The Pocket Guide To Stainless Steel

Stainless Steel Users Guide

STEEL & TUBE STAINLESS

Branch Details

Steel and Tube Stainless is one of New Zealand's leading suppliers of industrial stainless steel, architectural stainless steel and stainless steel fasteners.

We hope you'll find this Steel & Tube Stainless pocket guide a useful reference tool for checking stainless steel data. Should you need more detailed information or a copy of our complete product and services catalogue please call 0508 782 465 and talk to one of our fully trained customer services team.

AUCKLAND
8 WESTFIELD PLACE
MT. WELLINGTON,
PO BOX 22-023, OTAHUHU
AUCKLAND
FREE PH: 0508 372 293
PH: 09 573 2400
FAX: 09 573 2422
E: aksales@ststainless.co.nz

CHRISTCHURCH
8 CABLE STREET
SOCKBURN,
PO BOX 16-413, HORNBY
CHRISTCHURCH
FREE PH: 0508 731 173
PH: 03 343 0606
FAX: 03 343 0605
E: chsales@ststainless.co.nz

HAMILTON
32 MAUI STREET
PUKETE INDUSTRIAL ESTATE,
PO BOX 20-468, TE RAPA
HAMILTON
FREE PH: 0508 478 575
PH: 07 849 5220
FAX: 07 849 5991
E: hnsales@ststainless.co.nz

INVERCARGILL
20A BOND STREET
PO BOX 1165,
INVERCARGILL
PH: 03 214 3666
FAX: 03 214 3660
E: insales@ststainless.co.nz

NELSON
2/74 QUARANTINE ROAD
TAHUNANUI,
PO BOX 2037, STOKE
NELSON
PH: 03 547 4444
FAX: 03 547 3334
E: nlsales@ststainless.co.nz

NEW PLYMOUTH
40 CORBETT ROAD
BELL BLOCK,
PO BOX 7028,
NEW PLYMOUTH
PH: 06 755 9993
FAX: 06 755 9998
E: npsales@ststainless.co.nz

PALMERSTON NORTH
84 ARMSTRONG STREET
PO BOX 4022,
PALMERSTON NORTH
FREE PH: 0508 736 969
PH: 06 355 2333
FAX: 06 355 2223
E: pnsales@ststainless.co.nz

STEEL & TUBE
STAINLESS

Contents

EDITION: 1ST August 2007

What Is Stainless Steel?

Stainless steels are alloys containing iron, relatively low carbon, a minimum 10.5% chromium and up to 30% nickel. However they are typically 18% chromium and 8% nickel. For increased corrosion resistance or for manufacturing requirements in specific applications, chromium may be increased and other elements such as manganese, aluminum, titanium and/or molybdenum may be added as required.
Stainless steels are sometimes called corrosion-resisting steels since the terms stainless may suggest non-staining. It does not mean non-staining in all environments, but less staining and more resistant to corrosive attack when compared with steels containing less than 10.5% chromium.

What Makes Stainless Steel Resist Corrosion?
Chromium [the key element in stainless steels] in excess of about 10.5% forms a tenacious, refractory oxide protective film on any exposed layer, i.e. a corrosion barrier. This relatively impervious film is considered to be self-healing or self-restoring. It will, if broken, repair itself spontaneously upon re-exposure to an oxidizing agent such as air or nitric acid.

Resistance to corrosive attack under specific conditions is enhanced by progressively increasing chromium over 10.5% and/or by the addition of other elements such as nickel, molybdenum and copper.

Types of Stainless Steel
Stainless steels are grouped according to the metallurgical structure which forms when they are cooled from high temperatures. Four basic types of stainless steel recognised are:

- Duplex
- Austenitic
- Ferritic
- Martensitic

Duplex Stainless Steel
Duplex has a structure of approximately equal amounts of ferrite and austenite. Chromium content varies from 18%-28% and 4.5%-8% nickel, with most grades also containing Molybdenum.
features:

- High resistance to stress corrosion cracking
- Increased level of passivity
- Good welding and formability
- Higher tensile and yield strengths than austenitic and ferritic grades

Austenitic Stainless Steel
[301, 304, 304L, 316, 316L 321, 310];
Basic composition of austenitic stainless steel is 18% chromium and 8% nickel. Austenitic grades are the most commonly used and accounts for more than 70% of production with type 304 the most common. The name comes from their stable metallurgical structure at room temperature, which is a single phase of austenitic.

Austenitic stainless steels have the following features;
- Can be strengthened by cold working [up to 4 times]
- Easily welded
- High ductility
- Good corrosion resistance
- Suitable for high temperatures to [e.g. 310 to 1100°C]
- Suitable for low temperatures [including cryogenic applications]
- Is non-magnetic

Ferritic Stainless Steel
[409, 430, 3CR12]
These are nickel free stainless steels. Varying chromium content of 12% to 18%, but a lower carbon content.
They derive their name from the ferritic metallurgical structure which is stable at room temperature.
When compared with austenitic stainless steels, ferritic stainless steels have the following features;
- Less expensive
- Lower corrosion resistance
- Can be welded, but requires more care
- Easily formed [bent, cut, etc.]
- Moderate high temperature [up to 800°C for 430]
- Slight increases in strength by cold working [up to 50%]
- Superior resistance to stress corrosion cracking
- Is magnetic

Martensitic Stainless Steel
These stainless steels are alloys of iron, chromium [12 to 18%] and carbon [up to 1%].

These stainless steels can be hardened by heat treatment. This type of stainless steel is used where high mechanical strength combined with corrosion resistance is required [e.g. knives].

