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# International Standard



# 3506

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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

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## Corrosion-resistant stainless steel fasteners — Specifications

*Éléments de fixation en acier inoxydable résistant à la corrosion — Spécifications*

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## FOREWORD

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 3506 was developed by Technical Committee ISO/TC 2, *Fasteners*, and was circulated to the member bodies in June 1978.

It has been approved by the member bodies of the following countries :

Australia	Germany, F.R.	Poland
Austria	Hungary	Romania
Belgium	India	South Africa, Rep. of
Bulgaria	Ireland	Sweden
Canada	Italy	Switzerland
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The member body of the following country expressed disapproval of the document on technical grounds :

New Zealand

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# Corrosion-resistant stainless steel fasteners — Specifications

## 0 INTRODUCTION

In the preparation of this International Standard, special attention has been given to the fundamentally different property characteristics of the stainless steel fastener grades compared with carbon and low-alloy steel fasteners of similar dimensions. The ferritic and austenitic stainless steels are strengthened only by cold working, and consequently the components do not have as homogeneous a condition as a hardened and tempered part. These special features have been recognized in the preparation of the clauses applicable to property classes and the mechanical test procedures, which differ from the carbon and low alloy steel fastener test procedures with regard to the measurement of yield point (stress at 0,2 % permanent strain) and ductility (total extension at fracture) on the finished component.

— effective thread engagement is at least 0,6 times nominal diameter.

This International Standard does not define corrosion or oxidation resistance in particular environments. It does specify grades for fasteners made from corrosion-resistant stainless steels. Some have mechanical properties allowing use at temperatures down to  $-200^{\circ}\text{C}$  in air. Some have oxidation resistance allowing use at temperatures up to  $+800^{\circ}\text{C}$  in air.

Acceptable corrosion and oxidation performances and mechanical property values allowing use at elevated or sub-zero temperatures must be the subject of agreement between user and manufacturer wherever appropriate to the proposed service environment.

## 2 REFERENCES

## 1 SCOPE AND FIELD OF APPLICATION

This International Standard gives specifications for bolts, screws, studs and nuts made from austenitic, ferritic and martensitic grades of corrosion-resistant stainless steels.

It is applicable only to fastener components after completion of manufacture,

- with nominal thread diameters from 1,6 up to and including 39 mm,
- of any triangular ISO metric threads according to ISO 68 and with diameters and pitches according to ISO 262,
- of any shape;

and additionally for nuts of any shape provided that

- width across flats or outside diameters is not less than 1,45 times nominal diameter, and

ISO 68, *ISO general purpose screw threads — Basic profile.*

ISO/R 79, *Brinell hardness test for steel.*

ISO/R 80, *Rockwell hardness test (B and C scales) for steel.*

ISO/R 81, *Vickers hardness test for steel.*

ISO 82, *Steel — Tensile testing.*

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

ISO 683/XIII, *Heat-treated steels, alloy steels and free-cutting steels — Part XIII : Wrought stainless steels.*

ISO 898/I, *Mechanical properties of fasteners — Part I : Bolts, screws and studs.*

ISO 898/II, *Mechanical properties of fasteners — Part II : Nuts with specified proof load values.<sup>1)</sup>*

ISO 3651, *Austenitic stainless steels — Determination of resistance to intergranular corrosion.*

ISO 4954, *Steels for cold heading and extruding.<sup>2)</sup>*

1) At present at the stage of draft. (Revision of ISO/R 898/II-1969 and ISO 898/IV-1972.)

2) At present at the stage of draft.

### 3 DESIGNATION, MARKING, FINISH AND MAGNETIC PROPERTIES

#### 3.1 Designation

The designation of fasteners is given in table 1. The steel grades and property classes are designated by a four-character identifier consisting of a letter followed by three digits. The letter indicates the general composition groups of steels as follows :

- A for austenitic steels;
- C for martensitic steels;
- F for ferritic steels.

The first digit following the letter indicates the type of alloying elements present for the particular group A, C or F. The last two digits indicate the property class (metallurgical condition); for example :

- 1) A2-70 indicates :  
austenitic steel, cold-worked, minimum 700 N/mm<sup>2</sup>\* tensile strength.
- 2) C4-70 indicates :  
martensitic 12 % Cr steel, hardened and tempered, minimum 700 N/mm<sup>2</sup> tensile strength.

