1983 edition, specifications regarding testing for core segregation have been included.

Previous editions

DIN 17140: 1962-12; DIN 17140-1: 1983-03.

Standards referred to

(and not included in **Normative references**)

DIN V 17006-100	Designation systems for steel; additional symbols for steel names
DIN 50192	Determination of depth of decarburization of steel
DIN 59110	Steel wire rod; dimensions, tolerances and mass
DIN EN 10204	Inspection documents for metallic products

International Patent Classification

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ICS 77.140.70

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English version

Non-alloy steel rod for drawing and/or cold rolling

Part 1: General requirements

Fil machine en acier non-allié destiné au
tréfilage et/ou au laminage à froid.
Partie 1: Prescriptions générales

Walzdraht aus unlegiertem Stahl zum
Ziehen und/oder Kaltwalzen. Teil 1:
Allgemeine Anforderungen

This European Standard was approved by CEN on 1994-11-10.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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

CEN members are the national standards bodies of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

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Foreword

This European Standard is subdivided as follows:

Part 1: General requirements

Part 2: Specific requirements for general purpose rod

Part 3: Specific requirements for rimmed and rimmed substitute low carbon steel rod

Part 4: Specific requirements for rod for special applications

This European Standard has been drawn up by ECISS/TC 15 'Wire rod; qualities, dimensions, tolerances and specific tests' the Secretariat of which is held by UNI/UNSIDER.

Parts 1 to 4 of this European Standard replace

EURONORM 16-87 Non-alloy steel wire rod for cold drawing and/or cold rolling

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, and conflicting national standards withdrawn, by June 1995 at the latest.

In accordance with the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard:

Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

1 Scope

1.1 This Part of EN 10016 is applicable to non-alloy steel rod intended for wire drawing and/or cold rolling. The cross-sectional shape of the rod may be round, square, rectangular, hexagonal, half-round or any other shape and, as a general rule, of nominal size 5 mm or above (see EURONORM 17); its surface is smooth.

1.2 It is not applicable to the following products, for which standards exist or are under study:

- steel rod intended for heat treatment (see EN 10083 and EURONORMs 84, 85 and 86);
- rod of free-cutting steel (see EURONORM 87);
- steel rod for cold heading and cold extrusion (see EURONORM 119);
- steel rod intended for the production of electrodes and products for welding (see EURONORM 133);
- steel rod for welded fabric and for concrete reinforcement (see prEN 10080);
- steel rod for wire for high fatigue strength mechanical springs, such as valve springs.

1.3 In addition to the requirements specified in this standard, the general technical delivery conditions specified in EN 10021 apply.

2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

- EN 10002-1 Metallic materials; tensile testing. Part 1: Method of test at ambient temperature
- EN 10020 Definition and classification of grades of steel
- EN 10021 General technical delivery requirements for steel and iron and steel products
- EN 10027-1 Designation systems for steel. Part 1: Steel names, principles symbols
- EN 10027-2 Designation systems for steel. Part 2: Steel numbers
- EN 10052 Vocabulary of heat treatment terms for ferrous products
- EN 10079 Definition of steel products
- EN 10204 Metallic products; types of inspection documents (including Amendment 1:1995)

EURONORM 17-70 ¹⁾	General purpose rod of non-alloy steel for drawing; dimensions and tolerances
EURONORM 18-79 ¹⁾	Selection and preparation of samples and test pieces for steel and iron and steel products
EURONORM 104-70 ¹⁾	Determination of the depth of decarburization of non-alloy and low alloy structural steels
ECISS IC 10	Designation systems for steel; additional symbols for steel names

3 Definitions

For the purposes of this standard, the following definitions apply in addition to the definitions given in EN 10020, EN 10021, EN 10052, EN 10079, and EURONORM 18:

heat analysis: A chemical analysis representative of the heat determined by the steelmaker in a manner of his choice.

product analysis: A chemical analysis carried out on a sample taken from the delivered product.

4 Classification and designation

4.1 Classification

The classification of the steel grades covered by this European Standard in accordance with EN 10020 is indicated in table 1 of EN 10016-2 to -4 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 table 1 of EN 10016-2 to -4 have been allocated in accordance with EN 10027-1 and ECISS JC 10.

4.2.2 Steel numbers

For the steel grades covered by this European Standard the steel numbers as given in table 1 of EN 10016-2, -3 and -4 are allocated in accordance with EN 10027-2.