AUSTENITIC

GRADE	APPLICATION	PROPERTIES
304	Architecture [exterior & interior]; food processing; handling and serving equipment; saucepans; hospital equipment; rainwater goods; household appliances; domestic sinks and laundry troughs, general deep drawing applications; brewing and dairy equipment; evaporators; drums; barrels; heat exchangers and refrigerator parts.	A general purpose austenitic corrosion resistant steel. Excellent deep drawing and cold forming qualities in the annealed condition. Can be polished to a high finish. Readily weldable for use in moderate corrosion resistant applications. Using appropriate techniques, 304 can be welded in thickness up to 12mm without subsequent heat treatment unless it is required for stress purposes.
304L	Chemical plant; food processing equipment; and for use in coal and petroleum industry.	An extra-low carbon austenitic stainless steel, with general corrosion resistance similar to 304, but with greater resistance to inter granular corrosion. Can be welded in greater thickness than 304, or heated for appreciable periods of time above 500°C without the need for subsequent solution heat treatment. Recommended when fabricating thickness in excess of 12mm, or where high heat input methods are used and subsequent solution heat treatment cannot be performed.
310	Furnace parts and equipment, baffles; heat treatment; boxes; retorts; furnace linings; heat exchangers.	Austenitic 25/20 chromium nickel steel offering excellent resistance to scaling at high temperatures. Mechanical properties in the higher temperature ranges are superior to other standard heat resisting steels. Can be employed for continuous service in the temperature range 900/950°C to 1100°C

AUSTENITIC

GRADE	APPLICATION	PROPERTIES
316	Exterior applications subject to severe industrial or marine atmospheres; chemical; textile; photographic and paper making equipment; wine vats.	More resistant to certain corrosive conditions than the standard non-molybdenum bearing austenitic stainless steel. Suitable where protection is required from highly corrosive non-oxidising acids. Is used for plant and equipment in chemical manufacture. Has moderate deep drawing and cold forming properties. Able to be welded in thickness up to 12mm without subsequent heat treatment for most applications.
316L	Chemical plant and food processing equipment.	An extra low carbon modification for 316, with similar corrosion resistance. Intended for heavier sheet or plate fabrication where welding without subsequent heat treatment is required. Can be welded in heavy sections without the risk of inter-granular corrosion [weld decay] in the as-welded condition and also in the stress relieved condition under most circumstances. Suitable for polishing to a bright finish.

FERRITIC

GRADE	APPLICATION	PROPERTIES
409	Automotive exhaust components.	Ferritic heat resistant chromium steel. Good workability, formability and moderate resistance to corrosion.
430	Interior architecture and automotive trim; domestic appliances; restaurant equipment; stove and heater components.	A 17% chromium stainless steel. Good resistance to normal atmospheric corrosive conditions. Can be used with various chemicals, such as nitric acid, caustic soda, ammonia, detergents and alkalis. Moderate ductility for forming and drawing operations. Not as suitable for welding as austenitic grades, as welds tend to be brittle. Satisfactory for resistance to scale and oxidation up to approximately 800°C.

Stainless Steel Strip, Sheet & Plate

A. MILL FINISHES

FINISH No.	DESCRIPTION	REMARKS
1	Hot rolled, annealed and pickled. (HRAP)	Generally used when smoothness and uniformity of finish are not important.
2D	Cold-rolled, softened and de scaled.	A uniform, matt finish.
2B	Cold-rolled, softened, de scaled and lightly rolled on polished rolls.	A smooth finish for general applications. A brighter finish than 2D.
BA	Bright Annealed.	A cold-rolled reflective finish retained through annealing.

B. MECHANICALLY POLISHED FINISHES

FINISH No.	DESCRIPTION	REMARKS
3	Ground.	A uniform finish generally obtained with 100-180 grit size.
4	Polished with 120-240 grit. "Brushed".	Has a grained texture, not highly reflective, which is suitable for general purposes. Meets international 3A standard of hygiene.
8	Polished. Mirror finished for reflectiveness.	Has a bright reflective finish with a medium degree of image clarity.

A.I.S.I STAINLESS GRADE	STRUCTURE	WELDING PROPERTIES	MACHINING PROPERTIES	COLD PRESSING PROPERTIES	MAXIMUM SERVICE TEMP
302	Austenitic	Good*	Fair	Good	800°C**
303	Austenitic	Fair*	Excellent	Fair	800°C**
304L	Austenitic	Good	Fair	Excellent	800°C**
304	Austenitic	Good	Fair	Very Good	800°C**
310	Austenitic	Good	Fair	Good	1100°C
316L	Austenitic	Good	Fair	Good	800°C**
316	Austenitic	Good	Fair	Good	800°C**
317L	Austenitic	Good	Fair	Good	800°C
317	Austenitic	Good	Fair	Good	800°C
321	Austenitic	Excellent	Fair	Good	800°C
410	Martensitic	Poor - Welds Brittle	Good	Fair	750°C
420	Martensitic	Not Generally Recommended	Good	Poor	750°C
430	Ferritic	Fair - Welds Brittle	Good	Fair	800°C
432	Martensitic	Not Recommended	Good	Poor	650°C

* But only recommended for applications involving mildly corroding conditions
** Where heat resistance is the only requirement. Otherwise max. service temperature 400°C.
• Austenitic stainless steels [300 Series] are generally classed as non-magnetic, though cold working can sometimes induce slight magnetism. Both martensitic and ferritic types are magnetic.

THICKNESS [mm]	WEIGHT [kg/m2]	APPROX. WEIGHT FOR 1220 x 2440 [kg]	APPROX. WEIGHT FOR 1500 x 3000 [kg]
0.45	3.60	10.72	16.20
0.55	4.40	13.10	19.80
0.70	5.60	16.67	25.20
0.90	7.20	21.43	32.40
1.00	8.00	23.81	36.00
1.20	9.60	28.57	43.20
1.50	12.00	35.72	54.00
2.00	16.00	47.63	72.00
2.50	20.00	59.54	90.00
3.00	24.00	71.44	108.00
4.00	32.00	95.26	144.00
5.00	40.00	119.07	180.00
6.00	48.00	142.89	216.00
8.00	64.00	190.52	288.00
10.00	80.00	238.14	360.00
12.00	96.00	285.77	432.00
16.00	128.00	381.03	576.00
20.00	160.00	476.29	720.00
25.00	200.00	595.36	900.00
30.00	240.00	714.43	1080.00
40.00	320.00	952.58	1440.00
50.00	400.00	1190.72	1800.00

