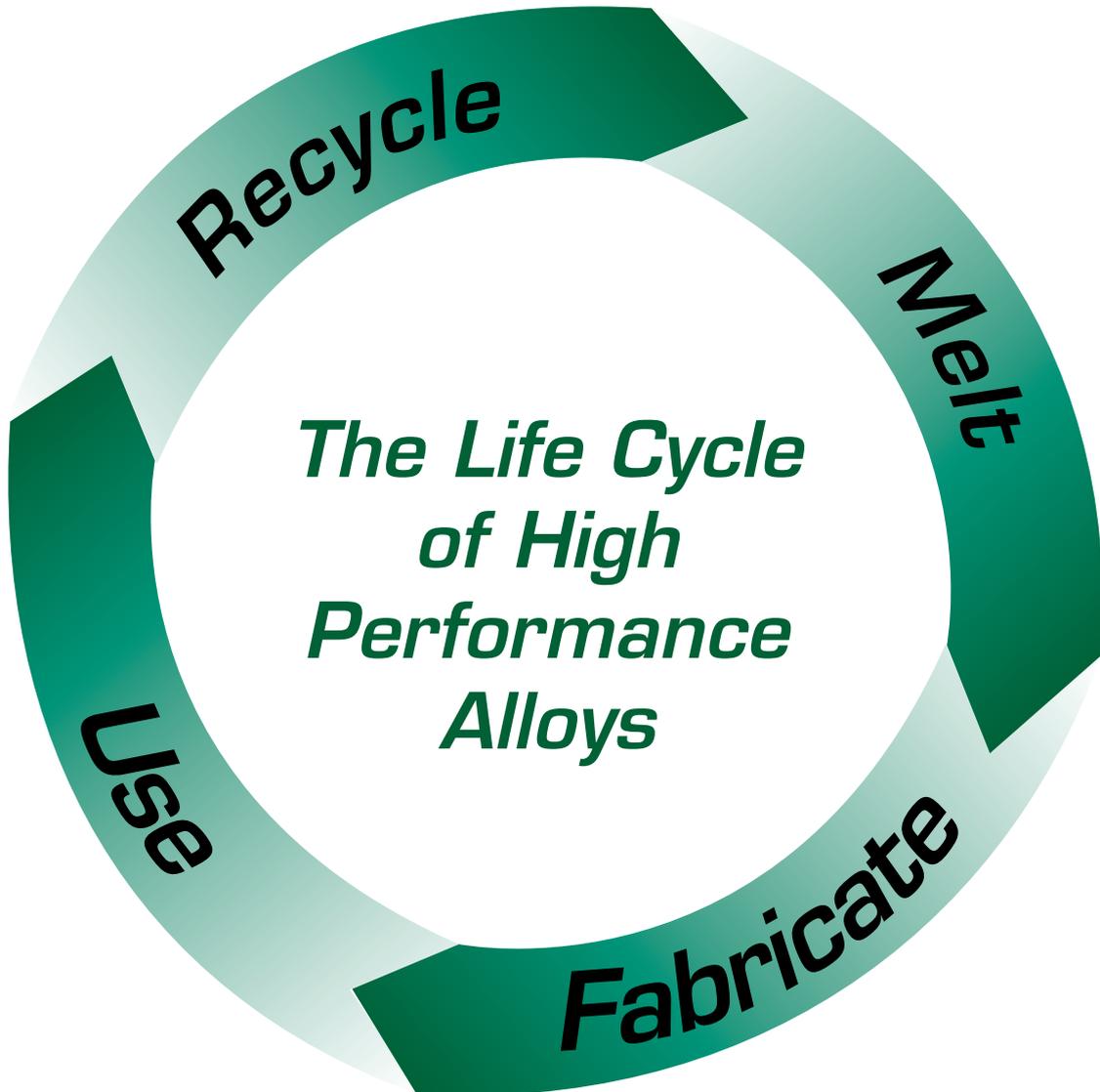


HIGH PERFORMANCE ALLOYS

CATALOGUE

HIGH PERFORMANCE ALLOYS



A complete life cycle material for the Consumer, Industry and the Environment.

To ensure a high quality of life, the materials that we as consumers and manufacturers use, should meet not only technical performance standards, but have a long service life, be useable in a greater number of applications and be environmentally friendly. Once their service is complete, they should be 100% recyclable, thereby completing the life cycle to be used once again.

Welcome to

Austral Wright Metals

Austral Wright Metals is the result of the merging, on 1st December 1997, of two long established well respected Australian owned metal distribution companies. Austral Bronze Crane Copper Limited (the metal distribution division of the Crane Group) and Wright and Company Pty Limited.

This brought together Australia's leaders in the distribution of:

Copper, brass and bronze – sheet, coil, bar, rod, extrusions and tube.

Stainless steel – sheet, coil, plate, bar, rod tube and fittings.

Aluminum – sheet, coil, plate and tread plate.

High Performance Alloys – including nickel based alloys, welding consumables and high technology metals.

Austral Bronze Crane Copper was incorporated in 1914 to manufacture non ferrous sheet, coil and extruded product. The business was restructured in 1990 to clearly focus on the distribution of non ferrous and specialty metals.

Incorporated in 1913, Wright and Company concentrated its efforts on the distribution of stainless steel and non ferrous alloys through its Australia wide warehouse network. In 1993, a state-of-the-art Metal Processing Centre was opened in Sydney.

Austral Wright Metals draws on nearly 100 years of experience in metal manufacturing and distribution to challenge industry standards and present a forward thinking, vibrant customer focused way to the future.

We can offer:

World leading sources in the supply of non ferrous metals and stainless steels.

In house processing for economical, speedy supply of customized product.

Technical knowledge and co-operative service from our employees.

Australia wide supply from our network of warehouses.

Austral Wright Metals is committed to fulfill its mission as your preferred business partner in the supply of Stainless Steel and Non Ferrous Metals and Alloys.

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TABLE OF CONTENTS

SECTION 1 – ROUND BAR

Nickel 200	Page 8
Inco alloy C22	Page 8
Chrome Zirconium Copper Alloy	Page 8
Inco alloy C276	Page 9
Monel 400	Page 10
Monel K500	Page 11
Inconel 600	Page 12
Inconel 601	Page 12
Inconel 625	Page 13
Incoloy 800	Page 13
Incoloy 825	Page 14
Aqualoy 17	Page 14
Aqualoy 22	Page 15
Titanium Gr2	Page 15

SECTION 2 – SHEET, COIL & PLATE

Nickel 200/201 Sheet	Page 18
Inco Alloy C276 Sheet & Plate	Page 18
Alloy 31 Plate	Page 19
Monel 400 Sheet & Plate	Page 19
Inconel Alloy 600 Sheet & Plate	Page 20
Inconel Alloy 601 Sheet & Plate	Page 20
Inconel Alloy 625 Sheet & Plate	Page 21
Inconel Alloy 800H/T Sheet & Plate	Page 21
Alloy 825 Sheet	Page 21
Duplex 2205 Sheet & Plate	Page 22
Super Duplex 2507 Sheet & Plate	Page 22
310/s Stainless Steel Sheet & Plate	Page 23
321 Stainless Steel Sheet & Coil	Page 23

SECTION 3 – WELDING PRODUCTS

Brazing Rod	Page 26
Welding Electrodes AWS A5.11	Page 27
Welding Electrodes	Page 28
Welding Wires	Page 29-31

SECTION 4 – MISCELLANEOUS PRODUCTS

Various Foundry Products	Page 34
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SECTION 5 – PRODUCT DATA SHEETS

Problem Solving Alloys	Page 36
Alloy C276	Page 37-39
Monel 400, R-405	Page 40-42
Monel K500	Page 43-45
Inconel 600	Page 46-48
Inconel 601	Page 49-50
Inconel 625, 625LCF	Page 51-53
Titanium Grade 2	Page 54-56
Titanium Grade 12	Page 57-58
Stainless Steel Grades 310, 310S	Page 59-60
Comparison Between Heat-Resistant Stainless Steel Grades 253MA & 310/310S	Page 61-64
Corrosion of Titanium & Titanium Alloys	Page 65-66

SECTION 6 – PRODUCT SPECIFICATIONS

Pipe Wall Thickness Table	Page 68
Pipe Weight per Metre	Page 69
ANSI Flange Dimensions	Page 70-71
Tube Standards	Page 72-74

AUSTRAL WRIGHT METALS WELCOME YOUR ENQUIRIES FOR ANY OF THE FOLLOWING MATERIALS:

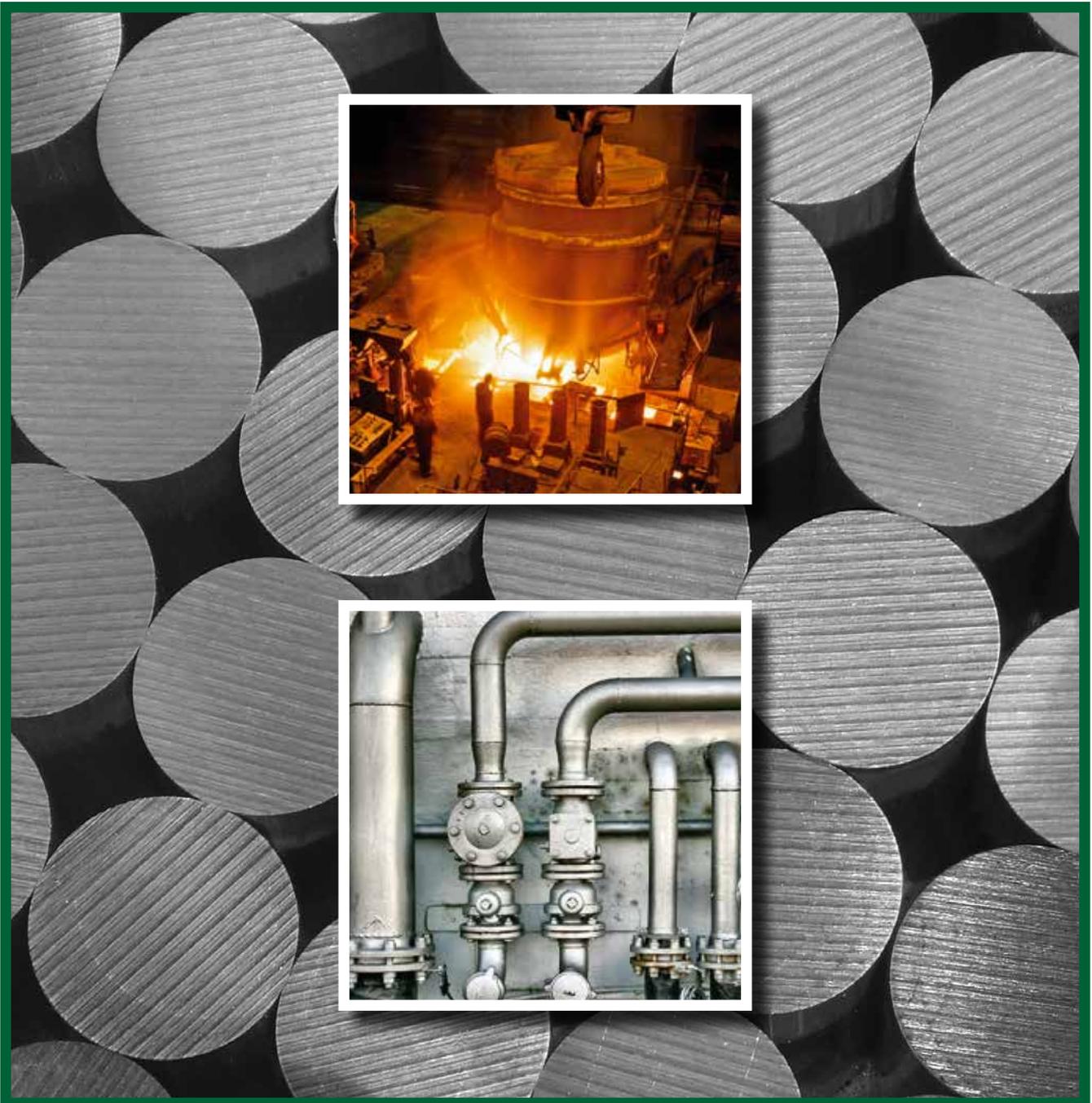
Aluminium	Coil, sheet, bar, tubing, welding wire
Aluminium Bronze	Bar, plate, castings, welding consumables
Aqualoy	Aqualoy boat shafting
Brass	Coil, sheet plate, shim, bar, engraving, tube, wire
Bearing Alloys	Leaded gunmetal, phosphor bronzes, aluminium bronzes
Bimetal	Coil, sheet
Beryllium Copper	Bar, flat, plate, hollow, castings, master alloys, coil
Cobalt	Alloy powder, granules, oxides and salts
Copper	Coil, sheet, plate, shim, busbar, free machining bar, tube, wire
Cupro Nickel	Pipe, tube, fittings, plate, sheet and welding consumables (70/30 & 90/10)
Hard Facing	Cobalt, nickel and iron based welding products in all forms, Stellite* Alloys
Heat Exchanger Tube	Stainless steel, brass, aluminium brass, copper nickel to AS1569, ASTM, BS and JIS Standards
Incoloy* Alloys	Heat and corrosion resistant material in wrought forms, welding consumables
Incomag*	Material for foundry use for production of SG cast iron
Inconel* Alloys	Heat and corrosion resistant material in wrought forms, welding consumables
Mumetal	Nickel iron alloys for use in the transformer and shielding applications
Molybdenum	Bar, sheet, wire, components and molybdenum compounds
Monel* Alloys	Corrosion resisting nickel alloy in bar, flat, plate, sheet, coil, tube and wire, welding consumables
Nickel	Primary nickel shot, pellets, squares, powder, oxides and salts
Nickel Alloys	Corrosion and heat resisting material in all wrought forms and welding consumables
Nickel Iron	Controlled expansion and electrical alloys in all wrought forms
Nickel Silver	Coil, sheet, bar, wire, in soft, hard, spring hard tempers
Nimonic Alloys	Coil, sheet, rod, wire sections
Nitronic*	Nitronic* grades of stainless steel
Phosphor Bronze	Coil, sheet, rod, wire
Powdered Metals	Nickel, tungsten, cobalt, iron, molybdenum, selenium, tellurium
Silicon Bronze	Sheet, bar, welding consumables
Stainless Steel	Coil, sheet, flats, angles, bar, tube, pipe fittings, welding consumables, all grades
Stellite*	Wear and corrosion resistant products
Tantalum	Sheet, tube, rod, wire
Titanium	Sheet, tube, rod, wire, pipe, fittings and fasteners
Tungsten	Sheet, powder, wire, rod
Tungsten-Copper	Sintered bars
Welding Materials	Wire, electrode and fluxes for gas or electric welding nickel alloys, cupro-nickels, aluminium, bronzes, stainless steel, dissimilar metals.

