
**Mechanical properties of corrosion-
resistant stainless steel fasteners —**

**Part 4:
Tapping screws**

*Caractéristiques mécaniques des éléments de fixation en acier
inoxydable résistant à la corrosion —*

Partie 4: Vis à tôle

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 3506-4 was prepared by Technical Committee ISO/TC 2, *Fasteners*, Subcommittee SC 1, *Mechanical properties of fasteners*.

This second edition cancels and replaces the first edition (ISO 3506-4:2003), which has been technically revised.

ISO 3506 consists of the following parts, under the general title *Mechanical properties of corrosion-resistant stainless steel fasteners*:

- Part 1: Bolts, screws and studs
- Part 2: Nuts
- Part 3: Set screws and similar fasteners not under tensile stress
- Part 4: Tapping screws

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Introduction

In the preparation of this part of ISO 3506, special attention has been given to the fundamentally different property characteristics of the stainless steel fastener grades compared with those of carbon steel and low-alloy steel fasteners. Ferritic and austenitic stainless steels are strengthened only by cold working and consequently, the components do not have as homogeneous local material properties as hardened and tempered parts. These special features have been recognized in the elaboration of the hardness classes and the test procedures for mechanical properties.

The primary objective of this part of ISO 3506 is to ensure that corrosion-resistant austenitic, martensitic and ferritic stainless steel tapping screws will form mating threads in materials such as aluminium into which they are normally driven without deforming their own thread and without breaking during assembly or service. Selection of the steel group is based on the intended application.

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Mechanical properties of corrosion-resistant stainless steel fasteners —

Part 4: Tapping screws

1 Scope

This part of ISO 3506 specifies the mechanical properties of tapping screws made of austenitic, martensitic and ferritic steel grades of corrosion-resistant stainless steels, when tested over an ambient temperature range of 10 °C to 35 °C. Properties vary at higher or lower temperatures.

It applies to tapping screws with threads from ST2,2 up to and including ST8, in accordance with ISO 1478.

It does not apply to screws with special properties, such as weldability.

NOTE The designation system of this part of ISO 3506 can be used for sizes outside the limits given in this clause (e.g. $d > ST8$), provided that all applicable mechanical and physical requirements of the hardness classes are met.

This part of ISO 3506 does not define corrosion or oxidation resistance in particular environments. However, some information on materials for particular environments is given in Annex C. Regarding definitions of corrosion and corrosion resistance, see ISO 8044.

The aim of this part of ISO 3506 is the classification of corrosion-resistant stainless steel tapping screws into hardness classes.

Corrosion and oxidation performances and mechanical properties for use at elevated or sub-zero temperatures can be agreed on between the user and the manufacturer in each particular case. Annex D shows how the risk of intergranular corrosion at elevated temperatures depends on the carbon content.

All austenitic stainless steel fasteners are normally non-magnetic in the annealed condition; after cold working, some magnetic properties can be evident (see Annex E).

2 Normative references

The following referenced documents are indispensable for the application 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 1478, *Tapping screws thread*

ISO 3651-1, *Determination of resistance to intergranular corrosion of stainless steels — Part 1: Austenitic and ferritic-austenitic (duplex) stainless steels — Corrosion test in nitric acid medium by measurement of loss in mass (Huey test)*

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 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*

ISO 16048, *Passivation of corrosion-resistant stainless-steel fasteners*

ISO 16426, *Fasteners — Quality assurance system*

3 Designation, marking and finish

3.1 Designation

The designation system for stainless steel grades and hardness classes for tapping screws is given in Figure 1. The designation of the material consists of two blocks, which are separated by a hyphen. The first block designates the steel grade and the second block, the hardness class.

The designation of the steel grade (first block) consists of one of the letters

- **A** for austenitic steel,
- **C** for martensitic steel, or
- **F** for ferritic steel

which indicates the group of steel and a digit, which indicates a range of chemical compositions within this steel group (see Table 2).