Average Weights For Stainless Steel Bars - Metric

SIZE [mm]	ROUND	SQUARE
3	0.06	-
4	0.10	-
5	0.16	0.20
6	0.23	0.29
8	0.40	0.51
10	0.63	0.80
12	0.90	1.15
14	1.23	1.57
16	1.61	2.05
18	2.03	2.59
20	2.51	3.20
22	3.04	3.87
24	3.62	4.61
25	3.93	5.00
30	5.65	7.20
35	7.69	9.80
40	10.05	12.80
45	12.72	16.20
50	15.70	20.00
55	19.00	24.20
60	22.61	28.80
65	26.53	33.80
70	30.77	39.20
75	35.33	45.00
80	40.19	-
90	50.87	-
100	62.80	-
110	75.99	-
120	90.43	-
130	106.13	-
140	123.09	-
150	141.30	-
160	160.77	-
170	181.49	-
180	203.47	-
190	226.71	-
200	251.20	-
220	303.95	-
250	392.50	-
300	565.20	-

In Kilograms per metre

SIZE [IN]	ROUND	SQUARE
1/8	0.06	0.08
1/5	0.14	0.18
1/4	0.25	0.32
1/3	0.40	0.50
3/8	0.57	0.73
4/9	0.78	0.99
1/2	1.01	1.29
4/7	1.28	1.63
5/8	1.58	2.02
3/4	2.28	2.90
7/8	3.10	3.95
1	4.05	5.16
1 1/8	5.13	6.30
1 1/4	6.33	8.06
1 3/8	7.66	9.76
1 1/2	9.12	11.61
1 5/8	10.70	13.63
1 3/4	12.41	15.81
2	16.21	20.65
2 1/4	20.51	26.13
2 3/8	22.85	29.11
2 1/2	25.32	32.26
2 3/4	30.64	39.03
3	36.46	46.45
3 1/4	42.80	-
3 1/2	49.63	-
3 3/4	56.98	-
4	64.83	-
4 1/2	82.04	-
5	101.29	-
5 1/2	122.56	-
6	145.86	-
6 1/2	171.18	-
7	198.53	-
8	259.30	-
9	328.18	-
10	405.16	-
12	583.43	-

In Kilograms per metre

SIZE [mm]	KGS / M	SIZE [mm]	KGS / M
13 x 3	0.31	50 x 9	3.60
20 x 3	0.48	25 x 10	2.00
25 x 3	0.60	30 x 10	2.40
38 x 3	0.91	40 x 10	3.20
40 x 3	0.96	50 x 10	4.00
50 x 3	1.20	65 x 10	5.20
20 x 5	0.80	75 x 10	6.00
25 x 5	1.00	100 x 10	8.00
30 x 5	1.20	150 x 10	12.00
32 x 5	1.28	25 x 12	2.40
38 x 5	1.52	40 x 12	3.84
40 x 5	1.60	50 x 12	4.80
50 x 5	2.00	65 x 12	6.24
75 x 5	3.00	75 x 12	7.20
100 x 5	4.00	100 x 12	9.60
20 x 6	0.96	150 x 12	14.40
25 x 6	1.20	50 x 16	6.40
30 x 6	1.44	75 x 16	9.60
40 x 6	1.92	50 x 19	7.60
50 x 6	2.40	100 x 19	15.20
65 x 6	3.12	100 x 20	16.00
75 x 6	3.60	50 x 25	10.00
100 x 6	4.80	75 x 25	15.00
150 x 6	7.20	100 x 25	20.00

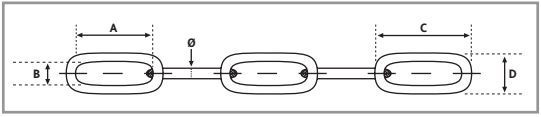
AVERAGE WEIGHTS FOR STAINLESS STEEL EQUAL ANGLE

SIZE [mm]	KGS / M	SIZE [mm]	KGS / M
20 x 20 x 3	0.89	50 x 50 x 5	3.80
25 x 25 x 3	1.13	50 x 50 x 6	4.46
25 x 25 x 5	1.80	65 x 65 x 6	5.85
30 x 30 x 3	1.36	75 x 75 x 6	6.88
30 x 30 x 5	2.20	100 x 100 x 6	9.10
40 x 40 x 3	1.85	75 x 75 x 9	10.00
40 x 40 x 5	2.98	100 x 100 x 10	15.00
50 x 50 x 3	2.30	-	-

SPECIFIED THICKNESS		THICKNESS TOLERANCES FOR WIDTHS OF		
OVER	UP TO AND INCLUDING + OR -	UP TO 450mm + OR -	450mm TO 1250mm + OR -	OVER 1250mm
mm	mm	mm	mm	mm
-	0.40	0.025	0.030	-
0.40	0.80	0.030	0.050	-
0.80	1.00	0.040	0.070	-
1.00	1.60	0.050	0.080	-
1.60	2.00	0.065	0.090	0.190
2.00	2.50	0.075	0.110	0.200
2.50	3.00	0.075	0.120	0.220

[BS 1449 Part 2:1975]

STAINLESS STEEL LINK CHAIN AISI 316/DIN 763



SIZE	A	B	C	D	S.W.L	WEIGHT
mm ø	mm	mm	mm	mm	kg	KG / M
1.5	12	4	15	7	20	0.038
2.0	22	4	26	8	40	0.060
3.0	26	6	32	12	90	0.150
4.0	32	8	40	16	170	0.270
5.0	35	10	45	20	260	0.430
6.0	42	12	54	24	380	0.630
8.0	52	16	68	32	670	1.100
10.0	56	20	76	40	1040	1.750

[in millimetres]

DIAMETER	ISO h.9	ISO h.11
0 - 3	-0.025	-0.060
3 - 6	-0.030	-0.075
6 - 10	-0.036	-0.090
10 - 18	-0.043	-0.110
18 - 30	-0.052	-0.130
30 - 50	-0.074	-0.160
50 - 80	-0.074	-0.190
80 - 120	-0.087	-0.220

C.F - Cold Formed with smooth satin finish and square edge.
H.R.A.P - Hot Rolled Annealed and Pickled (304 & 316).
S.R.E - Slit Rolled Edge.
C.F and S.R.E carried in thicknesses 3mm, 5mm & 6mm (304 & 316).
All flat bar thicknesses 9mm and over carried in H.R.A.P.

