
**Stainless steels for general
purposes —**

**Part 3:
Wire**

*Aciers inoxydables pour usage général —
Partie 3: Fil*



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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 17, *Steel*, Subcommittee SC 4, *Heat treatable and alloy steels*.

This second edition cancels and replaces the first edition (ISO 16143-3:2005), which has been technically revised.

ISO 16143 consists of the following parts, under the general title *Stainless steels for general purposes*:

- *Part 1: Corrosion-resistant flat products*
- *Part 2: Corrosion-resistant semi-finished products, bars, rods and sections*
- *Part 3: Wire*

Stainless steels for general purposes —

Part 3: Wire

1 Scope

This part of ISO 16143 specifies requirements for stainless steel wire for common use for which no product standard exists. It includes round, flat, and shaped wire (such as square, hexagonal, or rectangular wire), made of the most commonly used types of stainless steels for general corrosion resistance and high-temperature service. The wire can be supplied in coils or in straightened and cut lengths.

NOTE Steel wire made of corrosion-resistant stainless steel is manufactured from steels mentioned in ISO 16143-2, and steel wire intended for high-temperature purposes is manufactured from steels mentioned in ISO 4955.

In addition to this part of ISO 16143, the general technical delivery requirements of ISO 404 are applicable.

Excluded from this part of ISO 16143 are

- wire for cold heading,
- welding wire, and
- any wire for which a specific product standard exists.

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.

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

ISO 4955, *Heat-resistant steels*

ISO 6892-1:2009, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 6929:2013, *Steel products — Vocabulary*

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

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

ISO 15510, *Stainless steels — Chemical composition*

ISO 16143-2, *Stainless steels for general purposes — Part 2: Corrosion-resistant semi-finished products, bars, rods and sections*

ISO/TS 4949, *Steel names based on letter symbols*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6929 and the following apply.

3.1 stainless steel

steel with at least 10,5 % Cr and maximum 1,2 % C

3.2 wire

cold-worked product generally of constant cross section throughout its length, the dimensions of the section being very small compared with the length

Note 1 to entry: The cold working is accomplished by drawing rod through a reducing die or by passing under pressure between driven rolls and recoiling the drawn product. The cross section is generally circular, sometimes oval, rectangular, square, hexagonal, octagonal, or another shape (other than strip).

[SOURCE: ISO 6929:2013, modified]

4 Designation

For the steel grades covered by this part of ISO 16143, the steel names as given in the tables are allocated in accordance with ISO/TS 4949.

For the steel grades covered by this part of ISO 16143, the steel numbers as given in the tables are allocated in accordance with ISO 15510.

5 Information to be supplied by the purchaser

The purchaser shall clearly state, at the time of ordering, the following information:

- the desired quantity;
- the term “wire” or “straightened and cut wire”;
- the diameter or, for non-round wire, the characteristic dimension;
- for round wire, the tolerances in accordance with [Table 5](#), (N) for normal tolerances and (R) for restricted tolerances; for non-round wire, the desired tolerances on dimensions;
- the type of material (steel);
- the number of this part of ISO 16143, i.e. ISO 16143-3;
- the steel name or steel number of the steel grade and the standard manufacturing condition of the wire (see [6.2](#));
- if applicable, the tensile-strength level in accordance with [Table 4](#) (for hard-drawn wire);
- any further optional test agreed between the manufacturer and purchaser at the time of enquiry and order [see 8.2.3 b)];
- the type of coiling;
- the type of inspection document and its designation in accordance with ISO 10474 (see [8.2.1](#)).

EXAMPLE 1 2 t round stainless steel wire of 2,00 mm diameter with normal tolerances (N) in accordance with Table 5 of ISO 16143-3 made of a steel grade with name X20Cr13 and number 4021-420-00-I, as specified in ISO 16143-3, standard manufacturing condition +A, in coils of about 500 kg, inspection document 3.1 as specified in ISO 10474, is designated as follows:

2 t wire 2,00 N
ISO 16143-3 – X20Cr13+A in coils of about 500 kg
ISO 10474 – 3.1

or

2 t wire 2,00 N
ISO 16143-3 – 4021-420-00-I +A in coils of about 500 kg
ISO 10474 – 3.1

EXAMPLE 2 5 t round stainless steel wire of 3,00 mm diameter with restricted tolerances (R) in accordance with Table 5 of ISO 16143-3 made of a steel grade with name X6CrNi18-12 and number, as specified in ISO 16143-3, hard drawn with a tensile strength 1 600 MPa to 1 900 MPa, on spools of about 300 kg, inspection document 3.1 as specified in ISO 10474, is designated as follows:

5 t wire 3,00 R
ISO 16143-3 – X6CrNi18-12 +C1600 on spools of about 300 kg
ISO 10474 – 3.1

or

5 t wire 3,00 R
ISO 16143-3 – 4304-305-00-I +C1600 on spools of about 300 kg
ISO 10474 – 3.1

6 Manufacturing conditions

6.1 General

If not stated otherwise, the manufacturing procedure is at the discretion of the manufacturer.

