



**International
Standard**

ISO 4954-2

**Steels for cold heading and cold
extruding — Technical delivery
conditions —**

**Part 2:
Stainless steels**

*Aciers pour transformation à froid et extrusion à froid —
Conditions techniques de livraison —*

Partie 2: Aciers inoxydables

**First edition
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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 document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 4, *Heat treatable and alloy steels*.

This first edition of ISO 4954-2, together with ISO 4954-1 cancels and replaces ISO 4954:2022, which has been technically revised.

The main changes are as follows:

- new [Annex B](#) was added for the comparison with steel grades mentioned in ISO 3506.

A list of all parts in the ISO 4954 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Steels for cold heading and cold extruding — Technical delivery conditions —

Part 2: Stainless steels

1 Scope

This document specifies requirements for stainless steels that are intended for cold heading or cold extruding and are delivered as wire rods, wire or bars. It lists specific requirements for steels with diameters of 0,8 mm up to 50 mm for austenitic steels, up to 25 mm for ferritic steels and up to 100 mm for martensitic steels.

This document is applicable to the properties of cold-headed or cold-extruded parts which have been subjected to a subsequent heat treatment.

NOTE Non-alloy and alloy steels for cold heading and cold extruding are covered by ISO 4954-1.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

ISO 643, *Steels — Micrographic determination of the apparent grain size*

ISO 1035-1, *Hot-rolled steel bars — Part 1: Dimensions of round bars*

ISO 1035-2, *Hot-rolled steel bars — Part 2: Dimensions of square bars*

ISO 1035-3, *Hot-rolled steel bars — Part 3: Dimensions of flat bars*

ISO 1035-4, *Hot-rolled steel bars — Part 4: Tolerances*

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

ISO 4885, *Ferrous materials — Heat treatments — Vocabulary*

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

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

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

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

ISO 6929, *Steel products — Vocabulary*

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

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 15549, *Non-destructive testing — Eddy current testing — General principles*

ISO 16124, *Steel wire rod — Dimensions and tolerances*

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

ISO 16143-4, *Stainless steels for general purposes — Part 4: Bright products*

ISO 22034-2, *Steel wire and wire products — Part 2: Tolerances on wire dimensions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 377, ISO 4885, ISO 4948-1, ISO 4948-2, ISO 6929, ISO 14284, ISO 16143-2, ISO 16143-4 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

bright steel product

drawn or peeled/turned bar with smoother surface quality and better dimensional accuracy in comparison with a hot-rolled bar

3.2

drawn product

product of various cross-sectional shapes obtained, after descaling, by cold drawing of hot-rolled bars or wire rod, on a drawing bench (cold deformation without removing material)

Note 1 to entry: This operation gives the product special features with respect to shape, dimensional accuracy and surface finish. Products in lengths are delivered straightened, products of small cross-section may also be supplied in coils.

3.3

peeled/turned bar

steel bar of circular cross-section having the same features of *drawn products* (3.2) concerning shape, dimensional accuracy and bright surface finish but without work hardening

Note 1 to entry: They are produced by peeling on a peeling machine usually followed by straightening and by polishing. The removal of metal by peeling is carried out in such a way that the bright product is generally free from surface defects and decarburization coming from the hot-rolling process.

3.4

stainless steels

steel with at least 10,5 % (mass fraction) Cr and maximum 1,2 % (mass fraction) C

[SOURCE: ISO 15510:2014, 3.1]

4 Classification and designation

4.1 Classification

The classification of the relevant steel grades shall be in accordance with ISO 4948-1 and ISO 4948-2.

All steel grades mentioned in this document are special steels in accordance with ISO 4948-2.

The stainless steel grades are classified according to their microstructures.

4.2 Designation

For the steel grades covered by this document, the steel names as given in the relevant tables shall be allocated in accordance with ISO/TS 4949.

[Annex C](#) provides a list of steels given in this document and the comparable grades covered in various designation systems.

5 Information to be supplied by the purchaser

5.1 Mandatory information

The manufacturer shall obtain the following information from the purchaser at the time of enquiry and order:

- a) the quantity to be delivered (mass, length);
- b) the product form (round bar, wire rod, wire);
- c) the nominal diameter and the tolerances on dimensions and shape of the product with reference to the relevant International Standard;
- d) for bars, the length; and for wire rod and wire, the dimensions, i.e. inner diameter and mass of the coils;
- e) a reference to this document, i.e. ISO 4954-2;
- f) the designation of the steel grade given in [Tables 5](#);
- g) if applicable, the symbol for the required treatment condition, see [Tables 6 to 9](#);
- h) standard designation for a test report 2.2 or, if required, any other type of inspection document in accordance with ISO 10474.

5.2 Options and/or supplementary or special requirements

A number of options are specified in this document and listed below. If the purchaser does not indicate a wish to implement any of these options, the products shall at least be supplied in accordance with the basic specifications of this document (see [5.1](#)).