SIZE TOLERANCES ON FLAT BAR			
C.F			
Width		+ or -	0.2mm
Thickness		+ or -	0.1mm
H.R.A.P			
Width	10 - 35mm	+ or -	0.75
	38 - 75mm	+ or -	1.00
	80 - 100mm	+ or -	1.50
Thickness	5 - 20mm	+ or -	0.50

SIZE TOLERANCES ON EQUAL ANGLE			
C.F			
Width		+ or -	0.2mm
Thickness		+ or -	0.1mm
H.R.A.P			
Width	20 - 40mm	+ or -	1.5mm
	50mm	+ or -	2.0mm
	60 - 100mm	+ or -	3.0mm
Thickness	5 - 20mm	+ or -	0.5mm

ASTM - A312 Specification

Nominal BORE		Nominal O.D	SCHEDULE 10S			SCHEDULE 40S			SCHEDULE 80S		
			WALL	WEIGHT	PRESSURE	WALL	WEIGHT	PRESSURE	WALL	WEIGHT	PRESSURE
mm	IN	mm	mm	KG / M	kPa*	mm	KG / M	kPa*	mm	KG / M	kPa*
6	1/8	10.29	1.24	0.277	125139	1.73	0.365	173575	2.41	0.468	242523
8	1/4	13.72	1.65	0.491	124450	2.24	0.634	168576	3.02	0.797	227871
10	3/8	17.15	1.65	0.631	99629	2.31	0.845	139446	3.20	1.100	193053
15	1/2	21.34	2.11	1.000	102214	2.77	1.270	134275	3.73	1.620	180987
20	3/4	26.67	2.11	1.280	81702	2.87	1.680	111350	3.91	2.190	151684
25	1	33.40	2.77	2.090	85839	3.38	2.500	104628	4.55	3.240	140825
32	1 1/4	42.16	2.77	2.690	67913	3.56	3.390	87218	4.85	4.460	118934
40	1 1/2	48.26	2.77	3.110	59295	3.68	4.050	78945	5.08	5.410	108937
50	2	60.33	2.77	3.930	47401	3.91	5.440	67224	5.54	7.490	94975
65	2 1/2	73.03	3.05	5.260	43092	5.16	8.640	73084	7.01	11.400	99284
80	3	88.90	3.05	6.460	35508	5.49	11.300	63776	7.62	15.300	88646
100	4	114.30	3.05	8.370	27579	6.02	16.100	54468	8.56	22.300	77452
125	5	141.30	3.40	11.600	24993	6.55	21.800	47918	9.52	30.900	69678
150	6	168.28	3.40	13.300	21029	7.11	28.300	43782	10.97	42.600	67418
200	8	219.08	3.76	20.000	17754	8.18	42.500	38610	12.70	64.600	59974
250	10	273.05	4.19	27.800	15857	9.27	60.300	35163	12.70	81.500	48102
300	12	323.85	4.57	36.000	14651	9.52	73.800	30337	12.70	97.400	40557
350	14	355.60	4.78	41.400	13967						
400	16	406.40	4.78	47.300	12238						
450	18	457.20	4.78	53.300	10859						
500	20	508.00	5.54	68.600	11204						

*Theoretical internal bursting pressure calculated using formula $P = \frac{2ST}{D}$

[American Society for Testing & Materials]

SPEC.	DESCRIPTION	APPLICATIONS
A249	Welded austenitic S/S boiler, superheater, heat exchanger and condenser tubes.	For superheaters and heat exchangers.
A268	Seamless and welded ferritic stainless tubing for general service.	For general corrosion resistance and high temperature service.
A269	Seamless and welded austenitic stainless steel tubing for general service.	For general corrosion resistance and low or high temperature service.
A270	Seamless and welded austenitic stainless steel feed water heater tubes.	For use in food and dairy industry.
A554	Welded stainless steel mechanical tubing.	For mechanical applications where appearance, mechanical properties or corrosion resistance is needed.
A789	Seamless and welded ferritic/ austenitic stainless steel tubing for general service.	For general service with particular emphasis on resistance to stress corrosion cracking.
9688	Welded austenitic stainless steel feed water heater tubes.	For feed water heater tubes, including those bent, if specified, into the form of U-tubes.

ASTM and ASME tube users may find reference to some of the above specifications numbers prefixed by an 'S' e.g. 'SA249'.

AW [As welded]	As welded tube receives no further treatment after forming and welding. It is used where limited manipulation is to be carried out. It has a smooth matt finish.
AWA [As Welded Annealed]	Bright annealing after welding increases corrosion resistance and softens the tube for severe manipulations such as bending, expanding and forming.
CW & CWA [Cold Worked] &[Cold Worked Annealed]	For applications requiring a smooth internal surface, high corrosion resistance and compliance with specifications such as ASTM A249. Tube is available in cold worked annealed [CWA] condition. In both conditions the weld area is subject to a mechanical forging process for grain refinement. CWA tube is then bright annealed, an economical alternative to fully welded drawn tube.
WD & WDA [Welded Drawn] & [Welded Drawn Annealed]	By cold drawing tube in AWA or CWA conditions, fine dimensional tolerances are achieved, having excellent uniformity of wall thickness and concentricity, uniform grain structure and hardness. For maximum corrosion resistance this tube is supplied in the annealed [WDA] condition.
S [Seamless]	Cold drawn from seamless hollows annealed and pickled to ASTM A269 specification. Suitable for high pressure lines.

SURFACE FINISHES

The natural metallic lustre of stainless steel, which remains during its extremely prolonged lifespan, can be further enhanced by polishing and buffing. This applies particularly in applications for decorative purposes. A number of polished finishes are available.

MF [Mill Finish]	An off-the-mill finish; roll forming marks are retained and an indication of the weld may be visible.
BP [Buff Polish]	Bright finishes with varying degrees of lustre. Available in 240, 400 and 600 Grit finish.