6.2 Treatment conditions

The wire shall be specified in one of the following conditions, depending on the structure:

- Condition +A: The wire is annealed as the final heat treatment. Note that this material might be slightly deformed by straightening, cold work, size control, or finish. This will result in a slight increase of the tensile strength.
- Condition +A_N: The wire is solution annealed as the final heat treatment. Note that this material might be slightly deformed by straightening, cold work, size control, or finish. This will result in a slight increase of the tensile strength.
- Condition +C: The wire is hard drawn as the last operation, in order to achieve higher strength.

6.3 Surface finish

If not specified otherwise, the surface finish of the wire is one of the following, depending on previous processing steps.

6.3.1 Cold drawn

This is the natural finish resulting from the drawing to final size, generally with cold-drawing lubricant left on. The finish will be duller for dry-drawn wire or shinier for wire that is wet drawn. Fine sizes are commonly wet drawn, whereas coarser sizes are commonly dry drawn. Special bright finishes, lubricant removal, etc. required for special end-use shall be negotiated with the manufacturer.

6.3.2 Annealed

This is a dull matt appearance, necessarily associated with the dead soft condition of annealed wire when no final drawing is permitted. With an additional surface treatment, a bright appearance can be realized.

6.3.3 Polished finish

This is a smooth and uniform bright finish of cold-processed (+C) material obtained by mechanical smoothing, burnishing, abrading, or grinding.

7 Requirements

7.1 Manufacturing process

The steelmaking process for products according to this part of ISO 16143 shall be in accordance with ISO 4955 and ISO 16143-2. The wire processing, insofar as it is not specified in this part of ISO 16143 or agreed between the parties, shall be at the discretion of the wire drawer.

7.2 Delivery condition

The product shall be supplied as described in [Clause 6](#) and agreed in the order.

7.3 Chemical analysis

7.3.1 Cast analysis

The chemical composition requirements given in [Table 1](#) apply with respect to the chemical composition of the cast analysis.

7.3.2 Product analysis

The product analysis can deviate from the limiting values for the cast analysis given in [Table 1](#) by the values listed in [Table 2](#).

7.4 Mechanical properties

7.4.1 Mechanical properties for annealed wire

The tensile strength and elongation shall satisfy the requirements of [Table 3](#). It specifies the mechanical properties at room temperature in the annealed condition. For austenitic, austenitic-ferritic, and precipitation-hardening steels, the wire is in the condition +AT; for ferritic and martensitic steels, this is in the condition +A.

7.4.2 Mechanical properties of hard-drawn wire

This wire is in condition +C. The tensile strength will depend on the degree of work hardening, the specific type of steel, and the processing of the material. The tensile strength is specified by a minimum and maximum. Not all the tensile strength levels listed in [Table 4](#) can be achieved for all steel grades. Therefore, the required tensile-strength level shall be agreed between the manufacturer and the purchaser at the time of ordering.

[Table 4](#) gives an overview of the standardized tensile-strength levels and the corresponding minimum and maximum.

7.5 Tolerances on dimensions

For round wire, the purchaser shall specify normal tolerance (N) or restricted tolerance (R), as defined in [Table 5](#). For non-round wire, tolerances shall be agreed upon at the time of ordering.

The out-of-roundness is the difference between the largest and the smallest diameter in the same cross section of the wire. The cross section shall be perpendicular to the longitudinal wire axis. The out-of-roundness shall not exceed half the total diameter tolerance specified for coils.

8 Inspection, testing, and conformance of products

8.1 General

The manufacturer shall carry out appropriate process control, inspection, and testing to ensure that the delivery complies with the requirements of the order.

This includes the following:

- a suitable frequency of verification of the dimensions of the products;
- an adequate intensity of visual examination of the surface quality of the products;
- an appropriate frequency and type of test to ensure that the correct grade of steel is delivered.

The nature and frequency of these verifications, examinations, and tests are determined by the manufacturer, based on the degree of consistency that has been determined by the evidence of his quality system. In view of this, verifications by specific tests for these requirements are not necessary, unless otherwise agreed.

