International Standard ISO 3506

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

Corrosion-resistant stainless steel fasteners — Specifications

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

First edition — 1979-05-15

UDC 621.882 : 669.14.018.8 **Ref. No. ISO 3506-1979 (E)**

Descriptors : fasteners, bolts, screws, studs, nuts (fasteners), specifications, designation, steel products, corrosion resistant steels, stainless steels, austenitic steels, ferritic steels, martensitic steels, chemical composition, marking, mechanical properties, tests, mechanical tests, tension tests, torsion tests, test equipment, elongation at rupture.

Price based on 14 pages

FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

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
Chile	Japan	Turkey
Denmark	Korea, Rep. of	United Kingdom
Egypt, Arab Rep. of	Mexico	USA
Finland	Netherlands	USSR
France	Norway	

The member body of the following country expressed disapproval of the document on technical grounds :

New Zealand

Printed in Switzerland

CONTENTS Page

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.

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
- 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 °C in air. Some have oxidation resistance allowing use at temperatures up to + 800 °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

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.*[1)]

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

ISO 4954, *Steels for cold heading and extruding.*[2)]

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^2* tensile strength.

2) C4-70 indicates :

martensitic 12 % Cr steel, hardened and tempered, minimum 700 N/mm^2 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.

* 1 N/mm^2 = 1 MPa

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.

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
- 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 °C in air. Some have oxidation resistance allowing use at temperatures up to +800 °C in air.

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

2 REFERENCES

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.*[1]

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

ISO 4954, *Steels for cold heading and extruding.*[2]

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^2* tensile strength.

2) C4-70 indicates :

martensitic 12 % Cr steel, hardened and tempered, minimum 700 N/mm^2 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

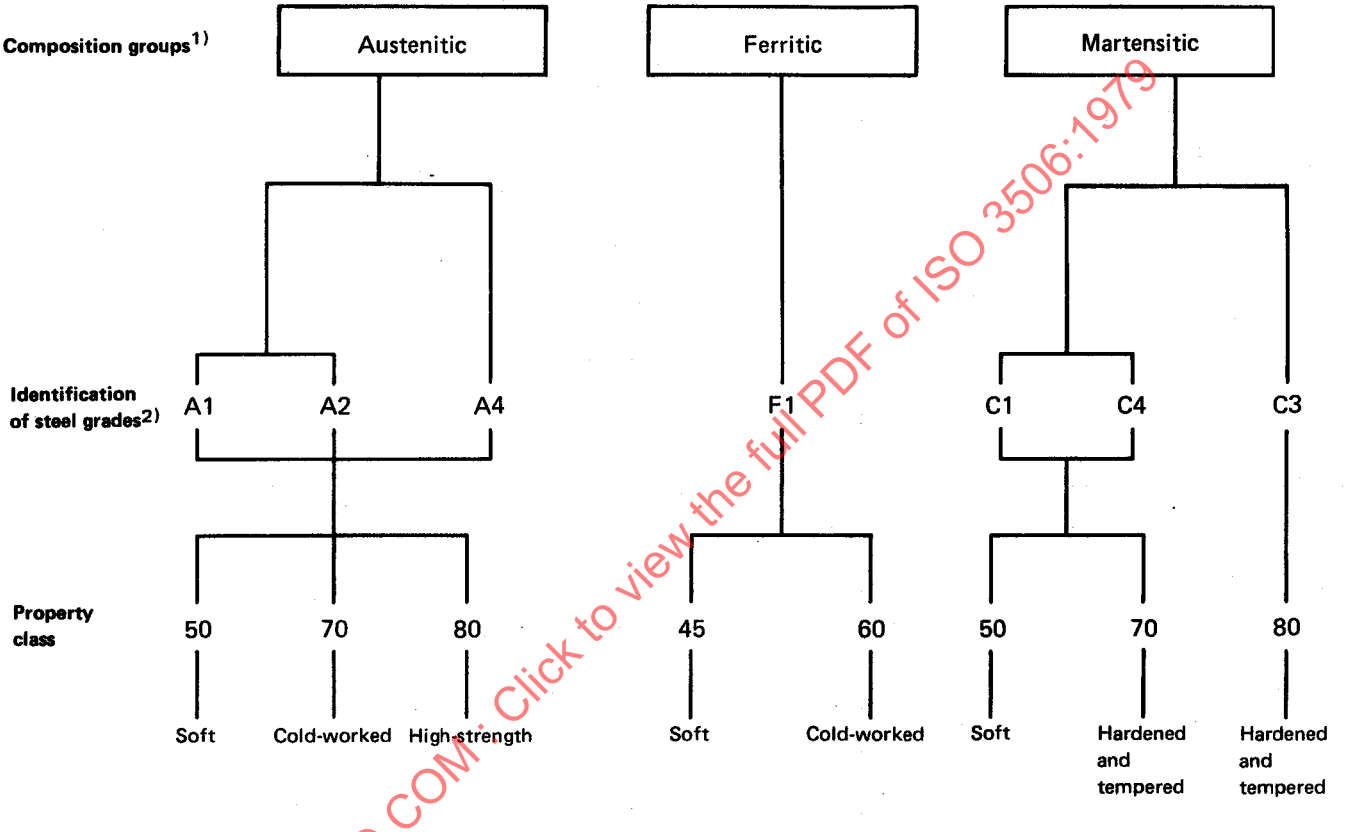
Unless otherwise specified, stainless steel fasteners shall be supplied clean and bright.