O.D		WALL THICKNESS - INCHES & B.W.G						
		.022" 24	.028" 22	.035" 20	.049" 18	.065" 16	.083" 14	.134" 10
3.20mm	[1/8"]	26,400	33,600	42,000	58,800	-	-	-
6.40mm	[1/4"]	13,200	16,800	21,000	29,400	39,000	-	-
9.52mm	[3/8"]	8,800	11,200	14,000	19,600	26,000	-	-
12.70mm	[1/2"]	6,600	8,400	10,500	14,700	19,500	24,900	-
16.00mm	[5/8"]	5,300	6,725	8,400	11,750	16,600	19.952	-
19.00mm	[3/4"]	4,400	5,600	7,000	9,800	13,000	13,600	-
22.20mm	[7/8"]	-	-	6,000	8,400	11,150	14,225	-
25.40mm	[1"]	-	-	5.250	7,350	9,750	12,450	20,100
31.80mm	[1 1/4"]	-	-	4,200	5,875	7,800	9,950	16,075
38.10mm	[1 1/2"]	-	-	3,500	4,900	6,500	8,300	13,400
44.45mm	[1 3/4"]	-	-	3,000	4,200	5,575	7,125	11,475
50.80mm	[2"]	-	-	2,650	3,675	4,875	6,225	10,050
63.50mm	[2 1/2"]	-	-	-	2,950	3,900	4,975	8,050
76.20mm	[3"]	-	-	-	2,450	3,250	4,150	6,700
101.60mm	[4"]	-	-	-	-	2,425	3,100	5,025

Pressure shown is in PSI metric conversion $1 lb/in^2 = 6.89 kPa$

The figures above are based on Barrow's formula: $P = \frac{2ST}{D}$

Where

P = Bursting pressure in PSI;

D = Outside diameter of tube in inches;

S = Fibre stress in PSI (75,000 PSI was used in the figures above)

The Strength Factor

The method by which A2 [18/8] and A4 [18.10/Mo] stainless steel fasteners are made - cold forging and thread rolling greatly increases their strength. This 'work hardening' makes them so much stronger than similar products made from mild steel and plated - an important consideration in the selection of load bearing fasteners.

The International Organisation for Standardisation [ISO] published in May 1979 a specification [Standard 3506] for stainless steel fasteners. This defined a four digit product designation:

The first digit indicates the general classification of the steel:
A = austenitic.

The second digit indicates the type of alloying elements:
A2 = austenitic 18/8 type [not free-machining types] [T304]
A4 = austenitic 18/10/3 type [T316]

The third and fourth digits indicate the strength [mechanical property] class and represent one tenth of the tensile strength expressed in newtons per millimetre squared [N/mm^2]:
50 = lowest strength class which is usually for products of softened steel and with machined thread
70 = higher strength class resulting from cold forging and thread rolling
80 = highest strength - attained by mainly cold forged, extruded thread rolled parts and when specially drawn cold bars are used. Thus:
A2-70 = austenitic 18/8 class 70 cold forged with minimum 700N/mm2 tensile strength.

	TENSILE STRENGTH	YIELD STRENGTH
Class 80	800MPa min.	600 MPa min.
Class 70	700MPa min.	450 MPa min.
Class 50	500MPa min.	210 MPa Min.

HANDY CONVERSION FIGURES:

Nm - 1 lb ft multiply by 0.737562
mm^2 - in^2 multiply by 0.001550
N - lbf multiply by 0.224809
MPa - PSI multiply by 145

METRIC		DIA. IN	THREADS PER INCH			
DIA.	PITCH	INCHES	BSW	BSF	UNC	UNF
5	0.80	3/16	24	32	24	32
6	1.00	1/4	20	26	20	28
8	1.25	5/16	18	22	18	24
10	1.50	3/8	16	20	16	24
12	1.75	7/16	14	18	14	20
14	2.00	1/2	12	16	13	20
16	2.00	9/16	12	16	12	18
18	2.50	5/8	11	14	11	18
20	2.50	3/4	10	12	10	16
22	2.50	7/8	9	11	9	14
24	3.00	1	8	10	8	12
27	3.00	1 1/8	7	9	7	12
30	3.50	1 1/4	7	9	7	12
33	3.50	1 3/8	6	8	6	12
36	4.00	1 1/2	6	8	6	12
-	4.00	1 5/8	5	8	6	12
48	5.00	1 3/4	5	7	-	-

Hexagon Head Bolts

Metric threads, dimensions [mm] [DIN 931/933]

THREAD	Ds	s	e	k	G L≤125mm
d	NOM. MAX.	NOM. MAX.	MAX.	NOM.	NOM. MIN.
M 3	3	5.5	6.01	2.0	12
M 4	4	7.0	7.66	2.8	14
M 5	5	8.0	8.79	3.5	16
M 6	6	10.0	10.95	4.0	18
M 8	8	13.0	14.26	5.5	22
M 10	10	17.0	18.74	7.0	26
M 12	12	19.0	20.91	8.0	30
M 14	14	22.0	24.49	8.8	34
M 16	16	24.0	26.51	10.0	38
M 20	20	30.0	33.23	13.0	46
M 22	22	32.0	35.72	14.0	50
M 24	24	36.0	39.63	15.0	54
M 27	27	41.0	45.20	17.0	60
M 30	30	46.0	50.85	18.7	66

UNC threads, dimensions [mm] [ANSI B18.2]

THREAD	Ds	s	e	k	G L≤152mm
d	NOM. MAX.	NOM. MAX.	MAX.	NOM.	NOM. MIN.
1/4 - 20	6.35	11.11	12.4	4.0	19
5/16 - 18	7.94	12.70	14.1	5.2	22
3/8 - 16	9.53	14.29	16.0	6.0	25
1/2 - 13	12.70	19.05	21.3	7.9	32
5/8 - 11	15.88	23.81	26.7	9.9	38
3/4 - 10	19.05	28.58	31.9	11.9	44
7/8 - 9	22.23	33.34	37.2	13.9	51
1 - 8	25.40	38.10	42.5	15.5	57

Hexagon Nuts

Metric threads, dimensions [mm] [DIN934]

THREAD	s	e	k
D	NOM. MAX.	MIN.	NOM.
M 3	5.5	6.01	2.4
M 4	7	7.66	3.2
M 5	8	8.79	4.0
M 6	10	10.95	5.0
M 8	13	14.26	6.5
M 10	17	18.74	8.0
M 12	19	20.91	10.0
M 14	22	24.49	11.0
M 16	24	26.51	13.0
M 20	30	33.23	16.0
M 22	32	35.03	18.0
M 24	36	39.63	19.0
M 27	41	45.2	22.0
M 30	46	50.85	24.0