8.2 Inspection and testing procedures and types of inspection documents

8.2.1 Products complying with this part of ISO 16143 shall be ordered and delivered with one of the inspection documents as specified in ISO 10474. The type of document shall be agreed upon at the time of enquiry and order. If the order does not contain any specification of this type, a test report 2.2 shall be issued.

8.2.2 If, in accordance with the agreements made at the time of ordering, a test report is to be provided, this shall cover

- a) the statement that the material complies with the requirements of the order and
- b) the results of the cast analysis for all elements specified for the type of steel supplied.

8.2.3 If, in accordance with the agreements in the order, an inspection certificate 3.1 or 3.2 of ISO 10474 is to be provided, the specific inspections and tests described in [8.3](#) shall be carried out and their results shall be certified in the document.

In addition to [8.2.2](#), the document shall cover

- a) the results of the tests of [Table 6](#) and
- b) the results of any optional test or inspection agreed when ordering.

8.3 Specific inspection and testing

8.3.1 Extent of testing

The tests to be carried out, the composition and size of the test units, and the number of sample products, samples, and test pieces to be taken are given in [Table 6](#).

8.3.2 Selection and preparation of samples and test pieces

The general conditions for selection and preparation of samples and test pieces shall be in accordance with ISO 377 and ISO 14284. The samples shall be taken from products in the delivery condition.

8.4 Test methods

8.4.1 Product analysis

Unless otherwise agreed when ordering, the choice of a suitable physical or chemical method of analysis to determine the product analysis is at the discretion of the manufacturer. In cases of dispute, the analysis shall be carried out by a laboratory approved by the two parties. In these cases, the reference method of analysis shall be agreed, where possible, with reference to ISO/TR 9769.

8.4.2 Tensile test

The tensile test shall be carried out in accordance with ISO 6892-1 and it shall be performed under controlled conditions in accordance with Clause 5 of ISO 6892-1:2009. The tensile strength (R_m) shall be measured and, for annealed material only, the elongation (A).

8.4.3 Measurement of the wire diameter

The diameter of the round wire shall be measured in a cross section perpendicular to the wire axis with a micrometer of appropriate precision. Any dimensional measurement methods to be used on non-round wire shall be agreed upon at the time of ordering.

8.5 Retests

Retests shall be in accordance with ISO 404.

9 Packing and marking

9.1 Packing shall be such that it permits normal handling and shipping without damage. The dimensions of the units shall be agreed between the manufacturer and the purchaser at the time of ordering.

9.2 The products shall be marked with the manufacturer's trademark or symbol, the steel name or number, the manufacturing condition of the wire, and the tensile level (for hard-drawn wire). The product shall also be marked with the cast number, thickness or dimension, as well as an identification number related to an appropriate inspection certificate.

9.3 Unless otherwise agreed, the method of marking and the material of marking shall be at the option of the manufacturer. Its quality shall be durable for at least one year, can withstand normal handling, and can be stored in unheated storage under cover. The corrosion resistance of the product shall not be impaired by the marking.

9.4 Each unit shall be marked by means of a label attached to the coil, spool, or bundle or, by agreement at the time of enquiry and order, by inking, adhesive labels, electrolytic etching, or stamping.

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Table 1 — Chemical composition (cast analysis) for wire
(for information only — chemical composition as listed in ISO 16143-2 and ISO 4955)

