A4-80

DIN ES ISO 3506-1: 1997 specifies the mechanical properties of bolts, screws and nuts made of austenitic (amongst others) stainless steels, when tested over an ambient temperature range of 15°C to 25°C.

Broder Metals Group Ltd, through its' trading division High Tensile Stainless, supplies a range of material that enable fastener manufacturers and others to produce products that meet or exceed the properties required in the above standard. Material to meet the properties of A4-80 is one element of our product range.

The designation A4-80 derives from "A" meaning the material is a cold worked austenitic stainless, divided into 5 grades (1-5, hence the "4") according to material characteristics (see Annex B of DIN ES ISO 3506-1: 1997 for full description of each grade). The "80" denotes the minimum tensile strength to be met by the material (actually the bolt, screw or nut after manufacture).

Therefore, **A4-80 is an austenitic, acid proof stainless grade (usually 316 material - 316 or 316L) which has been cold worked to provide a minimum tensile strength of 800 N/mm^2 (MPa).**

We stock round bar from 10 mm to 60 mm diameter, and hexagons from 10 mm to 37 mm AF.

We can also produce flats and squares not covered by the standard, on request, to reduce machining costs (up to 101.6 mm [4"] square and flats to 100 mm x 50 mm [4" x 2"]). Please enquire detailing the properties required.

Background

Grade 316 is the standard molybdenum-bearing grade. The molybdenum gives 316 better overall corrosion resistant properties and has resistance to pitting and crevice corrosion in a range of atmospheric environments and chloride and other corrosive media. Stress corrosion cracking starts above about 60°C. 316 is considered resistant to potable water with up to about 1000mg/L chlorides at ambient temperatures, reducing to about 500mg/L at 60°C. It has good oxidation resistance in intermittent service to 870°C and in continuous service to 925°C. Continuous use of 316 in the 425-860°C range is not recommended if subsequent aqueous corrosion resistance is important. Grade 316L is more resistant to carbide precipitation and can be used in the above temperature range. Grade 316H has higher strength at elevated temperatures and is sometimes used for structural and pressure-containing applications at temperatures above about 500°C.

It has excellent forming and welding characteristics. Grade 316L, the low carbon version of 316 and is immune from sensitisation (grain boundary carbide precipitation). Grade 316H, with its higher carbon content has application at elevated temperatures, as does stabilised grade 316Ti. However please note that DIN ES ISO 3506-1: 1997 does not apply to screws with special properties, such as weldability.

The austenitic structure also gives these grades excellent toughness, even down to cryogenic temperatures.

Heat Treatment is by solution annealing - Heat to 1010-1120°C and cool rapidly. These grades cannot be hardened by thermal treatment. Cold working (normally drawing) produces enhanced levels of tensile strength. All austenitic stainless steel fasteners are normally non-magnetic in the annealed condition. However, after cold working, some magnetic properties may be evident. – A4-80 has a μ_r of 1.015.

It is common for 316 and 316L to be stocked in "Dual Certified" form. These items have chemical and mechanical properties complying with both 316 and 316L specifications

Chemical Composition

See table below for A4-80 material chemical composition (standard chemical compositions for a range of 316 stainless steels is also given for information).

Note:

1. The final choice of chemical composition is at the discretion of the manufacturer.
2. Where the carbon content is restricted to a maximum of 0.3% (to provide better resistance to chlorine induced intergranular stress corrosion), minimum nickel content is increased and nitrogen may be present to a maximum of 0.22% - see below A4-80 ISO [2]
3. At the discretion of the manufacturer, the carbon content may be higher, to a maximum of 0.12%

Grade		C	Si	Mn	P	S	Cr	Mo	Ni	Cu	N
A4-80	**Min**	**-**	**-**	**-**	**-**	**-**	**16.0**	**2.0**	**10.5**	**-**	**-**
ISO	**Max**	**0.08**	**1.00**	**2.00**	**0.045**	**0.03**	**18.5**	**3.0**	**14.0**	**1.0**	**-**
A4-80	**Min**	**-**	**-**	**-**	**-**	**-**	**16.0**	**2.0**	**11.5**	**-**	**0.12**
ISO [2]	**Max**	**0.03**	**1.00**	**2.00**	**0.045**	**0.03**	**18.5**	**3.0**	**14.0**	**1.0**	**0.22**
316	Min	-	-	-	0	-	16.0	2.00	10.0		-
	Max	0.08	0.75	2.0	0.045	0.03	18.0	3.00	14.0		0.10
316L	Min	-	-	-	-	-	16.0	2.00	10.0		-
	Max	0.03	0.75	2.0	0.045	0.03	18.0	3.00	14.0		0.10
316H	Min	0.04	0	0.04	-	-	16.0	2.00	10.0		-
	max	0.10	0.75	0.10	0.045	0.03	18.0	3.00	14.0		-

Mechanical Properties

The mechanical properties of bolts, screws and studs shall conform to the values below. For comparison, the "normal" mechanical properties of 316 stainless are given for information.

Note: for fasteners with a nominal thread diameter of > 24 mm, the mechanical properties are to be agreed between the user and manufacturer.

Grade	Tensile Str (MPa) min	Yield Str 0.2% Proof (MPa) min	Elong (% in 50 mm) min	Hardness	
				Rockwell B (HR B) max	Brinell (HB) max
A4-80	**800**	**600**	**30**	**Not reqd**	**Not reqd**
316	515	205	40	95	217
316L	485	170	40	95	217
316H	515	205	40	95	217

Note: – see annex F of DIN ES ISO 3506-1: 1997 where loads may fluctuate and operating periods at elevated temperatures are extensive, or where products will operate for continuous periods at low temperatures.

On request we can produce material with a tensile strength of over 1000 MPa (suitable after head forging to stress relieve and still achieve above 800 MPa). Please ring ++(0) 114 232 9245 or email:sales@high-tensile-stainless.com for details and a quote.

Physical Properties

Typical physical properties for 316 grade stainless steels:

Grade	Density (kg/m^3)	Elastic Modulus (GPa)	Mean Co-eff of Thermal Expansion (µm/m/°C)			Thermal Conductivity (W/m.K)		Specific Heat 0-100°C (J/kg.K)	Elec Resistivity (nΩ.m)
			0-100°C	0-315°C	0-538°C	At 100°C	At 500°C		
316/L/H	8000	193	15.9	16.2	17.5	16.3	21.5	500	740

If you have questions or require further information, please contact our Sales team at High tensile Stainless on ++(0) 114 232 9245, or email to mailto:sales@high-tensile-stainless.com.