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

Part 1:
Bolts, screws and studs

*Caractéristiques mécaniques des éléments de fixation en acier
inoxydable résistant à la corrosion —
Partie 1: Vis et goujons*

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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 3506-1 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 3506-1:1997), which has been technically revised.

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

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

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 property classes and the test procedures for mechanical properties. The latter differ from the carbon steel and low-alloy steel fastener test procedures with regard to the measurement of the stress at 0,2 % permanent strain (yield stress) and ductility (total elongation after fracture).

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Mechanical properties of corrosion-resistant stainless steel fasteners —

Part 1: Bolts, screws and studs

1 Scope

This part of ISO 3506 specifies the mechanical properties of bolts, screws and studs 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.

This part of ISO 3506 applies to bolts, screws and studs

- with nominal thread diameter $d \leq 39$ mm,
- of triangular ISO metric threads with diameters and pitches in accordance with ISO 68-1, ISO 261 and ISO 262, and
- of any shape.

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. $d > 39$ mm), provided that all applicable mechanical and physical requirements of the property 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 E. 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 fasteners¹⁾ into property classes. Some materials can be used at temperatures down to – 200 °C, while some can be used at temperatures up to + 800 °C in air. Information on the influence of temperature on mechanical properties is found in Annex F.

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 G 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 H).

1) The term “fasteners” is used when bolts, screws and studs are considered all together.

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 68-1, *ISO general purpose screw threads — Basic profile — Part 1: Metric screw threads*

ISO 261, *ISO general purpose metric screw threads — General plan*

ISO 262, *ISO general purpose metric screw threads — Selected sizes for screws, bolts and nuts*

ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch 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 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method*

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

ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)*

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

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

ISO 16426, *Fasteners — Quality assurance system*

3 Symbols

A	elongation after fracture
$A_{s,nom}$	nominal stress area
d	nominal thread diameter
d_1	basic minor diameter of external thread
d_2	basic pitch diameter of external thread
d_3	minor diameter of external thread (for stress calculation)
H	height of the fundamental triangle of the thread
L_1	total length of fastener
L_2	total length of fastener after fracture
L_3	distance between the underside of the head and the threaded adapter
l	nominal length of the fastener
l_s	plain shank length

M_B	breaking torque
P	pitch of the thread
R_{eL}	lower yield stress
R_m	tensile strength
$R_{p0,2}$	stress at 0,2 % permanent strain
α	wedge angle
μ_r	permeability value in a magnetic field

4 Designation, marking and finish

4.1 Designation

The designation system for stainless steel grades and property classes for bolts, screws and studs 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 property class.

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

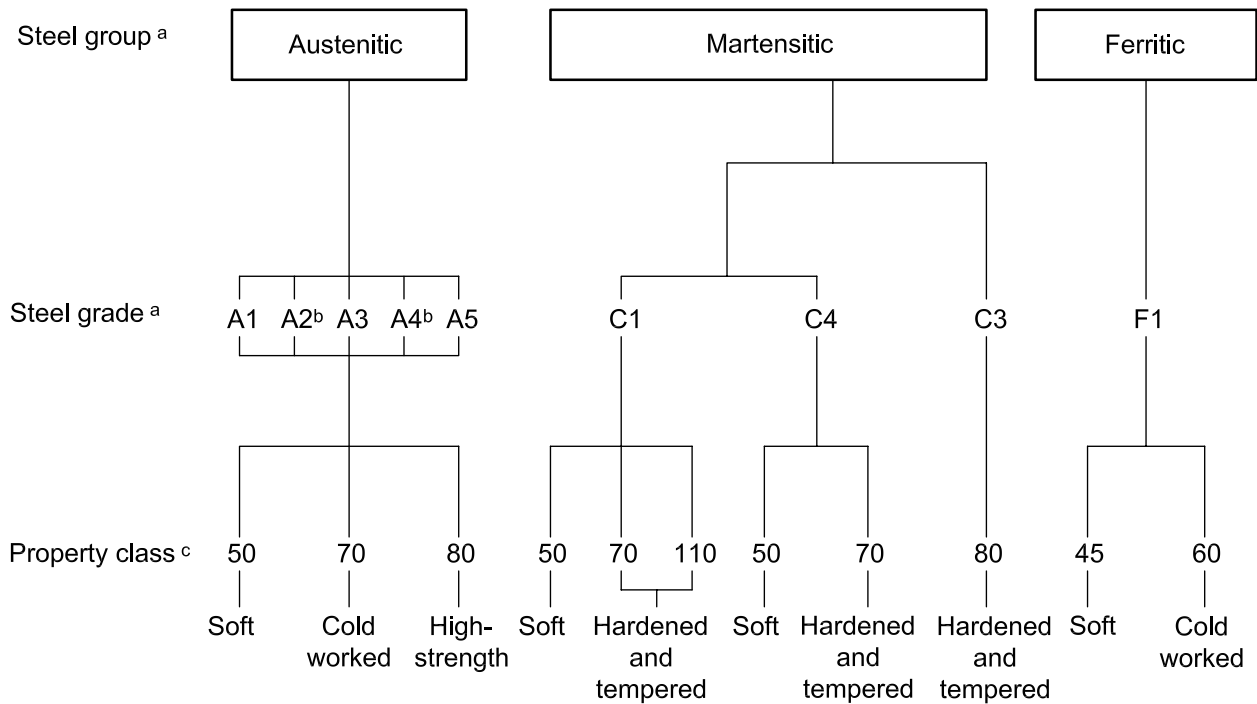
- **A** for austenitic steel,
- **C** for martensitic steel, or
- **F** for ferritic steel

which indicates the group of steel and a digit, which indicates a range of chemical compositions within this steel group (see Table 1).