- a) any requirement relating to the removal of surface defects, see [7.6.4](#);
- b) any requirement for the verification of the surface quality, see [7.6.3](#);
- c) any requirement for a product analysis, see [7.1.2.2](#);
- d) internal soundness and any requirements for non-destructive testing, see [7.4](#) and [10.3](#);
- e) verification of aptitude to cold forming, see [7.5](#) and [10.4](#);
- f) maximum depth of surface discontinuities, see [7.6.2](#) and [A.2](#);
- g) any requirement concerning non-destructive testing of the surface, see [7.6.5](#) and [10.3](#);
- h) corrosion resistance and any requirements for resistance to intergranular corrosion, see [7.7](#) and [A.3](#);
- i) any requirement concerning surface treatment, see [11.1](#);
- j) any special requirements concerning special or additional marking, see [11.2](#);

- k) any special requirements concerning packaging, see [11.3](#);
- l) statistical evaluation, see [6.5](#).

5.3 Ordering example

EXAMPLE 50 t round bars with a nominal diameter of 40 mm and a nominal length of 6 000 mm with diameter tolerance according to class S and with length tolerance according to class L2 of ISO 1035-4 made of steel grade ISO 4954-2, X5CrNi18-10 in the condition +AT+PE (see [Table 6](#)), and product analysis with an inspection certificate [3.1](#) in accordance with ISO 10474.

50 t round bars ISO 1035-4 – 40,0S × 6 000L2

ISO 4954-2, X5CrNi18-10+AT+PE – product analysis

ISO 10474 – 3.1

6 Manufacturing process

6.1 General

The manufacturing process of the steel and of the products is, with the restrictions given by the requirements in [6.2](#) to [6.4](#), left to the discretion of the manufacturer.

6.2 Deoxidation

All steels shall be deoxidized. By agreement, aluminium may be replaced by another suitable element having a similar effect.

6.3 Heat-treatment condition and surface condition at delivery

6.3.1 Heat-treatment condition

Treatment and heat-treatment condition shall conform to one of the conditions indicated in [Table 4](#).

Bright steel products in cold drawn or peeled/turned condition could show a residual film of grease from processing.

6.3.2 Particular surface conditions

If so agreed at the time of enquiry and order, the products shall be delivered in one of the particular surface conditions given in [Table 1](#).

Table 1 — Surface condition at delivery

Surface condition at delivery		Symbol	Bar	Wire rod	Wire
Unless otherwise agreed	as-rolled	none or +AR	x	x	—
Particular surface conditions supplied by agreement	cold drawn	+C	x	—	x
	skin passed	+LC	x	—	x
	peeled	+PE	x	x	x

6.4 Traceability of the cast

Each product shall be traceable to the cast, see [11.2](#).

6.5 Statistical evaluation

Suppliers are responsible, using the means they think fit, for inspecting their product in accordance with various quality criteria specified. In view of the practical difficulties in inspecting a coil of wire rod along its entire length, it cannot be proved that no value greater than the specified limits occur 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 Requirements

7.1 Chemical composition, mechanical properties and hardenability

7.1.1 General

Wire rod, bars and wire shall be supplied in one of the delivery conditions as indicated in [Table 4](#) as agreed at the time of enquiry and order. These tables show the combinations of usual heat-treatment conditions at delivery, product forms and applicable requirements.

In addition to this document, the general technical delivery requirements of ISO 404 shall apply.

If grades other than those included in this document are required for cold heading and cold extruding purposes they shall comply with ISO 16143-2 or ISO 16143-3 and the mechanical values must be agreed at the time of enquiry and order, see also [Annex B](#).

7.1.2 Chemical composition

7.1.2.1 The chemical composition determined by cast analysis shall conform to the values in [Table 5](#).

7.1.2.2 Permissible deviations between the limiting values for cast analysis and the values for product analysis are given in [Table 2](#). The product analysis shall be carried out when specified at the time of the enquiry and order.

Table 2 — Permissible deviations between product analysis and the limiting values of the cast analysis specified in [Table 5](#)

Elements	Limiting values of the cast (heat) analysis % mass fraction	Permissible deviation for the product analysis % mass fraction ^a
C	≤0,030	+0,005
	>0,030 ≤ 0,15	±0,01
Si	≤1,00	+0,05
	>1,00 ≤ 2,00	±0,10
Mn	≤1,00	+0,03
	>1,00 ≤ 2,00	±0,04
P	≤0,045	+0,005
S	≤0,015	+0,003
	>0,015 ≤ 0,030	±0,005
Cr	≥11,5 < 15,0	±0,15
	≥15,0 ≤ 20,0	±0,20
	>20,0 ≤ 23,0	±0,25

^a ± means that in one heat the deviation of the product analysis for a given element may occur over the upper value or under the lower value of the specified range of the cast analysis, but not both at the same time.