UNC threads, dimensions [mm] [ANSI B18.2]

THREAD	s	e	k
D	NOM. MAX.	MIN.	NOM.
1/4 - 20	11.11	12.4	5.74
5/16 - 18	12.70	14.1	6.93
3/8 - 16	14.29	16.0	8.56
1/2 - 13	19.05	21.3	11.38
5/8 - 11	23.81	26.7	14.20
3/4 - 10	28.58	31.5	16.89
7/8 - 9	33.34	36.8	19.71
1 - 8	38.10	42.0	22.53

Bolts & Screws Diameter Comparison Chart

ISO METRIC	DIAMETER			SCREW S/TAP
COARSE	mm	INCH	UNIFIED	GAUGE
M2.5	2.50	0.0980	#3	-
M3	3.00	0.1181	-	4
-	3.18	0.1250	#5	5
-	3.51	0.1380	#6	6
-	3.97	0.1562	#8	-
M4	4.00	0.1574	-	-
-	4.17	0.1640	-	-
-	4.76	0.1875	-	8
-	4.83	0.1900	#10	-
M5	5.00	0.1968	-	10
-	5.49	0.2160	-	12
M6	6.00	0.2362	-	-
-	6.15	0.2420	-	-
-	6.35	0.2500	1/4	14
-	7.94	0.3125	5/16	-
M8	8.00	0.3149	-	-
-	9.53	0.3750	3/8	-
M10	10.00	0.3937	-	-
-	11.11	0.4375	7/16	-
M12	12.00	0.4724	-	-
-	12.70	0.5000	1/2	-
-	14.29	0.5625	9/16	-
-	15.88	0.6250	5/8	-
M16	16.00	0.6299	-	-
-	19.05	0.7500	3/4	-
M20	20.00	0.7874	-	-
-	22.23	0.8750	7/8	-
M24	24.00	0.9448	-	-
-	25.40	1.0000	1	-

Comparison Of Thread Sizes

METRIC				UNIFIED				BRITISH				
SIZE	THREAD	MAJOR	T.P.I	SIZE	T.P.I		MAJOR	SIZE	T.P.I		MAJOR	T.P.I
	PITCH	DIA. INCH			UNC	UNF	DIA. INCH		BSW	BSF	DIA. INCH	BA
M1.4	0.30	0.055	-	-	-	-	-	-	-	-	-	-
M1.6	0.35	0.063	73.0	#0	-	80	0.060	-	-	-	-	-
M2.0	0.40	0.079	64.0	#1	-	72	0.073	-	-	-	-	-
-	-	-	-	#2	56.0	64	0.086	8BA	-	-	0.087	59.1
M2.5	0.45	0.098	55.0	#3	48.0	56	0.099	-	-	-	-	-
-	-	-	-	#4	40.0	48	0.112	6BA	-	-	0.110	47.9
M3	0.50	0.118	51.0	#5	40.0	44	0.125	1/8	40.0	-	0.125	-
M3.5	0.60	0.138	-	-	-	-	-	5BA	-	-	0.126	43.1
-	-	-	-	#6	32.0	40	0.138	4BA	-	-	0.142	38.5
M4	0.70	0.157	36.0	-	-	-	-	5/32	32.0	-	0.156	-
-	-	-	-	#8	32.0	36	0.164	3BA	-	-	0.161	34.8
M5	0.80	0.197	32.0	#10	24.0	32	0.190	3/16	24.0	32	0.187	-
-	-	-	-	-	-	-	-	2BA	-	-	0.185	31.3
-	-	-	-	-	-	-	-	1BA	-	-	0.209	28.2
M6	1.00	0.236	25.0	1/4	20.0	28	0.250	1/4	20.0	26	0.250	-
-	-	-	-	-	-	-	-	0BA	-	-	0.236	25.4
M8	1.25	0.315	20.0	5/16	18.0	24	0.313	5/16	18.0	22	0.313	-
M10	1.50	0.394	17.0	3/8	16.0	24	0.375	3/8	16.0	20	0.375	-
-	-	-	-	7/16	14.0	20	0.483	7/16	14.0	18	0.438	-
M12	1.75	0.472	14.5	1/2	13.0	20	0.500	1/2	12.0	16	0.500	-
M14	2.00	0.551	12.5	9/16	12.0	18	0.562	9/16	12.0	16	0.562	-
M16	2.00	0.630	12.5	5/8	11.0	18	0.625	5/8	11.0	14	0.625	-
M18	2.50	0.708	10.0	-	-	-	-	-	-	-	-	-
M20	2.50	0.787	10.0	3/4	10.0	16	0.750	3/4	10.0	12	0.750	-
M22	2.50	0.866	10.0	7/8	9.0	14	0.875	7/8	9.0	12	0.875	-
M24	3.00	0.945	8.50	1	8.0	12	1.000	1	8.0	10	1.000	-
M27	3.00	1.063	8.50	1 1/8	7.0	12	1.125	1 1/8	7.0	9	1.125	-
M30	3.50	1.181	7.30	1 1/4	7.0	12	1.250	1 1/4	7.0	9	1.250	-
M33	3.50	1.299	7.30	-	-	-	-	-	-	-	-	-
M36	4.00	1.417	6.40	1 1/2	6.0	12	1.500	1 1/2	6.0	8	1.500	-
M42	4.50	1.654	5.60	1 3/4	5.0	12	1.750	-	-	-	-	-
M48	5.00	1.890	-	2	4.5	-	2.000	2	4.5	7	2.000	-

