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

Part 3:

**Set screws and similar fasteners not under tensile stress**

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

*Partie 3. Vis sans tête et éléments de fixation similaires non soumis à des contraintes de traction*

ISO 3506-3:2009

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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 3506-3 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 3506-3:1997), which has been technically revised.

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

- 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. 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.

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# Mechanical properties of corrosion-resistant stainless steel fasteners —

## Part 3: Set screws and similar fasteners not under tensile stress

### 1 Scope

This part of ISO 3506 specifies the mechanical properties of set screws and similar fasteners not under tensile stress made of austenitic stainless steel, 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 set screws and similar fasteners:

- with nominal thread diameter  $1,6 \text{ mm} \leq d \leq 24 \text{ mm}$ ;
- of triangular ISO metric threads with diameters and pitches in accordance with ISO 68-1, ISO 261 and ISO 262;
- 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.  $d > 24 \text{ mm}$ ), 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.

The aim of this part of ISO 3506 is the classification of corrosion-resistant stainless steel fasteners 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 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 898-5, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 5: Set screws and similar threaded fasteners not under tensile stresses*

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

ISO 16426, *Fasteners — Quality assurance system*

### 3 Designation, marking and finish

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#### 3.1 Designation

The designation system for stainless steel grades and hardness classes for set screws and similar fasteners 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 the letter A for austenitic steel, which indicates the group of steel and a digit, which indicates a range of chemical compositions within this steel group (see Table 2).

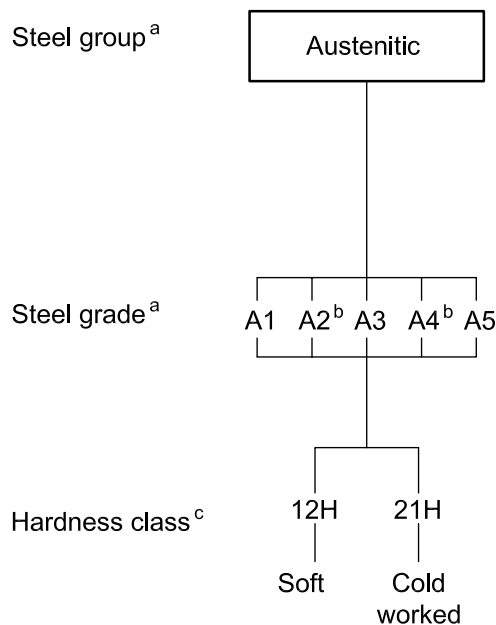
The designation of the hardness class (second block) consists of two digits representing 1/10 of the minimum Vickers hardness and the letter H, referring to hardness (see Table 1).

**Table 1 — Designations of hardness classes in relation to Vickers hardness**

<b>Hardness class</b>	12H	21H
<b>Vickers hardness, HV min.</b>	125	210

EXAMPLE **A1-12H** indicates: austenitic steel, soft, minimum hardness 125 HV.





<sup>a</sup> 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.

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

EXAMPLE **A4L-21H**

<sup>c</sup> Set screws and similar fasteners passivated in accordance with ISO 16048 may additionally be marked with a “P”.

EXAMPLE **A4-21HP**

ISO 3506-3:2009

Figure 1 — Designation system for stainless steel grades and hardness classes for set screws and similar fasteners

## 3.2 Marking

### 3.2.1 General

Marking of set screws and similar fasteners is not mandatory.

When set screws and similar fasteners manufactured 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 set screws and similar fasteners which are marked with a hardness class symbol, provided this is possible for technical reasons. Manufacturer's identification marking is also recommended on set screws and similar fasteners which are not marked with a hardness class symbol.

### 3.2.3 Set screws and similar fasteners

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

## 4 Chemical composition

The chemical compositions of stainless steels suitable for set screws and similar fasteners 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 <sup>a</sup> mass fraction, %									Footnotes
		C	Si	Mn	P	S	Cr	Mo	Ni	Cu	
Austenitic	A1	0,12	1	6,5	0,2	0,15 to 0,35	16 to 19	0,7	5 to 10	1,75 to 2,25	bcd
	A2	0,10	1	2	0,05	0,03	15 to 20	— <sup>e</sup>	8 to 19	4	fg
	A3	0,08	1	2	0,045	0,03	17 to 19	— <sup>e</sup>	9 to 12	1	h
	A4	0,08	1	2	0,045	0,03	16 to 18,5	2 to 3	10 to 15	4	gi
	A5	0,08	1	2	0,045	0,03	16 to 18,5	2 to 3	10,5 to 14	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 683-13 and ISO 4954 are given in Annexes B and C, respectively.

<sup>a</sup> Values are maximum, unless otherwise indicated.

<sup>b</sup> Sulfur may be replaced by selenium.

<sup>c</sup> If the nickel content is below 8 %, the minimum manganese content shall be 5 %.

<sup>d</sup> There is no minimum limit to the copper content, provided that the nickel content is greater than 8 %.

<sup>e</sup> 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.

<sup>f</sup> If the chromium content is below 17 %, the minimum nickel content should be 12 %.

<sup>g</sup> For austenitic stainless steels having a maximum carbon content of 0,03 %, nitrogen may be present to a maximum of 0,22 %.

<sup>h</sup> 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.

<sup>i</sup> 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 %.

## 5 Mechanical properties

### 5.1 General

The mechanical properties of set screws and similar fasteners in accordance with this part of ISO 3506 shall conform to the values given in Tables 3 and 4.

For acceptance purposes, the mechanical properties specified in 5.2 and 5.3 apply and shall be tested according to 6.1 and 6.2, respectively.

### 5.2 Proof torque of hexagon socket set screws

Hexagon socket set screws shall conform to the proof torque requirements given in Table 3.