Stainless Steel

Stainless steel is a broad term used for steels containing a minimum of 10.5% chromium. These steels exhibit various degrees of corrosion resistance; their other properties can be manipulated by the addition of nickel, molybdenum, titanium, niobium and other elements such as carbon and nitrogen.
Stainless steels' corrosion resistance is thanks largely to the chromium oxide film that forms naturally on the surface of the steels corrosion.
There are 5 basic types of stainless steel: Austenitic, Martensitic, Ferritic, Duplex and Precipitation Hardening.
80% of all stainless steel fasteners are produced in Austenitic grades.

Austenitic Stainless Steels % Chemical Composition

		Material Grade	
Element	Symbol	A2	A4
Carbon	C	0.10	0.08
Silicon	S	1.00	1.00
Manganese	Mn	2.00	2.00
Phosphorous	P	0.05	0.045
Sulphur	S	0.03	0.03
Chromium	Cr	15.00 to 20.00	16.00 to 18.50
Molybdenum	Mo	-	2.00 to 3.00
Nickel	Ni	8.00 to 19.00	10.00 to 15.00
Copper	Cu	4.00	1.00

Note: Single values are maximum allowed.

Typical Applications:
A2 (satisfied by 304)
Architecture, Food processing equipment, Rainwater goods, Hospital equipment, Dairy equipment, Heat exchangers, Brewing equipment, Bulk milk coolers, Refrigeration equipment, Evaporators, Beer barrels, Kitchen equipment.

A4 (satisfied by 316)
Exterior applications, Marine conditions, Chemical processing, Textile manufacture, Pulp and paper equipment, Photographic developing, Wine vats, Sewerage/effluent plants, Pumping stations, Dyeing equipment, Sugar mills, Mining equipment.

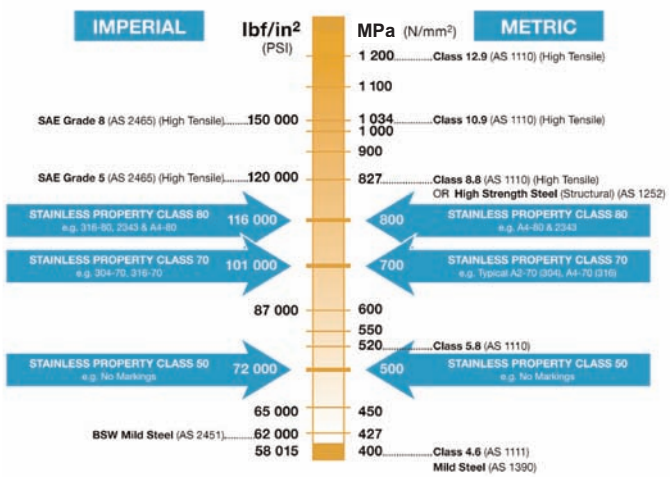
In addition to excellent corrosion resistance stainless steels have a range of other properties that make them well suited to a wide range of service conditions.

- Very low temperatures - resists brittleness
- High temperatures - resists scaling & maintains strength
- High strength to weight ratio
- Easy cleaning for hygienic conditions
- Aesthetic appearance - no rust & no painting required
- Wet abrasion resistance

The strengths of a product group of fasteners are expressed as:

- in the imperial system as GRADES
- in the metric system as PRODUCT CLASS

The approximate tensile strength comparison of steel grades and classes



NEW SOUTH WALES : Head Office Address - LIDCOMBE BUSINESS PARK, Unit F2, 3-29 Birnie Avenue, Lidcombe NSW 2141 Australia
Postal Address - Private bag 2002, Lidcombe NSW 1825
Telephone (02) 9737 5252 : Facsimile (02) 9737 0028 : Email sales@jglen.com
Outside Metropolitan area telephone freecall (1-800) 112 415

