FINAL DRAFT
International
Standard

ISO/FDIS 3506-3

Fasteners — Mechanical properties of corrosion resistant stainless steel fasteners —

Part 3:
Set screws (and similar fasteners not under tensile stress) with specified grades and hardness classes

Fixations — Caractéristiques mécaniques des fixations en acier inoxydable résistant à la corrosion —

Partie 3: Vis sans tête (et fixations similaires non soumises à des contraintes de traction) de grades et classes de dureté spécifiées

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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).

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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 2, *Fasteners*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 185 *Fasteners*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 3506-3:2009), which has been technically revised.

The main changes are as follows:

— annexes common to several parts of the ISO 3506 series have been withdrawn from this document and are now included in the new ISO 3506-6 which is to be used with this document;

— austenitic stainless steel of grade A8 and duplex (austenitic-ferritic) stainless steels of grades D2 to D8 for hardness class 21H have been added (see Figure 1);

— operational temperature ranges have been clarified (see Clause 1);

— terms and definitions have been added (see Clause 3);

— wording for surface conditions and corrosion resistance have been improved (see 5.2 and 5.3);

— manufacturer's, supplier's and purchaser's inspections have been added (see Clause 7);

— hardness test and proof torque test methods have been improved (see Clause 8);

— marking and labelling have been improved (see Clause 9);

— structure and content of this document have been brought in line with other parts of ISO 3506 published recently.

A list of all parts in the ISO 3506 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.

Introduction

The properties of stainless steel fasteners result from the chemical composition of the material (especially corrosion resistance) and from the mechanical properties due to manufacturing process. Austenitic and duplex (austenitic-ferritic) stainless steel fasteners are generally manufactured by cold working; they consequently do not have homogeneous local material properties when compared to quenched and tempered fasteners.

Austenitic-ferritic stainless steels referred to as duplex stainless steels were originally invented in the 1930s and have been increasingly used since the 1980s. This document was revised to reflect their standardization for fasteners.

All duplex stainless steels show improved resistance to stress corrosion cracking compared to the commonly used A2 to A5 austenitic grades. Most duplex grades also show higher levels of pitting corrosion resistance, where D2 matches at least A2 and where D4 matches at least A4.

ISO 3506-6 provides general rules and additional technical information on suitable stainless steels and their properties (detailed properties of stainless steel grades, corrosion behaviour with regards to pitting, crevice and intergranular corrosion, magnetic properties, etc.).

Fasteners — Mechanical properties of corrosion resistant stainless steel fasteners —

Part 3:
Set screws (and similar fasteners not under tensile stress) with specified grades and hardness classes

1 Scope

This document specifies the mechanical and physical properties of set screws and similar fasteners not under tensile stress, made of corrosion resistant austenitic and duplex stainless steels, with specified grades and hardness classes.

WARNING — Set screws conforming to the requirements of this document are tested at the ambient temperature range of 10 °C to 35 °C and are used in application ranging from –20 °C to +150 °C. It is possible that they do not retain the specified mechanical and physical properties at lower and/or elevated temperatures. Therefore, it is the responsibility of the user to determine the appropriate choices based on service environment conditions of the assembly (see also Clauses 5 and 6).

This document applies to set screws and similar fasteners not under tensile stress

— with ISO metric thread in accordance with ISO 68-1,

— with diameter/pitch combinations in accordance with ISO 261 and ISO 262,

— with nominal thread diameter 1,6 mm to 24 mm,

— with thread tolerances in accordance with ISO 965-1 and ISO 965-2,

— with specified hardness classes, and

— of any shape.

NOTE The term set screw is used in the following for all screws and similar fasteners not under tensile stress within the scope of this document.

This document does not apply to screws under tensile stress (see ISO 3506-1). It does not specify requirements for functional properties such as shear strength or weldability.