Table 2 (continued)

Elements	Limiting values of the cast (heat) analysis % mass fraction	Permissible deviation for the product analysis % mass fraction ^a
Ni	≤1,00	+0,03
	>1,00 ≤ 5,0	±0,07
	>5,0 ≤ 10,0	±0,10
	>10,0 ≤ 20,0	±0,15
	>20,0 ≤ 27,0	±0,20
Mo	<1,75	±0,05
	≥1,75 ≤ 3,5	±0,10
N	≤0,22	±0,02
Al	≤0,35	+0,10
B	>0,001 ≤ 0,010	±0,000 5
Cu	≤1,00	+0,04
	>1,00 ≤ 4,0	±0,10
Ti	≤1,00	±0,05
	>1,00 ≤ 2,35	±0,07
V	≤0,50	±0,03

^a ± means that in one heat the deviation of the product analysis for a given element may occur over the upper value or under the lower value of the specified range of the cast analysis, but not both at the same time.

7.1.3 Mechanical properties

The mechanical properties of the products, to be determined by the tensile test and by consideration of the delivery conditions of [Table 4](#) and of the surface condition of [Table 1](#), shall conform to [Tables 6 to 9](#).

As the properties of the parts in the cold-headed or cold-extruded, and subsequently not-heat-treated condition, are largely dependent on the applied cold-heading or cold-extruding conditions, these are, if necessary, subject to agreement between the purchaser and the manufacturer of the parts.

7.2 Grain size

Unless otherwise agreed, the austenitic grain size is left to the manufacturer's discretion.

If agreed at the time of enquiry and order requirements concerning the grain size and its verification can be agreed according to ISO 643 or another standard.

7.3 Non-metallic inclusions

This requirement is applicable to the verification of the macroscopic inclusions. If verification is agreed, the method and acceptance limits shall be agreed at the time of enquiry and order.

7.4 Internal soundness

Wire rod, bars and wire shall be free from internal defects, which can cause an adverse effect on products during cold heading or cold extrusion or during heat treatment.

Where appropriate, non-destructive testing relating to the internal soundness of the products shall be agreed at the time of enquiry and order, see [10.3](#).

7.5 Aptitude to cold forming

A test for verification of the aptitude of products to cold forming shall be carried out if agreed at the time of enquiry and order with reference to [10.4](#)

7.6 Surface quality

7.6.1 General

All products shall have a smooth surface finish appropriate to the manufacturing process applied. For hot-rolled products, minor surface imperfections, which can occur also under normal manufacturing conditions, such as prints originating from rolled-in scale, shall not be regarded as defects. It is more difficult to detect and eliminate surface discontinuities from coiled products than from cut lengths. This should be taken into account when agreements on surface quality are made.

7.6.2 Wire rod and bars

Wire rod is normally supplied in the pickled condition. Mechanical descaling can also be used, in which case a subsequent treatment in a pickling solution shall be carried out unless otherwise agreed. Particular processes, such as peeling or shaving, may also be applied, subject to specific agreement at the time of enquiry and order. For an agreement concerning the maximum depth of surface discontinuities, see [A.2](#).

7.6.3 Bright products and wire

For wire, the permissible depth of surface discontinuities shall be in proportion to the reduction of the diameter during cold drawing. Depending on the starting material for cold drawn products, the same requirements apply as specified in [7.6.2](#).

Cold drawn bars shall be delivered with the surface quality class 1 and peeled/turned bars shall be delivered with surface quality class 3 in accordance with ISO 16143-4.

7.6.4 Removal of surface discontinuities

Removal of surface defects and imperfections shall only be done after approval from the purchaser.

7.6.5 Non-destructive testing of the surface

The surface shall be non-destructive inspected with magnetic particles if agreed at the time of enquiry and order, see [10.3](#).

7.7 Corrosion resistance

The stainless steels shall be tested for corrosion resistance in accordance with [A.3](#) if agreed at the time of enquiry and order.

7.8 Shape, dimensions and tolerances

The shape, dimensions and tolerances of the products shall conform to the requirements agreed at the time of enquiry and order. The agreements shall be based on corresponding International Standards: ISO 16143-4, ISO 1035-1, ISO 1035-2, ISO 1035-3, ISO 1035-4, ISO 16124 and ISO 22034-2, or on other suitable regional standards.

8 Inspection

8.1 Testing procedures and types of documents

8.1.1 Products conforming to this document shall be ordered and delivered with one of the inspection documents as specified in ISO 10474 or another comparable national standard. 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.

NOTE Other comparable national standards such as EN 10204, JIS G0415 or GB/T 18253 can be used.

8.1.2 If, in accordance with the agreements made at the time of enquiry and order, a test report 2,2 is to be provided, this shall cover the following information:

- a) confirmation that the material conforms to the requirements of the order;
- b) results of the cast analysis for all elements specified in [Table 5](#) for the steel grade concerned.

8.1.3 If, in accordance with the agreements in the order, an inspection certificate [3.1](#) or [3.2](#), must be provided, the specific inspections and tests described in [8.2](#) and [Clause 10](#) shall be carried out and the results shall be confirmed in the inspection certificate.

