

Marking and mechanical requirements for fasteners in stainless steel

Table 191 Stainless steel screws/nuts

	<p>Alternative marking for screws with cylindrical heads and hexagon holes</p>	<p>1) manufacturer's identification mark 2) steel grade 3) property class</p> <p>Thin nuts</p> <p>Alternative groove marking (for A2 and A4 steel grades only)</p>
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Source: EN ISO 3506-1.

Table 192 Designation system for stainless steel grades and property classes for bolts, screws and nuts

Steel group ¹⁾	Austenitic					Martensitic					Ferritic		
Steel grade ¹⁾	A1	A2 ²⁾	A3	A4 ²⁾	A5	C1		C4		C3		F1	
Property class													
Screws													
Nuts style I	50		70		80	50	70	110	50	70	80	45	60
Thin nuts	025		035		040	025	035	055	025	035	040	020	030
	Soft		Cold-worked		High-strength	Soft	Hardened and tempered		Soft	Hardened and tempered	Hardened and tempered	Soft	Cold worked

¹⁾ The steel groups and steel grades classified in the table above are described on page 215 and specified by the chemical composition in table 6.1.

²⁾ Low carbon stainless steels with carbon content not exceeding 0,03% may additionally be marked with an L.
Example: A4L - 80.

Source: EN ISO 3506-2.

Designation

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

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

which indicate the group of steel and a digit which indicates a range of chemical compositions within this steel group.

The designation of the property class (second block) consists of 2 digits which indicates 1/10 of the tensile strength of the fastener:

Examples:

- 1) **A2-70** indicates:
austenitic steel, cold worked, minimum 700 N/mm² (700 MPa) tensile strength.
- 2) **C4-70** indicates:
martensitic steel, hardened and tempered, minimum 700 N/mm² (700 MPa) tensile strength.

Table 193 Designation system for stainless steel grades and property classes for set screws and similar fasteners

Steel group	Austenitic				
Steel grade ¹⁾	A1	A2 ²⁾	A3	A4 ²⁾	A5
Property class					
	12H				21H
	Soft				Cold worked

¹⁾ The steel grades classified in the table above are described on page 215 and specified by the chemical composition in table 6.1.

²⁾ Low carbon stainless steels with carbon content not exceeding 0,03% may additionally be marked with an L.
Example: A4L - 21H.

Source: EN ISO 3506-3.

Table 6.1 Stainless steel grades - Chemical composition

Group	Grade	Chemical composition % (m/m) ¹⁾									Notes
		C	Si	Mn	P	S	Cr	Mo	Ni	Cu	
Austenitic	A1	0,12	1	6,5	0,2	0,15 - 0,35	16 - 19	0,7	5 - 10	1,75 - 2,25	2) 3) 4)
	A2	0,1	1	2	0,05	0,03	15 - 20	— ⁵⁾	8 - 19	4	7) 8)
	A3	0,08	1	2	0,045	0,03	17 - 19	— ⁵⁾	9 - 12	1	9)
	A4	0,08	1	2	0,045	0,03	16 - 18,5	2 - 3	10 - 15	1	8) 10)
	A5	0,08	1	2	0,045	0,03	16 - 18,5	2 - 3	10,5 - 14	1	9) 10)
Martensitic ^{a)}	C1	0,09 - 0,15	1	1	0,05	0,03	11,5 - 14	—	1	—	10)
	C3	0,17 - 0,25	1	1	0,04	0,03	16 - 18	—	1,5 - 2,5	—	
	C4	0,08 - 0,15	1	1,5	0,06	0,15 - 0,35	12 - 14	0,6	1	—	2) 10)
Ferritic ^{a)}	F1	0,12	1	1	0,04	0,03	15 - 18	— ⁶⁾	1	—	11) 12)

1) Values are maximum unless otherwise indicated.

2) Sulfur may be replaced by selenium.

3) If the nickel content is below 8%, the minimum manganese content must be 5%.

4) There is no minimum limit to the copper content provided that the nickel content is greater than 8%.

5) Molybdenum may be present at the discretion of the manufacturer. However, if for some applications limiting of the molybdenum content is essential, this must be stated at the time of ordering by the purchaser.

6) Molybdenum may be present at the discretion of the manufacturer.