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 965-3, *ISO general purpose metric screw threads — Tolerances — Part 3: Limit deviations for screw threads*

ISO 1891-4, *Fasteners — Vocabulary — Part 4: Control, inspection, delivery, acceptance and quality*

ISO 3506-6, *Fasteners — Mechanical properties of corrosion-resistant stainless steel fasteners — Part 6: General rules for the selection of stainless steels and nickel alloys for fasteners*

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*

ISO 16228, *Fasteners — Types of inspection documents*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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
set screw
headless screw with ISO metric thread designed to be used under compression load

3.2
stainless steel
steel with at least 10,5 % (mass fraction) of chromium (Cr) and maximum 1,2 % (mass fraction) of carbon (C)

[SOURCE: ISO 3506-1:2020, 3.5]

3.3
austenitic stainless steel
stainless steel (3.2) with high amounts of chromium and nickel which usually cannot be hardened by heat treatment, providing excellent resistance to corrosion, good ductility, and usually low or non-magnetic properties

[SOURCE: ISO 3506-1:2020, 3.6]

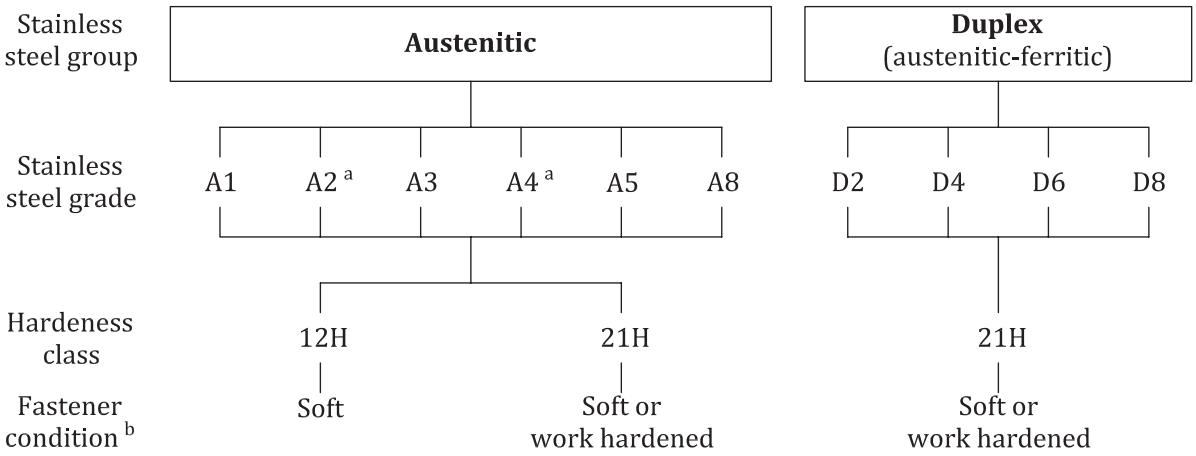
3.4
duplex stainless steel
stainless steel (3.2) with a micro-structure that includes both austenitic and ferritic phases providing excellent resistance to corrosion, containing a higher amount of chromium and a reduced quantity of nickel compared to austenitic steel, with high strength, and with magnetic properties

[SOURCE: ISO 3506-1:2020, 3.9]

4 Designation system for stainless steel grades and hardness classes

4.1 General

The designation system for stainless steel set screws consists of two blocks, separated by a hyphen: the stainless steel grade and the hardness class, as specified in Figure 1.



[a] For low carbon austenitic stainless steels with carbon content not exceeding 0,030 %, set screws can additionally be designated with the letter "L" just after the grade. Example: A4L-21H.

[b] For information only.

Figure 1 — Designation system for stainless steel set screws

The marking, labelling and designation of set screws with stainless steel grade and hardness class shall be as specified in Clause 9.

This designation system may be used for sizes outside the diameter limits specified in this document (e.g. for d > 24 mm), provided that all applicable chemical, mechanical and physical requirements are met.

4.2 Designation of stainless steel grades (first block)

The designation of the stainless steel grade (first block) consists of one letter which specifies the stainless steel group:

— **A** for austenitic,
— **D** for duplex (austenitic-ferritic),

and

— a digit which specifies the range of chemical compositions within this stainless steel group.