In addition, the inspection certificate shall cover:

- a) confirmation that the material conforms to the requirements of the order;
- b) results of the cast analysis for all elements specified in in [Tables 5](#) for the steel grade concerned;
- c) results of all mandatory and optional inspections and tests (see [Table 3](#));
- d) the symbol, letters or numbers relating the inspection certificate, test pieces and products to each other.

8.2 Summary of specific inspection and frequency of testing

The requirements for specific inspection and frequency of testing for steels for cold heading and cold extrusion shall be as given in [Table 3](#).

Table 3 — Specific inspection and frequency of inspection of steels for cold heading and cold extrusion

Inspection requirements				Test unit ^a	Frequency of testing		Applicable
Type of test		Clause/ subclause reference	Number of samples per test unit		Number of test pieces per sample		
Mandatory tests	1	Cast analysis	7.1.2 and 10.1	C	the cast analysis is given by the manufacturer		m
	2	Tensile test	7.1.3 and 10.2	C + D + T	1 for each 15 t with a maximum of 3	1	m
	3	Surface condition and dimensions	Clause 7 and 10.5	C + D + T	at the manufacturer's discretion		m
Optional tests	4	Product analysis	7.1.2 , 9.1 , 10.1	C	1 per cast	1	o
	5	NDT-testing	7.4 , 7.6.5 and 10.3	C ^c	b	b	o
	6	Aptitude of cold forming	7.5 and 10.4	C ^c	b	b	o
	7	Depth of surface discontinuities	7.6.2 and A.2	C ^c	b	b	o
	8	Resistance to intergranular corrosion	7.7 and A.3	C ^c	b	b	o

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

^b Shall be agreed upon at the time of enquiry and order.

^c The test unit may be agreed at the time of enquiry and order.

^d m = mandatory (to be carried out in every case), o = optional, (to be carried out if agreed at the time of enquiry and order).

9 Preparation of samples and test pieces

9.1 Selection and preparation of samples for product analysis

Samples for product analysis shall be taken from the test pieces or samples for mechanical testing or from the same location as the mechanical test samples in accordance with ISO 14284.

9.2 Selection and preparation of samples and test pieces for the mechanical test

Samples and test pieces shall be taken in accordance with the general requirements of ISO 377. The test piece shall be prepared in accordance with ISO 6892-1.

- For products with $d > 25$ mm: The test piece for the tensile test shall be taken to conform to the indication given in [Figure 1 c\)](#);
- For products with $d \leq 25$ mm: The test piece for the tensile test shall be tested without preliminary machining, see [Figure 1 a\)](#). If test equipment does not allow this, the test piece may be prepared by machining, as shown in [Figure 1 b\)](#).

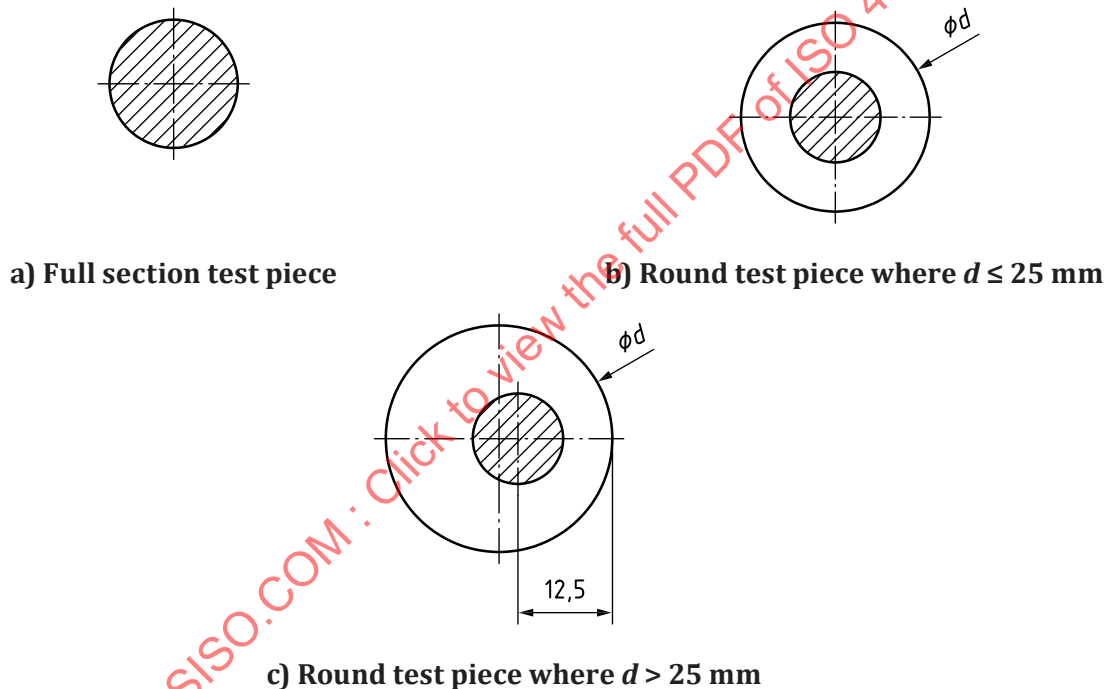


Figure 1 — Location of test piece for the tensile test

10 Test methods

10.1 Chemical analysis

The choice of a suitable physical or chemical analytical method for the analysis shall be at the discretion of the manufacturer. In cases of dispute, the method for product analysis used shall be agreed taking into account the relevant existing International Standards.