Steel designation		% (mass fraction) ^a									
Name	ISO number	C	Si	Mn	P	S	Cr	Mo	Ni	N	Others
Austenitic steels											
X10CrNi18-8	4310-301-00-I	0,05 to 0,15	2,00	2,00	0,045	0,030	16,0 to 19,0	0,80	6,0 to 9,5	0,10	—
X2CrNi18-9	4307-304-03-I	0,030	1,00	2,00	0,045	0,030	17,5 to 19,5	—	8,0 to 10,0 ^b	0,10	—
X7CrNi18-9	4948-304-09-I	0,04 to 0,10	1,00	2,00	0,045	0,030	17,5 to 19,5	—	8,0 to 11,0	0,10	—
X10CrNiS18-9	4305-303-00-I	0,04 to 0,10	1,00	2,00	0,060	≥0,15	17,0 to 19,0	—	8,0 to 10,0	0,10	Cu: 1,00
X3CrNiCu18-9-4	4567-304-30-I	0,040	1,00	2,00	0,045	0,030	17,0 to 19,0	—	8,0 to 10,5	0,10	Cu: 3,0 to 4,0
X6CrNiCuS18-9-2	4570-303-31-I	0,08	1,00	2,00	0,045	≥0,15	17,0 to 19,0	0,60	8,0 to 10,0	0,10	Cu: 1,40 to 1,80
X5CrNi19-9	4315-304-51-I	0,08	1,00	2,50	0,045	0,030	18,0 to 20,0	—	7,0 to 10,5	0,10 to 0,30	— ^d
X5CrNi18-10	4301-304-00-I	0,07	1,00	2,00	0,045	0,030	17,5 to 19,5	—	8,0 to 10,5 ^b	0,10	—
X6CrNiTi18-10	4541-321-00-I	0,08	1,00	2,00	0,045	0,030	17,0 to 19,0	—	9,0 to 12,0 ^b	—	Ti: 5 × C to 0,70
X2CrNi19-11	4306-304-03-I	0,030	1,00	2,00	0,045	0,030	18,0 to 20,0	—	10,0 to 12,0 ^b	0,10	—
X6CrNi18-12	4303-305-00-I	0,08	1,00	2,00	0,045	0,030	17,0 to 19,0	—	10,5 to 13,0	0,10	—
X7CrNiSiN18-11 ^c	4835-308-15-U ^c	0,05 to 0,10	1,40 to 2,00	0,80	0,040	0,030	20,0 to 22,0	—	10,0 to 12,0	0,14 to 0,20	Ce: 0,03 to 0,08
X8CrMnCuN17-8-3	4597-204-76-I	0,10	2,00	6,5 to 9,0	0,040	0,030	15,0 to 18,0	1,00	3,00	0,10 to 0,30	Cu: 2,00 to 3,5
X12CrMnNi18-9-5	4373-202-00-I	0,15	1,00	7,5 to 10,0	0,060	0,030	17,0 to 19,0	—	4,0 to 6,0	0,15 to 0,30	—
X11CrNiMnN19-8-6	4369-202-91-I	0,07 to 0,15	0,50 to 1,00	5,0 to 7,5	0,030	0,015	17,5 to 19,5	—	6,5 to 8,5	0,20 to 0,30	—
X18CrNi23-13c	4833-309-08-I ^c	0,20	1,00	2,00	0,045	0,030	22,0 to 24,0	—	12,0 to 15,0	0,10	—
X1CrNi25-21	4335-310-02-I	0,020	0,25	2,00	0,025	0,010	24,0 to 26,0	0,20	20,0 to 22,0	0,10	—
X8CrNi25-21 ^c	4845-310-08-E ^c	0,10	1,50	2,00	0,045	0,030	24,0 to 26,0	—	19,0 to 22,0	0,10	—
Austenitic steels with Mo											
X2CrNiMo17-12-2	4404-316-03-I	0,030	1,00	2,00	0,045	0,030	16,5 to 18,5	2,00 to 3,00	10,0 to 13,0 ^b	0,10	—

Table 1 (continued)