3.4 Magnetic properties

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

* 1 N/mm^2 = 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.

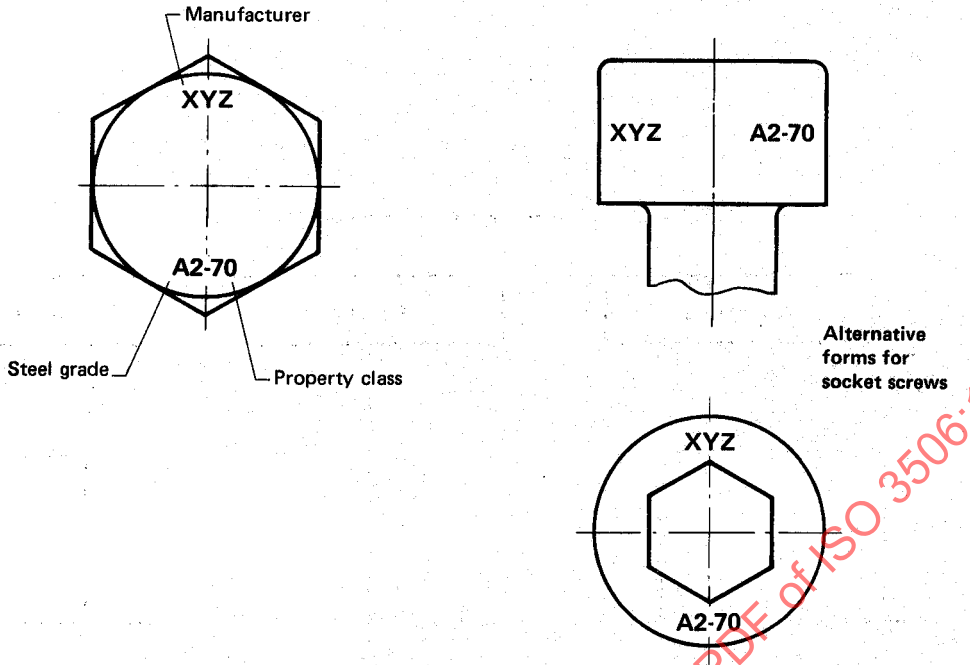
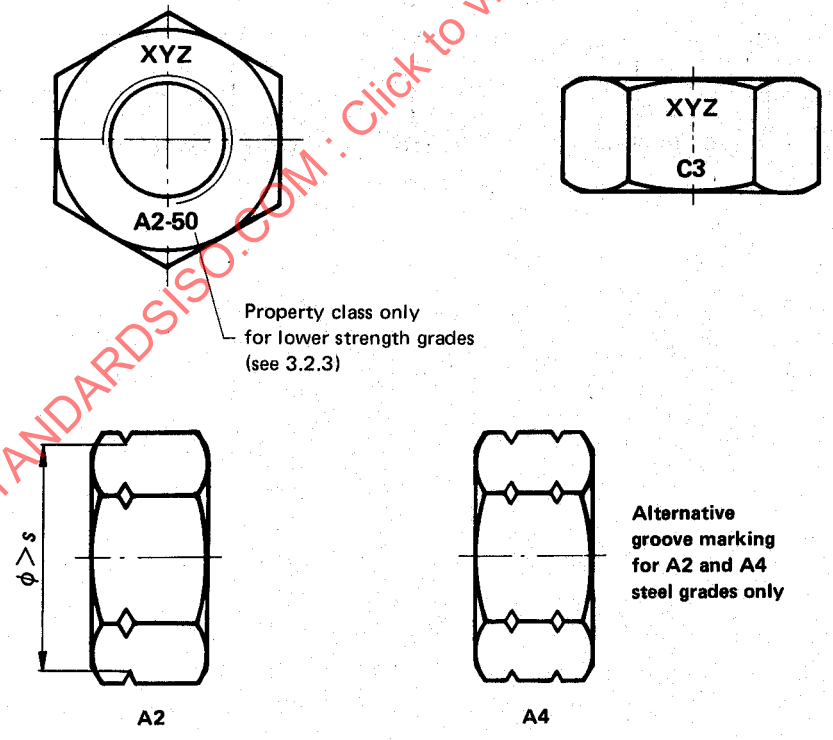


FIGURE 1 — **Marking of bolts and screws — Examples**



s = width across flats

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).