NOTE The list of available International Standards on chemical analysis is given in ISO/TR 9769.

10.2 Mechanical tests

The tensile test shall be carried out in accordance with ISO 6892-1.

For the specified yield strength in the tables on mechanical properties in this document, the upper yield strength, R_{eH} , shall be determined.

If a yield phenomenon is not present, the 0,2 % proof strength, $R_{p0,2}$, shall be determined.

10.3 Non-destructive testing

Concerning the internal soundness, the products shall be non-destructively tested, preferably with an ultrasonic test and under acceptance criteria to be agreed at the time of enquiry and order.

Concerning the surface of the products, the eddy current test in accordance with ISO 15549 or the magnetic particle test in accordance with ISO 9934-1 shall be performed. The descaling of the test pieces is not requested unless otherwise agreed at the time of enquiry and order. The absence of detectable cracks on the test piece after it has been submitted to magnetic particle inspection shall be considered as evidence that the product concerned is free from surface defects.

10.4 Aptitude to cold forming — Upsetting test

A test piece with an initial length (height) equal to 1,5 d , where d is the product diameter, is submitted to axial heading by means of a press until its length is reduced to one third of the initial value.

The above test shall be carried out at an ambient temperature and shall be limited to products with a maximum diameter of 15 mm.

The criteria for the assessment of test results shall be agreed at the time of ordering, bearing in mind the end use for which the products are intended.

10.5 Visual and dimensional test

A sufficient number of products shall be inspected to ensure conformity to the specification. The corresponding International Standards are ISO 16143-4, ISO 1035-1, ISO 1035-2, ISO 1035-3, ISO 1035-4, ISO 16124 and ISO 22034-2.

10.6 Retests

Retests shall be as specified in ISO 404.

11 Surface treatment, marking and packaging

11.1 Surface treatment

Surface treatment can facilitate subsequent cold heading and cold extrusion. This treatment can include, e.g. descaling, treatment with lime and/or oxalate and/or salt coating and/or adequate protection during transport and storage, and shall be subject to an agreement at the time of enquiry and order.

11.2 Marking

The manufacturer shall mark the products or the bundles or boxes containing the products in a suitable way, so that the identification of the cast, the steel type and the origin of the delivery is possible.

Further requirements to special marking of the products shall be agreed at the time of enquiry and order.

11.3 Packaging

A special method of packaging of the product to be delivered shall be agreed at the time of enquiry and order.

Table 4 — Combinations of heat-treatment conditions at delivery, product forms and applicable requirements

Heat-treatment condition at delivery	Symbol	Product form ^a			Steels ^a			Applicable requirements		
		Wire rod	Bar	Wire	Ferritic	Martensitic	Austenitic and austenitic-ferritic			
Solution annealed or solution annealed + peeled	+AT or AT + PE	X	X	X	—	—	X	Chemical composition as specified in Table 5	Mechanical properties as specified in Tables 6 to 9	Supplementary or special requirements as specified in Annex A ^b
Solution annealed + cold drawn	+AT + C	—	X	X	—	—	X			
Solution annealed + cold drawn + solution annealed	+AT + C + AT	—	X	X	—	—	X			
Solution annealed + cold drawn + solution annealed + skin passed	+AT + C + AT + LC	—	X	X	—	—	X			
Soft annealed or soft annealed + peeled	+A or +A + PE	X	X	X	X	X	—			
Soft annealed + skin passed	+A +LC	—	X	X	X	X	—			
Soft annealed + cold drawn + soft annealed	+A + C + A	—	X	X	X	X	—			
Soft annealed + cold drawn + soft annealed + skin passed	+A + C + A + LC	—	X	X	X	X	—			
Others	Other delivery conditions may be agreed at the time of enquiry and order.									
^a X = applicable, — = not applicable.										
^b If agreed at the time of the enquiry and order.										

Table 5 — Chemical composition (applicable to cast analysis) of stainless steel grades

