
**Non-alloy steel wire rod for conversion to
wire —**

**Part 1:
General requirements**

Fil-machine en acier non allié destiné à la fabrication de fils —

Partie 1: Exigences générales



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Contents

Foreword.....	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Classification.....	2
5 Ordering information to be supplied by the purchaser	3
6 Production process	3
7 Requirements	4
8 Dimensions, mass and tolerances.....	4
9 Inspection	4
10 Marking	7
11 Complaints after delivery	7
Annex A (normative) Determination of core segregation	8

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 16120 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 16120-1 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 17, *Steel wire rod and wire products*.

This first edition of ISO 16120-1, together with parts 2, 3 and 4 cancels and replaces ISO 8457-2 (1989) which has been technically revised and augmented.

ISO 16120 consists of the following parts, under the general title *Non-alloy steel wire rod for conversion to wire*:

- *Part 1: General requirements*
- *Part 2: Specific requirements for general purpose wire rod*
- *Part 3: Specific requirements for rimmed and rimmed-substitute, low-carbon steel wire rod*
- *Part 4: Specific requirements for wire rod for special applications*

Annex A forms a normative part of this part of ISO 16120.

Non-alloy steel wire rod for conversion to wire —

Part 1: General requirements

1 Scope

1.1 This part of ISO 16120 is applicable to wire rod of non-alloy steel intended for wire drawing and/or cold rolling. The cross-section may be circular, oval, square, rectangular, hexagonal, octagonal, half-round or other shape and generally with at least 5 mm nominal dimension. Wire rod has a smooth surface and is generally intended for subsequent conversion.

1.2 It is not applicable to products for which standards exist or are under study, e.g.:

- steel wire rod intended for heat treatment;
- rod for free-cutting steels;
- steel rod for cold heading and cold extrusion;
- steel rod intended for the production of electrodes and products for welding;
- steel rod for welded fabric for reinforcement for concrete;
- steel rod for wire for high fatigue strength mechanical springs, such as valve springs.

1.3 In addition to the requirements of this part of ISO 16120 the general technical delivery requirements specified in ISO 404 apply.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 16120. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 16120 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 377:1997, *Steel and steel products — Location and preparation of samples and test pieces for mechanical testing*

ISO 404:1992, *Steel and steel products — General technical delivery requirements*

ISO 3887:1976, *Steel, non-alloy and low-alloy — Determination of depth of decarburization*

ISO 4885:1996, *Ferrous products — Heat treatments — Vocabulary*

ISO 4948-1:1982, *Steels — Classification — Part 1: Classification of steels into unalloyed and alloyed steels based on chemical composition*

ISO 4948-2:1981, *Steels — Classification — Part 2: Classification of unalloyed and alloyed steels according to main quality classes and main property or application characteristics*

ISO 6892:1998, *Metallic materials — Tensile testing at ambient temperature*

ISO 6929:1987, *Steel products — Definitions and classification*

ISO 8457-1:1989, *Steel wire rod — Part 1: Dimensions and tolerances*

ISO/TR 9769:1991, *Steel and iron — Review of available methods of analysis*

ISO 10474:1991, *Steel and steel products — Inspection documents*

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

ISO 16120-3:2001, *Non-alloy steel wire rod for conversion to wire — Part 3: Specific requirements for rimmed and rimmed-substitute, low-carbon steel wire rod*

ISO 16120-4:2001, *Non-alloy steel wire rod for conversion to wire — Part 4: Specific requirements for wire rod for special applications*

3 Terms and definitions

For the purpose of this part of ISO 16120, the terms and definitions given in ISO 377, ISO 404, ISO 4885, ISO 4948-1, ISO 4948-2 and ISO 6929 as well as the following apply.

3.1

rod

hot-rolled finished product hot wound into irregular coils

NOTE Rod used for wire-drawing purposes in coil form is generally termed wire rod.

3.2

heat analysis

chemical analysis representative of the heat, by a method determined at the steelmaker's discretion

3.3

product analysis

chemical analysis carried out on a sample of the product taken after the final hot rolling operation

4 Classification

The classification of the steel grades covered by this part of ISO 16120 are indicated in ISO 16120-2, ISO 16120-3 and ISO 16120-4 for the corresponding steel grades.

5 Ordering information to be supplied by the purchaser

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 part of ISO 16120:

- a) product type (wire rod);
- b) reference to this part of ISO 16120, i.e. ISO 16120-1;
- c) steel grade;
- d) cross-section (round, square, hexagonal, etc.);
- e) nominal dimensions of the wire rod;
- f) quantity to be delivered;
- g) dimensions and mass of coils;
- h) reference to the dimensional standard ISO 8457-1;
- i) surface condition (where different from the as-rolled condition);
- j) where applicable, indication of the type of descaling (chemical or mechanical);
- k) where applicable, the type of inspection and inspection document in accordance with ISO 404 and ISO 10474 respectively (see 9.1);
- l) where applicable, the method of binding and labelling;
- m) where applicable, if the steel grade shall be suitable for galvanizing;
- n) where applicable, suitable for direct drawing;
- o) where applicable, suitable for patenting;
- p) where applicable, the austenitic grain size;
- q) where applicable, the microscopic structure;
- r) where applicable, the quality system (see 7.2).

6 Production process

At the request of the purchaser at the time of enquiry and ordering, the steelmaking and manufacturing process shall be made known to the purchaser. Those processes that are specifically agreed shall not be changed without prior agreement of the purchaser.

7 Requirements

7.1 General

Manufacturers are responsible, using the means they think fit, for inspecting their production 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 system

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

7.3 Method of delivery

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

7.4 Delivery condition

Wire 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 cut back 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 of ISO 8457-1.

