



## BRODER METALS GROUP HTS 316

Broder Metals supply 316 and 316L stainless cold drawn in **B8M Class 2**, **B8M Class 2B**, **A4-70** and **A4-80**.

**A4-70** and **A4-80** are named by their minimum tensile strength to be met by the material (70 & 80) by the bolt, screw or nut after manufacture.

In ASTM A193/A193M -11, austenitic steels are divided into 6 classes (1, 1A, 1B and 2, 2B and 2C) and 27 grades (B8, B8A, BBC, BBCA, **B8M**, B8MA, B8M2, B8M3, BBP, B8PA, B8N, B8NA, B8MN, B8MNA, B8MNLcUN, B8MLCuNA, B8T, B8TA, B8R, B8RA, B8S, B8SA, B8LN, B8LBNA, B8MLN, and B8MLNA).

### Stock

**316 B8M** we stock round bar from 10 mm to 75 mm diameter, and hexagons from 10 mm to 60 mm AF.

**316 A4-70** and **A4-80** we stock round bar from 10 mm to 60 mm diameter, and hexagons from 10 mm to 37mm 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 with details of 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 up to 870°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.

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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  $\mu_r$  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.

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 0.03% (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.
3. At the discretion of the manufacturer, the carbon content may be higher, to a maximum of 0.12%

**A4-80 Chemical Composition**

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

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## A4-70 Chemical Composition

Grade		C	Si	Mn	P	S	Cr	Mo	Ni	Cu	N
A4-70 ISO	Min	-	-	-	-	-	16.0	2.0	10.5	-	-
	Max	0.08	1.00	2.00	0.045	0.03	18.5	3.0	14.0	1.0	-
A4-70 ISO <sup>2</sup>	Min	-	-	-	-	-	16.0	2.0	11.5	-	0.12
	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	2.0	10.0	-	-
	Max	0.08	0.75	2.0	0.045	0.03	18.0	3.0	14.0	-	-
316L	Min	-	-	-	-	-	16.0	2.0	10.0	-	-
	Max	0.03	0.75	2.0	0.045	0.03	18.0	3.0	14.0	-	0.10
316H	Min	0.04	0	0.04	-	-	16.0	2.0	10.0	-	-
	Max	0.10	0.75	0.10	0.045	0.03	18.0	3.0	14.0	-	-

## B8M Chemical Composition

Grade		C	Mn	P	S	Si	Cr	Ni	Mo
B8M	Min	-	-	-	-	-	16.0	Ni	Mo
	Max	0.08	2.00	0.045	0.03	1.00	18.5	14.0	3.0
316	Min	-	-	0	-	-	16.0	10.0	2.0
	Max	0.08	2.0	0.045	0.03	0.75	18.0	14.0	3.0
316L	Min	-	-	-	-	-	16.0	10.0	2.0
	Max	0.03	2.0	0.045	0.03	0.75	18.0	14.0	3.0
316H	Min	0.04	0.04	-	-	0	16.0	10.0	2.0
	Max	0.10	0.10	0.045	0.03	0.75	18.0	14.0	3.0

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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. 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.

### A4-70, A4-80 Mechanical Properties

Grade	Tensile Strength (MPa) min	Yield Strength 0.2% Proof (Mpa) min	Elongation (% in 50mm) Min	Hardness	
				Rockwell B (HR B) max	Brinell (HB) Max
A4-80	800	600	0.3 <i>d</i>	Not required	Not required
A4-70	700	450	0.4 <i>d</i>	Not required	Not required
316	515	205	40	95	217
316L	485	170	40	95	217
316H	515	205	40	95	217

**\*This is determined according to 7,2,4 on the actual screw length and not on a prepared test piece.**

**E.g. A4-80 10mm dia elongation = 3mm.**

**A4-70 10mm dia elongation = 4mm.**

Grade	Density (kg/m <sup>3</sup> )	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)
316/L/H	8000	193	0—100°C—15.9 0-315° C—16.2 0-538° C—17.5	At 100° C—16.3 At 500° C—21.5	500	740

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### B8M Mechanical properties

Grade	Size Dia (mm)	Tensile Strength (MPa) min	Yield Strength 0.2% proof (MPa) min	Elongation (% in 4D min)	Red of area (% min)	Hardness (HRC max)
B8M CL2	<=19.05	758	655	15	45	35
B8M CL2	>19.05 <=31.75	690	550	20	45	35
B8M CL2	>25.4 <=31.75	655	450	25	45	35
B8M CL2	>31.75 <38.1	620	345	30	45	35
B8M CL2B	>38.1 <=50.8	655	515	25	40	35
B8M CL2B	>50.8 <=63.5	620	450	30	40	35
B8M CL2B	>63.5 <=76.2	550	380	30	40	35

Note: the standard allows that, for diameters over 1.1/2" (38.1 mm), centre (core) properties may be lower than indicated by test results which are based on values determined at 1/2 radius.

**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).**

316 is just one of a range of high tensile stainless steels stocked by Broder Metals Group Ltd – please see our website for the full range stocked: [www.broder-metals-group.com](http://www.broder-metals-group.com)

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