Designation		% mass fraction ^a										
Steel name	ISO steel number	C	Si	Mn	P	S	Cr	Ni	Mo	N	Cu	Others
Austenitic steels												
X10CrNi18-8	4310-301-00-I	0,05 to 0,15	2,00	2,00	0,045	0,015	16,0 to 19,0	6,0 to 9,5	0,80	0,10	1,00	—
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 ^f	—	0,10	1,00	—
X6CrNiCu18-9-2	4567-304-98-X	0,08	1,00	2,00	0,045	0,030	17,0 to 19,0	8,0 to 10,5	—	0,10	1,00 to 3,00	—
X3CrNiCu18-9-4	4567-304-30-I	0,04	1,00	2,00	0,045	0,030	17,0 to 19,0	8,5 to 10,5 ^b	—	0,10	3,00 to 4,00	—
X3CrNiCu19-9-2	4560-304-75-E	0,035	1,00	1,50 to 2,00	0,045	0,015	18,0 to 19,0	8,0 to 9,0	—	0,10	1,50 to 2,00	—
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	—	0,10	1,00	—
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	—	—	1,00	Ti = 5xC 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 ^g	—	0,10	1,00	—
X6CrNi18-12	4303-305-00-I	0,08	1,00	2,00	0,045	0,030	17,0 to 19,0 ^c	10,5 to 13,0	—	0,10	—	—
X3NiCr18-16	4839-384-00-I	0,04 ^d	1,00	2,00	0,045	0,030	15,0 to 17,0	17,0 to 19,0	—	—	—	—
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	10,0 to 13,0	2,00 to 3,00	0,10	1,00	—
X5CrNiMo17-12-2	4401-316-00-I	0,07	1,00	2,00	0,045	0,030	16,5 to 18,5	10,0 to 13,0	2,00 to 3,00	0,10	1,00	—
X6CrNiMoTi17-12-2	4571-316-35-I	0,08	1,00	2,00	0,045	0,030	16,5 to 18,5	10,5 to 13,5	2,00 to 2,50	—	1,00	Ti = 5xC to 0,70
X2CrNiMo17-12-3	4432-316-03-I	0,030	1,00	2,00	0,045	0,015	16,5 to 18,5	10,5 to 13,0	2,50 to 3,00	0,10	1,00	—
X3CrNiMo17-13-3	4436-316-00-I	0,05	1,00	2,00	0,045	0,015	16,5 to 18,5	10,5 to 13,0	2,50 to 3,00	0,10	—	—
X2CrNiMoN17-13-3	4429-316-53-I	0,030	1,00	2,00	0,045	0,015	16,5 to 18,5	10,5 to 13,0	2,50 to 3,00	0,12 to 0,22	1,00	—
X3CrNiCuMo17-11-3-2	4578-316-76-E	0,04	1,00	2,00	0,045	0,015	16,5 to 17,5	10,0 to 11,0	2,00 to 2,50	0,10	3,00 to 3,50	—
Elements not quoted in this table should not be intentionally added to the steel without the agreement of the purchaser except for finishing the heat. All appropriate precautions shall be taken to avoid the addition of such elements from scrap and other materials used in production that would impair mechanical properties and the suitability of the steel.												
^a Maximum values unless otherwise indicated.												
^b A minimum content of 8,0 % of Ni is permitted, unless otherwise agreed at the time of enquiry and order.												
^c For this document, a range for Cr: 16,5 to 19,0 is allowed.												
^d For this document, C: 0,08 is allowed.												
^e In order to improve the cold formability, a carbon content of max. 0,04 % is recommended and may be agreed at the time of enquiry and order.												
^f In order to improve cold heading properties Nickel content up to 10,5 % is permitted and recommended.												
^g In order to improve cold heading properties Nickel content up to 13 % is permitted and recommended.												

Table 5 (continued)

Designation		% mass fraction ^a										Others
Steel name	ISO steel number	C	Si	Mn	P	S	Cr	Ni	Mo	N	Cu	
X6NiCrTiMoVB25-15-2	4980-662-86-X	0,08	1,00	2,00	0,040	0,030	13,5 to 16,0	24,0 to 27,0	1,00 to 1,50	—	—	Ti: 1,90 to 2,35 Al: 0,35 V: 0,10 to 0,50 B: 0,001 to 0,010
Austenitic-ferritic steel												
X2CrNiMoN22-5-3	4462-318-03-I	0,030	1,00	2,00	0,035	0,015	21,0 to 23,0	4,5 to 6,5	2,50 to 3,50	0,10 to 0,22	—	—
Ferritic steels												
X6Cr17	4016-430-00-I	0,08 ^e	1,00	1,00	0,040	0,030	16,0 to 18,0	—	—	—	—	—
X6CrMo17-1	4113-434-00-I	0,08	1,00	1,00	0,040	0,030	16,0 to 18,0	—	0,75 to 1,40	—	—	—
Martensitic steel												
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	—	—	—	—
Elements not quoted in this table should not be intentionally added to the steel without the agreement of the purchaser except for finishing the heat. All appropriate precautions shall be taken to avoid the addition of such elements from scrap and other materials used in production that would impair mechanical properties and the suitability of the steel.												
^a Maximum values unless otherwise indicated.												
^b A minimum content of 8,0 % of Ni is permitted, unless otherwise agreed at the time of enquiry and order.												
^c For this document, a range for Cr: 16,5 to 19,0 is allowed.												
^d For this document, C: 0,08 is allowed.												
^e In order to improve the cold formability, a carbon content of max. 0,04 % is recommended and may be agreed at the time of enquiry and order.												
^f In order to improve cold heading properties Nickel content up to 10,5 % is permitted and recommended.												
^g In order to improve cold heading properties Nickel content up to 13 % is permitted and recommended.												