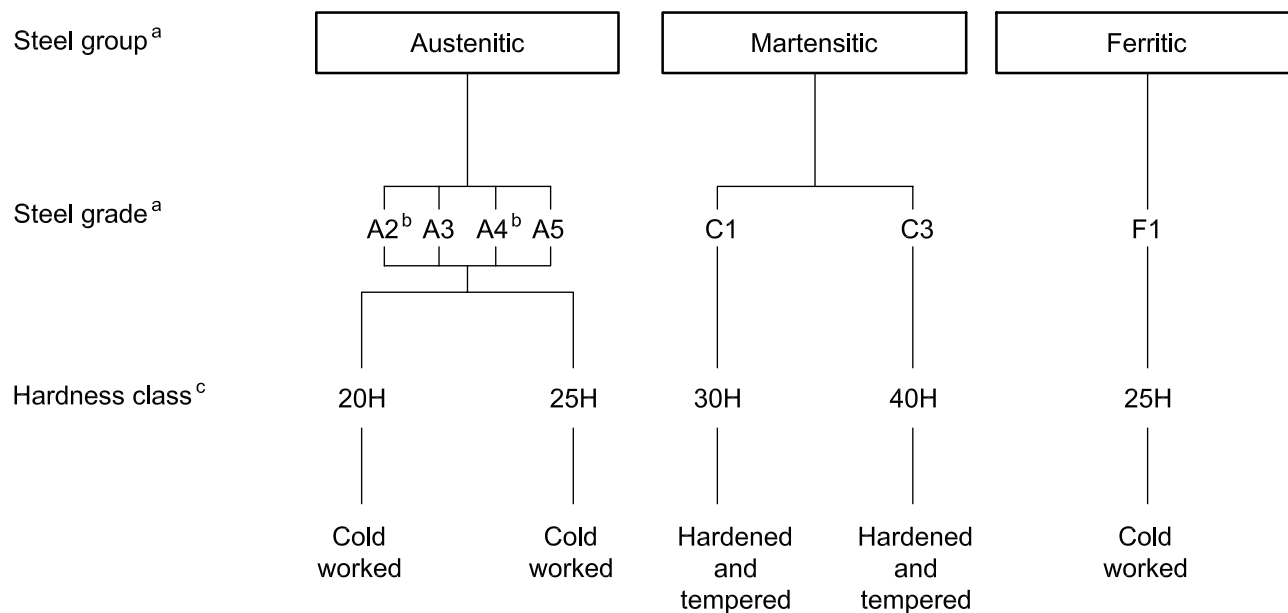
The designation of the hardness class (second block) consists of two digits representing 1/10 of the minimum Vickers hardness and the letter H, referring to hardness (see Table 1).

ISO 3506-4:2009
 Designations of hardness classes in relation to Vickers hardness

Hardness class	20H	25H	30H	40H
Vickers hardness, HV min.	200	250	300	400

EXAMPLE 1 **A4-25H** indicates: austenitic steel of steel grade A4, cold worked, minimum hardness 250 HV.

EXAMPLE 2 **C3-40H** indicates: martensitic steel of steel grade C3, hardened and tempered, minimum hardness 400 HV.



^a The steel groups and steel grades classified in Figure 1 are described in Annex A and specified by the chemical composition given in Table 2.

^b Low-carbon austenitic stainless steels with carbon content not exceeding 0,03 % may additionally be marked with an "L".

EXAMPLE **A4L-25H**

^c Tapping screws passivated in accordance with ISO 16048 may additionally be marked with a "P".

EXAMPLE **A4-25HP**

Figure 1 — Designation system for stainless steel grades and hardness classes for tapping screws

3.2 Marking

3.2.1 General

Marking of tapping screws is not mandatory.

When tapping screws manufactured according to the requirements of this part of ISO 3506 are designated and marked, they shall be designated in accordance with the designation system described in 3.1 and marked in accordance with 3.2.2 and 3.2.3. However, the designation system described in 3.1 and the provisions for marking according to 3.2.3 shall be used only if all relevant requirements of this part of ISO 3506 are met.

3.2.2 Manufacturer's identification mark

A manufacturer's identification mark shall be included during the manufacturing process on all tapping screws which are marked with a hardness class symbol, provided this is possible for technical reasons. Manufacturer's identification marking is also recommended on tapping screws which are not marked with a hardness class symbol.

3.2.3 Tapping screws

When tapping screws are marked, they shall be clearly marked in accordance with 3.1. The marking should include the steel grade and hardness class.

3.2.4 Packages

All packages for all types of tapping screws of all sizes shall be marked (e.g. through labelling). The marking shall include the manufacturer's and/or distributor's identification and the marking symbol for the steel grade and hardness class according to Figure 1 and the manufacturing lot number, as defined in ISO 16426.