*Registered Trade Names

SECTION 1

ROUND

BAR



NICKEL 200 ROUND BAR UNS N02200

Item Number	Description	Diameter mm	Stock/ Overseas	KG P/Mtr
50005722	NICKEL 200 ROUND BAR RANDOM LENGTHS	15.88 (5/8")	O	1.76
50006651	NICKEL 200 ROUND BAR RANDOM LENGTHS	20	O	2.79
50037349	NICKEL 200 ROUND BAR RANDOM LENGTHS	25.4 (1")	O	4.50
50065329	NICKEL 200 ROUND BAR RANDOM LENGTHS	30	O	6.28
50119821	NICKEL 200 ROUND BAR RANDOM LENGTHS	31.75 (1-1/4")	O	7.04
50006171	NICKEL 200 ROUND BAR RANDOM LENGTHS	40	O	11.17
50006627	NICKEL 200 ROUND BAR RANDOM LENGTHS	50	O	17.45
50007166	NICKEL 200 ROUND BAR RANDOM LENGTHS	65	O	29.50

INCO ALLOY C22 ROUND BAR UNS N06022

Item Number	Description	Diameter mm	Stock/ Overseas	KG P/Mtr
50007195	ALLOY C22 ROUND BAR RANDOM LENGTHS	6.35 (1/4")	O	0.27
50007196	ALLOY C22 ROUND BAR RANDOM LENGTHS	9.53 (3/8")	O	0.61
50037285	ALLOY C22 ROUND BAR RANDOM LENGTHS	12.7 (1/2")	O	1.09
50005527	ALLOY C22 ROUND BAR RANDOM LENGTHS	50.8 (2")	O	17.45
50011098	ALLOY C22 ROUND BAR RANDOM LENGTHS	75	O	38.04

CHROME ZIRCONIUM COPPER ALLOY ROUND BAR C18150

Item Number	Description	Dimension (mm)	Stock/ Overseas	KG P/Mtr
50100211	CR-CU BAR ROUND C18150 CD	8	O	0.447
50100215	CR-CU BAR ROUND C18150 CD	10	O	0.698
50037110	CR-CU BAR ROUND C18150 CD	12.7	O	1.12
50037111	CR-CU BAR ROUND C18150 CD	15.88	O	1.76
50006637	CR-CU BAR ROUND C18150 CD	16	O	1.78
50037112	CR-CU BAR ROUND C18150 CD	19.05	O	2.53
50093119	CR-CU BAR ROUND C18150 CD	20	O	2.79
50005954	CR-CU BAR ROUND C18150	22.23	O	3.44
50006695	CR-CU BAR ROUND C18150 CD	25.4	O	4.5
50037113	CR-CU BAR ROUND C18150 CD	31.75	O	7.04
50037114	CR-CU BAR ROUND C18150 CD	38.1	O	10.13
50005964	CR-CU BAR ROUND C18150 CD	50.8	O	18.01
50005968	CR-CU BAR SQUARE C18150	25.4 X 25.4 X RANDOM CD	O	5.73
50066746	CR-CU BAR SQUARE C18150 CD	30 X 30 X R/L HV 130/145	O	8

INCO ALLOY C276 ROUND BAR UNS N10276

Item Number	Description	Diameter mm	Stock/ Overseas	KG P/Mtr
50008330	ALLOY C276 ROUND BAR RANDOM LENGTHS	6.35 (1/4")	O	0.28
50007170	ALLOY C276 ROUND BAR RANDOM LENGTHS	12.7 (1/2")	O	1.13
50007171	ALLOY C276 ROUND BAR RANDOM LENGTHS	20	O	2.79
50007173	ALLOY C276 ROUND BAR RANDOM LENGTHS	22.23 (7/8")	O	3.45
50007174	ALLOY C276 ROUND BAR RANDOM LENGTHS	25.4 (1")	O	4.50
50007175	ALLOY C276 ROUND BAR RANDOM LENGTHS	30	O	6.28
50007154	ALLOY C276 ROUND BAR RANDOM LENGTHS	31.75 (1-1/4")	O	7.04
50007176	ALLOY C276 ROUND BAR RANDOM LENGTHS	32	O	7.15
50007177	ALLOY C276 ROUND BAR RANDOM LENGTHS	38.1 (1-1/2")	O	10.14
50005680	ALLOY C276 ROUND BAR RANDOM LENGTHS	44.45 (1-3/4")	O	13.80
50011589	ALLOY C276 ROUND BAR RANDOM LENGTHS	47.63 (1-7/8")	O	15.84
50024908	ALLOY C276 ROUND BAR RANDOM LENGTHS	50.8 (2")	O	18.02
50007180	ALLOY C276 ROUND BAR RANDOM LENGTHS	51.1	O	18.23
50007181	ALLOY C276 ROUND BAR RANDOM LENGTHS	60	O	25.14
50011588	ALLOY C276 ROUND BAR RANDOM LENGTHS	63.50 (2-1/2")	O	28.15
50007155	ALLOY C276 ROUND BAR RANDOM LENGTHS	76.2 (3")	O	40.54
50005524	ALLOY C276 ROUND BAR RANDOM LENGTHS	88.9 (3-1/2")	O	55.18
50007156	ALLOY C276 ROUND BAR RANDOM LENGTHS	101.6 (4")	O	72.08
50007186	ALLOY C276 ROUND BAR RANDOM LENGTHS	139.7 (5-1/2")	O	136.27
50007189	ALLOY C276 ROUND BAR RANDOM LENGTHS	152.4 (6")	O	162.17
50007183	ALLOY C276 ROUND BAR RANDOM LENGTHS	165.1 (6-1/2")	O	190.33
50007188	ALLOY C276 ROUND BAR RANDOM LENGTHS	203.2 (8")	O	288.31
50007172	ALLOY C276 ROUND BAR RANDOM LENGTHS	254 (10")	O	450.48

MANY OTHER SIZES OF BOTH C276 AND C22 AVAILABLE FROM OVERSEAS

MONEL* 400 ROUND BAR UNS N04400

Item Number	Description	Diameter mm	Stock/ Overseas	KG P/Mtr
50005822	MONEL 400 ROUND BAR RANDOM LENGTHS	8	O	0.44
50007108	MONEL 400 ROUND BAR RANDOM LENGTHS	10	O	0.69
50005724	MONEL 400 ROUND BAR RANDOM LENGTHS	12	O	1.00
50005743	MONEL 400 ROUND BAR RANDOM LENGTHS	15.88 (5/8")	O	1.74
50005725	MONEL 400 ROUND BAR RANDOM LENGTHS	16	O	1.77
50005726	MONEL 400 ROUND BAR RANDOM LENGTHS	20	O	2.76
50005740	MONEL 400 ROUND BAR RANDOM LENGTHS	25	O	4.32
50066678	MONEL 400 ROUND BAR RANDOM LENGTHS	32	O	7.08
50005728	MONEL 400 ROUND BAR RANDOM LENGTHS	34.93 (1-3/8")	O	8.43
50005729	MONEL 400 ROUND BAR RANDOM LENGTHS	35	O	8.47
50005730	MONEL 400 ROUND BAR RANDOM LENGTHS	38.1 (1-1/2")	O	10.03
50005731	MONEL 400 ROUND BAR RANDOM LENGTHS	40	O	11.06
50005732	MONEL 400 ROUND BAR RANDOM LENGTHS	44.45 (1-3/4")	O	13.67
50066677	MONEL 400 ROUND BAR RANDOM LENGTHS	45	O	14.00
50005741	MONEL 400 ROUND BAR RANDOM LENGTHS	50.8 (2")	O	17.84
50005734	MONEL 400 ROUND BAR RANDOM LENGTHS	57.15 (2-1/4")	O	22.58
50005735	MONEL 400 ROUND BAR RANDOM LENGTHS	63.5 (2-1/2")	O	27.87
50005736	MONEL 400 ROUND BAR RANDOM LENGTHS	65	O	29.20
50005742	MONEL 400 ROUND BAR RANDOM LENGTHS	90	O	55.98
50005747	MONEL 400 ROUND BAR RANDOM LENGTHS	75	O	38.88
50005748	MONEL 400 ROUND BAR RANDOM LENGTHS	100	O	69.12
50005744	MONEL 400 ROUND BAR RANDOM LENGTHS	101.6 (4")	O	71.35
50005738	MONEL 400 ROUND BAR RANDOM LENGTHS	130	O	116.81
50065313	MONEL 400 ROUND BAR RANDOM LENGTHS	165	O	188.17
50005739	MONEL 400 ROUND BAR RANDOM LENGTHS	203.2 (8")	O	285.39