#### 3.2 Marking

##### 3.2.1 Bolts and screws

All hexagon head screws and bolts and socket cap screws of M5 thread diameter and greater shall be clearly marked in accordance with the designation system given in 3.1. This marking can be applied to other types of bolts and screws where it is technically possible to do so on the head portion only.

The marking shall include the steel grade and property class and also the manufacturer's identification mark (see figure 1). Additional marking can be applied at the option

of the manufacturer or at the specific request of the purchaser. This additional marking should not be liable to cause confusion with any other standardized marking or identification.

##### 3.2.2 Studs and other fasteners

Marking of studs and other fasteners shall be agreed between user and manufacturer.

##### 3.2.3 Nuts

Nuts shall be marked with the steel grade and property class, if necessary, and with the manufacturer's identification mark in the case of nuts of M5 nominal thread diameter and greater (see figure 2), where this is technically possible for the manufacturer. Marking of one nut face is acceptable and shall be by indentation only when applied to the bearing surface of the nuts. Alternatively, marking on the side of the nuts is permissible. Property class marking and designation of nuts is necessary where the nuts do not meet the minimum proof load stress of the highest property class for the steel grade.

##### 3.2.4 Packages and containers

Marking of the designation is mandatory on all packages or containers of all sizes.

#### 3.3 Finish

Unless otherwise specified, stainless steel fasteners shall be supplied clean and bright.

#### 3.4 Magnetic properties

All austenitic stainless steel fasteners are normally non-magnetic; after cold working, some magnetic properties may be evident.

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#### 3.4 Magnetic properties

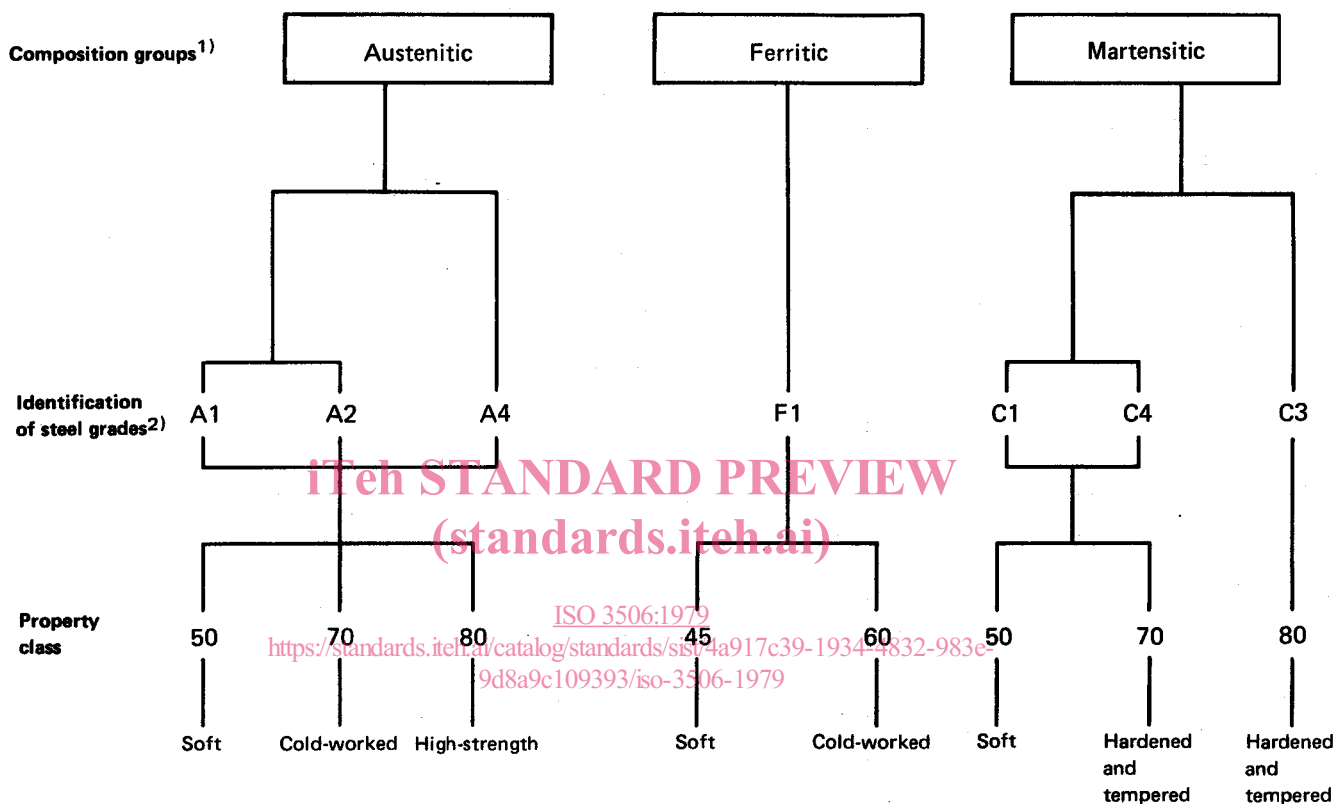
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\* 1 N/mm<sup>2</sup> = 1 MPa