7) If the chromium content is below 17%, the minimum nickel content should be 12%.

8) For austenitic stainless steels having a maximum carbon content of 0,03%, nitrogen may be present to a maximum of 0,22%.

9) Must contain titanium $\geq 5 \times C$ up to 0,8% maximum for stabilization and be marked appropriately in accordance with this table, or must contain niobium (columbium) and/or tantalum $\geq 10 \times C$ up to 1,0% maximum for stabilization and be marked appropriately in accordance with this table.

10) At the discretion of the manufacturer the carbon content may be higher where required to obtain the specified mechanical properties at larger diameters, but shall not exceed 0,12% for austenitic steels.

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

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

a) Not valid for set screws.

Source: EN ISO 3506.

Table 6 Stainless material translations

Description for types of steel according to ISO 3506	Corresponding types of steel according to Swedish material standards
A1	SS-steel 2346
A2	SS-steel 2332, SS-steel 2333, SS-steel 2337, SS-steel 2338, SS-steel 2351
A4	SS-steel 2343, SS-steel 2347, SS-steel 2350, SS-steel 2353
C1	SS-steel 2302, SS-steel 2303, SS-steel 2304
C3	SS-steel 2321
C4	SS-steel 2380
F1	SS-steel 2320, SS-steel 2326

Table 94 Application of stainless steel bolts, screws and studs at low temperatures (austenitic steel only)

Steel grade	Lower limits of operational temperature at continuous operation	
A2	-200 °C	
A4	bolts and screws ¹⁾	- 60 °C
	studs	-200 °C

1) In connection with the alloying element Mo the stability of the austenite is reduced and the transition temperature is shifted to

higher values if a high degree of deformation during manufacturing of the fastener is applied.

Table 95 Influence of temperature on R_{eL} and $R_{p0,2}$

Steel grade	R_{eL} and $R_{p0,2}$ % Temperature			
	+100 °C	+200 °C	+300 °C	+400 °C
A2 A4	85	80	75	70
C1	95	90	80	65
C3	90	85	80	60

NOTE - This applies to property classes 70 and 80 only.

Source: SS-EN ISO 3506-2.

Lower yield stress or stress at 0,2% permanent strain at elevated temperatures

The values given above are for guidance only. Users should understand that the actual chemistry, loading of the installed fastener and the environment may cause significant variation. If loads are fluctuating and operating periods at

elevated temperatures are great or the possibility of stress corrosion is high the user should consult the manufacturer.

Table 176 Mechanical properties for bolts, screws and studs - Austenitic grades

Group	Grade	Property class	Thread diameter range	Tensile strength $R_m^{1)}$ min. N/mm ²	Stress at 0,2% permanent strain $R_{p0,2}^{1)}$ min. N/mm ²	Elongation after fracture $A^{2)}$ min. mm
Austenitic	A1, A2	50	≤M39	500	210	0,6 d
	A3, A4	70	≤M24 ³⁾	700	450	0,4 d
	A5	80	≤M24 ³⁾	800	600	0,3 d

1) The tensile stress is calculated on the stress area.

2) To be determined on the actual screw length and not on a prepared test piece; d is the nominal thread diameter.

3) For fasteners with nominal thread diameters $d > 24$ mm the mechanical properties shall be agreed upon between user and manufacturer and marked with grade and property class according to this table.

Table 177 Mechanical properties for bolts, screws and studs - Martensitic and ferritic grades

Group	Grade	Property class	Tensile strength $R_m^{1)}$ min. N/mm ²	Stress at 0,2% permanent strain $R_{p0,2}^{1)}$ min. N/mm ²	Elongation after fracture $A^{2)}$ min. mm	Hardness		
						HB	HRC	HV
Martensitic	C1	50	500	250	0,2 d	147 - 209	—	155 - 220
		70	700	410	0,2 d	209 - 314	20 - 34	220 - 330
		110 ³⁾	1100	820	0,2 d	—	36 - 45	350 - 440
	C3	80	800	640	0,2 d	228 - 323	21 - 35	240 - 340
	C4	50	500	250	0,2 d	147 - 209	—	155 - 220
		70	700	410	0,2 d	209 - 314	20 - 34	220 - 330
Ferritic	F1 ⁴⁾	45	450	250	0,2 d	128 - 209	—	135 - 220
		60	600	410	0,2 d	171 - 271	—	180 - 285

1) The tensile stress is calculated on the stress area.