* registered trade name

MONEL* K500 ROUND BAR UNS N05500

Item Number	Description	Diameter mm	Stock/Overseas	KG P/Mtr
50007102	MONEL K500 ROUND BAR RANDOM LENGTHS	12.7 (1/2")	O	1.07
50005761	MONEL K500 ROUND BAR RANDOM LENGTHS	25	O	4.14
50007103	MONEL K500 ROUND BAR RANDOM LENGTHS	25.4 (1")	O	4.28
50011399	MONEL K500 ROUND BAR RANDOM LENGTHS	28.58 (1-1/8")	O	5.41
50005765	MONEL K500 ROUND BAR RANDOM LENGTHS	31.75 (1-1/4")	O	6.68
50005755	MONEL K500 ROUND BAR RANDOM LENGTHS	35	O	8.12
50007104	MONEL K500 ROUND BAR RANDOM LENGTHS	38.1 (1-1/2")	O	9.62
50103911	MONEL K500 ROUND BAR RANDOM LENGTHS	40	O	10.61
50005763	MONEL K500 ROUND BAR RANDOM LENGTHS	41.28 (1-5/8")	O	11.30
50005836	MONEL K500 ROUND BAR RANDOM LENGTHS	44.45 (1-3/4")	O	13.10
50096748	MONEL K500 ROUND BAR RANDOM LENGTHS	45	O	13.42
50005720	MONEL K500 ROUND BAR RANDOM LENGTHS	50.8 (2")	O	17.11
50005758	MONEL K500 ROUND BAR RANDOM LENGTHS	57.15 (2-1/4")	O	21.65
50006600	MONEL K500 ROUND BAR RANDOM LENGTHS	63.5 (2-1/2")	O	26.73
50005759	MONEL K500 ROUND BAR RANDOM LENGTHS	65	O	28.01
50032784	MONEL K500 ROUND BAR RANDOM LENGTHS	75	O	37.29
50007113	MONEL K500 ROUND BAR RANDOM LENGTHS	76.2 (3")	O	38.49
50005767	MONEL K500 ROUND BAR RANDOM LENGTHS	80	O	42.43
50103912	MONEL K500 ROUND BAR RANDOM LENGTHS	88.9 (3-1/2")	O	52.39
50005766	MONEL K500 ROUND BAR RANDOM LENGTHS	100	O	66.29
50005754	MONEL K500 ROUND BAR RANDOM LENGTHS	115	O	87.67
50032785	MONEL K500 ROUND BAR RANDOM LENGTHS	130	O	112.03
50005760	MONEL K500 ROUND BAR RANDOM LENGTHS	177.8 (7")	O	209.56

**AVAILABLE IN BOTH AGED AND SOLUTION ANNEALED. CHECK FOR AVAILABILITY.
Up to 1-1/8" diameter are sold in half & full lengths only.**

* registered trade name

INCONEL* ALLOY 600 ROUND BAR UNS N06600

Item Number	Description	Diameter mm	Stock/ Overseas	KG P/Mtr
50005776	ALLOY 600 ROUND BAR RANDOM LENGTHS	9.53	O	0.61
50005503	ALLOY 600 ROUND BAR RANDOM LENGTHS	12.7	O	1.08
50005771	ALLOY 600 ROUND BAR RANDOM LENGTHS	19.05	O	2.43
50005504	ALLOY 600 ROUND BAR RANDOM LENGTHS	20	O	2.68
50007115	ALLOY 600 ROUND BAR RANDOM LENGTHS	22.23	O	3.31
50005768	ALLOY 600 ROUND BAR RANDOM LENGTHS	25	O	4.19
50005772	ALLOY 600 ROUND BAR RANDOM LENGTHS	38.1	O	9.73
50005502	ALLOY 600 ROUND BAR RANDOM LENGTHS	44.45	O	13.24
50005773	ALLOY 600 ROUND BAR RANDOM LENGTHS	50.8	O	17.29
50005774	ALLOY 600 ROUND BAR RANDOM LENGTHS	57.15	O	21.88
50005775	ALLOY 600 ROUND BAR RANDOM LENGTHS	63.5	O	27.02
50007116	ALLOY 600 ROUND BAR RANDOM LENGTHS	75	O	37.69
50005769	ALLOY 600 ROUND BAR RANDOM LENGTHS	80	O	42.88
50005777	ALLOY 600 ROUND BAR RANDOM LENGTHS	130	O	113.23
50005778	ALLOY 600 ROUND BAR RANDOM LENGTHS	160	O	171.52

INCONEL* ALLOY 601 ROUND BAR UNS N06601

Item Number	Description	Diameter mm	Stock/ Overseas	KG P/Mtr
50005491	ALLOY 600 ROUND BAR RANDOM LENGTHS	6	O	0.24
50005789	ALLOY 600 ROUND BAR RANDOM LENGTHS	9.53	O	0.61
50005788	ALLOY 600 ROUND BAR RANDOM LENGTHS	10	O	0.67
50005785	ALLOY 600 ROUND BAR RANDOM LENGTHS	12	O	0.96
50005779	ALLOY 600 ROUND BAR RANDOM LENGTHS	12.7	O	1.08
50005786	ALLOY 600 ROUND BAR RANDOM LENGTHS	16	O	1.72
50005780	ALLOY 600 ROUND BAR RANDOM LENGTHS	19.05	O	2.43
50005787	ALLOY 600 ROUND BAR RANDOM LENGTHS	20	O	2.68
50005792	ALLOY 600 ROUND BAR RANDOM LENGTHS	25	O	4.19
50005781	ALLOY 600 ROUND BAR RANDOM LENGTHS	25.4	O	4.32
50025509	ALLOY 600 ROUND BAR RANDOM LENGTHS	31.75	O	6.75
50024525	ALLOY 600 ROUND BAR RANDOM LENGTHS	34.92	O	8.17
50005793	ALLOY 600 ROUND BAR RANDOM LENGTHS	35	O	8.21
50005782	ALLOY 600 ROUND BAR RANDOM LENGTHS	38.1	O	9.73
50007118	ALLOY 600 ROUND BAR RANDOM LENGTHS	44.45	O	13.24
50108324	ALLOY 600 ROUND BAR RANDOM LENGTHS	50	O	16.75
50005783	ALLOY 600 ROUND BAR RANDOM LENGTHS	50.8	O	17.29
50005784	ALLOY 600 ROUND BAR RANDOM LENGTHS	76.2	O	38.90
50005790	ALLOY 600 ROUND BAR RANDOM LENGTHS	101.6	O	69.16
50024524	ALLOY 600 ROUND BAR RANDOM LENGTHS	127	O	108.06
50005509	ALLOY 600 ROUND BAR RANDOM LENGTHS	152.4	O	155.61
50005791	ALLOY 600 ROUND BAR RANDOM LENGTHS	203.2	O	276.64

* registered trade name

INCONEL* ALLOY 625 ROUND BAR UNS N06625

Item Number	Description	Diameter mm	Stock/Overseas	KG P/Mtr
50037171	ALLOY 625 ROUND BAR RANDOM LENGTHS	16	O	1.70
50005486	ALLOY 625 ROUND BAR RANDOM LENGTHS	31.75 (1-1/4")	O	6.68
50037170	ALLOY 625 ROUND BAR RANDOM LENGTHS	35	O	8.12
50037169	ALLOY 625 ROUND BAR RANDOM LENGTHS	40	O	10.61
50063243	ALLOY 625 ROUND BAR RANDOM LENGTHS	50	O	16.57
50005495	ALLOY 625 ROUND BAR RANDOM LENGTHS	50.8 (2")	O	17.11
50063244	ALLOY 625 ROUND BAR RANDOM LENGTHS	70	O	32.48
50005497	ALLOY 625 ROUND BAR RANDOM LENGTHS	76.2 (3")	O	38.49
50063245	ALLOY 625 ROUND BAR RANDOM LENGTHS	100	O	66.28
50005494	ALLOY 625 ROUND BAR RANDOM LENGTHS	101.6 (4")	O	68.42
50005488	ALLOY 625 ROUND BAR RANDOM LENGTHS	114.3 (4-1/2")	O	86.60
50005489	ALLOY 625 ROUND BAR RANDOM LENGTHS	203	O	273.15

INCOLOY* ALLOY 800H/HT ROUND BAR UNS N08800/UNS N08811

Item Number	Description	Diameter mm	Stock/Overseas	KG P/Mtr
50005797	ALLOY 800H/HT ROUND BAR RANDOM LENGTHS	12.7 (1/2")	O	1.01
50005798	ALLOY 800H/HT ROUND BAR RANDOM LENGTHS	15.88 (5/8")	O	1.57
50005799	ALLOY 800H/HT ROUND BAR RANDOM LENGTHS	16	O	1.60
50007119	ALLOY 800H/HT ROUND BAR RANDOM LENGTHS	19.05 (3/4")	O	2.26
50007122	ALLOY 800H/HT ROUND BAR RANDOM LENGTHS	25.4 (1")	O	4.02
50005805	ALLOY 800H/HT ROUND BAR RANDOM LENGTHS	40	O	9.98
50005800	ALLOY 800H/HT ROUND BAR RANDOM LENGTHS	44.45 (1-3/4")	O	12.32
50005804	ALLOY 800H/HT ROUND BAR RANDOM LENGTHS	50.8 (2")	O	16.09
50005801	ALLOY 800H/HT ROUND BAR RANDOM LENGTHS	60	O	22.45
50005802	ALLOY 800H/HT ROUND BAR RANDOM LENGTHS	90	O	50.51
50005806	ALLOY 800H/HT ROUND BAR RANDOM LENGTHS	100	O	62.36

* registered trade name

INCOLOY* ALLOY 825 ROUND BAR UNS N08825

Item Number	Description	Diameter mm	Stock/Overseas	KG P/Mtr
50005863	ALLOY 825 ROUND BAR RANDOM LENGTHS	10	O	0.64
50005808	ALLOY 825 ROUND BAR RANDOM LENGTHS	12.7 (1/2")	O	1.03
50005809	ALLOY 825 ROUND BAR RANDOM LENGTHS	15.88 (5/8")	O	1.61
50037325	ALLOY 825 ROUND BAR RANDOM LENGTHS	16	O	1.16
50007123	ALLOY 825 ROUND BAR RANDOM LENGTHS	19.05 (3/4")	O	2.32
50037326	ALLOY 825 ROUND BAR RANDOM LENGTHS	20	O	2.56
50005810	ALLOY 825 ROUND BAR RANDOM LENGTHS	25	O	4.00
50005811	ALLOY 825 ROUND BAR RANDOM LENGTHS	31.75 (1-1/4")	O	6.44
50005813	ALLOY 825 ROUND BAR RANDOM LENGTHS	35	O	7.83
50005812	ALLOY 825 ROUND BAR RANDOM LENGTHS	38.1 (1-1/2")	O	9.28
50011564	ALLOY 825 ROUND BAR RANDOM LENGTHS	40	O	10.23
50011405	ALLOY 825 ROUND BAR RANDOM LENGTHS	45	O	12.95
50005814	ALLOY 825 ROUND BAR RANDOM LENGTHS	50	O	15.98
50007124	ALLOY 825 ROUND BAR RANDOM LENGTHS	60	O	23.02
50005815	ALLOY 825 ROUND BAR RANDOM LENGTHS	63.5 (2-1/2")	O	25.78
50005816	ALLOY 825 ROUND BAR RANDOM LENGTHS	65	O	27.01
50005818	ALLOY 825 ROUND BAR RANDOM LENGTHS	75	O	35.96
50025487	ALLOY 825 ROUND BAR RANDOM LENGTHS	90	O	51.78
50025488	ALLOY 825 ROUND BAR RANDOM LENGTHS	100	O	63.93
50007055	ALLOY 825 ROUND BAR RANDOM LENGTHS	101.6(4")	O	65.99
50006618	ALLOY 825 ROUND BAR RANDOM LENGTHS	114	O	83.09
50025489	ALLOY 825 ROUND BAR RANDOM LENGTHS	130	O	108.04
50005817	ALLOY 825 ROUND BAR RANDOM LENGTHS	150	O	143.85
50005807	ALLOY 825 ROUND BAR RANDOM LENGTHS	250	O	399.57

AQUALOY* 17 BOAT SHAFT UNS S17400

Item Number	Description	Diameter mm	Stock/Overseas	KG P/Mtr
50005478	AQUALOY 22 BOAT SHAFT CENTRELESS GROUND	25.4 (1")	O	3.95
50005479	AQUALOY 22 BOAT SHAFT CENTRELESS GROUND	44.45 (1-3/4")	O	12.10
50005480	AQUALOY 22 BOAT SHAFT CENTRELESS GROUND	63.5 (2-1/2")	O	24.70

MANY OTHER SIZES OF BOTH AQUALOY 17 & 22 AVAILABLE FROM OVERSEAS
Up to 1-1/8" diameter are sold in half & full lengths only.