COMMON NAME	UNS NUMBER	EURO-NORM GRADE NO.	DENSITY KG/M³	ELASTIC MODULUS AT 20°C Gpa (a)	MEAN CO-EFFICIENT OF THERMAL EXPANSION (b)			THERMAL CONDUC-TIVITY AT 100°C W / m.k	SPECIFIC HEAT 0-20°C	ELECTRICAL RESISTIVITY AT 20°C nΩm
					20-100°C µm/m/°C	20-300°C µm/m/°C	20-500°C µm/m/°C			
301	S30100	1.4310	7900	200	16.0	17.0	18.0	15.0	500	730
304	S30400	1.4301	7900	200	16.0	17.0	18.0	15.0	500	730
304L	S30403	1.4307	7900	200	16.0	17.0	18.0	15.0	500	730
310	S31008	1.4845	7900	200	15.0	16.2	17.2	15.0	500	850
316	S31600	1.4401	8000	200	16.0	17.0	18.0	15.0	500	750
316L	S31603	1.4404	8000	200	16.0	17.0	18.0	15.0	500	750
321	S32100	1.4541	7900	200	16.0	17.0	18.0	15.0	500	730
409	S40900	1.4512	7700	220	10.5	11.5	12.0	25.0	460	600
410	S41000	1.4006	7700	215	10.5	11.5	30.0	30.0	460	600
430	S43000	1.4016	7700	220	10.0	10.5	11.0	25.0	460	600

Notes:
(a) 1 Gpa = 1000 Mpa
(b) µm/m/°C = 10^{-6}/°C
These properties are approximate and intended for guidance only.

			TYPICAL ANALYSIS						TYPICAL MECHANICAL PROPERTIES			
CLASSIFICATION	CHARACTERISTICS	STAINLESS GRADE	C	Ni	Cr	Mo	Ti	S	YP	TS MPa	ELONGATION % ON 50mm	HB
Austenitic	Essentially non-magnetic in softened condition but show varying degrees of magnetism when cold worked. Cannot be hardened by heat treatment.	302	0.08	9.0	18.0	-	-	-	260	600	50	160
		303	0.12	9.0	18.0	-	-	0.2	260	600	50	160
		304	0.06	9.0	18.5	-	-	-	260	600	50	160
		304L	0.03	10.0	18.5	-	-	-	220	560	50	145
		310	0.13	20.0	25.0	-	-	-	310	620	45	170
		316	0.06	12.0	17.0	2.2	-	-	260	600	50	155
		316L	0.03	12.0	17.0	2.2	-	-	230	560	50	145
		317	0.07	13.0	19.0	3.2	-	-	310	620	45	170
		321	0.06	10.0	18.0	-	0.5	-	250	580	45	160
Ferritic	Magnetic. Cannot be hardened by heat treatment.	409	0.04	-	11.5	-	0.4	-	250	450	25	140
		430	0.08	-	17.0	-	-	-	310	540	30	170

Carbon - C Chromium - Cr Titanium - Ti
Nickel - Ni Molybdenum - Mo Sulphur - S

U.S.A	GERMANY	FRANCE	ITALY	BRITAIN	SWEDEN	JAPAN
ASTM AISI GRADE	WERKSTOFF NO.	AFNOR GRADE	UNI GRADE	BS DESIGNATION	SIS GRADE	JIS GRADE
304L	1.4306	Z2 CN 18-10	X2CrNi 18 11	304S 12	14 2352	SUS 304L
304	1.4301	Z6 CN 18-09	X5CrNi 18 10	304S 15	14 2332	SUS 304
-	-	-	-	-	14 2333	-
309S	1.4833	Z15 CN 24-13	X16CrNi 23 14	309S 24	-	SUS 309S
309	-	-	-	-	-	SUS 309
310S	1.4845	Z12 CN 25-20	X6CrNi 25 20	310S 24	14 2361	SUS 310S
310	-	-	X22CrNi 25 20	-	-	SUS 310
316L	1.4404	Z2 CND 17-12	X2CrNiMo 17 12	316S 12	14 2348	SUS 316L
-	1.4435	Z2 CND 17-13	X2CrNiMo 17 13	-	14 2353	-
316	1.4401	Z6 CND 17-11	X5CrNiMo 17 12	316S 16	14 2347	SUS 316
-	1.4436	Z6 CND 17-12	X5CrNiMo 17 13	-	14 2343	-
317L	1.4438	Z2 CND 19-15	X2CrNiMo 18 16	317S 12	14 2367	SUS 317L
317	-	-	-	317S 16	14 2366	SUS 317
-	1.4571	Z6 CHDT 17-12	X6CrNiMoTi 17 12	320S 17	14 2350	-
-	1.4573	Z6 CHDT 17-13	X6CrNiMoTi 17 13	-	-	-
321	1.4541	Z6 CNT 18-10	X6CrNiTi 18 11	321S 12	14 2337	SUS 321
347	1.4500	Z6 CNNb 18-10	X6CrNiNb 18 11	347S 17	14 2338	SUS 347

Approximate amount of thermal expansion that occurs in types 316 and 304 stainless steels subjected to temperature changes in the range 0-100˚. [GUIDE ONLY]

LENGTH [mtrs]	EXPANSION [mm]										
10	0	2	3	5	6	8	10	11	13	15	16
9	0	1	3	4	6	7	9	10	12	13	15
8	0	1	3	4	5	6	8	9	10	12	13
7	0	1	2	3	5	6	7	8	9	10	11
6	0	1	2	3	4	5	6	7	8	9	10
5	0	1	2	2	3	4	5	6	6	7	8
4	0	1	1	2	3	3	4	5	5	6	6
3	0	0	1	1	2	2	3	3	4	4	5
2	0	0	1	1	1	2	2	2	3	3	3
1	0	0	0	0	1	1	1	1	1	1	2

NOM. PIPE SIZE	FLANGE SPECIFICATION	PRESSURE RATING	FLANGE DIAMETER	FLANGE THICKNESS	NUMBER OF BOLTS	DRILLING	BOLT PCD
			mm	mm			
25mm/1"	ANSI B16.5	CL 150	108	11.5	4	16	79.4
	BS 4504	NP10	115	18.0	4	14	85.0
	BS 10	TE	114	9.0	4	14	82.0
32mm/1.25"	ANSI B16.5	CL 150	117	13.0	4	16	88.9
	BS 4504	NP10	140	18.0	4	18	100.0
	BS 10	TE	120	12.0	4	14	87.0
40mm/1.5"	ANSI B16.5	CL 150	127	14.5	4	16	98.4
	BS 4504	NP10	150	18.0	4	18	110.0
	BS 10	TE	133	12.0	4	14	98.0
50mm/2"	ANSI B16.5	CL 150	152	16.0	4	20	120.6
	BS 4504	NP10	165	20.0	4	18	125.0
	BS10	TE	152	14.0	4	17	114.0
65mm/2.5"	ANSI B16.5	CL 150	178	17.5	4	20	139.7
	BS4504	NP10	185	18.0	4	18	145.0
	BS 10	TE	165	14.0	4	17	127.0