¹⁾ It may be agreed at the time of ordering that, until this EURONORM has been adopted as a European Standard, either this EURONORM or a corresponding national standard should be applied.

5 Information to be supplied by the purchaser

The following information shall be supplied by the purchaser at the time of ordering, to enable the supplier to comply satisfactorily with the requirements specified in this European Standard:

- a) quantity to be delivered;
- b) product designation ('rod');
- c) cross-sectional shape (round, square, hexagonal, etc.);
- d) reference to the dimensional standard, EURONORM 17;
- e) nominal dimensions;
- f) reference to this European Standard;
- g) steel name or steel number (see 4.2);
- h) dimensions and mass of coils;
- i) surface condition (where different from the as-rolled condition);
- j) where applicable, indication of the method of descaling used (chemical or mechanical);
- k) where applicable, the type of inspection and inspection document in accordance with EN 10021 and EN 10204 respectively;
- l) where applicable, the method of binding and labeling;
- m) where applicable, that the steel grade is to be suitable for galvanization;
- n) where applicable, suitability for direct drawing;
- o) where applicable, suitability for patenting.

6 Production process

The steelmaking and fabrication processes shall be made known to the purchaser.

Those processes which are specifically agreed shall not be changed without the prior consent of the purchaser.

7 Requirements

7.1 General

The manufacturer is responsible, using the means he thinks fit, for inspecting his production from the point of view of the various quality criteria specified. In view of the fact that, in practice, it is impossible to inspect coils of rod except at their ends, it cannot be ensured that no value greater than the specified limits will be found in the coil as a whole.

Table 1: Scope of inspection

Property/item tested	General purpose rod (cf. EN 10016-2)	Low carbon steel rod (cf. EN 10016-3)	Rod for special applications (cf. EN 10016-4)
Surface defects	0	+	+
Decarburization	0	-	+
Non-metallic inclusions	-	0	0
Core segregation	0	-	0
Product analysis	0	0	0
Tensile strength	0	0	0
+ = test is to be carried out. - = test need not to be carried out. 0 = test is only to be carried out if agreed at time of ordering.			

Statistical evaluation of performance data applicable to all coils may be agreed between the purchaser and the manufacturer at the time of ordering.

7.2 Quality control

All products shall be supplied under a recognized quality control system.

7.3 Method of delivery

The products shall be delivered by heat or part of a heat. The number of heats per consignment shall be minimized as far as possible.

7.4 Form supplied

Rod shall be supplied in the as-rolled state, in coils of one continuous length with non-aligned turns, but capable of being unwound in a regular manner during subsequent processing.

The coils shall be cropped at both ends to provide a product of uniform shape and properties.

8 Dimensions, mass and tolerances

The dimensions, mass and tolerances of the products shall be in accordance with the requirements specified in EURONORM 17.

9 Inspection

9.1 Inspection and inspection documents

The provisions of EN 10021 and EN 10204 shall apply.

9.2 Scope of inspection

If the order is accompanied by a request for an inspection certificate, inspection shall be carried out in accordance with table 1.

9.3 Acceptance unit and number of samples and test pieces

An acceptance unit is composed of rod of the same diameter or equivalent dimension, originating from the same heat and rolled as a single continuous lot unless otherwise agreed.

If specific inspection is required, the number of test pieces specified in table 2 shall be used; for rod for special wire applications, a higher frequency of sampling may be agreed. If non-specific inspection is required, the performance statistics or suitable data may be used.

9.4 Testing for chemical composition

Where it has been agreed to verify the chemical composition on the product, samples shall be taken and prepared in accordance with EURONORM 18.

9.5 Testing for decarburization, surface defects, non-metallic inclusions and core segregation

9.5.1 For testing for surface defects, decarburization, non-metallic inclusions and core segregation, test pieces shall be taken from one end of the cropped coil (see 7.4).

9.5.2 Testing for decarburization shall be carried out on the rod in the as-rolled condition, in accordance with EURONORM 104, with the following exceptions.

