STEEL TUBES INDIA
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A2 vs A4 Stainless Steel Bolts

Grades A1, A2 (A3) & A4 (A5) Stainless Steel Fasteners Comparison

Stainless Steel Fasteners to BS EN ISO 3506
Grades A1, A2 (A3) & A4 (A5)

Stainless steel fasteners are specified in BS EN ISO 3506
Part 1 covers bolts, screw & studs. Part 2 covers nuts and part 4 (published in 2003), covers tapping screws.
These specifications replace BS6105, which is withdrawn as a British Standard.

Chemical Compositions

The chemical compositions of austenitic stainless steel fasteners with the designations A1, A2 & A4 are shown in table 1. (These designations are common for the different parts of BSENISO 3506. The composition ranges are based on part 1 and vary slightly to those in part 4). The table shows some of the grade designations, which have been used, in other British Standards

Table 1 - Chemical Compositions for Austenitic Stainless Steel Fasteners

Grade	Chemical Composition (% maxima unless stated)									Types Included
	C	Si	Mn	S	P	Cr	Mo	Ni	Cu	
A1	0.12	1	6.5	0.15-0.35	0.20	16-19	0.7	5-10	1.75-2.25	303, 1.4305
A2	0.1	1	2	0.03	0.05	15-20	-	8-19	4	304,349S17 (BS3111) 1.4567
A4	0.08	1	2	0.03	0.045	16-18.5	2-3	10-15	1	316,396S17 (BS3111)

Notes

Either sulphur or selenium (less common) is allowed in grade A1.
These additions make the steel free machining for ease of manufacture but can reduce the corrosion resistance under certain conditions such as marine environments (chloride pitting attack risk)

Grade A2 does not specify molybdenum additions but allows these (Normally the deliberate addition of molybdenum makes the grade A4).

The carbon level of grade A4 is allowed to be up to 0.12% max. to obtain specified mechanical properties at larger diameters.

The less common grades A3 & A5 are included in the standard and are based on the A2 & A4 grades respectively. These have additions of either titanium or niobium/tantalum to form ‘stabilized’ grades and can be used as alternatives to A2 or A4 grades, with carbon levels restricted to 0.03% max, in applications where there may be a risk of intergranular corrosion.
The standards also refer to a duplex composition as steel group “FA” (ferritic-austenitic) in their informative annex sections. This grade (similar to a 1.4462, 2205 of EN 10088-1) is

not included in BS EN ISO 3506 but is likely to be included in the future, the standard suggests.

Mechanical Properties

Three "property classes" are assigned to each of the austenitic stainless steel fastener grades in parts 1 and 2 of BS EN ISO 3506. Table 2 shows the 0.2% proof stress, tensile strength and elongation values for each of these property classes for the austenitic stainless steel bolts, screws, studs and nuts.

Table 2 - Mechanical Properties for A1, A2 and A4 Austenitic Stainless Steel Bolts, Screws, Studs and Nuts (BS EN ISO 3506 Parts 1 & 2)

		Bolts, Screws and Studs (Part 1)			Nuts (Part 2)
Property Class	**Diameter Range**	**Tensile Strength R_m (Nmm^{-2})**	**0.2% Proof Stress $R_{p0.2}$ (Nmm^{-2})**	**Elongation A (mm)**	**Stress under Proof Load S_p (Nmm^{-2})**
50	≤M39	500	210	0.6*d*	500
70	≤M24	700	450	0.4*d*	700
80	≤M24	800	600	0.3*d*	800

Notes

The mechanical property limits are minima.

Property class 50 represents the steel in the annealed condition.

The most common & readily available supply condition is property class 70, which represents a "cold drawn" for the bar stock from which the fasteners are made.

Property class 80 is based on severely hard cold drawn bar.

All tensile stress values are calculated and reported in terms of the nominal tensile stress area of the thread.

The elongation measurement is determined on the actual bolt or screw length and not on a prepared test piece. This is expressed in millimetres (mm) of extension and not as a percentage elongation.

i.e. $A = (L_2 - L_1)$ (where L_1 = original length and L_2 = length after fracture)

d = nominal diameter of bolt, screw or stud.

Tapping screw mechanical properties are defined in part 4 of BS EN ISO 3506 through minimum Vickers Hardness values, as shown in table3. These values apply to austenitic and ferritic grades as core hardnesses and to martensitic types as surface hardnesses of the screws.

Table 3 - Mechanical Properties for Tapping Screws (BS EN ISO 3506 Part 4)

Property class	20H	25H	30H	40H
Vickers hardness, Hv min.	200	250	300	400

Property classes 20H & 25H apply to either cold worked austenitic (A2, A3, A4, A5) or ferritic (F1) grades, whereas classes 30H & 40H apply to hardened and tempered martensitic (C1, C3) grades. Marking of the grade and property class on the actual tapping screws is not mandatory to BS EN ISO 3506 part 4, but is required to be shown on the manufacturers packaging.

Designations and Grade Selection

The designation for fasteners is in the form

A2-70

This represents a “304” type bolt, screw or stud to part 1 with a minimum tensile strength of 700 Nmm^{-2}

Tapping screw designations are in the form

A4-25H

This represents a “316” type tapping screw to part 4 with a minimum Vickers hardness of 250 HV

Low carbon variants of the austenitic grades, if used may be additionally marked in the form

A4L-70 or A4L-25H

The informative annexes to the standards give some guidance on selection for some specific environments. These annexes specifically note that the risk of failure to bolts, screws and studs by chloride induced stress corrosion cracking (eg in indoor swimming pools) can be reduced by using grade types, 1.4439, 1.4439, 1.4529, 1.4462. These grades are not however covered in the standard grade schedules.