Steel designation		% (mass fraction) ^a									
Name	ISO number	C	Si	Mn	P	S	Cr	Mo	Ni	N	Others
X5CrNiMo17-12-2	4401-316-00-I	0,07	1,00	2,00	0,045	0,030	16,5 to 18,5	2,00 to 3,00	10,0 to 13,0 ^b	0,10	—
X6CrNiMoTi17-12-2	4571-316-35-I	0,08	1,00	2,00	0,045	0,030	16,5 to 18,5	2,00 to 2,50	10,5 to 13,5 ^b	—	Ti: 5 × C to 0,70
X2CrNiMo17-12-3	4432-316-03-I	0,030	1,00	2,00	0,045	0,030	16,5 to 18,5	2,50 to 3,00	10,5 to 13,0 ^b	0,10	—
X3CrNiMo17-12-3	4436-316-00-I	0,05	1,00	2,00	0,045	0,030	16,5 to 18,5	2,50 to 3,00	10,5 to 13,0 ^b	0,10	—
X2CrNiMo18-14-3	4435-316-91-I	0,030	1,00	2,00	0,045	0,015	17,0 to 19,0	2,50 to 3,00	12,5 to 15,0	0,10	—
X2CrNiMoN18-12-4	4434-317-53-I	0,030	1,00	2,00	0,045	0,030	16,5 to 19,5	3,0 to 4,0	10,5 to 14,0 ^b	0,10 to 0,20	—
X1CrNiMoCuN20-18-7	4547-312-54-I	0,020	0,70	1,00	0,035	0,015	19,5 to 20,5	6,0 to 7,0	17,5 to 18,5	0,18 to 0,25	Cu: 0,50 to 1,00
X1CrNiMoN25-22-2	4466-310-50-E	0,020	0,70	2,00	0,025	0,010	24,0 to 26,0	2,00 to 2,50	21,0 to 23,0	0,10 to 0,16	—
Austenitic steels with Ni/Co as main alloying elements											
X1NiCrMoCu25-20-5	4539-089-04-I	0,020	0,75	2,00	0,035	0,015	19,0 to 22,0	4,0 to 5,0	23,5 to 26,0	0,15	Cu: 1,20 to 2,00
X1NiCrMoCuN25-20-7	4529-089-26-I	0,020	0,75	2,00	0,035	0,015	19,0 to 21,0	6,0 to 7,0	24,0 to 26,0	0,15 to 0,25	Cu: 0,50 to 1,50
X8NiCrAlTi32-21 ^c	4876-088-00-I ^c	0,10	1,00	1,50	0,015	0,015	19,0 to 23,0	—	30,0 to 34,0	—	Al: 0,15 to 0,60 Ti: 0,15 to 0,60 Cu: 0,70
X1NiCrMoCu31-27-4	4563-080-28-I	0,020	0,70	2,00	0,030	0,010	26,0 to 28,0	3,0 to 4,0	30,0 to 32,0	0,10	Cu: 0,70 to 1,50
Austenitic-ferritic (duplex) steels											
X2CrMnNiN21-5-1 ^f	4162-321-01-E ^f	0,040	1,00	4,0 to 6,0	0,040	0,015	21,0 to 22,0	0,10 to 0,80	1,35 to 1,90	0,20 to 0,25	Cu: 0,10 to 0,80
X2CrNiN23-4	4362-323-04-I	0,030	1,00	2,00	0,035	0,015	22,0 to 24,5	0,10 to 0,60	3,5 to 5,5	0,05 to 0,20	Cu: 0,10 to 0,60
X2CrNiMoN22-5-3	4462-318-03-I	0,030	1,00	2,00	0,035	0,015	21,0 to 23,0	2,5 to 3,5	4,5 to 6,5	0,10 to 0,22	—

Table 1 (continued)

Steel designation		% (mass fraction) ^a									
Name	ISO number	C	Si	Mn	P	S	Cr	Mo	Ni	N	Others
X2CrNiMoN25-7-4	4410-327-50-E	0,030	1,00	2,00	0,035	0,015	24,0 to 26,0	3,0 to 4,5	6,0 to 8,0	0,24 to 0,35	—
X2CrNiMoCoN28-8-5-1 ^f	4658-327-07-U ^f	0,030	0,50	1,50	0,035	0,010	26,0 to 29,0	4,0 to 5,0	5,5 to 9,5	0,30 to 0,50	Cu: 1,00 Co: 0,50 to 2,00
Ferritic steels											
X6Cr17	4016-430-00-I	0,08 ^e	1,00	1,00	0,040	0,030	16,0 to 18,0	—	—	—	—
X7Cr17	4004-430-20-I	0,09	1,50	1,50	0,040	≥0,15	16,0 to 18,0	0,60	—	—	—
X3CrNb17	4511-430-71-I	0,05	1,00	1,00	0,040	0,015	16,0 to 18,0	—	—	—	Nb: 12 × C to 1,00
X15CrN26 ^c	4749-446-99-I ^c	0,20	1,00	1,00	0,040	0,030	24,0 to 28,0	—	1,00	0,15 to 0,25	—
X6CrMo17-1	4113-434-00-I	0,08	1,00	1,00	0,040	0,030	16,0 to 18,0	0,90 to 1,40	—	—	—
X2CrMoTiS18-2	4523-182-35-I	0,030	1,00	0,50	0,040	≥0,15	17,5 to 19,0	2,00 to 2,50	—	—	Ti: 0,30 to 0,80 (C+N): 0,040
Martensitic steels											
X12Cr13	4006-410-00-I	0,08 to 0,15	1,00	1,50	0,040	0,030	11,5 to 13,5	—	0,75	—	—
X12CrS13	4005-416-00-I	0,08 to 0,15	1,00	1,50	0,040	≥0,15	12,0 to 14,0	0,60	—	—	—
X20Cr13	4021-420-00-I	0,16 to 0,25	1,00	1,50	0,040	0,030	12,0 to 14,0	—	—	—	—
X30Cr13	4028-420-00-I	0,26 to 0,35	1,00	1,50	0,040	0,030	12,0 to 14,0	—	—	—	—
X17CrNi16-2	4057-431-00-X	0,12 to 0,22	1,00	1,50	0,040	0,030	15,0 to 17,0	—	1,50 to 2,50	—	—
X14CrS17	4019-430-20-I	0,10 to 0,17	1,00	1,50	0,040	≥0,15	16,0 to 18,0	0,60	—	—	—
Precipitation-hardening steels											
X5CrNiCuNb16-4	4542-174-00-I	0,07	1,00	1,50	0,040	0,030 ^b	15,0 to 17,0	0,60	3,0 to 5,0	—	Cu: 3,0 to 5,0 Nb: 0,15 to 0,45