Table 2: Acceptance unit and number of samples and test pieces

Property	Number of samples or test pieces
Product analysis	3, from 3 different coils originating from the same heat, but not necessarily rolled as a single continuous lot
Permissible depth of surface defects	One for every 20 tons, with a minimum of 3
Permissible depth of decarburization	
Non-metallic inclusions	
Tensile strength	
Core segregation	10

Decarburization is inspected by microscope on a transverse microsection suitably etched, with a magnification of X200. The depth of decarburization of the sample is considered as being the average from eight measurements at the ends of four diameters located at 45° to each other, starting from the zone of maximum decarburization and avoid starting from a defective zone. In the calculation of the above average value, any measuring point of the remaining seven points situated in a local surface defect shall be ignored.

9.5.3 For the determination of non-metallic inclusions and core segregation, the tests shall be carried out on the rod in the as-rolled condition and in accordance with EN 10016-2 (3.4), EN 10016-3 (3.4) and EN 10016-4 (3.5 and 3.6).

9.6 Test methods

9.6.1 Testing for chemical composition

The methods to be applied for carrying out the product analysis shall be agreed at the time of ordering, with reference to existing European Standards where these are available. For arbitrational analysis, the methods shall be the subject of agreement between the parties concerned.

9.6.2 Testing for surface defects

The method to be used for revealing surface defects shall be chosen by the manufacturer.

9.6.3 Tensile test

The tensile test is carried out on rod in the as-rolled condition, in accordance with EN 10002-1.

9.6.4 Testing for core segregation

Determination of core segregation shall be by macro-graphic examination on a transverse microsection of the sample as detailed in Annex A to this European Standard.

9.7 Invalidation of tests

See EN 10021.

9.8 Retests

See EN 10021.

9.9 Sorting or reprocessing

See EN 10021.

10 Marking

Each coil in each consignment shall be marked with the following information:

- dimensions of the cross section of the rod;
- designation of the steel grade;
- cast number;

Annex A (normative)

Determination of core segregation

NOTE: The method which is outlined below is based on French Standard NF A 04-114 and reflects general practice in Europe.

A.1 Scope

This annex is applicable for rod made from continuously cast steel with a carbon content of at least 0,40% C and defined in this European Standard.

The method described below is a macrographic method aimed at determining and evaluating the core segregation present in continuously cast high carbon rod.

A.2 Definitions

For the purposes of this annex, the following definition applies.

core segregation: Core segregation is the local variation in chemical composition which can be noticed over a cross section of rod by macrographic examination. It concerns primarily the segregation resulting from the steelmaking process. This segregation occurs concurrently for many elements: carbon, phosphorus, manganese, sulfur, etc. This is the reason why we can examine core segregation by revealing specifically the carbon segregation.

Grain boundary cementite, which is particularly influenced by the thermal history of the rod – from liquid steel to rod – and of its size can also cause problems in below processing. This justifies the use of specific methods for evaluating the presence of grain boundary cementite, which is related to carbon segregation, but should not be confused with core segregation.

A.3 Principle

The chemical heterogeneity is revealed by chemical etching of a microsection of the rod in a nital solution.

The images observed by macrographic examination are compared with those shown in the reference chart and classified accordingly.

A.4 Preparation of samples

A.4.1 Cutting

The surface to be examined is a transverse microsection of each sample to be examined. This is obtained by gradually cutting at low speed. In any case excessive heating is to be avoided by appropriate cooling.

- manufacturer's name and symbol;
- any subsequently agreed information.

The marking shall withstand pickling. The durability of the labels utilized for marking shall be agreed at the time of ordering.

11 Complaints after delivery

See EN 10021.

A.4.2 Polishing

The sample is first polished stepwise, whereby the finishing will be carried out with diamond paste of final grain size 1 μm .

After mirror polishing, the sample is carefully washed with water and dried in alcohol.

A.4.3 Etching

The polished surface is etched at ambient temperature in the nital solution during about ten seconds.

The nital solution is a solution of 2 ml of nitric acid ($\rho_{20} = 1,33 \text{ g/ml}$) in 100 ml of ethanol.

After etching, the surface is dried in alcohol.

A.5 Evaluation of the segregation

The etched surface is observed with a binocular, with illumination under a small angle with a magnification so as to obtain about the same dimensions as for the reference images.

The images in the chart represent limits for each class concerned. Actual images are compared, positioned and graded within the reference chart. They are assigned the class of the reference image equal to or worse than the image under observation.

A.5.1 Classes of segregation

The reference chart presents 5 classes of segregation.