Table 6 — Mechanical properties for austenitic stainless steels in the specified delivery condition

Designation		Diameter		Delivery condition							
				+AT or +AT+PE		+AT+C		+AT+C+AT		+AT+C+AT+LC	
				R_m max. MPa	Z min. %	R_m max. MPa	Z min. %	R_m max. MPa	Z min. %	R_m max. MPa	Z min. %
Steel name	ISO steel number	above mm	up to mm								
X10CrNi18-8	4310-301-00-I	≥ 2	5	—	—	—	—	780	65	820	60
		5	10	660	65	900	—	680	65	750	60
		10	25	660	65	850	—	660	65	—	—
		25	50	660	65	—	—	—	—	—	—
X2CrNi18-9	4307-304-03-I	≥ 0,8	2	—	—	—	—	720	68	800	63
		2	5	—	—	—	—	680	68	750	63
		5	10	630	68	880	—	630	68	680	63
		10	25	630	68	760	—	630	68	680	63
		25	50	630	68	740	—	630	68	—	—
X6CrNiCu18-9-2	4567-304-98-X	≥ 0,8	2	—	—	—	—	710	60	760	63
		2	5	—	—	—	—	700	60	680	63
		5	10	—	—	—	—	650	65	680	63
		10	25	—	—	—	—	650	65	680	63
		25	50	—	—	—	—	—	—	—	—
X3CrNiCu18-9-4	4567-304-30-I	≥ 0,8	2	—	—	—	—	650	68	680	63
		2	5	—	—	—	—	620	68	650	63
		5	10	590	68	740	—	590	68	640	63
		10	25	590	68	700	—	590	68	630	65
		25	50	590	68	—	—	—	—	—	—
X3CrNiCu19-9-2	4560-304-75-E	≥ 2	5	—	—	—	—	630	68	720	63
		5	10	610	68	800	—	610	68	660	63
		10	25	610	68	750	—	610	68	—	—
		25	50	610	68	—	—	—	—	—	—
X5CrNi18-10	4301-304-00-I	≥ 0,8	2	—	—	—	—	750	60	850	60
		2	5	—	—	—	—	750	60	800	60
		5	10	650	65	900	—	650	65	720	60
		10	25	650	65	800	—	650	65	720	63
		25	50	650	65	—	—	—	—	—	—
X6CrNiTi18-10	4541-321-00-I	≥ 2	5	—	—	—	—	720	65	770	60
		5	10	680	65	870	—	680	65	730	60
		10	25	680	65	810	—	680	65	—	—
		25	50	680	65	—	—	—	—	—	—
X2CrNi19-11	4306-304-03-I	≥ 2	5	—	—	—	—	680	68	730	63
		5	10	630	68	800	—	630	68	700	63
		10	25	630	68	740	—	630	68	680	63
		25	50	630	68	—	—	—	—	—	—

Table 6 (continued)

Designation		Diameter		Delivery condition							
				+AT or +AT+PE		+AT+C		+AT+C+AT		+AT+C+AT+LC	
Steel name	ISO steel number	above mm	up to mm	R_m max. MPa	Z min. %	R_m max. MPa	Z min. %	R_m max. MPa	Z min. %	R_m max. MPa	Z min. %
X6CrNi18-12	4303-305-00-I	≥ 0,8	2	—	—	—	—	720	65	780	60
		2	5	—	—	—	—	670	65	720	60
		5	10	650	65	800	—	650	65	700	60
		10	25	650	65	770	—	650	65	680	63
		25	50	650	65	—	—	—	—	—	—
X3NiCr18-16	4839-384-00-I	≥ 0,8	2	—	—	—	—	640	68	690	63
		2	5	—	—	—	—	600	68	640	63
		5	10	—	—	—	—	—	—	640	63
		10	25	—	—	—	—	—	—	640	63
		25	50	—	—	—	—	—	—	—	—
X2CrNiMo17-12-2	4404-316-03-I	≥ 0,8	2	—	—	—	—	720	68	800	63
		2	5	—	—	—	—	700	68	750	63
		5	10	650	68	800	—	650	68	700	63
		10	25	650	68	750	—	650	68	700	63
		25	50	650	68	—	—	—	—	—	—
X5CrNiMo17-12-2	4401-316-00-I	≥ 0,8	2	—	—	—	—	720	68	820	63
		2	5	—	—	—	—	700	65	750	60
		5	10	660	65	840	—	670	65	720	60
		10	25	660	65	790	—	660	65	720	60
		25	50	660	65	—	—	—	—	—	—
X6CrNiMoTi17-12-2	4571-316-35-I	≥ 2	5	—	—	—	—	720	65	770	60
		5	10	680	65	850	—	680	65	730	60
		10	25	680	65	810	—	680	65	—	—
		25	50	680	65	—	—	—	—	—	—
X2CrNiMo17-12-3	4432-316-03-I	≥ 2	5	—	—	—	—	670	68	720	63
		5	10	650	68	780	—	650	68	700	63
		10	25	650	68	750	—	650	68	—	—
		25	50	650	68	—	—	—	—	—	—
X3CrNiMo17-13-3	4436-316-00-I	≥ 2	5	—	—	—	—	690	65	750	60
		5	10	660	65	850	—	670	65	720	60
		10	25	660	65	790	—	660	65	—	—
		25	50	660	65	—	—	—	—	—	—
X2CrNiMoN17-13-3	4429-316-53-I	≥ 2	5	—	—	—	—	820	60	870	55
		5	10	780	60	940	—	800	60	850	55
		10	25	780	60	910	—	780	60	—	—
		25	50	780	60	—	—	—	—	—	—
X3CrNiCu-Mo17-11-3-2	4578-316-76-E	≥ 2	5	—	—	—	—	630	68	680	63
		5	10	610	68	760	—	610	68	660	63
		10	25	610	68	720	—	610	68	—	—
		25	50	610	68	—	—	—	—	—	—