TABLE 2 – **Stainless steel fasteners – Grade composition ranges**

Group	Grade	Chemical composition, % (*m/m*) [1]								Notes
		C	Si	Mn	P	S	Cr	Mo [8]	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.

5.1.3 *Nuts of all nominal thread diameters*

— proof load at corresponding bolt grade minimum tensile strength (see 6.6);

— hardness test, applicable only to grades C1, C3 and C4 when hardened and tempered (see 6.7).

5.2 Mechanical property values

The mechanical properties specified for the various grades and property classes are given in tables 3, 4 and 5.

These mechanical property values apply to products of sizes up to and including eight diameters in length (8 *d*), for A1-, A2- and A4-70 and 80, and F1-60. This length limitation does not apply to fasteners of the soft and the hardened and tempered property classes, i.e. A1-, A2- and A4-50, F1-45, C1-, C3- and C4-50, 70 and 80. For fasteners of greater length strenghened by cold working, mechanical property values shall be agreed upon between user and manufacturer. The agreed values will depend upon the grade of steel and the type of manufacturing process employed.

Minimum breaking torque values for other steel and property grades shall be agreed upon between user and manufacturer.

6 METHODS OF TEST

6.1 General

All length measurements shall be made by methods with an accuracy of ± 0,05 mm or better. All tensile and load tests shall be performed with testing machines equipped with self-aligning grips in order to prevent any non-axial loading (see 6.2, 6.3, 6.4 and 6.6 and figure 3).

TABLE 3 — **Mechanical properties of martensitic and ferritic grade fasteners**

Group	Grade	Property class	Bolts, screws and studs			Nuts	Bolts, screws, studs and nuts					
			Tensile strength R_m [1] N/mm² min.	Stress at 0,2 % permanent strain $R_{p0,2}$ N/mm² min.	Extension A_L [2] min.	Proof load stress S_p N/mm²	Hardness					
							HV		HB		HRC	
							min.	max.	min.	max.	min.	max.
Martensitic	C1	50	500	250	0,2 *d*	500	—	—	—	—	—	—
		70	700	410	0,2 *d*	700	220	330	209	314	20	34
	C3	80	800	640	0,2 *d*	800	240	340	228	323	21	35
	C4	50	500	250	0,2 *d*	500	—	—	—	—	—	—
		70	700	410	0,2 *d*	700	220	330	209	314	20	34
Ferritic	F1 [3]	45	450	250	0,2 *d*	450	—	—	—	—	—	—
		60	600	410	0,2 *d*	600	—	—	—	—	—	—

1) All tensile stress values are calculated and reported in terms of the nominal tensile stress area of the thread (see annex C).

2) The extension measurements are determined in accordance with the test procedure in 6.4 and are on the actual screw or bolt length and not on a prepared test piece gauge length of 5 *d* of the test piece (see annex D).

3) Maximum diameter for F1 is M24.

TABLE 4 — **Mechanical properties of austenitic grade fasteners**

Group	Grade	Property class	Diameter range	Bolts, screws and studs			Nuts
				Tensile strength R_m [1] N/mm² min.	Stress at 0,2 % permanent strain $R_{p0,2}$ N/mm² min.	Extension A_L [2] min.	Proof load stress S_p N/mm²
Austenitic	A1, A2 and A4	50	⩽ M39	500	210	0,6 *d*	500
		70	⩽ M20 [3]	700	450	0,4 *d*	700
		80	⩽ M20 [3]	800	600	0,3 *d*	800

1) All tensile stress values are calculated and reported in terms of the nominal tensile stress area of the thread (see annex C).

2) The extension measurements are determined in accordance with the test procedure in 6.4 and are on the actual screw or bolt length and not on a prepared test piece gauge length of 5 *d* of the test piece (see annex D).

3) Above M20 the higher strength property classes should have the property values specially agreed upon between user and manufacturer because at the tensile strength values given in table 4 alternative values of stress at 0,2 % permanent strain may occur.