Class 1: without segregation zone

Class 2: core segregation with slight contrast (medium-grey)

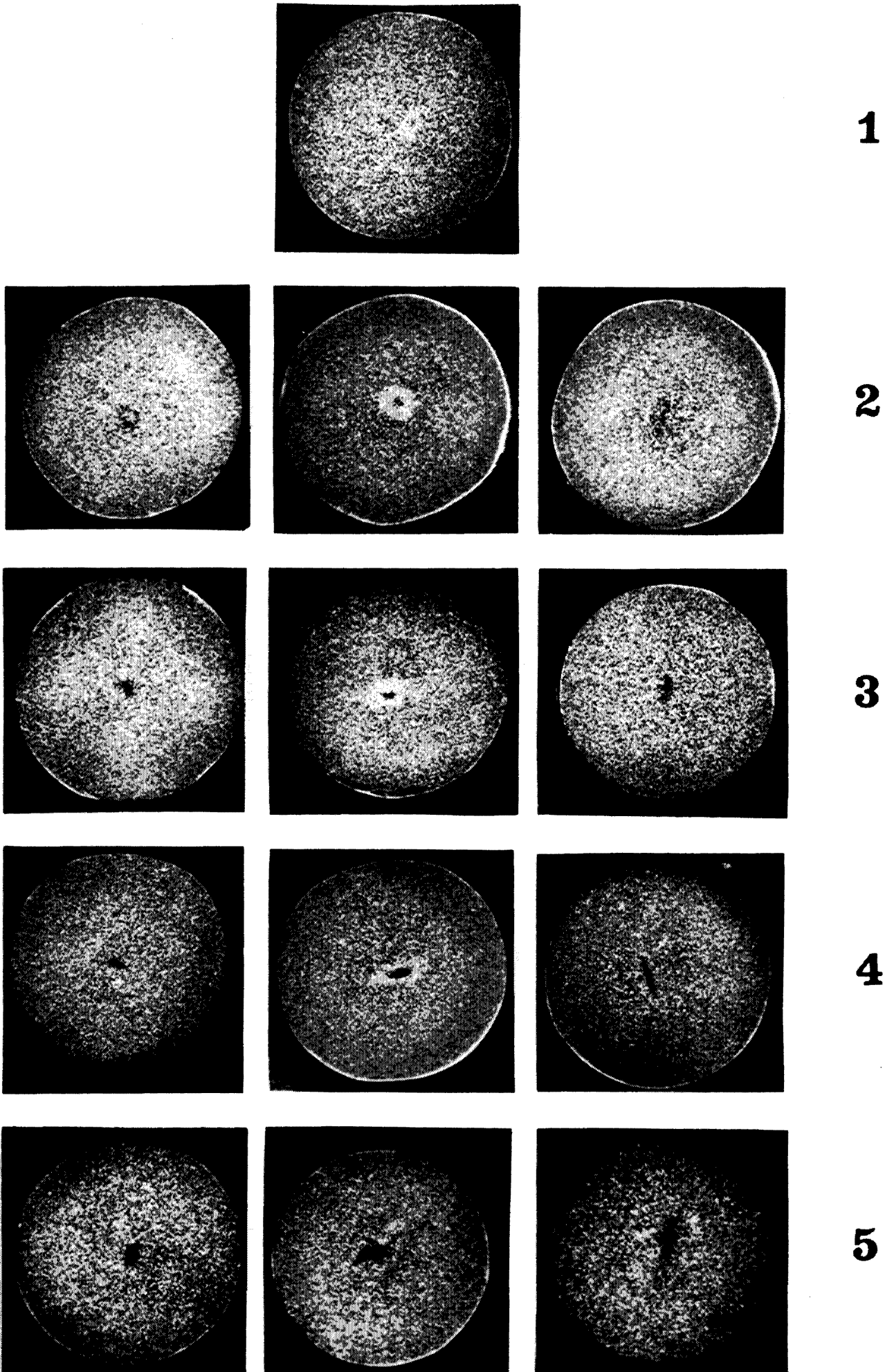
Class 3: core segregation with medium contrast (dark grey)

Class 4: core segregation with pronounced contrast (small black core)

Class 5: core segregation with heavy contrast (big black core)

A.5.2 Evaluation

It is generally accepted that a large number of results is required for a statistically significant evaluation of the core segregation of a cast or a consignment. The value obtained from the assessment of the core segregation on an individual sample is only a relative value. For this reason and in order to limit the number of tests to an economically acceptable level it is advisable to use the determination of the segregation as part of a quality control system.



Figure