Table 1 (continued)

Steel designation		% (mass fraction) ^a									
Name	ISO number	C	Si	Mn	P	S	Cr	Mo	Ni	N	Others
X7CrNiAl17-7	4568-177-00-I	0,09	0,70	1,00	0,040	0,015	16,0 to 18,0	—	6,5 to 7,8	—	Al: 0,70 to 1,50

NOTE 1 Elements not listed in this table cannot be intentionally added to the steel without the agreement of the purchaser, except for finishing the cast. All appropriate precautions shall be taken to avoid the addition of such elements from scrap and other materials used in production, which would impair mechanical properties and the suitability of the steel.

NOTE 2 All of the grades defined in ISO 15510 can be used for the production of wire for general application. The mechanical properties shall be agreed upon at the time of ordering.

^a Maximum values unless indicated otherwise.

^b Where, for special reasons (e.g. hot workability or low magnetic permeability), it is necessary to minimize the ferrite content, the maximum nickel mass fraction can be increased by the following amounts:

- by 0,50 % for steels X2CrNi18-9, X5CrNi18-10, and X6CrNiMoTi17-12-2;
- by 1,00 % for steels X6CrNiTi18-10, X2CrNi19-11, X5CrNiMo17-12-2, X3CrNiMo17-12-3, and X2CrNiMo18-12-4;
- by 1,50 % for steels X2CrNiMo17-12-2 and X2CrNiMo17-12-3.

^c In accordance with ISO 4955.

^d Nb can be added up to 0,15 %.

^e For certain applications, e.g. weldability or high strength wire, a maximum of 0,12 % C can be agreed upon.

^f Patented grade.

Table 2 — Permissible deviations between the product analysis and the limiting values given in [Table 1](#) for the cast analysis

Element	Specified limits, cast analysis % (mass fraction)		Permissible deviation ^a % (mass fraction)
Carbon		≤0,030	+0,005
	>0,030	≤0,20	±0,01
	>0,20	≤0,60	±0,02
	>0,60	≤1,20	±0,03
Silicon		≤1,00	+0,05
	>1,00	≤3,00	±0,10
	>3,00	≤6,00	±0,15
Manganese		≤1,00	+0,03
	>1,00	≤2,00	±0,04
	>2,00	≤15,0	±0,10
Phosphorus		≤0,045	+0,005
	>0,045	0,070	±0,010
Sulfur		≤0,015	+0,003
	>0,015	≤0,030	±0,005
	≥0,10	≤0,50	±0,02
Chromium	≥10,5	≤15,0	±0,15
	>15,0	≤20,0	±0,20
	>20,0	≤35,0	±0,25
Molybdenum		≤0,60	+0,03
	>0,60	≤1,75	±0,05
	>1,75	≤8,0	±0,10
Nickel		≤1,00	+0,03
	>1,00	≤5,0	±0,07
	>5,0	≤10,0	±0,10
	>10,0	≤20,0	±0,15
	>20,0	≤38,0	±0,20
Nitrogen		≤0,10	+0,01
	≥0,10	≤0,60	±0,02
Aluminium	≥0,05	≤0,30	±0,05
	>0,30	≤1,50	±0,10
Boron		≤0,010	+0,0005
Copper		≤1,00	+0,04
	>1,00	≤5,0	±0,10
Niobium		≤1,00	+0,05
Titanium		≤1,00	+0,05
	>1,00	≤3,0	±0,07
Tungsten		≤3,00	+0,05
Vanadium		≤0,50	+0,03

^a ± means that in one cast, the deviation can occur over the upper value or under the lower value of the specified range in [Table 1](#), but not both at the same time.