The chemical compositions of stainless steel groups and grades classified in Figure 1 are specified in Table 2.

4.3 Designation of hardness classes (second block)

The designation of the hardness class (second block) consists of two parts, as specified in Table 1:

— the number to the left corresponds to 1/10 of the minimum Vickers hardness, and

— the letter H to the right represents Vickers hardness.

Table 1 — Designation of hardness classes in relation to Vickers hardness

Hardness class		**12H**	**21H**
Vickers hardness, HV	min.	125	210

EXAMPLE 1 A2-12H specifies a set screw in austenitic stainless steel of grade A2, soft, with a minimum hardness of 125 HV.

EXAMPLE 2 D4-21H specifies a set screw in duplex stainless steel of grade D4, soft or work hardened, with a minimum hardness of 210 HV.

5 Materials

5.1 Chemical composition

Table 2 specifies the limits for chemical composition of the stainless steel grades for fasteners. The chemical composition shall be assessed in accordance with the relevant International Standards.

The final choice of the chemical composition within the specified stainless steel grade is at the discretion of the manufacturer, unless otherwise agreed between the purchaser and the manufacturer.

The stainless steel grade suitable for an application shall be selected in accordance with ISO 3506-6. ISO 3506-6 also gives examples of stainless steels related to each grade specified in Table 2 (see also Bibliography for additional material information).

Stainless steel grades A2 and A4, as well as A1 for machined screws (e.g. slotted set screws), are usually available on the market; for other grades, it is recommended that a fastener expert be consulted.

For corrosion resistance, see also 5.2 and 5.3.

Table 2 — Stainless steel grades — Chemical composition

Stainless steel grade		Chemical composition [a] (cast analysis, % by mass) [b]										Other elements and notes
		C	Si	Mn	P	S	Cr	Ni	Mo	Cu	N	
Auste-nit-ic	**A1**	0,12	1,00	6,5	0,020	0,15 to 0,35	16,0 to 19,0	5,0 to 10,0	0,70	1,75 to 2,25	—	[c, d, e]
	A2	0,10	1,00	2,00	0,050	0,030	15,0 to 20,0	8,0 to 19,0	— [f]	4,0	—	[g, h]
	A3	0,08	1,00	2,00	0,045	0,030	17,0 to 19,0	9,0 to 12,0	— [f]	1,00	—	$5C \le Ti \le 0,80$ and/or $10C \le Nb \le 1,00$
	A4	0,08	1,00	2,00	0,045	0,030	16,0 to 18,5	10,0 to 15,0	2,00 to 3,00	4,0	—	[h, i]
	A5	0,08	1,00	2,00	0,045	0,030	16,0 to 18,5	10,5 to 14,0	2,00 to 3,00	1,00	—	$5C \le Ti \le 0,80$ and/or $10C \le Nb \le 1,00$ [i]
	A8	0,030	1,00	2,00	0,040	0,030	19,0 to 22,0	17,5 to 26,0	6,0 to 7,0	1,50	—	—

[a] According to material standards, values are maximum unless otherwise specified; the number of digits shown is in accordance with usual rules, see e.g. ISO 6306 or EN 10088-1.

[b] In case of dispute, product analysis applies.

[c] Selenium can be used to replace sulphur, however restrictions may apply to its use.

[d] If the nickel content is below 8,0 %, the minimum manganese content shall be 5,0 %.

[e] There is no minimum limit to the copper content provided that the nickel content is greater than 8,0 %.

[f] 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.

[g] If the chromium content is below 17,0 %, the minimum nickel content should be 12,0 %.

[h] For austenitic stainless steels having a maximum carbon content of 0,030 %, nitrogen may be present but shall not exceed 0,22 % (see ISO 15510).

[i] At the discretion of the manufacturer, the carbon content may be higher as necessary to achieve the specified mechanical and physical properties for larger diameters, but shall not exceed 0,12 %.

[j] This formula is used solely for the purpose of classifying duplex stainless steels in accordance with this document (it is not intended to be used as a selection criterion for corrosion resistance).