2) To be determined on the actual screw length and not on a prepared test piece; d is the nominal thread diameter.

3) Hardened and tempered at a minimum tempering temperature of 275°C.

4) Nominal thread diameter $d \leq 24$ mm.

Table 178 Minimum breaking torque, $M_{B,min}$ for austenitic grade bolts and screws M1,6 - M16 (coarse thread)

Thread	Minimum breaking torque, $M_{B,min}$ Nm		
	Property class		
	50	70	80
M1,6	0,15	0,2	0,24
M2	0,3	0,4	0,48
M2,5	0,6	0,9	0,96
M3	1,1	1,6	1,8
M4	2,7	3,8	4,3
M5	5,5	7,8	8,8
M6	9,3	13	15
M8	23	32	37
M10	46	65	74
M12	80	110	130
M16	210	290	330

Minimum breaking torque values for martensitic and ferritic grade fasteners shall be agreed upon between manufacturer and user.

Table 179 Mechanical properties for nuts - Austenitic grades

Group	Grade	Property class		Range of thread diameter d mm	Stress under proof load S_p min N/mm ²	
		Nuts style I ($m \geq 0,8 d$)	Thin nuts ($0,5 d \leq m < 0,8 d$)		Nuts style I ($m \geq 0,8 d$)	Thin nuts ($0,5 d \leq m < 0,8 d$)
Austenitic	A1	50	025	≤ 39	500	250
	A2, A3	70	035	$\leq 24^{1)}$	700	350
	A4, A5	80	040	$\leq 24^{1)}$	800	400

1) For fasteners with nominal thread diameters $d > 24$ mm the mechanical properties shall be agreed upon between user and manufacturer and marked

with grade and property class according to this table.

Table 180 Mechanical properties for nuts - Martensitic and ferritic grades

Group	Grade	Property class		Stress under proof load S_p min N/mm ²		Hardness		
		Nuts style I ($m \geq 0,8 d$)	Thin nuts ($0,5 d \leq m < 0,8 d$)	Nuts style I ($m \geq 0,8 d$)	Thin nuts ($0,5 d \leq m < 0,8 d$)	HB	HRC	HV
Martensitic	C1	50	025	500	250	147 - 209	—	155 - 220
		70	—	700	—	209 - 314	20 - 34	220 - 330
		110 ¹⁾	055 ¹⁾	1100	550	—	36 - 45	350 - 440
	C3	80	040	800	400	228 - 323	21 - 35	240 - 340
	C4	50	—	500	—	147 - 209	—	155 - 220
		70	035	700	350	209 - 314	20 - 34	220 - 330
Ferritic	F1 ²⁾	45	020	450	200	128 - 209	—	135 - 220
		60	030	600	300	171 - 271	—	180 - 285

1) Hardened and tempered at a minimum tempering temperature of 275°C.

2) Nominal thread diameter $d \leq 24$ mm.

Table 182 Hardness - Set screws shall conform to the hardness requirements given in the table below

Test method	Property class	
	12H	21H
	Hardness	
Vickers hardness HV	125 - 209	210 min
Brinell hardness HB	123 - 213	214 min
Rockwell hardness HRB	70 - 95	96 min

Table 181 Proof torque of hexagon socket set screws

Hexagon socket set screws shall conform to the torque requirements given in table 181

Nominal thread diameter d	Minimum length ¹⁾ of set screws for test mm				Proof torque Nm min	
					Property class	
	Flat point	Cone point	Dog point	Cup point	12H	21H
1,6	2,5	3	3	2,5	0,03	0,05
2	4	4	4	3	0,06	0,1
2,5	4	4	5	4	0,18	0,3
3	4	5	6	5	0,25	0,42
4	5	6	8	6	0,8	1,4
5	6	8	8	6	1,7	2,8
6	8	8	10	8	3	5
8	10	10	12	10	7	12
10	12	12	16	12	14	24
12	16	16	20	16	25	42
16	20	20	25	20	63	105
20	25	25	30	25	126	210
24	30	30	35	30	200	332

1) The minimum lengths to be tested are the lengths having the normal hexagon socket depth.