3.3 Finish

Unless otherwise specified, tapping screws in accordance with this part of ISO 3506 shall be supplied clean and bright. For maximum corrosion resistance, passivation is recommended. When passivation is required, it shall be performed in accordance with ISO 16048. Tapping screws that are passivated may additionally be marked with the symbol "P" after the symbols for steel grade and hardness class (see footnote c of Figure 1).

For tapping screws manufactured to a specific order, the additional marking should be applied to both the fastener and the label. For tapping screws delivered from stock, the additional marking should be applied to the label.

4 Chemical composition

The chemical compositions of stainless steels suitable for tapping screws in accordance with this part of ISO 3506 are given in Table 2.

NOTE The chemical compositions given in Table 2 correspond with the chemical compositions given in ISO 3506-1:2009, Table 1, for the relevant steel grades.

The final choice of the chemical composition within the specified steel grade is at the discretion of the manufacturer, otherwise by prior agreement between the purchaser and the manufacturer.

In applications where risk of intergranular corrosion is present, testing in accordance with ISO 3651-1 or ISO 3651-2 is recommended. In such cases, stabilized stainless steels of grades A3 and A5 or stainless steels of grades A2 and A4 with carbon content not exceeding 0,03 % are recommended.

Table 2 — Stainless steel grades — Chemical composition

Steel group	Steel grade	Chemical composition ^a mass fraction, %									Footnotes
		C	Si	Mn	P	S	Cr	Mo	Ni	Cu	
Austenitic	A2	0,10	1	2	0,05	0,03	15 to 20	— ^b	8 to 19	4	cd
	A3	0,08	1	2	0,045	0,03	17 to 19	— ^b	9 to 12	1	e
	A4	0,08	1	2	0,045	0,03	16 to 18,5	2 to 3	10 to 15	4	df
	A5	0,08	1	2	0,045	0,03	16 to 18,5	2 to 3	10,5 to 14	1	ef
Martensitic	C1	0,09 to 0,15	1	1	0,05	0,03	11,5 to 14	—	1	—	f
	C3	0,17 to 0,25	1	1	0,04	0,03	16 to 18	—	1,5 to 2,5	—	—
Ferritic	F1	0,12	1	1	0,04	0,03	15 to 18	— ^g	1	—	hi

NOTE 1 A description of the groups and grades of stainless steels also entering into their specific properties and applications is given in Annex A.

NOTE 2 Examples of stainless steels standardized in accordance with ISO 4954 are given in Annex B.

NOTE 3 Certain materials for specific application are given in Annex C.

a Values are maximum, unless otherwise indicated.

b Molybdenum may be present at the discretion of the manufacturer. However, if for some applications limiting of the molybdenum content is essential, this shall be stated at the time of ordering by the purchaser.

c If the chromium content is below 17 %, the minimum nickel content should be 12 %.

d For austenitic stainless steels having a maximum carbon content of 0,03 %, nitrogen may be present to a maximum of 0,22 %.

e This shall contain titanium $\geq 5 \times C$ up to 0,8 % maximum for stabilization and be marked appropriately as specified in this table, or shall contain niobium (columbium) and/or tantalum $\geq 10 \times C$ up to 1,0 % maximum for stabilization and be marked appropriately as specified in this table.

f At the discretion of the manufacturer, the carbon content may be higher where required in order to obtain the specified mechanical properties at larger diameters, but shall not exceed 0,12 % for austenitic steels.

g Molybdenum may be present at the discretion of the manufacturer.

h This may contain titanium $\geq 5 \times C$ up to 0,8 % maximum.

i This may contain niobium (columbium) and/or tantalum $\geq 10 \times C$ up to 1 % maximum.

5 Mechanical properties

5.1 General

For acceptance purposes, the mechanical properties and performance characteristics specified in 5.2 to 5.5 apply and shall be tested in accordance with 6.1 to 6.4.

5.2 Surface hardness

Screws of martensitic steel grades shall conform to the surface hardness requirements given in Table 3 when tested in accordance with 6.1.

Table 3 — Surface hardness

Steel group	Steel grade	Hardness class	Surface hardness HV min.
Martensitic	C1	30H	300
	C3	40H	400