Table 3 — Mechanical properties at room temperature for steel grades in the form of round wire^a in the solution-annealed (+AT) or annealed (+A) condition

Name	ISO number	Wire diameter ^b mm	R_m^c max. MPa*	Elongation ^{cd} min. %
Austenitic steels (+AT)				
All austenitic steels except X3CrNiCu18-9-4 and X8CrMnCuN17-8-3		0,050 < $d \leq$ 0,10	1 100	20
		0,10 < $d \leq$ 0,20	1 070	20
		0,20 < $d \leq$ 0,50	1 020	30
		0,50 < $d \leq$ 1,00	970	30
		1,00 < $d \leq$ 3,00	920	30
		3,00 < $d \leq$ 5,00	870	35
		5,00 < $d \leq$ 16,00	820	35
X3CrNiCu18-9-4 X8CrMnCuN17-8-3	4567-304-30-I 4597-204-76-I	0,50 < $d \leq$ 1,00	850	30
		1,00 < $d \leq$ 3,00	820	30
		3,00 < $d \leq$ 5,00	780	35
		5,00 < $d \leq$ 16,00	750	35
Austenitic-ferritic (duplex) steels (+AT)				
All austenitic-ferritic steels except X2CrNiMoCoN28-8-5-1		0,50 < $d \leq$ 1,00	1 050	20
		1,00 < $d \leq$ 3,00	1 000	20
		3,00 < $d \leq$ 5,00	950	25
		5,00 < $d \leq$ 16,00	900	25
X2CrNiMoCoN28-8-5-1	4658-327-07-U	0,50 < $d \leq$ 1,00	1 150	25
		1,00 < $d \leq$ 3,00	1 100	25
		3,00 < $d \leq$ 5,00	1050	25
		5,00 < $d \leq$ 16,00	1000	25
Ferritic steels (+A)				
All ferritic steels		0,50 < $d \leq$ 1,00	850	15
		1,00 < $d \leq$ 3,00	800	15
		3,00 < $d \leq$ 5,00	760	15
		5,00 < $d \leq$ 16,00	740	20
Martensitic steels (+A)				
X12Cr13 X12CrS13	4006-410-00-I 4005-416-00-I	0,50 < $d \leq$ 1,00	950	10
		1,00 < $d \leq$ 3,00	900	10
		3,00 < $d \leq$ 5,00	840	10
		5,00 < $d \leq$ 16,00	800	15
X20Cr13 X30Cr13 X17CrNi16-2 X14CrS17	4021-420-00-I 4028-420-00-I 4057-431-00-X 4019-430-20-I	0,50 < $d \leq$ 1,00	1 000	10
		1,00 < $d \leq$ 3,00	950	10
		3,00 < $d \leq$ 5,00	920	10
		5,00 < $d \leq$ 16,00	850	15
Precipitation-hardening steel (+AT)				
X5CrNiCuNb16-4 X7CrNiAl17-7	4542-174-00-I 4568-177-00-I		850	
^a Properties for non-round wire to be agreed upon at the time of ordering.				
^b Other sizes can be specified after agreement between the manufacturer and the purchaser at the time of ordering.				
^c Without skin pass.				
^d For $d < 4$ mm, the gauge length shall be 100 mm, and for $d \geq 4$ mm, the gauge length shall be $5 \times d$.				
* 1 MPa = 1 N/mm ² .				

Table 4 — Tensile-strength levels and corresponding tensile-strength ranges

Steel grades	Tensile-strength level	Range of tensile strength MPa ^b
Austenitic steels	+C600	600 to 800
	+C700	700 to 900
	+C800	800 to 1 000
	+C900	900 to 1 100
	+C1 000	1 000 to 1 250
	+C1 100	1 100 to 1 350
	+C1 200	1 200 to 1 450
	+C1 400	1 400 to 1 650
	+C1 600	1 600 to 1 900
	+C1 800	1 800 to 2 100
	+C2 000	2 000 to 2 300
Austenitic-ferritic (duplex) steels	+C700	700 to 900
	+C800	800 to 1 000
	+C1 000	1 000 to 1 250
	+C1 200	1 200 to 1 450
	+C1 400	1 400 to 1 650
	+C1 600	1 600 to 1 900
	+C1 800	1 800 to 2 100
	+C2 000	2 000 to 2 300
Ferritic and martensitic steels	+C500	500 to 700
	+C600	600 to 800
	+C700	700 to 900
	+C800	800 to 1 000
	+C900	900 to 1 100
	+C1 000	1 000 to 1 250
Precipitation-hardening steels	a	a
^a Not relevant. ^b 1 MPa = 1 N/mm ² .		