* registered trade name

AQUALOY* 22 BOAT SHAFT UNS S20910

Item Number	Description	Diameter mm	Stock/ Overseas	KG P/Mtr
50004896	AQUALOY 22 BOAT SHAFT CENTRELESS GROUND	19.05 (3/4")	O	2.20
50004895	AQUALOY 22 BOAT SHAFT CENTRELESS GROUND	22.23 (7/8")	O	3.00
50004894	AQUALOY 22 BOAT SHAFT CENTRELESS GROUND	25.4 (1")	O	3.99
50004897	AQUALOY 22 BOAT SHAFT CENTRELESS GROUND	28.58 (1-1/8")	O	5.00
50005463	AQUALOY 22 BOAT SHAFT CENTRELESS GROUND	31.75 (1-1/4")	O	6.20
50005465	AQUALOY 22 BOAT SHAFT CENTRELESS GROUND	38.1 (1-1/2")	O	8.90
50005464	AQUALOY 22 BOAT SHAFT CENTRELESS GROUND	44.45 (1-3/4")	O	12.10
50005467	AQUALOY 22 BOAT SHAFT CENTRELESS GROUND	50.8 (2")	O	15.80
50005468	AQUALOY 22 BOAT SHAFT CENTRELESS GROUND	57.15 (2-1/4")	O	20.00
50005469	AQUALOY 22 BOAT SHAFT CENTRELESS GROUND	63.5 (2-1/2")	O	24.70
50005470	AQUALOY 22 BOAT SHAFT CENTRELESS GROUND	69.85 (2-3/4")	O	30.00
50005481	AQUALOY 22 BOAT SHAFT CENTRELESS GROUND	70.6	O	30.50
50005471	AQUALOY 22 BOAT SHAFT CENTRELESS GROUND	76.2 (3")	O	35.40
50005476	AQUALOY 22 BOAT SHAFT CENTRELESS GROUND	82.55 (3-1/4")	O	41.70
50005473	AQUALOY 22 BOAT SHAFT CENTRELESS GROUND	88.9 (3-1/2")	O	48.50
50005477	AQUALOY 22 BOAT SHAFT CENTRELESS GROUND	101.6 (4")	O	63.20
50005475	AQUALOY 22 BOAT SHAFT CENTRELESS GROUND	114.3 (4-1/2")	O	80.00

Up to 1-1/8" diameter are sold in half & full lengths only.

TITANIUM GRADE 2 ROUND BAR UNS R50400

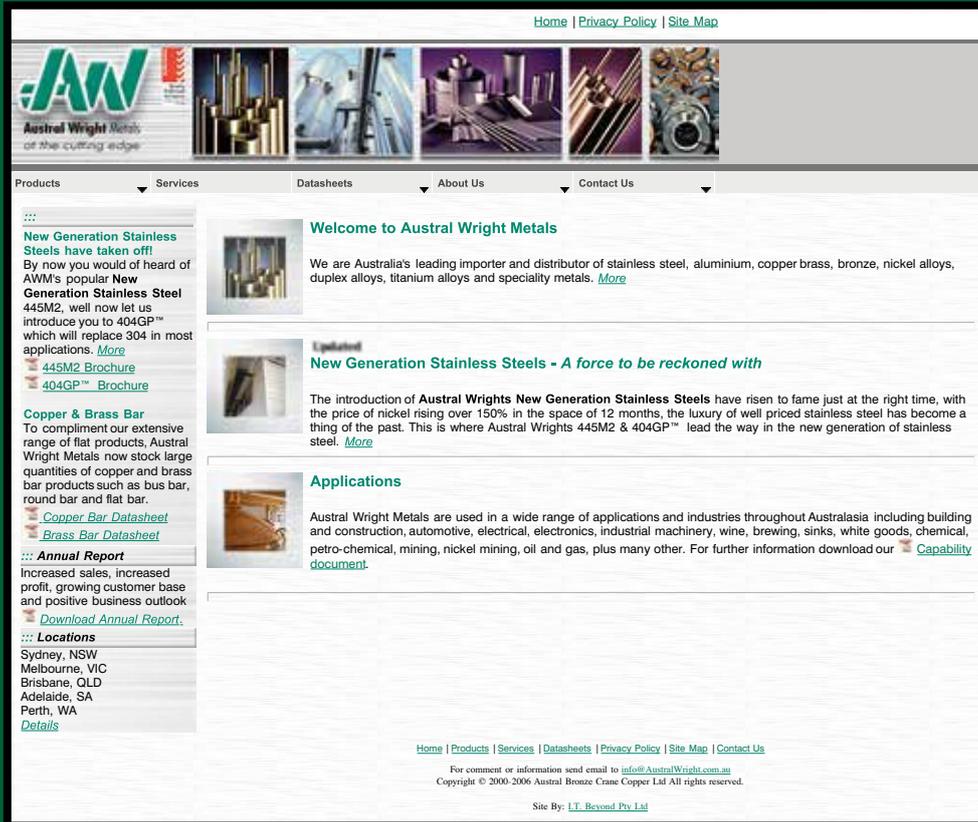
Item Number	Description	Diameter mm	Stock/ Overseas	KG P/Mtr
50005631	TITANIUM GRADE 2 ROUND BAR RANDOM LENGTHS	5mm	O	0.10
50122480	TITANIUM GRADE 2 ROUND BAR RANDOM LENGTHS	6.35mm (1/4")	O	0.15
50122479	TITANIUM GRADE 2 ROUND BAR RANDOM LENGTHS	9.53mm (3/8")	O	0.33
50122477	TITANIUM GRADE 2 ROUND BAR RANDOM LENGTHS	13mm	O	0.60
50005633	TITANIUM GRADE 2 ROUND BAR RANDOM LENGTHS	15.88mm (5/8")	O	0.90
50122476	TITANIUM GRADE 2 ROUND BAR RANDOM LENGTHS	19.05mm (3/4")	O	1.30
50005634	TITANIUM GRADE 2 ROUND BAR RANDOM LENGTHS	25.4mm (1")	O	2.30
50122475	TITANIUM GRADE 2 ROUND BAR RANDOM LENGTHS	38.1mm (1-1/2")	O	5.20

MANY OTHER SIZES OF TITANIUM GRADE 2 AVAILABLE FROM OVERSEAS

* registered trade name

For further information and data sheets please visit our website

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SECTION 2

SHEET, COIL & PLATE



NICKEL 200/201 SHEET UNS N02200/NO2201

Item Number	Description	Dimension (mm)	Stock/ Overseas	KG P/M2
50009448	NICKEL 200 COLD ROLLED SHEET	1.2 X 914 X 3048 ANN	O	9.9
50011312	NICKEL 200 COLD ROLLED SHEET	1.2 X 1000 X 2000	O	9.9
50009447	NICKEL 200 COLD ROLLED SHEET	1.58 X 914 X 2438 ANN	O	14.2
50009442	NICKEL 200 COLD ROLLED SHEET	1.6 X 1000 X 2000 ANN	O	14.4
50009443	NICKEL 200 COLD ROLLED SHEET	2 X 1000 X 2000 ANN	O	18.0
50009445	NICKEL 200 COLD ROLLED SHEET	3 X 1200 X 3000 COLD ROLLED	O	27.0
50033800	NICKEL 201 COLD ROLLED SHEET	2 X 1000 X 2000 CR ANN	O	18.0
50033803	NICKEL 201 COLD ROLLED SHEET	3 X 1200 X 3000 CR ANN	O	27.0

INCO ALLOY C276 SHEET & PLATE UNS N10276

Item Number	Description	Dimension (mm)	Stock/ Overseas	KG P/M2
50009519	ALLOY C276 COLD ROLLED SHEET	0.5 X 1000 X 2000	O	4.5
50010149	ALLOY C276 COLD ROLLED SHEET	0.7 X 1219 X 3048	O	6.3
50010149	ALLOY C276 COLD ROLLED SHEET	0.9 X 1219 X 3048	O	8.1
50010149	ALLOY C276 COLD ROLLED SHEET	1.2 X 1219 X 3048	O	10.8
50009522	ALLOY C276 COLD ROLLED SHEET	1.6 X 1200 X 3048	O	14.4
50005714	ALLOY C276 COLD ROLLED SHEET	2.0 X 1219 X 3048	O	18.0
50009521	ALLOY C276 COLD ROLLED SHEET	3 X 1200 X 3000	O	27.0
50007151	ALLOY C276 COLD ROLLED SHEET	3.18 X VARIOUS ANN	O	28.6
PLATE				
50009525	ALLOY C276 HOT ROLLED PLATE	6MM X CUT PLATE	O	54.0
50009524	ALLOY C276 HOT ROLLED PLATE	8MM X CUT PLATE	O	72.0
50009526	ALLOY C276 HOT ROLLED PLATE	10MM CUT PLATE	O	90.0
50009527	ALLOY C276 HOT ROLLED PLATE	12MM X CUT PLATE	O	108.0
50005530	ALLOY C276 HOT ROLLED PLATE	16MM X CUT PLATE	O	144.0
50009528	ALLOY C276 HOT ROLLED PLATE	19MM X CUT PLATE	O	171.0
50009529	ALLOY C276 HOT ROLLED PLATE	25MM X CUT PLATE	O	225.0
50010149	ALLOY C276 HOT ROLLED PLATE	32MM X CUT PLATE	O	288.00
50010149	ALLOY C276 HOT ROLLED PLATE	38MM X CUT PLATE	O	342.00
50010149	ALLOY C276 HOT ROLLED PLATE	50MM X CUT PLATE	O	450.00

ALLOY 31 PLATE UNS N08031

Item Number	Description	Size (mm)	Stock/ Overseas	KG P/M2
50118282	ALLOY 31 PLATE HOT ROLLED	3MM CUT PLATE	O	27.00
50116638	ALLOY 31 PLATE HOT ROLLED	6MM CUT PLATE	O	54.00
50118283	ALLOY 31 PLATE HOT ROLLED	8MM CUT PLATE	O	72.00
50118284	ALLOY 31 PLATE HOT ROLLED	10MM CUT PLATE	O	90.00
50120139	ALLOY 31 PLATE HOT ROLLED	12MM CUT PLATE	O	108.00
50001090	ALLOY 31 PLATE HOT ROLLED	16MM CUT PLATE	O	144.00
50001091	ALLOY 31 PLATE HOT ROLLED	20MM CUT PLATE	O	180.00
50120140	ALLOY 31 PLATE HOT ROLLED	25MM CUT PLATE	O	225.00

Also available in bar, pipe and fittings

MONEL * 400 SHEET & PLATE UNS N04400

Item Number	Description	Dimension (mm)	Stock/ Overseas	KG P/M2
50009455	MONEL 400 COLD ROLLED SHEET	0.45 X 914 X 3048	O	3.8
50009450	MONEL 400 COLD ROLLED SHEET	0.5 X 1000 X 2000	O	4.3
50006647	MONEL 400 COLD ROLLED SHEET	0.7 X 1000 X 2000	O	6.0
50009567	MONEL 400 COLD ROLLED SHEET	0.8 X 1000 X 2000	O	6.8
50096554	MONEL 400 COLD ROLLED SHEET	1 X 1200 X 3000	O	8.5
50104685	MONEL 400 COLD ROLLED SHEET	1 X 1000 X 3000	O	8.5
50009451	MONEL 400 COLD ROLLED SHEET	1.58 X 914 X 3048	O	13.4
50009456	MONEL 400 COLD ROLLED SHEET	1.6 X 1200 X 3000	O	13.6
50009457	MONEL 400 COLD ROLLED SHEET	2 X 1200 X 3000	O	17.0
50009458	MONEL 400 COLD ROLLED SHEET	2.5 X 1200 X 3000	O	2.1
50024828	MONEL 400 COLD ROLLED SHEET	3 X 1200 X 3000	O	25.5
PLATE				
50007068	MONEL 400 HOT ROLLED PLATE	6MM THICK CUT PLATE	O	49.00
50010244	MONEL 400 HOT ROLLED PLATE	8MM THICK CUT PLATE	O	66.00
50009452	MONEL 400 HOT ROLLED PLATE	10MM THICK CUT PLATE	O	82.00
50007067	MONEL 400 HOT ROLLED PLATE	12MM THICK CUT PLATE	O	98.00
50010244	MONEL 400 HOT ROLLED PLATE	16MM THICK CUT PLATE	O	131.00
50005695	MONEL 400 HOT ROLLED PLATE	19MM THICK CUT PLATE	O	156.00