NOM. PIPE SIZE	FLANGE SPECIFICATION	PRESSURE RATING	FLANGE DIAMETER	FLANGE THICKNESS	NUMBER OF BOLTS	DRILLING	BOLT PCD
				mm	mm		
80mm/3"	ANSI B16.5	CL 150	191	19.5	4	20	152.4
	BS 4504	NP10	200	20.0	8	18	160.0
	BS 10	TE	184	14.0	4	17	146.0
100mm/4"	ANSI B16.5	CL 150	229	24.0	8	20	190.5
	BS 4504	NP10	220	20.0	8	18	180.0
	BS 10	TE	216	17.0	8	17	178.0
150mm/6"	ANSI B16.5	CL 150	279	25.5	8	23	241.3
	BS 4504	NP10	285	22.0	8	22	240.0
	BS 10	TE	279	17.0	8	22	235.0
200mm/8"	ANSI B16.5	CL 150	343	29.0	8	23	298.4
	BS 4504	NP10	340	24.0	8	22	295.0
	BS10	TE	336	19.0	8	22	292.0
250mm/10"	ANSI B16.5	CL 150	406	30.5	12	26	361.9
	BS4504	NP10	395	26.0	12	22	350.0
	BS 10	TE	406	22.0	12	22	355.0

A micron is 1/1000mm [0.00003937"]. To the average naked eye only particle sizes as small as 40 microns [0.0057"] are visible. When extremely fine woven cloth, covering a range from about 40 to 2 microns [nominal], is woven the number of holes per square inch may be upward of 1 million.
These fine meshes are used predominantly for filter elements employed in fluid power systems for the purpose of removing any impurities. Because of its hard working properties and also its corrosion resistance, Stainless Steel Woven Wire is generally used.

MICRON	INCHES	MICRON	INCHES	MICRON	INCHES	MICRON	INCHES
1	.00003937	11	.000433	21	.000827	40	.001575
2	.00007874	12	.000472	22	.000866	50	.001969
3	.00011810	13	.000512	23	.000906	60	.002362
4	.00015740	14	.000551	24	.000945	70	.002756
5	.00019680	15	.000591	25	.000984	80	.003150
6	.00023620	16	.000630	26	.001024	90	.003543
7	.00027560	17	.000669	27	.001063	100	.003937
8	.00031490	18	.000709	28	.001102	150	.005906
9	.00035430	19	.000748	29	.001142	200	.007874

NOMINAL MESH NUMBER	NOMINAL WIDTH OF APERTURE	
	mm	MICRONS
4	4.000	4000
5	3.250	3350
6	2.800	2800
7	2.360	2360
8	2.000	2000
10	1.700	1700
12	1.400	1400
14	1.180	1180
16	1.000	1000
18	0.850	850
22	0.710	710
25	0.600	600
30	0.500	500
36	0.435	425
44	0.355	355
52	0.300	300
60	0.250	250
72	0.212	212
85	0.180	180
100	0.150	150
120	0.125	125
150	0.100	100
170	0.090	90
200	0.075	75
240	0.063	63
300	0.053	53
350	0.045	45

Excerpts from Standard 410: 1969 Table 3 for Fine Wire Cloth in Test Sieves.

CONDITION	CLEANING AGENTS	PRECAUTIONS
Readily removed stains. Construction dirt. Routine cleaning.	Soap. Liquid detergents. Powder detergents. Hose pipe jet.	Avoid scratching. Do not use cleaners containing bleaching agents. Rinse with clean water to remove residual cleaning compounds.
Non-washable deposits.	Domestic cleaning powders. Recommended stainless steel cleaners such as Autosol.	Do not use steel wool. Stainless steel wool may be used. Rub in straight lines along the polish pattern. Avoid scratching.
Oil and greasy deposits.	[a] Organic solvents such as acetone, methylated spirits, Xylol, Benzene. [b] Caustic soda or tri sodium phosphate solution [5 to 10%].	Final wash with detergent and clean water. Wipe dry. Care is required with flammable solvents.
Rust stains from external sources.	[a] Oxalic acid, sulphamic acid [10%] [b] Abrasive cleaning paste. [c] Nitric acid.	Avoid scratching. Rinse thoroughly with water and detergent. Wipe dry.
Finger Prints.	Dilute phosphoric acid with detergent.	Rinse thoroughly and wipe dry.
Welding scale. Heat tint.	10 to 15% by volume nitric acid with 1 to 2% by volume hydrofluoric acid up to 50°C for up to 15 mins.	As for nitric acid.
Water 'scale' - calcium/magnesium salt deposits.	Citric acid solution. Tartaric acid solution. Up to 10% W/v hot versene may be added.	Wash with detergent and warm water. Wipe dry.

Exclusions – Limitations of Liability
Whilst Steel and Tube Stainless has taken every reasonable precaution in compiling this pocket guide, the guide is provided on an "as is" basis. Steel and Tube Stainless shall not be liable for any representation or warranty of any kind (express or implied) with respect to products (including specifications) supplied pursuant to, or the contents of this pocket guide and any such representations or warranties are disclaimed.

Whilst care has been taken to ensure all information in this pocket guide is accurate and complete, any typographical, clerical or other error or omission in this pocket guide, including but not limited to, product information and product specifications shall be subject to corrections without any liability on the part of Steel and Tube Stainless.

contact us for more...

FREEPHONE: 0508 782 465
www.ststainless.co.nz

STEEL & TUBE
STAINLESS

A DIVISION OF STEEL & TUBE HOLDINGS LIMITED

AUCKLAND • HAMILTON • PALMERSTON NORTH
NEW PLYMOUTH • NELSON • CHRISTCHURCH • INVERCARGILL