Table 5 — Size tolerance for round wire

Dimensions in millimetres

Diameter <i>d</i>	Normal tolerances (N)			Restricted tolerances (R)		
	Wire in coils	Wire in cut lengths		Wire in coils	Wire in cut lengths	
		Minus toler- ance	Plus tolerance		Minus toler- ance	Plus tolerance
$0,050 < d \leq 0,070$	±0,003	0,003	—	±0,002	0,002	—
$0,070 < d \leq 0,10$	±0,004	0,004	—	±0,003	0,003	—
$0,10 < d \leq 0,16$	±0,005	0,005	—	±0,004	0,004	—
$0,16 < d \leq 0,25$	±0,006	0,006	0,008	±0,004	0,004	0,006
$0,25 < d \leq 0,40$	±0,008	0,008	0,010	±0,006	0,006	0,010
$0,40 < d \leq 0,60$	±0,010	0,010	0,015	±0,008	0,008	0,010
$0,60 < d \leq 0,70$	±0,010	0,010	0,015	±0,008	0,008	0,015

Table 5 (continued)

Diameter d	Normal tolerances (N)			Restricted tolerances (R)		
	Wire in coils	Wire in cut lengths		Wire in coils	Wire in cut lengths	
		Minus tolerance	Plus tolerance		Minus tolerance	Plus tolerance
$0,70 < d \leq 0,80$	$\pm 0,015$	0,015	0,020	$\pm 0,010$	0,010	0,020
$0,80 < d \leq 1,00$	$\pm 0,015$	0,015	0,025	$\pm 0,010$	0,010	0,020
$1,00 < d \leq 1,20$	$\pm 0,020$	0,020	0,030	$\pm 0,015$	0,015	0,025
$1,20 < d \leq 1,60$	$\pm 0,020$	0,020	0,035	$\pm 0,015$	0,015	0,030
$1,60 < d \leq 1,70$	$\pm 0,030$	0,030	0,040	$\pm 0,015$	0,015	0,030
$1,70 < d \leq 2,40$	$\pm 0,030$	0,030	0,050	$\pm 0,015$	0,015	0,035
$2,40 < d \leq 2,80$	$\pm 0,030$	0,030	0,060	$\pm 0,015$	0,015	0,040
$2,80 < d \leq 3,50$	$\pm 0,040$	0,040	0,070	$\pm 0,020$	0,020	0,050
$3,50 < d \leq 4,50$	$\pm 0,040$	0,040	0,080	$\pm 0,020$	0,020	0,060
$4,50 < d \leq 5,00$	$\pm 0,040$	0,040	0,090	$\pm 0,020$	0,020	0,070
$5,00 < d \leq 5,50$	$\pm 0,050$	0,050	0,100	$\pm 0,025$	0,025	0,080
$5,50 < d \leq 6,35$	$\pm 0,050$	0,050	0,110	$\pm 0,025$	0,025	0,090
$6,35 < d \leq 6,50$	$\pm 0,050$	0,050	0,110	$\pm 0,030$	0,030	0,090
$6,50 < d \leq 7,50$	$\pm 0,050$	0,050	0,120	$\pm 0,030$	0,030	0,100
$7,50 < d \leq 9,00$	$\pm 0,050$	0,050	0,130	$\pm 0,030$	0,030	0,110
$9,00 < d \leq 11,00$	$\pm 0,060$	0,060	0,150	$\pm 0,035$	0,035	0,130
$11,00 < d \leq 12,00$	$\pm 0,060$	0,060	0,180	$\pm 0,035$	0,035	0,150
$12,00 < d \leq 16,00$	$\pm 0,070$	0,070	0,200	$\pm 0,040$	0,040	0,170

Table 6 — Tests to be carried out, test units, and extent of testing in specific testing

Test	Test unit	Product per test unit	Number of samples per product	Number of test pieces per sample
Chemical analysis	Cast	The cast analysis is given by the manufacturer ^a		
Tensile test at room temperature	Batch ^b	10 % ^c	1	1

^a A product analysis can be agreed upon at the time of ordering; the extent of testing shall be specified at the same time.

^b Each batch consists of products coming from the same cast. The products shall be subjected to the same heat-treatment cycle in the same furnace. In the case of a continuous furnace or in process annealing, a batch is the lot heat treated without intermission with the same process parameters. The shape and size of cross sections of products in a single batch can be different, providing that the ratio of the largest to the smallest areas shall be equal to or less than three.

^c 10 % of the wire units in the production batch, at least two but no more than 10 coils.