TABLE 5 — **Breaking torque (T_m), for screws of M5 and smaller**

Thread size (coarse series)	Breaking torque (minimum) — Austenitic grades only		
	Property class 50 N·m	Property class 70 N·m	Property class 80 N·m
M1,6	0,15	0,2	0,27
M2	0,3	0,4	0,56
M2,5	0,6	0,9	1,2
M3	1,1	1,6	2,1
M4	2,7	3,8	4,9
M5	5,5	7,8	10,0

6.2 Determination of tensile strength (R_m)

Tests shall be carried out on complete bolts and screws in the finished condition, in accordance with the test procedure specified in ISO 82 and ISO 898. This test is applicable only to fasteners of lengths equal to twice the diameter (2 d) or longer.

When carrying out the test, a free threaded length at least equal to one diameter (d) shall be subject to the tensile load.

The measured tensile strength value must be at least equal to the values given in tables 3 and 4, irrespective of the location of the point of fracture between the bearing face of the bolt head and the end of the adapter.

6.3 Determination of stress at 0,2 % permanent strain ($R_{p0,2}$)

Tests for determination of stress at 0,2 % permanent strain shall be carried out only on complete bolts and screws in the finished condition. This test is applicable only to fasteners of lengths equal to twice the diameter (2 d) or longer.

The test shall be carried out by measuring the extension of the bolt or screw when subjected to axial tensile loading (see figure 3).

A curve of load against extension shall be plotted as shown in figure 4.

The clamping length from which $R_{p0,2}$ is calculated is taken as the distance L_3 between the underside of the head and the threaded adapter — see figure 3 (see also note 2 below tables 3 and 4). A value equal to 0,2 % of L_3 is then applied to the horizontal (strain) axis of the load-extension curve, OP, and the same value is plotted horizontally from the straight-line portion of the curve as QR. A line is then drawn through P and R and the intersection, S, of this line with the load-extension curve corresponds to a load at point T on the vertical axis. This load, when divided by the thread tensile stress area, gives the stress at 0,2 % permanent strain ($R_{p0,2}$).

The component under test shall be screwed into a hardened threaded adapter to a depth of one diameter (see figure 3).

The value of extension is determined between the bearing face of the bolt head and the end of the adapter.

6.4 Determination of total extension at fracture (A_L)

The extension test shall be carried out on bolts, screws and studs in the finished condition. It is applicable only to fasteners with lengths equal to three times the diameter (3 d) or longer.

The component under test shall be screwed into the threaded adapter to a depth of one diameter (see figure 3).

After the bolt or screw has been fractured in accordance with the tensile testing procedure, the two broken pieces shall be fitted closely together and the overall length (L_2) measured again (see figure 5).

The total extension at fracture shall then be calculated using the formula

$$A_L = L_2 - L_1$$

The value obtained shall exceed the minimum values of the appropriate property value tables.

If this test is required on machined samples, the test values should be specially agreed.

6.5 Determination of breaking torque (T_m)

The screws shall be tested in a clamping device as shown in figure 6. At failure under the applied torque, the minimum torque given in table 5 shall be exceeded.

The shank of the screw shall be clamped in a mating split blind-hole die in order that at least two full threads project above the clamping device, and a length equivalent to one nominal diameter, exclusive of the point, shall be held within the clamping device.

For this breaking torque test, a calibrated torque-measuring instrument shall be used with a measuring range not exceeding five times the specified minimum value.

The accuracy of the torque-measuring device shall not be worse than ± 7 % of the minimum specification value for the screw diameter to be tested.

6.6 Proof load test for nuts

The test procedure shall be in accordance with ISO 898/II.

The nut shall be assembled on a threaded mandrel and the specified load according to the thread size, steel grade and property class applied. The nut shall be capable of being fully loaded up to the proof load (specified minimum tensile strength of bolts of the same steel grade and property class) of the appropriate property class without thread stripping occurring.

6.7 Hardness test

Hardness tests shall be carried out in accordance with ISO/R 79 (Brinell), ISO/R 80 (Rockwell) or ISO/R 81 (Vickers).

The hardness tests on bolts shall be made at the end of the bolt, midway between the centre and the circumference.

The hardness test on nuts shall be made on the bearing face midway between the corner and the thread chamfer.