Table 6 (continued)

Designation		Diameter		Delivery condition							
Steel name	ISO steel number	above mm	up to mm	+AT or +AT+PE		+AT+C		+AT+C+AT		+AT+C+AT+LC	
				R_m max. MPa	Z min. %	R_m max. MPa	Z min. %	R_m max. MPa	Z min. %	R_m max. MPa	Z min. %
X6NiCrTi- MoVB25-15-2	4980-662- 86-X	≥ 0,8	2	—	—	—	—	780	65	830	60
		2	5	—	—	—	—	730	65	780	60
		5	10	—	—	—	—	—	—	780	60
		10	25	—	—	—	—	—	—	780	60
		25	50	—	—	—	—	—	—	—	—

Table 7 — Mechanical properties for austenitic-ferritic stainless steels in the specified delivery condition

Designation		Diameter		Delivery condition							
Steel name	ISO steel number	above mm	up to mm	+AT or +AT+PE		+AT+C		+AT+C+AT		+AT+C+AT+LC	
				R_m max. MPa	Z min. %	R_m max. MPa	Z min. %	R_m max. MPa	Z min. %	R_m max. MPa	Z min. %
X2CrNi- MoN22-5-3	4462-318- 03-I	≥ 2	5	880	55	—	—	950	55	1 070	50
		5	10	880	55	1 150	—	900	55	970	50
		10	25	880	55	1 000	—	880	55	—	—

Table 8 — Mechanical properties for ferritic stainless steels in the specified delivery condition

Designation		Diameter		Delivery condition							
Steel name	ISO steel number	above mm	up to mm	+A or +A+PE		+A+ LC		+A+C+A		+A+C+A+LC	
				R_m max. MPa	Z min. %	R_m max. MPa	Z min. %	R_m max. MPa	Z min. %	R_m max. MPa	Z min. %
X6Cr17	4016-430- 00-I	≥ 0,8	2	—	—	—	—	—	—	700	61
		2	5	—	—	—	—	560	63	620	61
		5	10	560	63	660	60	560	63	600	61
		10	25	560	63	640	60	560	63	600	61
X6CrMo17-1	4113-434- 00-I	≥ 0,8	2	—	—	—	—	—	—	740	61
		2	5	—	—	—	—	630	60	660	58
		5	10	600	60	750	57	600	60	640	58
		10	25	600	60	700	57	600	60	640	58

Table 9 — Mechanical properties for martensitic stainless steels in the specified delivery condition

Designation		Diameter		Delivery condition							
Steel name	ISO steel number	above mm	up to mm	+A or +A+PE		+A+ LC		+A+C+A		+A+C+A+LC	
				R_m max. MPa	Z min. %	R_m max. MPa	Z min. %	R_m max. MPa	Z min. %	R_m max. MPa	Z min. %
X12Cr13	4006-410-00-1	≥ 0,8	2	—	—	—	—	—	—	740	58
		2	5	—	—	—	—	600	60	660	58
		5	10	600	60	780	57	600	60	640	58
		10	25	600	60	700	57	600	60	640	58
		25	100	600	60	—	—	—	—	—	—

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Annex A (normative)

Supplementary or special requirements

A.1 General

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

A.2 Maximum depth of surface discontinuities

The maximum admissible depth of surface discontinuities is indicated in [Table A.1](#). The depth of a discontinuity is considered as being the distance between the surface of the product and the bottom of the discontinuity, to be measured in a direction perpendicular to the surface along a radius. In case of dispute, the determination of the depth of surface discontinuities shall be carried out by metallographic means with a magnification of $\times 100$, on a straight cross section of the product in the delivery condition concerned.

Table A.1 — Maximum depth of surface discontinuities

Diameter in the delivery condition ^a	Maximum permissible depth of discontinuities ^b
mm	mm
≤ 10	0,10
> 10	1 % of the diameter
^a For diameter less than 5 mm, the permissible depth of surface discontinuities shall be reduced in proportion of the reduction of the diameter during cold drawing.	
^b For ferritic, martensitic and austenitic-ferritic steels, higher values may be agreed at the time of enquiry and order.	

A.3 Corrosion resistance of stainless steel products

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

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

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