INCONEL* ALLOY 600 SHEET & PLATE UNS N06600

Item Number	Description	Dimension (mm)	Stock/ Overseas	KG P/M2
50009488	ALLOY 600 COLD ROLLED SHEET	0.53 X 914.4 X 3048	O	4.50
50009491	ALLOY 600 COLD ROLLED SHEET	0.79 X 1219.6 X 3048	O	6.70
50009462	ALLOY 600 COLD ROLLED SHEET	0.94 X 914 X 3000	O	8.00
50009463	ALLOY 600 COLD ROLLED SHEET	0.94 X 1219 X 3048	O	8.00
50005701	ALLOY 600 COLD ROLLED SHEET	0.94 X VARIOUS	O	8.00
50009464	ALLOY 600 COLD ROLLED SHEET	1.2 X 1200 X 3000	O	10.20
50009461	ALLOY 600 COLD ROLLED SHEET	2 X 1219 X 3048	O	17.00
50007074	ALLOY 600 COLD ROLLED SHEET	3 X 1200 X 3000	O	25.50
50007076	ALLOY 600 COLD ROLLED SHEET	3 X VARIOUS ANN	O	25.50
PLATE				
50007165	ALLOY 600 HOT ROLLED PLATE	6MM THICK X CUT PLATE	O	54.00
50099549	ALLOY 600 HOT ROLLED PLATE	8MM THICK X CUT PLATE	O	68.00
50007073	ALLOY 600 HOT ROLLED PLATE	10MM THICK CUT PLATE	O	102.00
50005698	ALLOY 600 HOT ROLLED PLATE	12MM THICK CUT PLATE	O	98.40
50005499	ALLOY 600 HOT ROLLED PLATE	16MM THICK CUT PLATE	O	131.00
50007075	ALLOY 600 HOT ROLLED PLATE	20MM THICK CUT PLATE	O	164.00
50007070	ALLOY 600 HOT ROLLED PLATE	25MM THICK CUT PLATE	O	205.00
50009459	ALLOY 600 HOT ROLLED PLATE	32MM THIS CUT PLATE	O	262.00

INCONEL* ALLOY 601 SHEET & PLATE UNS N06601

Item Number	Description	Dimension (mm)	Stock/ Overseas	KG P/M2
50007063	ALLOY 601 COLD ROLLED SHEET	0.8 X VARIOUS	O	6.80
50005706	ALLOY 601 COLD ROLLED SHEET	1.2 X 1219 X 3048	O	10.20
50009474	ALLOY 601 COLD ROLLED SHEET	1.57 X 1200 X 3000	O	13.34
50097133	ALLOY 601 COLD ROLLED SHEET	1.6 X 1219 X 3048	O	13.60
50009532	ALLOY 601 COLD ROLLED SHEET	2 X 1200 X 3000	O	17.00
50007081	ALLOY 601 COLD ROLLED SHEET	3 X VARIOUS	O	25.50
50009472	ALLOY 601 COLD ROLLED SHEET	3 X 1200 X 3000	O	25.50
PLATE				
50007077	ALLOY 601 HOT ROLLED PLATE	5MM THICK CUT PLATE	O	42.50
50005702	ALLOY 601 HOT ROLLED PLATE	6MM THICK CUT PLATE	O	51.00
50007062	ALLOY 601 HOT ROLLED PLATE	8MM THICK CUT PLATE	O	68.00
50007079	ALLOY 601 HOT ROLLED PLATE	10MM THICK CUT PLATE	O	85.00
50005707	ALLOY 601 HOT ROLLED PLATE	12MM THICK CUT PLATE	O	108.00
50005705	ALLOY 601 HOT ROLLED PLATE	16MM THICK CUT PLATE	O	136.00
50007159	ALLOY 601 HOT ROLLED PLATE	20MM THICK CUT PLATE	O	161.00
50005703	ALLOY 601 HOT ROLLED PLATE	25MM THICK CUT PLATE	O	216.00
50024677	ALLOY 601 HOT ROLLED PLATE	38MM THICK CUT PLATE	O	323.00

INCONEL* ALLOY 625 SHEET & PLATE UNS N06625

Item Number	Description	Dimension (mm)	Stock/ Overseas	KG P/M2
50009487	ALLOY 625 COLD ROLLED SHEET	0.64 X 914 X 3048	O	5.50
50009493	ALLOY 625 COLD ROLLED SHEET	0.7 X 1200 X 2400	O	5.95
50009494	ALLOY 625 COLD ROLLED SHEET	0.7 X 1200 X 3000	O	5.95
50009480	ALLOY 625 COLD ROLLED SHEET	0.9 X 1220 X 3000	O	7.70
50009492	ALLOY 625 COLD ROLLED SHEET	1.2 X 1000 X 3000	O	10.20
50009476	ALLOY 625 COLD ROLLED SHEET	1.2 X 1219 X 3048	O	10.20
50009478	ALLOY 625 COLD ROLLED SHEET	1.2 X 1200 X 3000	O	10.20
50009479	ALLOY 625 COLD ROLLED SHEET	1.6 X 1000 X 3000	O	13.60
50009483	ALLOY 625 COLD ROLLED SHEET	1.6 X 1219 X 3048	O	13.60
50024516	ALLOY 625 COLD ROLLED SHEET	2 X 1220 X 3048	O	17.00
50005711	ALLOY 625 COLD ROLLED SHEET	3.175 X VARIOUS	O	27.00
50010254	ALLOY 625 HOT ROLLED PLATE	6MM CUT PLATE	O	49.00
50010254	ALLOY 625 HOT ROLLED PLATE	8MM CUT PLATE	O	65.00
50010254	ALLOY 625 HOT ROLLED PLATE	10MM CUT PLATE	O	82.00
50010254	ALLOY 625 HOT ROLLED PLATE	12MM CUT PLATE	O	98.00
50010254	ALLOY 625 HOT ROLLED PLATE	16MM CUT PLATE	O	131.00
50010254	ALLOY 625 HOT ROLLED PLATE	20MM CUT PLATE	O	164.00
50010254	ALLOY 625 HOT ROLLED PLATE	25MM CUT PLATE	O	205.00

INCOLOY* ALLOY 800H/T SHEET & PLATE UNS N08800/11

Item Number	Description	Dimension (mm)	Stock/ Overseas	KG P/M2
50009499	ALLOY 800H/HT SHEET	2 X 1200 X 3000 COLD ROLLED	O	17.00
50025525	ALLOY 800H/HT SHEET	3 X 1200 X 3000	O	24.60
50025524	ALLOY 800H/HT PLATE	5 X 2000 X 6000	O	41.00

ALLOY 825 SHEET UNS N08825

Item Number	Description	Dimension (mm)	Stock/ Overseas	KG P/M2
50009504	ALLOY 825 COLD ROLLED SHEET	0.6 X 1000 X 2000	O	4.9
50009515	ALLOY 825 COLD ROLLED SHEET	0.7 X 1219 X 3048	O	5.7
50009503	ALLOY 825 COLD ROLLED SHEET	1 X 1200 X 3000	O	8.2
50103879	ALLOY 825 COLD ROLLED SHEET	1.2 X 1200 X 3000	O	9.8
50009501	ALLOY 825 COLD ROLLED SHEET	1.27 X 914 X 3048	O	10.4
50009512	ALLOY 825 COLD ROLLED SHEET	1.27 X 1219 X 3048	O	10.4
50009514	ALLOY 825 COLD ROLLED SHEET	1.6 X 1219 X 3000	O	13.1
50009507	ALLOY 825 COLD ROLLED SHEET	3.175 X 1219 X 3048	O	26.0

* registered trade name

DUPLEX 2205 SHEET & PLATE UNS S31803

Item Number	Description	Dimension (mm)	Stock/ Overseas	KG P/M2
50097838	DUPLEX 2205 SHEET	2 X 2000 X 2500	O	16.50
50097839	DUPLEX 2205 SHEET	2 X 1200 X 2500	O	16.50
50097837	DUPLEX 2205 SHEET	3 X 914 X 3660	O	24.60

PLATE

50004099	DUPLEX 2205 PLATE	3MM CUT PLATE	O	24.60
50004100	DUPLEX 2205 PLATE	4MM CUT PLATE	O	32.80
50004101	DUPLEX 2205 PLATE	5MM X 2000 X 6000	O	41.00
50004102	DUPLEX 2205 PLATE	5MM CUT PLATE	O	41.00
50004103	DUPLEX 2205 PLATE	6 X 2000 X 6000	O	49.20
50004104	DUPLEX 2205 PLATE	6MM CUT PLATE	O	49.20
50004105	DUPLEX 2205 PLATE	8 X 2000 X 6000	O	65.60
50004106	DUPLEX 2205 PLATE	8MM CUT PLATE	O	65.60
50004107	DUPLEX 2205 PLATE	10 X 2000 X 6000	O	82.00
50004108	DUPLEX 2205 PLATE	10MM CUT PLATE	O	82.00
50004109	DUPLEX 2205 PLATE	12 X 2000 X 6000	O	98.40
50011181	DUPLEX 2205 PLATE	12MM CUT PLATE	O	98.40
50004110	DUPLEX 2205 PLATE	16MM CUT PLATE	O	131.00
50024900	DUPLEX 2205 PLATE	25 X 2000 X 6000	O	205.00
50063207	DUPLEX 2205 PLATE	25MM CUT PLATE	O	205.00
50024070	DUPLEX 2205 PLATE	32MM CUT PLATE	O	262.40

SUPER DUPLEX 2507 SHEET & PLATE UNS S32750

Item Number	Description	Dimension (mm)	Stock/ Overseas	KG P/M2
50004112	SUPER DUPLEX 2507 PLATE	3MM CUT PLATE	O	24.6
50004079	SUPER DUPLEX 2507 SHEET	3 X 1500 X 3000	O	24.6
50011305	SUPER DUPLEX 2507 PLATE	5MM CUT PLATE	O	41
50024902	SUPER DUPLEX 2507 PLATE	6MM CUT PLATE	O	49
50024902	SUPER DUPLEX 2507 PLATE	6 X 2000 X 6000	O	49
50024901	SUPER DUPLEX 2507 PLATE	8MM CUT PLATE	O	65.6
50024901	SUPER DUPLEX 2507 PLATE	8 X 2000 X 6000	O	65.6
50011303	SUPER DUPLEX 2507 PLATE	10MM CUT PLATE	O	82
50004078	SUPER DUPLEX 2507 PLATE	10 X 2000 X 6000	O	82
50024903	SUPER DUPLEX 2507 PLATE	12MM CUT PLATE	O	98.4
50024903	SUPER DUPLEX 2507 PLATE	12 X 2000 X 6000	O	98.4
50024904	SUPER DUPLEX 2507 PLATE	20MM CUT PLATE	O	164
50024904	SUPER DUPLEX 2507 PLATE	20 X 2000 X 6000	O	164
50024905	SUPER DUPLEX 2507 PLATE	25MM CUT PLATE	O	205
50024905	SUPER DUPLEX 2507 PLATE	25 X 2000 X 6000 ANN	O	205

* registered trade name

310/s Stainless Steel Sheet & Plate UNS S31000/S31008

Item Number	Description	Size (mm)	Stock/ Overseas	KG P/M2
50004482	310S S/S SHEET	1.0 x 1250 x 2500	O	7.4
50010161	310S S/S SHEET	1.2 x 1250 x 2500	O	9.8
50010161	310S S/S SHEET	1.6 x 1250 x 2500	O	13.1
50010161	310S S/S SHEET	2.0 x 1250 x 2500	O	18
50010161	310S S/S SHEET	2.5 x 1250 x 2500	O	20.5
50010161	310S S/S SHEET	3.0 x 1250 x 2500	O	24.6
PLATE				
50125931	310S S/S PLATE	3.0MM CUT PLATE	O	24.6
50119272	310S S/S PLATE	6.0MM CUT PLATE	O	49.2
50010161	310S S/S PLATE	8.0MM CUT PLATE	O	65.6
50119274	310S S/S PLATE	10.0MM CUT PLATE	O	82
50037162	310S S/S PLATE	12.0MM CUT PLATE	O	98.40
50010161	310S S/S PLATE	16.0MM CUT PLATE	O	131.00
50119275	310S S/S PLATE	20.0MM CUT PLATE	O	164.00
50037163	310S S/S PLATE	25.0MM CUT PLATE	O	205.00