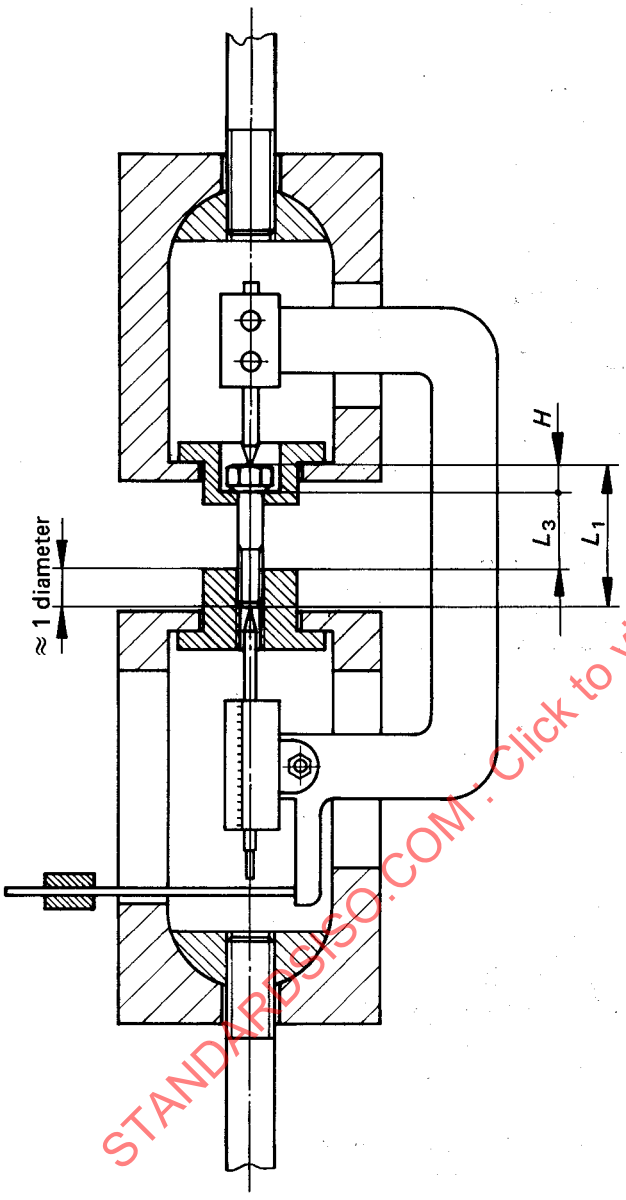


FIGURE 3 — **Bolt extensometer with self-aligning grips**

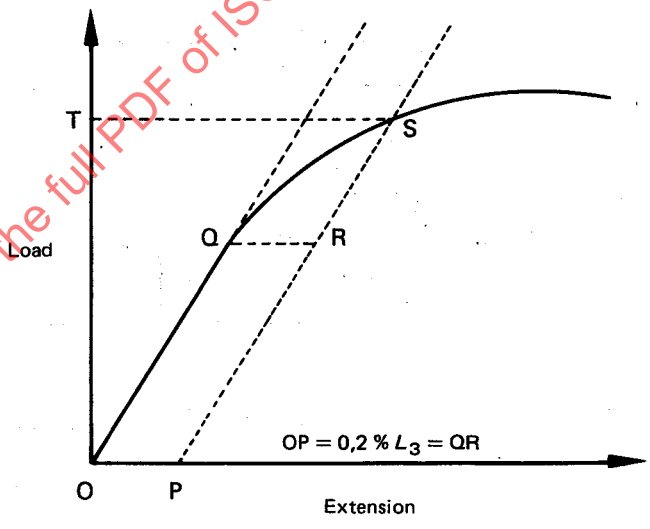


FIGURE 4 — **Load-extension curve for stress at 0,2 % permanent strain ($R_{p0,2}$)** (see 6.3)