TABLE 1 – ISO designation system for stainless steel fasteners



1) See table 2 for composition ranges.

2) For ISO steels, see ISO 683/XIII, annex A, ISO 4954 and annex B.

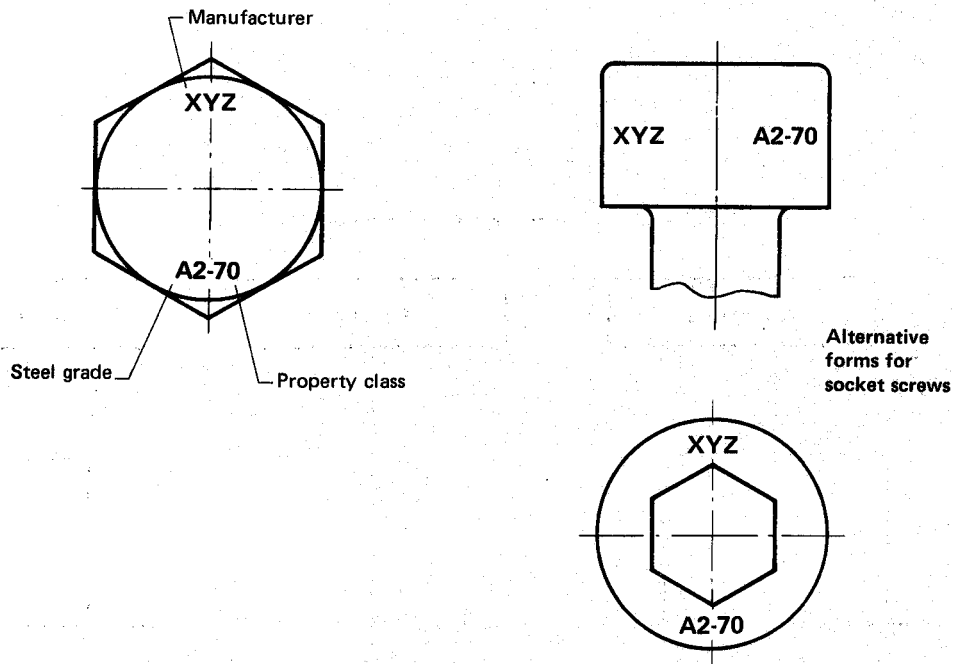


FIGURE 1 – Marking of bolts and screws – Examples

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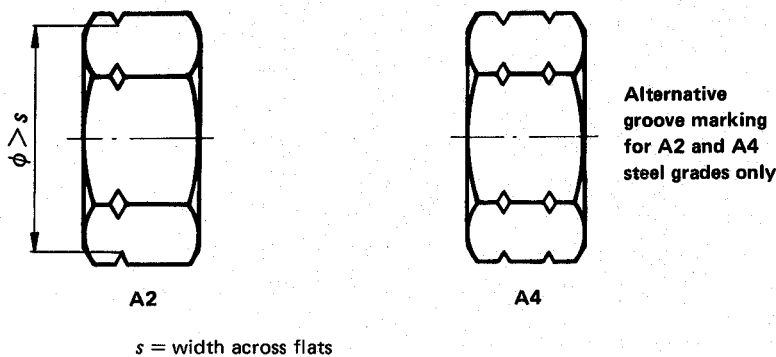
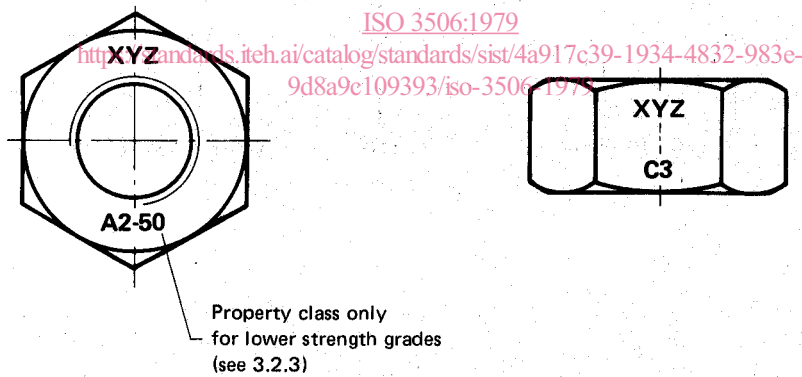


