

---

---

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

**Part 4:  
Specific requirements for wire rod for  
special applications**

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

*Partie 4: Exigences spécifiques au fil-machine pour applications spéciales*



**PDF disclaimer**

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

STANDARDSISO.COM : Click to view the full PDF of ISO 16120-4:2001

© ISO 2001

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.ch](mailto:copyright@iso.ch)  
Web [www.iso.ch](http://www.iso.ch)

Printed in Switzerland

## 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 16120-4 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 17, *Steel wire rod and wire products*.

This first edition of ISO 16120-4, together with parts 1, 2 and 3 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*



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

## Part 4:

## Specific requirements for wire rod for special applications

### 1 Scope

This part of ISO 16120 defines wire rod with improved characteristics intended for drawing and/or cold rolling.

### 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 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 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 4967:1998, *Steel — Determination of content of non metallic inclusions — Micrographic method using standard diagrams*

ISO 16120-1:2001, *Non-alloy steel wire rod for conversion to wire — Part 1: General requirements*

### 3 Requirements

#### 3.1 General

For the general requirements see ISO 16120-1.

#### 3.2 Chemical composition

For the heat analysis, the values shown in Table 1 apply. The permissible deviations of the product analysis relative to the specified value of the heat analysis are given in Table 2.

When subsequent patenting is envisaged wire rod may be ordered with restricted analysis for the residual elements.

Table 1 — Chemical analysis (heat analysis) <sup>a</sup>

| Steel grade <sup>b</sup> | Heat analysis       |                      |                      |                |                |                              |                              |                 |                                |                              |                             |
|--------------------------|---------------------|----------------------|----------------------|----------------|----------------|------------------------------|------------------------------|-----------------|--------------------------------|------------------------------|-----------------------------|
|                          | C <sup>c</sup><br>% | Si <sup>d</sup><br>% | Mn <sup>e</sup><br>% | P<br>%<br>max. | S<br>%<br>max. | Cr <sup>f</sup><br>%<br>max. | Ni <sup>f</sup><br>%<br>max. | Mo<br>%<br>max. | Cu <sup>f,g</sup><br>%<br>max. | Al <sup>h</sup><br>%<br>max. | N <sup>i</sup><br>%<br>max. |
| C3D2                     | ≤ 0,05              | ≤ 0,30               | 0,30-0,50            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,05            | 0,15                           | 0,01                         | 0,007                       |
| C5D2                     | ≤ 0,07              | ≤ 0,30               | 0,30-0,50            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,05            | 0,15                           | 0,01                         | 0,007                       |
| C8D2                     | 0,06-0,10           | ≤ 0,30               | 0,30-0,50            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,05            | 0,15                           | 0,01                         | 0,007                       |
| C10D2                    | 0,08-0,12           | ≤ 0,30               | 0,30-0,50            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,05            | 0,15                           | 0,01                         | 0,007                       |
| C12D2                    | 0,10-0,14           | ≤ 0,30               | 0,30-0,50            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,05            | 0,15                           | 0,01                         | 0,007                       |
| C15D2                    | 0,13-0,17           | ≤ 0,30               | 0,30-0,50            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,05            | 0,15                           | 0,01                         | 0,007                       |
| C18D2                    | 0,16-0,20           | ≤ 0,30               | 0,30-0,50            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,05            | 0,15                           | 0,01                         | 0,007                       |
| C20D2                    | 0,18-0,23           | ≤ 0,30               | 0,30-0,50            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,05            | 0,15                           | 0,01                         | 0,007                       |
| C26D2                    | 0,24-0,29           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C32D2                    | 0,30-0,34           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C36D2                    | 0,34-0,38           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C38D2                    | 0,36-0,40           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C40D2                    | 0,38-0,42           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C42D2                    | 0,40-0,44           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C46D2                    | 0,44-0,48           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C48D2                    | 0,46-0,50           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C50D2                    | 0,48-0,52           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C52D2                    | 0,50-0,54           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C56D2                    | 0,54-0,58           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C58D2                    | 0,56-0,60           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C60D2                    | 0,58-0,62           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C62D2                    | 0,60-0,64           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C66D2                    | 0,64-0,68           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C68D2                    | 0,66-0,70           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C70D2                    | 0,68-0,72           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C72D2                    | 0,70-0,74           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C76D2                    | 0,74-0,78           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C78D2                    | 0,76-0,80           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C80D2                    | 0,78-0,82           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C82D2                    | 0,80-0,84           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C86D2                    | 0,84-0,88           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C88D2                    | 0,86-0,90           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C92D2                    | 0,90-0,95           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |
| C98D2                    | 0,96-1,00           | 0,10-0,30            | 0,50-0,70            | 0,020          | 0,025          | 0,10                         | 0,10                         | 0,03            | 0,15                           | 0,01                         | 0,007                       |

<sup>a</sup> Elements not included in this table may not be added intentionally to the steel without the agreement of the purchaser, except those intended for finishing the heat. The addition of microalloying elements may be agreed upon between the manufacturer and purchaser at the time of ordering.

<sup>b</sup> Special non-alloy steel complying with ISO 4948-1 and ISO 4948-2.

<sup>c</sup> For steels C32D2 to C98D2 the carbon range may be enlarged by 0,01 % either by lowering the minimum or by increasing the maximum by agreement between manufacturer and purchaser.

<sup>d</sup> For wire rod intended for galvanizing the required lower limit of silicon content should be specified at the time of ordering.