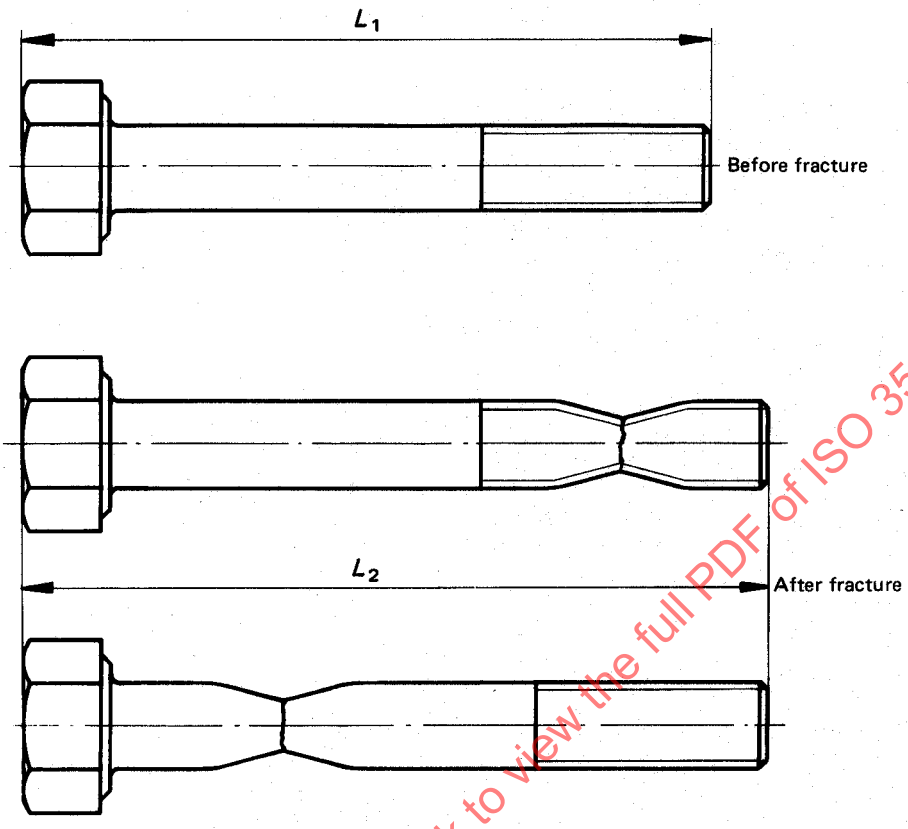


FIGURE 5 – **Determination of total extension at fracture** (A_L) (see 6.4)

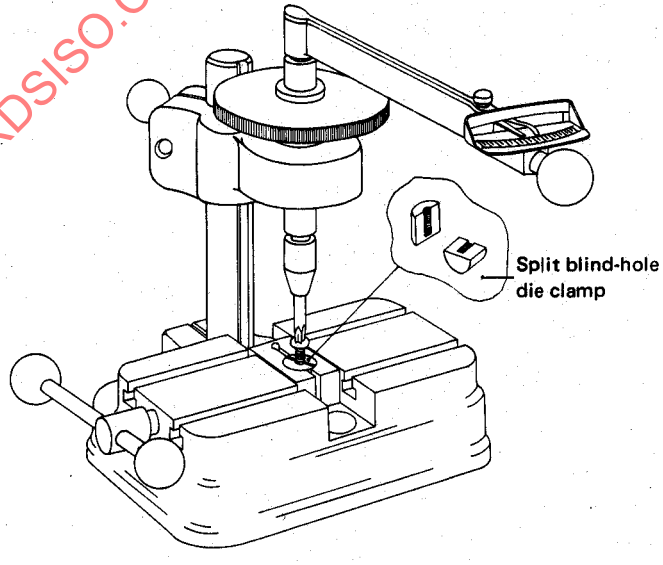


FIGURE 6 – **Apparatus for determination of breaking torque** (T_m) (see 6.5)

ANNEX A

STAINLESS STEEL COMPOSITION SPECIFICATIONS[1)]
(Extract from ISO 683/XIII)