Also available in other size sheets and plate as well as round bar, pipe and fittings

321 Stainless Steel Sheet & Coil UNS S32100

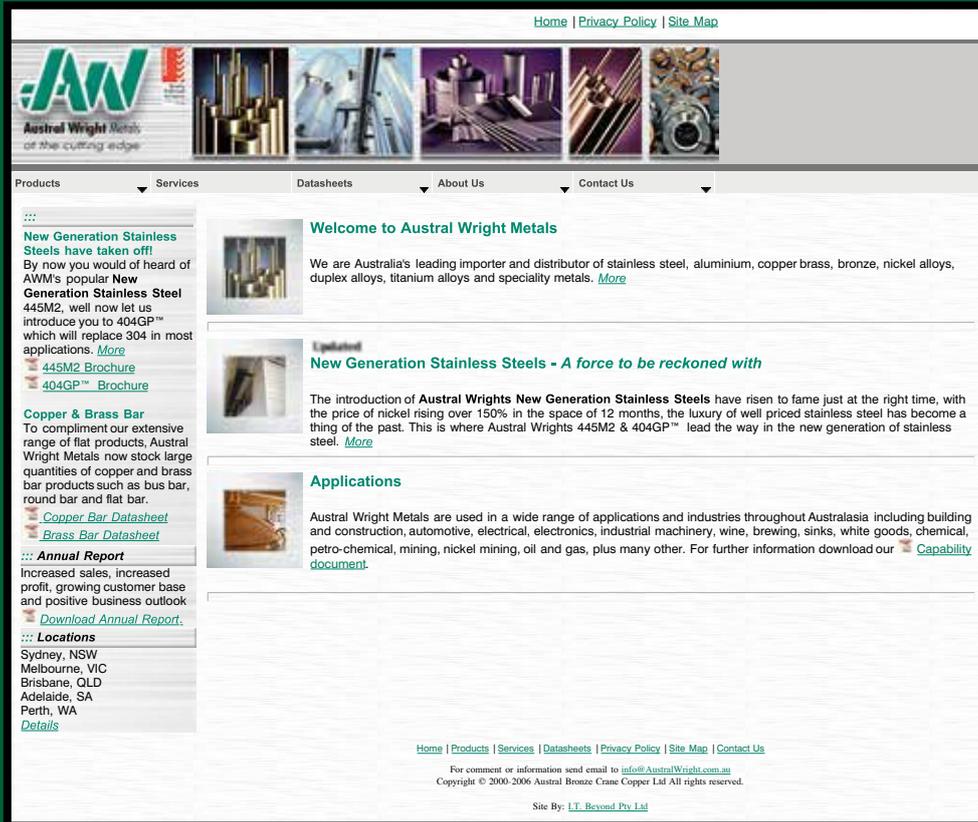
Item Number	Description	Size (mm)	Stock/ Overseas	KG P/M2
COIL				
50109052	321 S/S COIL 2B FINISH	0.5 X 1250MM	O	4.1
50109053	321 S/S COIL 2B FINISH	0.7 X 1250MM	O	5.7
50004220	321 S/S COIL 2B FINISH	0.9 X 1219MM	O	7
50109055	321 S/S COIL 2B FINISH	1.0 X 1250MM	O	7.4
50109056	321 S/S COIL 2B FINISH	1.2 X 1250MM	O	9.8
50010165	321 S/S COIL 2B FINISH	1.5 X 1250MM	O	12
50109057	321 S/S COIL 2B FINISH	1.5 X 1500MM	O	12
SHEET				
50010165	321 S/S SHEET 2B FINISH	0.5 X 1250 X 2500	O	4.1
50065284	321 S/S SHEET 2B FINISH	0.7 X 1250 X 2500	O	5.7
50008727	321 S/S SHEET 2B FINISH	0.9 X 1219 X 2400	O	7
50010165	321 S/S SHEET 2B FINISH	1.0 X 1250 X 2500	O	7.4
50009384	321 S/S SHEET 2B FINISH	1.2 X 1250 X 2500	O	9.8
50008781	321 S/S SHEET 2B FINISH	1.5 X 1500 X 3000	O	12
50008825	321 S/S SHEET 2B FINISH	1.6 X 1200 X 2400	O	12.8

Also available in other size sheets and plate as well as round bar, pipe and fittings

* registered trade name

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SECTION 3

WELDING

PRODUCTS



BRAZING ROD

Item Number	Description	Dimension (mm)	Stock/ Overseas
50006864	BRAZING ROD AG2	2 X 750 ANN AS1167.B2	O
50006853	BRAZING ROD AG2	2.5 X 750 ANN AS1167.B2	O
50006852	BRAZING ROD AG2	3 X 750 ANN AS1167.B2	O
50006854	BRAZING ROD AG5	2.5 X 750 ANN AS1167.B3	O
50006849	BRAZING ROD AG5	3 X 750 EO AS1167.B3	O
50006855	BRAZING ROD AG15	3 X 750 ANN AS1167.B4	O
50006856	BRAZING ROD AG15	2.5 X 750 ANN AS1167.B4	O
50006851	BRAZING ROD AG34	2.4 X 750 AS1167.A11	O
50037440	BRAZING ROD AG34	2.5 X 750 AS1167.A11	O
50006887	BRAZING ROD AG39	1.5 X 500 CD AS1167.A15	O
50006886	BRAZING ROD AG42	1.5 X 500 EO AS1167.A7	O
50006862	BRAZING ROD AG45	1.5 X 750 ANN AS1167.A6	O
50006942	BRAZING ROD AG45	2.5 X 750 EO AS1167.A6	O
50006897	BRAZING ROD AG56	1 AS1167.A2	O
50006889	BRAZING ROD AG56	2.5 X 500 EO AS1167.A2	O
50006888	BRAZING ROD CD FREE AG56	1.5 X 500 EO AS1167.A2	O
50006881	BRAZING ROD FLUX AG45	1.5 X 500 AS1167.A6 LIGHT BLUE	O
50006870	BRAZING ROD FLUXCOAT RED	2.4 DIAX 500 AS1167.A2	O
50006860	BRAZING ROD PCU	3 X 750 ANN AS1167.B1	O

WELDING ELECTRODES AWS A5.11

Product Code	Size	Pack Size	Stock/ Overseas
INCONEL 112 ENiCrMo-3			
50007209	2.4 dia	4.54 kg pack	O
50007210	3.2 dia	4.54 kg pack	O
50005537	4.0 dia	4.54 kg pack	O
INCONEL 117 ENiCrCoMo-1			
50011297	2.4 dia	4.54 kg pack	O
50011298	3.2 dia	4.54 kg pack	O
50063198	4.0 dia	4.54 kg pack	O
INCONEL 122 ENiCrMo-10			
50011299	2.4 dia	4.54 kg pack	O
50011300	3.2 dia	4.54 kg pack	O
50011301	4.0 dia	4.54 kg pack	O
INCONEL 182 ENiCrFe-3			
50007205	2.4 dia	4.54 kg pack	O
50005535	3.2 dia	4.54 kg pack	O
50007206	4.0 dia	4.54 kg pack	O
INCOWELD A ENiCrFe-2			
50005531	2.4 dia	4.54 kg pack	O
50005532	3.2 dia	4.54 kg pack	O
50005533	4.0 dia	4.54 kg pack	O
INCONEL 686CPT ENiCrMo-14			
50033766	2.4 dia	4.54 kg pack	O
50033770	3.2 dia	4.54 kg pack	O
INCO C 276 ENiCrMo-4			
50011302	2.4 dia	4.54 kg pack	O
50005558	3.2 dia	4.54 kg pack	O

WELDING ELECTRODES

Product Code	Size	Pack Size	Stock/ Overseas
MONEL 187 AWS A5.6 ECuNi			
50005842	3.2 dia	4.54 kg pack	0
MONEL 190 AWS A5-11 ENiCu-7			
50007203	3.2 dia	4.54 kg pack	0
50005534	4.0 dia	4.54 kg pack	0
50007204	4.8 dia	4.54 kg pack	0
NICKEL 141 AWS A5-11 ENi-1			
50007201	3.2 dia	4.54 kg pack	0
50033747	4.0 dia	4.54 kg pack	0
50007202	4.8 dia	4.54 kg pack	0
NI-ROD AWS A5-15 ENi-CI			
50005540	3.2 dia	4.54 kg pack	0
50007214	4.0 dia	4.54 kg pack	0
NI-ROD 55 AWS A5-15 ENiFe-CI			
50005539	2.4 dia	4.54 kg pack	0
50007211	3.2 dia	4.54 kg pack	0
50007212	4.0 dia	4.54 kg pack	0
50007213	4.8 dia	4.54 kg pack	0
904L (254SLX)			
50007258	2.5 dia	4.4 kg pack	0
DUPLEX 2209 AWS A5.4 E2209			
50006611	3.2 dia	3.5kg pack	0

WELDING WIRES

PRODUCT CODE	SIZE	PACK SIZE	Stock/ Overseas
MONEL FM60 ERNiCu-7			
50005545	1.2 dia Migwire	13.62 kg spool	O
50007219	1.6 dia Migwire	13.62 kg spool	O
50066408	2.4 dia SUB-ARC wire	27.2 kg spool	O
50066405	INCOFLUX 5	27.2 kg pail	O
50007218	1.6 dia Tigwire	4.54 kg pack	O
50005841	2.4 dia Tigwire	4.54 kg pack	O
MONEL FM67 ERCuNi			
50007224	1.2 dia Migwire	13.62 kg spool	O
50005547	1.6 dia Migwire	13.62 kg spool	O
50007225	1.6 dia Tigwire	4.54 kg pack	O
50007227	2.4 dia Tigwire	4.54 kg pack	O
50063199	3.2 dia Tigwire	4.54 kg pack	O
NICKEL FM61 ERNi-1			
50007220	1.2 dia Migwire	13.62 kg spool	O
50005546	1.6 dia Migwire	13.62 kg spool	O
50033767	2.4 dia SUB-ARC wire	27.2 kg spool	O
50033769	INCOFLUX 6	22.7 kg spool	O
50007221	1.6 dia Tigwire	4.54 kg pack	O
50007222	2.4 dia Tigwire	4.54 kg pack	O
NI-ROD FM44 ERNiFeMn-CI			
50005543	1.2 dia Migwire	13.62 kg spool	O
50005544	1.6 dia Migwire	13.62 kg spool	O
NI-ROD FM99 UNS N02215			
50007215	1.2 dia Migwire	13.62 kg spool	O
NILO CF36 Chemistry Only			
50007212	1.2 dia Migwire	13.62 kg spool	O
50007216	1.6 dia Migwire	13.62 kg spool	O
50037460	1.6 dia Tigwire	4.54 kg pack	O