The designation of the property class (second block) consists of two or three digits representing 1/10 of the tensile strength of the fastener, according to Table 2 or Table 3.

EXAMPLE 1 **A2-70** indicates: austenitic steel, cold worked, minimum 700 MPa tensile strength.

EXAMPLE 2 **C4-70** indicates: martensitic steel, hardened and tempered, minimum 700 MPa tensile strength.



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

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

EXAMPLE **A4L-80**

^c Fasteners passivated in accordance with ISO 16048 may additionally be marked with a “P”.

EXAMPLE **A4-80P**

Figure 1 — Designation system for stainless steel grades and property classes for bolts, screws and studs

4.2 Marking

4.2.1 General

Fasteners manufactured according to the requirements of this part of ISO 3506 shall be designated in accordance with the designation system described in 4.1 and marked in accordance with 4.2.2 and 4.2.3 or 4.2.4, as applicable. However, the designation system described in 4.1 and the provisions for marking according to 4.2.3 or 4.2.4 shall be used only if all relevant requirements of this part of ISO 3506 are met.

Unless otherwise specified in the product standard, the height of embossed markings on the top of the head shall not be included in the head height dimensions.

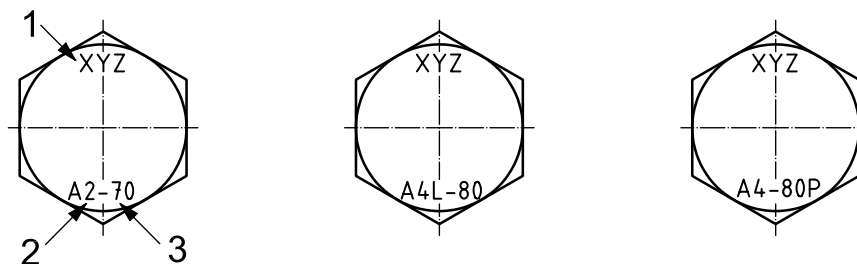
NOTE For marking of left-hand threads, see ISO 898-1.

4.2.2 Manufacturer's identification mark

A manufacturer's identification mark shall be included during the manufacturing process on all fasteners which are marked with a property class symbol. Manufacturer's identification marking is also recommended on fasteners which are not marked with a property class symbol.

4.2.3 Bolts and screws

All hexagon head bolts and screws, and hexagon or hexalobular socket head cap screws of nominal thread diameter $d \geq 5$ mm shall be clearly marked in accordance with 4.1, Figure 1, Figure 2 and Figure 3. The marking is mandatory and shall include the steel grade and property class.



Key

- 1 manufacturer's identification mark
- 2 steel grade
- 3 property class

Figure 2 — Marking of hexagon head bolts and screws



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Figure 3 — Marking of hexagon and hexalobular socket head cap screws — Alternative forms

Other types of bolts and screws can be marked in the same way, where it is possible to do so and on the head portion only. Additional marking is allowed, provided it does not cause confusion.

Fasteners that do not fulfil the tensile or torsional requirements because of the geometry (see Clause 6) may be marked with the steel grade, but shall not be marked with the property class (see Figure 4).

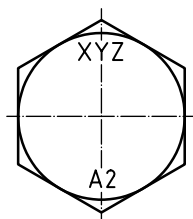


Figure 4 — Marking of fasteners not fulfilling tensile or torsional requirements because of the geometry

4.2.4 Studs

Studs of nominal thread diameter $d \geq 6$ mm shall be clearly marked in accordance with 4.1, Figure 1 and Figure 5. The marking shall be on the unthreaded part of the stud and shall contain the steel grade and property class. If marking on the unthreaded portion is not possible, marking of steel grade only on the nut end of the stud is allowed (see Figure 5).

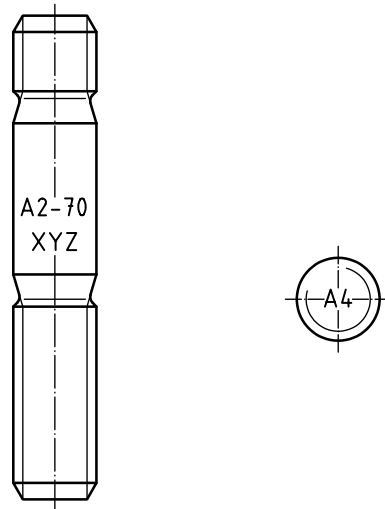


Figure 5 — Marking of studs — Alternative forms

4.2.5 Packages

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

4.3 Finish

Unless otherwise specified, fasteners 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. Fasteners that are passivated may additionally be marked with the symbol "P" after the symbols for steel grade and property class (see footnote c of Figure 1).

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

5 Chemical composition

The chemical compositions of stainless steels suitable for fasteners in accordance with this part of ISO 3506 are given in Table 1.

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.