Type of steel	C %	Si %	Mn %	P %	S %	Cr %	Mo %	Ni %	Other elements, %	Fastener grade identification
Ferritic steels										
8	0,10	1,0	1,0	0,040	0,030	16,0 to 18,0	–	⩽ 0,50		F1
8b	0,10	1,0	1,0	0,040	0,030	16,0 to 18,0	–	⩽ 0,50	5 × % C ⩽ Ti ⩽ 0,80	F1
9c	0,10	1,0	1,0	0,040	0,030	16,0 to 18,0	0,90 to 1,30	–		F1
Martensitic steels										
3	0,09 to 0,15	1,0	1,0	0,040	0,030	11,5 to 14,0	–	⩽ 1,0		C1
7	0,08 to 0,15	1,0	1,5	0,060	0,15 to 0,35	12,0 to 14,0	0,60 max.	⩽ 1,0		C4
4	0,16 to 0,25	1,0	1,0	0,040	0,030	12,0 to 14,0	–	⩽ 1,0		C1
9	0,10 to 0,20	1,0	1,0	0,040	0,030	15,0 to 18,0	–	1,5 to 3,0		C3
9b	0,17 to 0,25	1,0	1,0	0,040	0,030	16,0 to 18,0	–	1,5 to 2,5		C3
5	0,26 to 0,35	1,0	1,0	0,040	0,030	12,0 to 14,0	–	⩽ 1,0		C1
6	0,36 to 0,45	1,0	1,0	0,040	0,030	12,5 to 14,5	–	⩽ 1,0		C1
6a	0,42 to 0,50	1,0	1,0	0,040	0,030	12,5 to 14,5	–	⩽ 1,0		C1
Austenitic steels										
10	0,030	1,0	2,0	0,045	0,030	17,0 to 19,0	–	9,0 to 12,0		A2
11	0,07	1,0	2,0	0,045	0,030	17,0 to 19,0	–	8,0 to 11,0		A2
17	0,12	1,0	2,0	0,045	0,15 to 0,35	17,0 to 19,0	0,60 max.	8,0 to 10,0		A1
13	0,10	1,0	2,0	0,045	0,030	17,0 to 19,0	–	11,0 to 13,0		A2
15	0,08	1,0	2,0	0,045	0,030	17,0 to 19,0	–	9,0 to 12,0	5 × % C ⩽ Ti ⩽ 0,80	A2
16	0,08	1,0	2,0	0,045	0,030	17,0 to 19,0	–	9,0 to 12,0	10 × % C ⩽ Nb ⩽ 1,0	A2
19	0,030	1,0	2,0	0,045	0,030	16,0 to 18,5	2,0 to 2,5	11,0 to 14,0		A4
20	0,07	1,0	2,0	0,045	0,030	16,0 to 18,5	2,0 to 2,5	10,5 to 14,0		A4
21	0,08	1,0	2,0	0,045	0,030	16,0 to 18,5	2,0 to 2,5	10,5 to 14,0	5 × % C ⩽ Ti ⩽ 0,80	A4
23	0,08	1,0	2,0	0,045	0,030	16,0 to 18,5	2,0 to 2,5	10,5 to 14,0	10 × % C ⩽ Nb ⩽ 1,0	A4
19a	0,030	1,0	2,0	0,045	0,030	16,0 to 18,5	2,5 to 3,0	11,5 to 14,5		A4
20a	0,07	1,0	2,0	0,045	0,030	16,0 to 18,5	2,5 to 3,0	11,0 to 14,5		A4
21a	0,08	1,0	2,0	0,045	0,030	16,0 to 18,5	2,5 to 3,0	11,0 to 14,5	5 × % C ⩽ Ti ⩽ 0,80	A4
23a	0,08	1,0	2,0	0,045	0,030	16,0 to 18,5	2,5 to 3,0	11,0 to 14,5	10 × % C ⩽ Nb ⩽ 1,0	A4

1) This annex gives only a preliminary list of steels, pending the final version of ISO 683/XIII, which is under revision. The values given are maxima unless otherwise indicated.

ANNEX B

STAINLESS STEELS FOR COLD HEADING AND EXTRUDING
(Extract from ISO 4954)

Type of steel	C %	Si % max.	Mn % max.	P % max.	S % max.	Cr %	Mo %	Ni %	Other elements, %	Fastener grade identification
Ferritic steels										
D 1	⩽ 0,10	1,00	1,00	0,040	0,030	16,0/18,0		⩽ 0,50		F1
D 2	⩽ 0,10	1,00	1,00	0,040	0,030	16,0/18,0	0,90/1,30			F1
Martensitic steels										
D 10	0,09/0,15	1,00	1,00	0,040	0,030	11,5/14,0		⩽ 1,0		C1
D 11	0,10/0,20	1,00	1,00	0,040	0,030	15,0/18,0		1,5/3,0		(C3)
D 12	0,17/0,25	1,00	1,00	0,040	0,030	16,0/18,0		1,5/2,5		C3
Austenitic steels[1]										
D 20	⩽ 0,030	1,00	2,00	0,045	0,030	17,0/19,0		9,0/12,0		A2
D 21	⩽ 0,07	1,00	2,00	0,045	0,030	17,0/19,0		8,0/11,0		A2
D 22	⩽ 0,12	1,00	2,00	0,045	0,030	17,0/19,0		8,0/10,0		A2
D 23	⩽ 0,10	1,00	2,00	0,045	0,030	17,0/19,0		11,0/13,0		A2
D 24	⩽ 0,030	1,00	2,00	0,045	0,030	15,0/17,0		17,0/19,0		A2
D 25	0,08	1,00	2,00	0,045	0,030	15,0/17,0		17,0/19,0		A2
D 26	⩽ 0,08	1,00	2,00	0,045	0,030	17,0/19,0		9,0/12,0	Ti : 5 × % C/0,80	A2
D 27	⩽ 0,08	1,00	2,00	0,045	0,030	17,0/19,0		9,0/12,0	Nb : 10 × % C/1,0[2]	A2
D 28	⩽ 0,030	1,00	2,00	0,045	0,030	16,0/18,5	2,0/2,5	11,0/14,0		A4
D 29	⩽ 0,007	1,00	2,00	0,045	0,030	16,0/18,5	2,0/2,5	10,5/14,0		A4
D 30	⩽ 0,08	1,00	2,00	0,045	0,030	16,0/18,5	2,0/2,5	10,5/14,0	Ti : 5 × % C/0,80	A4
D 31	⩽ 0,08	1,00	2,00	0,045	0,030	16,0/18,5	2,0/2,5	10,5/14,0	Nb : 10 × % C/1,0[2]	A4
D 32	⩽ 0,08	1,00	2,00	0,045	0,030	16,0/18,5		8,5/10,5	Cu : 3,00/4,00	A2

1) The cold extrudability of these steels is in a high degree dependent on the cold extruding conditions.