WELDING WIRES

PRODUCT CODE	SIZE	PACK SIZE	Stock/ Overseas
INCO FM C-276 AWS A5-14 ERNiCrMo-4			
50005570	0.9 dia Migwire	13.62 kg spool	O
50007237	1.2 dia Migwire	13.62 kg spool	O
50007236	1.6 dia Tigwire	4.54 kg pack	O
50005561	2.4 dia Tigwire	4.54 kg pack	O
50005562	3.2 dia Tigwire	4.54 kg pack	O
INCONEL FM82 AWS A5-14 ERNiCr-3			
50007228	0.9 dia Migwire	13.62 kg spool	O
50007229	1.2 dia Migwire	13.62 kg spool	O
50066407	2.4 dia SUB-ARC wire	27.2 kg spool	O
50066404	INCOFLUX 4	27.2 kg pail	O
50007230	1.6 dia Tigwire	4.54 kg pack	O
50005548	2.4 dia Tigwire	4.54 kg pack	O
50007231	3.2 dia Tigwire	4.54 kg pack	O
INCONEL FM625 AWS A5-14 ERNiCrMo-3			
50005550	0.9 dia Migwire	13.62 kg spool	O
50007233	1.2 dia Migwire	13.62 kg spool	O
50007235	1.6 dia Migwire	13.62 kg spool	O
50032778	1.6 dia SUB-ARC wire	13.62 kg spool	O
50032779	INCOFLUX 7	27.2 kg pail	O
50007234	1.6 dia Tigwire	4.54 kg pack	O
50005551	2.4 dia Tigwire	4.54 kg pack	O
INCONEL FM 622 AWS A5-14 ERNiCrMo-10			
50005563	2.4 dia Tigwire	4.54 kg pack	O
50005564	3.2 dia Tigwire	4.54 kg pack	O
INCONEL FM 718 AWS A5-14 ERNiFeCr-2			
50005565	0.9 dia Migwire	13.62 kg spool	O
50005708	1.6 dia Tigwire	4.54 kg pack	O
INCONEL FM 601 AWS A5-14 ERNiCrFe-11			
50032777	1.6 dia Tigwire	4.54 kg pack	O
50007232	2.4 dia Tigwire	4.54 kg pack	O
INCONEL FM617 AWS A5-14 ERNiCrCoMo-1			
50005552	0.8 dia Migwire	13.62 kg spool	O
50024703	0.9 dia Migwire	13.62 kg spool	O
50032780	1.2 dia Migwire	13.62 kg spool	O
50032782	1.6 dia Tigwire	4.54 kg pack	O
50005553	2.4 dia Tigwire	4.54 kg pack	O
50006593	3.0 dia Tigwire	4.54 kg pack	O
50005554	3.2 dia Tigwire	4.54 kg pack	O
INCONEL FM 686 CPT AWS A5-14 ERNiCrMo-14			
50007057	2.4 dia Tigwire	4.54 kg pack	O

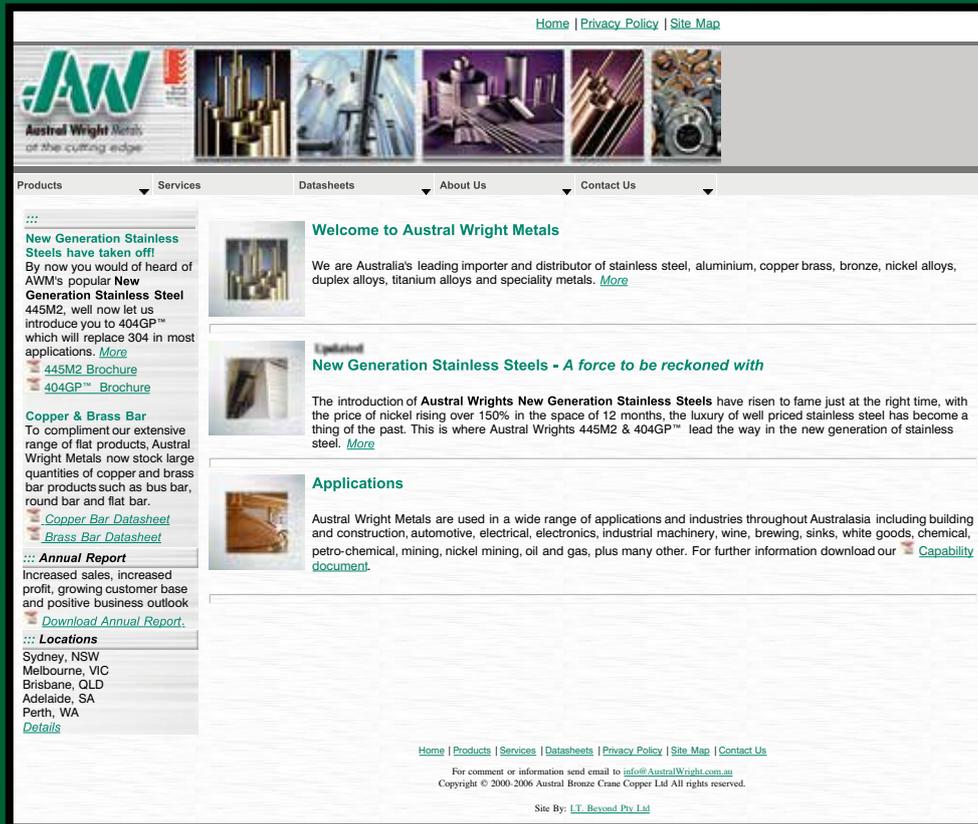
WELDING WIRES

PRODUCT CODE	SIZE	PACK SIZE	Stock/ Overseas
ALLOY 904L			
50006683	1.6 dia Tigwire	5 kg pack	O
50005587	2.4 dia Tigwire	2.5 kg pack	O
DUPLEX 2209 AWS A5.9 ER2209			
50006722	0.9 dia Migwire	15 kg spool	O
50066676	1.2 dia Migwire	15 kg spool	O
50006682	1.6 dia Tigwire	5 kg pack	O
50006610	2.4 dia Tigwire	5 kg pack	O
MILD STEEL AWS A5.18 ER705-6			
50005595	0.9 dia Migwire	15 kg spool	O
50005596	1.2 dia Migwire	15 kg spool	O
50005593	1.6 dia Migwire	15 kg spool	O
TITANIUM GRADE 2			
50005630	1.5 dia Tigwire	5 kg pack	O
TITANIUM GRADE 7			
50011100	2.4 dia Tigwire	5 kg pack	O
TITANIUM GRADE 12			
50011101	2.4 dia Tigwire	5 kg pack	O
SILICON BRONZE AWS A5.70 ERCuSi-A			
50006611	0.9 dia Migwire	12.5kg Spool	O
50005629	1.2 dia Migwire	12.5kg Spool	O
50006659	1.6 dia Migwire	12.5kg Spool	O
ALUMINIUM BRONZE AWS A5.70 ERCuSi-A2			
50006223	1.2 dia Migwire	12.5kg Spool	O

OTHER ELECTRODE, MIG & TIG WIRE ALLOYS AVAILABLE ON APPLICATION.

For further information and data sheets please visit our website

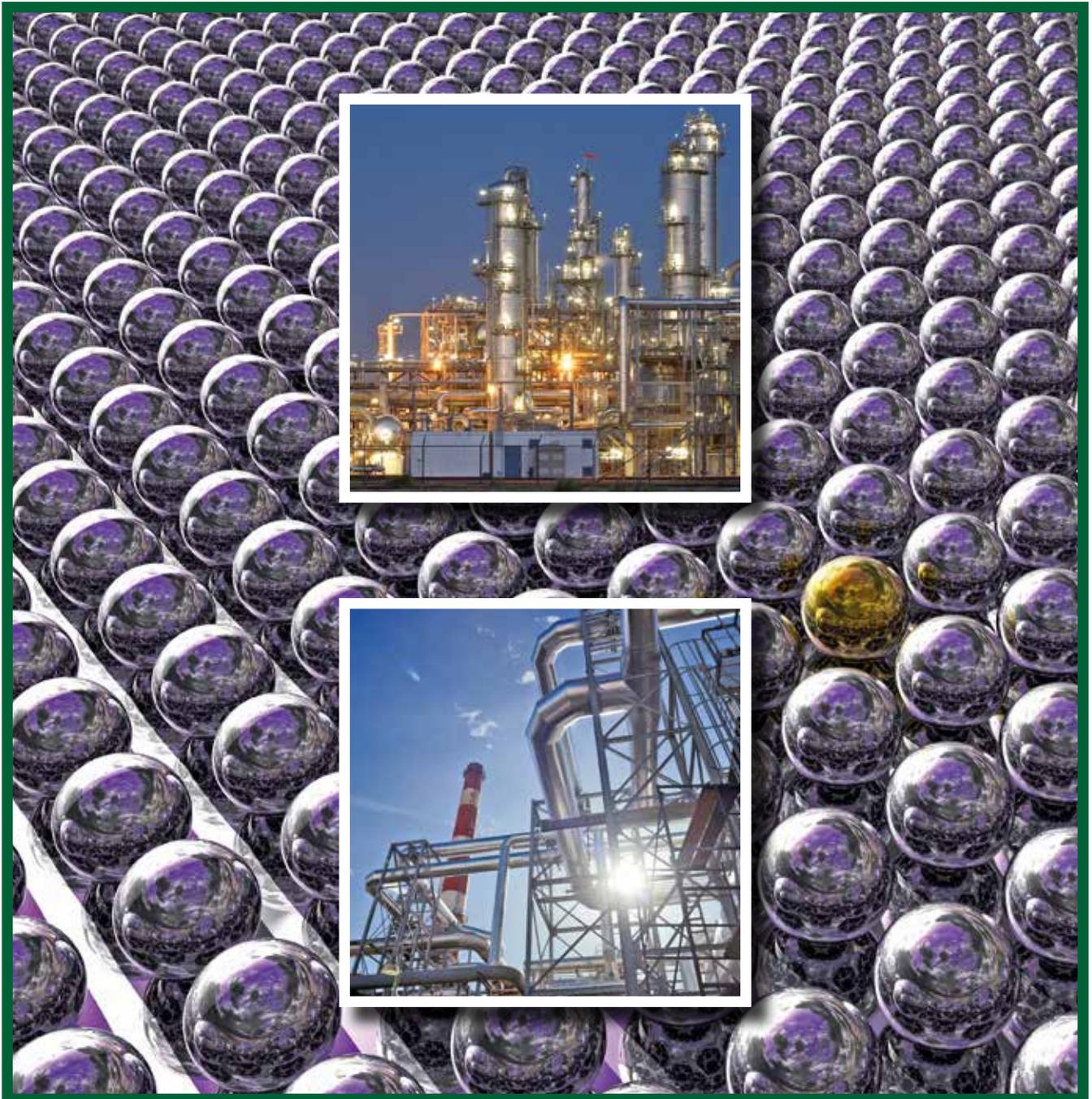
www.australwright.com.au



SECTION 4

MISCELLANEOUS

PRODUCTS



VARIOUS FOUNDRY PRODUCTS

Item Number	Description	Dimension (mm)	Stock/ Overseas
50000988	LATEX CEMENT POWDER	10KG PAIL	O
50005521	NICKEL POWDER TYPE 123	136 KG DRUMS	O
50005523	POWDER COBALT OXIDE(BLACK)	50KG	O
50005589	S/S HORNEX POWDER	13.5KG BAG	O
50005518	NICKEL ALLOY PELLETS	250KG DRUM	O

OTHER PRODUCTS AVAILABLE IN THE FOLLOWING GRADES AND FORMS:

304/L, 316/L, 310S, 321, 904L, CRMO, DUPLEX 2205, SUPER DUPLEX 2507,
INCONEL 600-601-625, INCOLOY 800HT- 825, C276, C22, MONEL 400-K500,
TITANIUM GR2-5-7-12