FIGURE 2 – Marking of nuts – Examples of alternative marking practice

NOTE – For marking of left-hand thread, see ISO 898/I and ISO 898/II.

#### 4 CHEMICAL COMPOSITION

The composition ranges of steels suitable for the different steel grades for fasteners are given in table 2.

At the discretion of the manufacturer, fasteners may be manufactured from all steels corresponding to the grade required, except where the user specifies steels covered by particular ISO or national specifications. Alternative steels may be used provided that they give the physical and mechanical properties to the required steel grade and property class and have equivalent corrosion resistance. When alternative compositions are used, consultation between the manufacturer and the user may be necessary in order to ensure suitability for the intended application. Only when all these conditions are met shall parts be marked and/or described according to the designation system described in clause 3.

Austenitic steel fasteners of grades A2 and A4 shall not show any grain-boundary carbide network and shall be resistant to inter-crystalline corrosion tests as defined in ISO 3651.

Grade A1 fasteners can also be supplied resistant to inter-crystalline corrosion subject to prior agreement with the manufacturer.

#### 5 MECHANICAL PROPERTIES

##### 5.1 Tests for acceptability

##### 5.1.1 Bolts, screws and studs of M5 nominal thread diameter and smaller

Testing shall be carried out by one of the following acceptance tests :

- tensile strength, minimum (see 6.2);
- breaking torque, minimum (see 6.5).

(Torque test values are valid only for austenitic steel grades.)

##### 5.1.2 Bolts, screws and studs above M5 nominal thread diameter

- tensile strength, minimum (see 6.2);
- stress at 0,2 % permanent strain, minimum (yield strength) (see 6.3);
- extension value at fracture, minimum (see 6.4);
- hardness test, applicable only to grades C1, C3 and C4 when hardened and tempered (see 6.7).

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TABLE 2 – Stainless steel fasteners – Grade composition ranges

Group	Grade	Chemical composition, % (m/m) <sup>1)</sup>								Notes
		C	Si	Mn	P	S	Cr	Mo <sup>8)</sup>	Ni	
Austenitic	A1	0,12	1,0	2,0	0,20	0,15 to 0,35	17,0 to 19,0	0,6	8,0 to 10,0	2) 3)
	A2	0,08	1,0	2,0	0,05	0,03	17,0 to 20,0		8,0 to 13,0	3) 4) 5) 7)
	A4	0,08	1,0	2,0	0,05	0,03	16,0 to 18,5	2,0 to 3,0	10,0 to 14,0	3) 4) 5)
Martensitic	C1	0,09 to 0,15	1,0	1,0	0,05	0,03	11,5 to 14,0		1,0	6)
	C3	0,17 to 0,25	1,0	1,0	0,04	0,03	16,0 to 18,0		1,5 to 2,5	
	C4	0,08 to 0,15	1,0	1,5	0,06	0,15 to 0,35	12,0 to 14,0	0,6	1,0	2) 6)
Ferritic	F1	0,12	1,0	1,0	0,04	0,03	15,5 to 18,0		0,5	3) 4) 7)

1) Values are maximum unless otherwise indicated.

2) Sulphur may be replaced by selenium.

3) May contain titanium  $\geq 5 \times C$  up to 0,8 % maximum.

4) May contain niobium (columbium) and/or tantalum  $\geq 10 \times C$  up to 1,0 % maximum.

5) May contain copper up to 4,0 % maximum.

6) Carbon content may be higher at the option of the manufacturer, where required to obtain the specified mechanical properties in larger diameters.

7) Molybdenum may also be present at the option of the manufacturer.

8) If for some applications a maximum molybdenum content is essential, this must be stated at the time of ordering by the purchaser.