

Stainless steel grades

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Stainless steel is 'ordinary' (carbon) steel to which various other things, particularly chromium, have been added to make it 'stainless'. The chromium reacts with air to form a light, invisible oxide covering which protects from further corrosion. If the covering is damaged, further corrosion takes place thus maintaining the film.

In the same way that carbon steel has various strengths, so stainless steel does as well, and combining this with the amount of 'stainlessness' can result in a wide variety (over 200) of types. The position is further complicated by the fact that steel for different purposes has different standards and different ways of specifying. The following is a guide to the various standards and the situation generally with regard to the use of stainless steel.

The types fall into 3 main usage groups:

1 Flat plate/sheet/strip

This is the easiest to define and is what is used to make angles, plates etc

2 Bar and rod

Precasters rarely use this, but others use it to make sockets and proprietary fixings

3 Fasteners

This is the term used for bolts, set screws, studding and nuts etc

Groups 1 & 2 are treated in the same way, group 3 is totally different.

Flat plate and sockets etc:

The common grades used for fittings are listed below, together with the various ways of specifying them, which may be found in specifications and literature -

'Old' UK	USA	Germany	Europe
303S31	303	1.4305	X 10 CrNiS 18 9
304S16	304	1.4301	X 5 CrNi 18 10
304S11/304S31	304L	1.4306	X 2 CrNi 18 10
316S33/316S31	316	1.4401	X 5 CrNiMo 17 12 2
316S11	316L	1.4404	X 2 CrNiMo 17 13 2

303/1.4305 - generally used for sockets etc

304/1.4301 - suitable for rural, urban, light industrial. Not suitable for heavy industrial or coastal

316/1.4401 - suitable for industrial and coastal

the L grades signify low carbon and need only be used when welding plates thicker than 16mm

**For most angles and plates therefore 'standard' grade is 1.4301 (304)
and 'higher' grade is 1.4401 (316)**

For sockets, the 'standard' grade is 1.4305 (303) and the 'higher grade is 1.4401 (316)

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The normally used British Standards for these in the past have been

BS970 - Wrought steels for mechanical and allied engineering purposes Part 1:1991 General inspection and testing procedures and specific requirements for carbon, carbon manganese, alloy and stainless steels

BS1449 - Steel plate, sheet and strip Part 2:1983 Specification for stainless and heat resisting steel plate, sheet and strip

A range of new British Standards have been issued which supersede both of the above. The terminology is 'messy' but the important ones relating to properties are

BS EN 10088-2:1995 – Technical delivery conditions for sheet/plate and strip for general purposes (replaces BS1449 Part 2)

BS EN 10088-3:1995 - Technical delivery conditions for semi finished products, bars, rods, and sections for general purposes (replaces most of BS970)

Being a 'Eurocode' the BS EN range does not use either the UK or USA naming methods. Instead, the numbering system similar to that used by Germany is used.

Thus grade 304 became 1.4301

1. = steel 43 = group of stainless steels 01 = grade identification

Fasteners

The system used for fasteners is totally different to that used for plates etc.

Basically the specification consists of two parts, which give the degree of stainlessness and the strength.

The steel grades are

A1 - Chromium-nickel steel (sometimes called free-machining grade 303/1.4305). Corrosion resistance is reduced and it is not suitable for coastal or industrial environments. This grade should not normally be specified

A2 - Chromium-nickel steel (grade 304/1.4301) suitable for rural, urban and light industrial.

A4 - Chromium-nickel-molybdenum steel (grade 316/1.4401) suitable for industrial and coastal areas.

The grades given are not true equivalents as they are strengths whilst the letters are for stainlessness. They are however often quoted (wrongly) in specifications. The letter A in the above stands for austenitic. This is the common type of stainless steel and can be readily formed and welded.

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Other types which may be mentioned are martensitic (stronger but cannot usually be welded), and ferritic (less strong).

The property classes are

50 - Softened

70 - Cold worked

80 - High strength

In theory any grade can be mixed with any class. However in practice the most common combinations are A2 70, A2 80, A4 80. Many suppliers say that class 50 is not easy to obtain and can in fact carry a cost penalty if insisted upon.

For most fasteners therefore it is normal to specify grade A2 class 70

The British Standard for these is BS EN ISO 3506-1: 1998 "Mechanical properties of corrosion-resistant stainless steel fasteners, Part 1. Bolts, screws and studs". This BS gives design capacities for fasteners.

There is however a snag. For grades 70 and 80, figures are not given for diameters greater than 24 mm. The background for this is that there are 2 main ways of making a circular section. The steel can be hot-rolled down to the required diameter, or cold-drawn. Hot rolling is gentler and leaves the cross section with approximately the same properties across the full width. Once sizes exceed 24 mm, very few manufacturers have the capacity to hot roll and thus they cold-draw. This entails squeezing the steel between rollers until the correct diameter is reached. The effect of this is to work-harden the outer part of the section, which is fine if a smooth bar is required. But if a thread is then cut into it, the hard part is removed, leaving the softer core and a weaker section. This does not happen with hot rolling, thus the BS requires that the design capacity of these larger sizes should be agreed between the user and the manufacturer. Very few British manufacturers exist, and most supplies come from Sweden, Germany and the Far East. It is difficult therefore to pre-agree strengths. What can be done is to get formal confirmation from suppliers that they will obtain and supply materials with an agreed capacity. In order to do this it is important to buy only from those suppliers who have agreed a quality, and to insist that the product can be identified as complying. Bolts and setscrews to BS EN ISO 3506 are stamped on the head with a code identifying the manufacturer, the steel grade and the property class.

Studding is more difficult as there is no way to identify the material. When ordering, it should always be specified as class 70. In the event that class 50 studding is supplied, this still has a capacity greater than that of standard sockets. The risk area is where studding is used without sockets and then torqued up. In this situation designs should be based on class 50. A major risk is if suppliers make up their own 'bolts' from studding and a nut as some have done. In this instance there is no guidance whatsoever as to its strength, hence the need for strict specification and identification.