VICTORIA : 114 Boundary Road, Braeside, VIC 3195
Telephone (03) 9587 1966 : Facsimile (03) 9580 9141Email jgvic@jglen.com
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Telephone (08) 9456 5955 : Facsimile (08) 9456 5911 : Email jgwa@jglen.com
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Telephone (07) 3395 5266 : Facsimile (07) 3395 6860 : Email jgqld@jglen.com
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TASMANIA : c/- R.M. Daniels & Co. Pty. Ltd. 29 Mornington Road, Mornington TAS 7018
Telephone (03) 6244 7455 : Facsimile (03) 6244 7317 : Email Rmdanielsandco@aol.com

NEW ZEALAND : 5 Industry Road, Penrose, Auckland 1006
Telephone (09) 571 0007 : Facsimile (09) 571 2111 : Email jamesglen@xtra.co.nz
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5 things you need to know about . . .

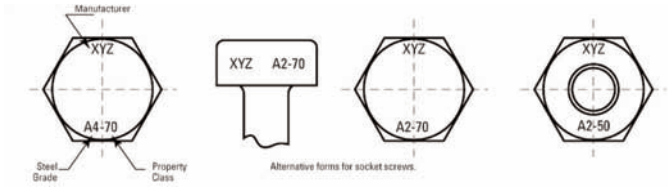
stainless fasteners

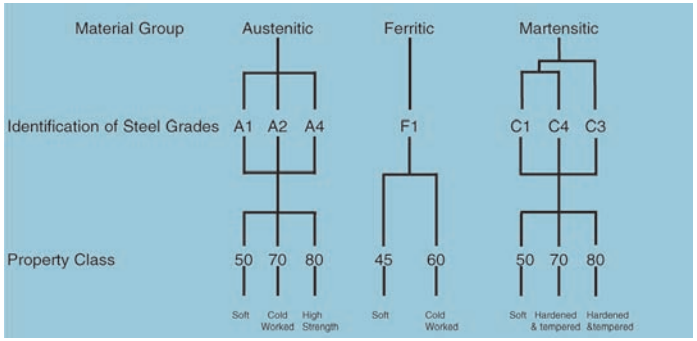
JAMES GLEN STAINLESS FASTENERS

THE BEST DESERVES THE BEST

JAMES GLEN PTY LTD ABN 38 000 472 506 ACN 00 472 506

Stainless Steel Fastener Head Markings





A4-70

- A = Austenitic steel (300 series)
- 1 = Free cutting stainless steel with lower corrosion resistance (known as 303)
- 2 = Cold formed steel containing chromium and nickel (known as 304)
- 4 = Cold formed stainless steel containing chromium, nickel and molybdenum (known as 316)

Indicates the strength (property class)

- 50 = 1/10 of the tensile strength min 500 MPa (approx 7200 psi)
- 70 = 1/10 of the tensile strength min 700 MPa (approx 101000 psi)
- 80 = 1/10 of the tensile strength min 800 MPa (approx 116000 psi)

Common Stainless Head Markings and Strengths				
Grade	Property Class	Tensile Strength Rm. MPa (N/mm^2) min	Yield Stress Rp. MPa (N/mm^2) min	Elongation
A2 & A4	50	500	210	0.6d
A2 & A4	70	700	450	0.4d
A2 & A4	80	800	600	0.3d

Points to note

- Product markings are not uniform over all stainless fasteners
- Where A2 and A4 are used without property class, assume it is lowest strength grade unless specified with a certificate
- A2 and A4 may be replaced with 304 and 316 respectively
- M used in Australia on non-stainless product to indicate metric is not consistently used on stainless.

Tightening Torques

Torque is the measure of resistance of a thread to further tightening measured in Newton metres (Nm).