2) Tantalum determined as niobium.

ANNEX A

STAINLESS STEEL COMPOSITION SPECIFICATIONS[1)]
(Extract from ISO 683/XIII)

Type of steel	C %	Si %	Mn %	P %	S %	Cr %	Mo %	Ni %	Other elements, %	Fastener grade identification
Ferritic steels										
8	0,10	1,0	1,0	0,040	0,030	16,0 to 18,0	–	⩽ 0,50		F1
8b	0,10	1,0	1,0	0,040	0,030	16,0 to 18,0	–	⩽ 0,50	5 X % C ⩽ Ti ⩽ 0,80	F1
9c	0,10	1,0	1,0	0,040	0,030	16,0 to 18,0	0,90 to 1,30	–		F1
Martensitic steels										
3	0,09 to 0,15	1,0	1,0	0,040	0,030	11,5 to 14,0	–	⩽ 1,0		C1
7	0,08 to 0,15	1,0	1,5	0,060	0,15 to 0,35	12,0 to 14,0	0,60 max.	⩽ 1,0		C4
4	0,16 to 0,25	1,0	1,0	0,040	0,030	12,0 to 14,0	–	⩽ 1,0		C1
9	0,10 to 0,20	1,0	1,0	0,040	0,030	15,0 to 18,0	–	1,5 to 3,0		C3
9b	0,17 to 0,25	1,0	1,0	0,040	0,030	16,0 to 18,0	–	1,5 to 2,5		C3
5	0,26 to 0,35	1,0	1,0	0,040	0,030	12,0 to 14,0	–	⩽ 1,0		C1
6	0,36 to 0,45	1,0	1,0	0,040	0,030	12,5 to 14,5	–	⩽ 1,0		C1
6a	0,42 to 0,50	1,0	1,0	0,040	0,030	12,5 to 14,5	–	⩽ 1,0		C1
Austenitic steels										
10	0,030	1,0	2,0	0,045	0,030	17,0 to 19,0	–	9,0 to 12,0		A2
11	0,07	1,0	2,0	0,045	0,030	17,0 to 19,0	–	8,0 to 11,0		A2
17	0,12	1,0	2,0	0,045	0,15 to 0,35	17,0 to 19,0	0,60 max.	8,0 to 10,0		A1
13	0,10	1,0	2,0	0,045	0,030	17,0 to 19,0	–	11,0 to 13,0		A2
15	0,08	1,0	2,0	0,045	0,030	17,0 to 19,0	–	9,0 to 12,0	5 X % C ⩽ Ti ⩽ 0,80	A2
16	0,08	1,0	2,0	0,045	0,030	17,0 to 19,0	–	9,0 to 12,0	10 X % C ⩽ Nb ⩽ 1,0	A2
19	0,030	1,0	2,0	0,045	0,030	16,0 to 18,5	2,0 to 2,5	11,0 to 14,0		A4
20	0,07	1,0	2,0	0,045	0,030	16,0 to 18,5	2,0 to 2,5	10,5 to 14,0		A4
21	0,08	1,0	2,0	0,045	0,030	16,0 to 18,5	2,0 to 2,5	10,5 to 14,0	5 X % C ⩽ Ti ⩽ 0,80	A4
23	0,08	1,0	2,0	0,045	0,030	16,0 to 18,5	2,0 to 2,5	10,5 to 14,0	10 X % C ⩽ Nb ⩽ 1,0	A4
19a	0,030	1,0	2,0	0,045	0,030	16,0 to 18,5	2,5 to 3,0	11,5 to 14,5		A4
20a	0,07	1,0	2,0	0,045	0,030	16,0 to 18,5	2,5 to 3,0	11,0 to 14,5		A4
21a	0,08	1,0	2,0	0,045	0,030	16,0 to 18,5	2,5 to 3,0	11,0 to 14,5	5 X % C ⩽ Ti ⩽ 0,80	A4
23a	0,08	1,0	2,0	0,045	0,030	16,0 to 18,5	2,5 to 3,0	11,0 to 14,5	10 X % C ⩽ Nb ⩽ 1,0	A4

1) This annex gives only a preliminary list of steels, pending the final version of ISO 683/XIII, which is under revision. The values given are maxima unless otherwise indicated.