<sup>e</sup> For the manganese content, a different range from the one indicated in the table can be agreed upon at the time of ordering with an amplitude of 0,20 %, with a maximum not exceeding 1,20 % and a minimum not lower than 0,30 %.

<sup>f</sup> The sum of the contents Cu + Ni + Cr shall not exceed 0,30 %.

<sup>g</sup> Cu + Sn ≤ 0,15 %. For certain applications the Cu content may be restricted to 0,12 % maximum by agreement.

<sup>h</sup> By agreement at the time of ordering the value for aluminium can be fixed at 0,02 % to 0,10 %. The value for silicon can then be fixed at ≤ 0,10 % on request.

<sup>i</sup> If in accordance with <sup>h</sup>, the Al content is fixed at 0,02 % to 0,10 %, the limit value of N shall be agreed at the time of ordering.

**Table 2 — Permissible deviation in the product analysis  
in relation to the specified value of the heat analysis**

| Elements | Steel grade    | Permissible deviation in<br>product analysis<br>% |
|----------|----------------|---------------------------------------------------|
| C        | C3D2 to C20D2  | ± 0,02                                            |
|          | C26D2 to C82D2 | ± 0,03                                            |
|          | C86D2 to C98D2 | ± 0,04                                            |
| Si       | All grades     | ± 0,04                                            |
| Mn       | All grades     | ± 0,06                                            |
| P and S  | All grades     | ± 0,005                                           |

### 3.3 Internal soundness and surface quality

The wire rod shall have no internal or surface imperfections such as: shrink holes, segregation, cracks, folds, incrustations, notches, scabs, rolling burrs and damage which may be detrimental to its correct use.

### 3.4 Depth of surface discontinuities

The rod shall not have any surface discontinuities of depth greater than the values shown in Table 3.

These limit values apply for the test chosen in accordance with 9.4.3 and 9.5.3 of ISO 16120-1:2001.

Table 3 applies to round wire rod only. Maximum discontinuity levels for other shapes may be agreed.

**Table 3 — Limit values for the depth of surface discontinuities of round wire rod**

| Nominal diameter<br>$d_N$ (mm)                                                                                        | Maximum permissible depth of<br>surface discontinuities<br>mm |
|-----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| $5 \leq d_N \leq 12$                                                                                                  | 0,15                                                          |
| $12 < d_N \leq 30$                                                                                                    | 0,20                                                          |
| NOTE 1 The depth of surface discontinuities is measured from the actual surface of the product in a radial direction. |                                                               |
| NOTE 2 By agreement at the time of enquiry and order, limit values in accordance with ISO 9443 may be specified.      |                                                               |

### 3.5 Depth of decarburization

The specifications given below concerning the depth of decarburization and the inspection procedure relating to it only apply to grades C42D2 to C98D2.

#### 3.5.1 Complete decarburization

The wire rod shall not display complete decarburization.

#### 3.5.2 Partial decarburization

The wire rod shall not display partial decarburization of depth greater than the values given in Table 4.

The maximum depth of decarburization shall not exceed twice the limit of Table 4.

These limit values are applicable for the test described in 9.5.4 of ISO 16120-1:2001.

At the time of enquiry and order, it shall be agreed whether Class A or Class B of Table 4 is requested.

**Table 4 — Limit of the depth of partial decarburization**

| Nominal diameter<br>$d_N$ (mm)                                                                   | Limit values <sup>a</sup><br>mm |             |
|--------------------------------------------------------------------------------------------------|---------------------------------|-------------|
|                                                                                                  | A                               | B           |
| $5 \leq d_N \leq 8$                                                                              | 0,10                            | 0,08        |
| $8 < d_N \leq 30$                                                                                | 1,2 % $d_N$                     | 1,0 % $d_N$ |
| <sup>a</sup> By agreement at the time of enquiry and order, other limit values may be specified. |                                 |             |

### 3.6 Non-metallic inclusions

The method for assessment of non-metallic inclusions and the assessment criteria shall be agreed at the time of ordering, as far as possible with reference to ISO 4967.

### 3.7 Core segregation

If so agreed at the time of enquiry and order, wire rod of grade C60D2 or grades with a higher carbon content shall be inspected for carbon segregation. Not more than 10 % of the samples tested shall be of Class 4; Class 5 is not allowed (see annex A of ISO 16120-1:2001). However, it is recommended that the evaluation be done as part of a quality system.

### 3.8 Tensile strength

If requested by the purchaser at the time of ordering, the manufacturer shall provide guidance values of tensile strength.

The permissible variation on the values agreed at the time of ordering shall not exceed the values reported in Table 5.

**Table 5 — Permissible variation of tensile strength values**

| Steel grade                                                                                                                                                                                                             | Permissible variation <sup>a</sup> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
|                                                                                                                                                                                                                         | N/mm <sup>2</sup>                  |
| C3D2 to C20D2                                                                                                                                                                                                           | 80                                 |
| C26D2 to C70D2                                                                                                                                                                                                          | 100                                |
| C72D2 to C98D2                                                                                                                                                                                                          | 120                                |
| <sup>a</sup> These values are applicable to wire rod with the same nominal diameter, up to 12 mm, of the same heat and rolled in the same continuous lot. They are not applicable when <sup>e</sup> of Table 1 is used. |                                    |
| NOTE 1 N/mm <sup>2</sup> = 1 MPa                                                                                                                                                                                        |                                    |

### 3.9 Austenitic grain size

If requested by the purchaser at the time of ordering, where applicable, the parties may agree with a specific austenitic grain size.