Tightening Torque M_V Nm*

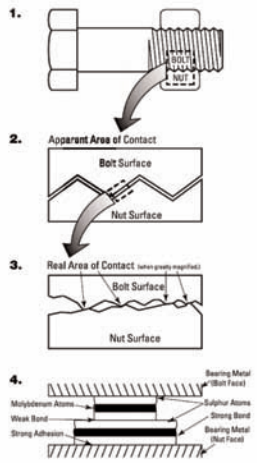
Diameter	Class 80	70	50
M3	1.20	0.90	0.40
M4	2.70	2.00	1.00
M5	5.40	4.10	1.90
M6	9.30	7.00	3.30
M8	22.00	17.00	7.80
M10	44.00	33.00	15.00
M12	76.00	57.00	27.00
M14	121.00	91.00	43.00
M16	187.00	140.00	65.00
M20	364.00	273.00	127.00
M24	629.00	472.00	220.00
M27	909.00	682.00	318.00
M30	1240.00	930.00	434.00
M36	2160.00	1620.00	755.00

Tightening Torque M_V Nm*

Diameter	Class 80	70	50
1/4 UNC	10.00	7.70	3.60
5/16 UNC	21.00	16.00	7.30
3/8 UNC	37.00	28.00	13.00
1/2 UNC	89.00	66.00	31.00
5/8 UNC	175.00	131.00	61.00
3/4 UNC	308.00	231.00	108.00
7/8 UNC	493.00	369.00	172.00
1 UNC	737.00	553.00	258.00

- * M_V information refers to flat blurr-free surfaces, lubricated with good-quality lubricant and was calculated using a friction factor of 0.16.
- The nominal induced load in joints tightened to these torque values is calculated as 65% of the load at the permanent set limit but in practice, the value can be expected to vary between 50% and 80% of the load at the permanent set limit.
- Many factors affect friction and even slight deviations from normal or test conditions can produce wide variations. Accordingly, when friction coefficients are used in design calculations, factors of safety should be considered and in critical cases, specific tests conducted to provide actual coefficients for material, geometery, and/or lubricant combinations.

Galling



- What is galling?

Whilst austenitic stainless steel fasteners exhibit many desirable properties a common problem is seizing or pick-up on assembly or disassembly. This phenomenon is known as galling. It is thought to be caused by cold welding of the high points of clean, oxide free metal left when the oxide film is dislodged by surfaces rubbing against each other.

- Surface hardness

Surfaces treated so that they are harder, e.g. hard faced or cold worked surfaces, are less susceptible to galling. There is a rule of thumb that a hardness difference of 50 Brinell between mating parts is required for effective prevention of galling.

- Surface Finish

Highly polished or very rough surfaces tend to gall more. Cold rolled surfaces are better as they tend to be smoother than machined surfaces. Machined threads should be carefully deburred before assembly. Significant galling problems may also arise with electropolished surfaces which can be very smooth.

- Surface Stress

Reducing the surface pressure is effective in reducing the risk of galling. This may be achieved by increasing the contact area or reducing the load, so that there is less stress on parts in contact and less thread wear. Over tightening the bolt will give excessive surface stresses and the only way to control this is to use the torque wrench set to the appropriate torque setting. Dirty threads may cause under-tightening and fatigue failures.

- Material Selection

It should be noted that while using 304 bolts with 316 nuts is often quoted as a cure for galling, the hardness difference is not sufficient to prevent galling even when cold rolled, harder 304 is used with an annealed softer 316 nut.
If an austenitic bolt such as 304 or 316 is used, a way to minimise galling would be to use a hard nut of duplex stainless steel or a soft (and also less corrosion resistant) nut of aluminium bronze.

- Heat

Heat is a major factor when combatting galling. Austenitic stainless steel has a heat conductivity rate 40-50% lower than mild steel and has a heat expansion rate 50% greater than mild steel. These two factors combined with a relatively high coefficient of friction create the conditions for seizing, cold welding or galling. To avoid the build up of heat, friction should be kept to a minimum by using copper free, solid type, quality lubricants, keeping application speeds low and torque within guidelines. Nickel filled lubricants are available for stainless. Graphite lubricants may cause corrosion.

- Lock Nuts

Prevailing torque locking nuts such as nylon insert lock nuts and Glenloch metal insert locking nuts present elevated risks of galling due to tight tolerances and increased friction from the locking mechanisms. Extra care must be taken when using these products. Appropriate lubrications should be used even in permanent applications.