9 Inspection

9.1 Inspection and inspection documents

Inspection and inspection documents shall be in accordance with ISO 10474 and ISO 404.

9.2 Extension of inspection

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

Tableau 1 — Extension of inspection

Subject of test	General-purpose wire rod (ISO 16120-2)	Rimmed-type steel wire rod (ISO 16120-3)	Wire rod for special applications (ISO 16120-4)
Surface discontinuities	0	0	+
Decarburization	—	—	+
Non-metallic inclusions	—	0	0
Core segregation	0	—	0
Product analysis	0	0	0
Tensile strength	0	0	0
Austenitic grain size	—	0	0
+ = is carried out. — = is not carried out. 0 = is only carried out if part of the options is agreed at time of ordering.			

9.3 Acceptance unit and number of samples and test pieces

Unless otherwise agreed the acceptance unit is composed of wire rod of the same cross-sectional dimension, originating from the same heat and rolled in the same continuous lot.

If specific inspection is required the number of test pieces given in Table 2 shall apply. For wire 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.

Tableau 2 — Acceptance unit and number of samples and test pieces

Type of requirement	Number of samples or test pieces
Product analysis	3, from 3 different coils originating from the same heat, but not necessarily rolled in the same continuous lot
Permissible depth of surface discontinuities Permissible depth of decarburization Austenitic grain size Non-metallic inclusions Tensile strength	1 for every 20 tonnes with a minimum of 3 ^a
Core segregation	10 ^b
^a Another number of samples to be examined shall be agreed upon between the two parties at the time of ordering.	
^b The number of samples to be examined shall be agreed upon between the parties with preferably a minimum of 10.	

9.4 Sampling and preparation of samples and test pieces

9.4.1 Chemical composition

Where it has been agreed to verify the chemical composition on the product, the samples shall be taken and prepared in accordance with ISO 14284.

9.4.2 Tensile strength

Where agreed to perform the tensile test, samples shall be taken and prepared in accordance with ISO 377.

9.4.3 Decarburization, surface discontinuities, austenitic grain size, non-metallic inclusions and core segregation

For testing for surface discontinuities, total decarburization, austenitic grain size, non-metallic inclusions and core segregation, the required number of test pieces shall be taken from one end of individually cropped coils (see 7.4).

9.5 Test methods

9.5.1 Chemical composition

The methods to be applied for the verification of the product analysis shall be agreed upon at the time of ordering. In case of dispute about analytical methods, the chemical composition shall be determined in accordance with a reference method from ISO standards listed in ISO/TR 9769.

9.5.2 Tensile strength

The tensile test is carried out on wire rod in the as-rolled condition in accordance with ISO 6892.

9.5.3 Surface discontinuities

The method to be used for revealing and measuring surface discontinuities shall be chosen by the manufacturer.

9.5.4 Decarburization

Testing for decarburization shall be carried out on the wire rod in the as-rolled condition, in accordance with ISO 3887. Decarburization is inspected by microscope, preferably at a magnification of 200 $\times$, on a transverse metallographic test piece that has been suitably etched.

The depth of decarburization of the sample is considered as being the average of eight measurements at the ends of four diameters (or diagonals) located at 45° to each other, starting from the zone of maximum decarburization and avoiding 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 discontinuity shall not be taken into account in the calculation. Depth of decarburization is measured normal to the surface of the test piece.

9.5.5 Non-metallic inclusions

The tests shall be carried out on the wire rod in the as-rolled condition and in accordance with 3.4 of ISO 16120-3:2001, and 3.5 and 3.6 of ISO 16120-4:2001.

9.5.6 Austenitic grain size

The method for revealing austenitic grain size shall be agreed upon between the parties at the time of enquiry and order.

9.5.7 Core segregation

The method for determining the core segregation shall be by macrographic examination on a transverse section of the sample as described in annex A.

10 Marking

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

- a) dimensions of the cross-section of the wire rod;
- b) steel grade;
- c) heat number;
- d) manufacturer's name and/or symbol;
- e) any subsequently agreed information.

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

11 Complaints after delivery

See ISO 404.

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Annex A **(normative)**

Determination of core segregation

A.1 Scope

This annex is applicable for wire rod made from continuously cast steel with a carbon content of at least 0,40 % and defined in this part of ISO 16120. The method described below is a macrographic method aimed at determining and evaluating the core segregation present in continuously cast high carbon wire rod by revealing the carbon segregation.

A.2 Term and definition

For the purpose of this part of ISO 16120, the following term and definition applies.

A.2.1

Core segregation

local variation in chemical composition that is noticeable over a cross-section of wire rod by macrographic examination and that concerns primarily the segregation resulting from the steelmaking process

NOTE 1 It is for this reason that an examination, specifically for carbon segregation, will reveal the presence of coresegregation.

NOTE 2 A different technique is used to assess grain boundary cementite (which may be detrimental to further processing), the formation of which is related to carbon segregation and the cooling rate after wire rod rolling. However, grain boundary cementite should not be confused with core segregation.

A.3 Principle

Chemical heterogeneity is revealed by chemical etching of a cross-section of the wire rod using a nital solution.

The images observed by macrographic examination are compared with the pictures 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 section from each sample to be examined. This is obtained by gradually cutting at low speed. At all times excessive heating shall be avoided by means of appropriate cooling.

A.4.2 Polishing

The specimen is polished stepwise by use of graduated emeries, finishing with fine diamond paste of grain size 1 μm .

After polishing to a mirror finish, the specimen is carefully washed with water and dried using alcohol.