PIPE – WELDED AND SEAMLESS

FITTINGS – BUTT WELD AND SCREWED

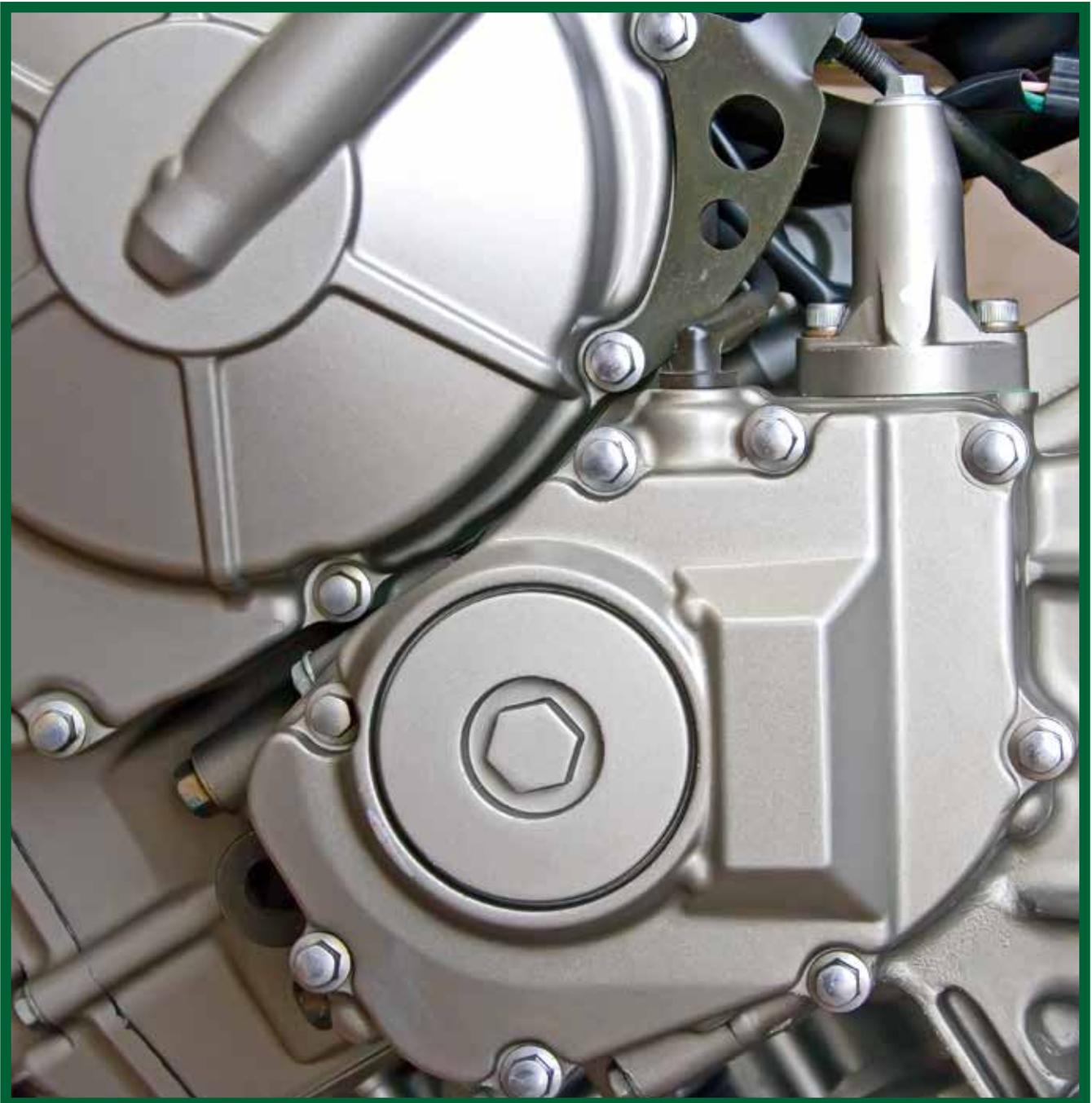
FLANGES –ANSI FLANGES CL150, CL300, CL600 - RFSO, RFWN, BLIND

HEAT EXCHANGER TUBES – PLEASE ASK YOUR LOCAL SALES OFFICE FOR A
COPY OF OUR 'HEAT EXCHANGER CATALOGUE'

SECTION 5

PRODUCT

DATA SHEETS



PROBLEM SOLVING ALLOYS FROM AUSTRAL WRIGHT METALS

This section contains a few examples of product data sheets we have available. For these and may other product data sheets please visit our web site www.australwright.com.au or contact your local sales office.

Designation	Nearest Related Specification	Description
ALLOY C-276	ASTM B-574, 575, 619, 622, 626	Outstanding resistance to a variety of environments, including strong oxidisers, hot contaminated mineral acids, wet or dry chlorine contaminated media, acetic anhydride and sodium chloride solutions.
NICKEL 200	ASTM B160-3, BS 3072-6: NA11	Commercial wrought nickel; good mech. props; excel.resistance to many corrosion environments including foods, synthetic fibres and alkalis.
MONEL* ALLOY 400	ASTM B127, 163-165, BS 3072-6: NA13	Good resistance to corrosion by sea water, dilute sulphuric, chemical, steam and petroleum plant, marine and pickling equipment.
MONEL* ALLOY K-500	BS 3072-6: NA18 QQ-N-286D	Similar corrosion resistance to Monel Alloy 400, but amenable to precipitation-hardening to give high strength. For propeller and pump shafts, bolts, doctor blades and valves.
INCONEL* ALLOY 600	ASTM-B163, 166, 168, BS 3072-6: NA14	Combines excellent high temp strength with resistance to oxidising, carburising, nitriding and reducing atmospheres.
INCONEL* ALLOY 601		Improved alloy where maximum high temp strength and oxidation resistance required. Good sulphidation and carburising resistance.
INCONEL* ALLOY 625	ASTM B443,444,446	For wet corrosive, high temp and cyrogenic service. High resistance to range of corrosive solutions including acids, salts and sea water where pitting, crevice or stress cracking may occur. Excellent for overlay and dissimilar metal welds.
INCOLOY* ALLOY DS	BS 3072-6: NA17	A general purpose heat-resisting alloy with particular resistance to carburisation and alternating carburisation and oxidation. For furnace parts, heat-treatment and vitreous enamelling equipment.
INCOLOY* ALLOYS 800 & 800H	ASTM B163, 407-9, BS 3072-16: NA15	Resistant to chloride-ion stress-corrosion cracking, excellent high temperature strength and immunity to Sigma phase formation. Widely used for petrochemical and high temperature process equipment.
INCOLOY* ALLOY 825	ASTM B163, B423-5, BS 3072-6: NA16	Developed for use in aggressive corrosive environments. Exceptional resistance to corrosion by acids and alkalis in reducing or oxidising conditions. It is resistant to stress corrosion cracking and pitting and used for chemical plant and pickling plant.
DUPLEX STAINLESS STEEL 2507	ASTM A240, A47 9, A959	2507 is a duplex stainless steel with very high strength. It has very high resistance to uniform corrosion, pitting and crevice corrosion and to stress corrosion cracking.
AUSTENITIC STAINLESS STEEL 310 (S31000)	ASTM A240	A heat resistant austenitic stainless steel with better scaling resistance than standard grades. Usable to 1035°C in intermittent service, 1150°C in continuous service
AUSTENITIC STAINLESS STEEL 253MA (S30815)	ASTM A240	253 MA is microalloyed with rare earth metals (REM) for excellent heat resistance. Best used at 850-1100°C. Can become brittle at room temperature after service at 600-850°C.
AUSTENITIC STAINLESS STEEL 254SMO (S31254)	ASTM A240	Highly corrosion resistant austenitic stainless steel containing 6% molybdenum, plus copper. Pitting resistance equivalent =43.
ALLOY 31 (N08031)	ASTM B625, B462, B649, B366, B626	An advanced super-austenitic, high-chromium 6% moybdenum corrosion resisting alloy. Bridges the cost/performance gap between Ni-Cr-Mo alloys and 300 series stainless steels. Is used in the chemical process and petrochemical industries.

*Registered Trade Names

ALLOY C-276 UNS N10276

Alloy C-276 is a versatile nickel molybdenum chromium tungsten alloy with outstanding corrosion resistance in a wide range of severe media. It resists corrosion attack of many types, and is often used in severe environments of variable or undefined aggressiveness.

CHEMICAL COMPOSITION (ASTM B575 – {Nickel Alloy} plate, sheet & strip)	Element	%	Element	%
	Nickel	rem {~57}	Tungsten	3.0 – 4.5
	Molybdenum	15.0 – 17.0	Cobalt	2.5 max
	Chromium	14.5 – 16.5	Carbon	0.010 max
	Iron	4.0 – 7.0	Sulphur	0.03 max

SPECIFIED MINIMUM MECHANICAL PROPERTIES (ASTM B575 – {Nickel Alloy} plate, sheet & strip)		ASTM B575	Typical
	0.2% Proof Stress, MPa	283 min	350
	Tensile Strength, MPa	690 min	740
	Elongation, %	40 min	67
	Hardness, HRB	100 max	-

Typical Applications: Chemical plant, pollution control, pulp & paper production, waste treatment, process vessels & piping, heat exchangers, stack liners, ducts, dampers, scrubbers, fans & housings.

Description: Alloy C-276 is a Ni-Mo-Cr-W alloy developed for outstanding resistance to corrosion. It has good strength and excellent ductility, good weldability and fabrication ability, and is tough at all temperatures. It is highly resistant to oxidising atmospheres up to 1040°C, and to pitting and stress corrosion attack. C-276 is readily welded, and generally does not require post weld heat treatment.

Austral Wright Metals can supply alloy C-276 as plate, sheet and strip, rod and bar, seamless and welded tube and pipe, condenser and heat exchanger tube, welding fittings, forgings and forging billet, wire.

Corrosion Resistance: C-276 is outstanding in resisting general corrosion, stress corrosion cracking, pitting and crevice corrosion even in severe environments. It has a low carbon content, and resists intergranular corrosion in the as-welded condition.

It gives excellent service in highly oxidising neutral and acid chlorides, solvents, formic & acetic acids, acetic anhydride, wet chlorine gas, hypochlorites and chlorine solutions. It has good resistance to many hot acids.

The broad range of corrosion resistance makes the alloy useful in applications where a mixture of corrosives, often undefined or variable, are present. Examples are flue gas desulphurisation equipment in power generation plant, downhole environments in sour oil & gas wells, & in pulp & paper manufacturing.

Corrosion rates in laboratory tests in various media.

Solution	Temperature		Corrosion Rate	
	°F	°C	mpy	mm/y
10% HNO ₃	Boiling	Boiling	15 ^b	0.38 ^b
10% HNO ₃ + 3% HF	140	60	113	2.87
15% HNO ₃ + 3% HF	140	60	179	4.55
20% HNO ₃ + 2% HF	140	60	215	5.46
3% HF	176	80	53	1.35
10% HF	75	24	2	0.05
10% HF	176	80	28	0.71
Concentrated HF	75	24	1	0.03
Concentrated HF	176	80	34	0.86
1% HCl	Boiling	Boiling	9	0.23
5% HCl	140	60	10	0.25
10% HCl	150	66	35-39	0.89-0.99
20% HCl	212	100	154	3.91
30% HCl	150	66	22-28	0.56-0.71
20% H ₃ PO ₄	Boiling	Boiling	<1	<0.03
60% H ₃ PO ₄	Boiling	Boiling	1	0.03
85% H ₃ PO ₄	212	100	5	0.13
85% H ₃ PO ₄	Boiling	Boiling	121	3.07
20% H ₂ SO ₄	176	80	3	0.08
20% H ₂ SO ₄	194	90	13	0.33
20% H ₂ SO ₄	Boiling	Boiling	22-27	0.56-0.69
40% H ₂ SO ₄	176	80	5	0.13
60% H ₂ SO ₄	200	93	16-25	0.41-0.64
80% H ₂ SO ₄	176	80	4	0.10
99.9% CH ₃ COOH + 0.1% NaCl	Boiling	Boiling	<1	<0.03
50% NaOH	Boiling	Boiling	1	0.03

^aTest duration of 168 h except as noted. ^bTest duration of 24 h.

Maximum pitting or crevice attack, mm, in flue gas desulphuriser scrubber slurry

Alloy	Quencher	Absorber	Absorber Outlet	Outlet Duct	Bypass Duct
316L	0.56	0.53	0.89 b	0.89b	0.30
317LM	0.51	0.56	0.74	0.84	0.74
Incoloy 825	0.38	0.84	0.99	1.27 b	0.25
Inconel 625	<0.05	0.25	0.28	0.18	nil
C-276	nil	nil	<0.05	nil	nil

a: 6 month exposure at 52°C, pH 5.5, 5000 ppm chloride
 b: perforated

Please consult Austral Wright Metals for your specific corrosion application.

Pressure Vessels AS1210 & ASME Boiler & Pressure Vessel Codes pre-qualify C-276 for use in pressure vessels up to 675°C.

EQUIVALENT GRADE SPECIFICATIONS	Country	Body	Grade
	USA	UNS	N10276
	France	AFNO R	NC 17 D
	Germany	DIN	2.4819

Fabrication C-276 can be readily fabricated, using standard methods for nickel alloys. Hot working is done at 870 – 1230°C, with all heavy forming above 1090°C. Cold forming may require intermediate annealing to remove the work hardening developed.

Machinability C-276 is fairly difficult to machine (group D-2). Sharp tools, slow speeds and deep uninterrupted cuts to remove the work hardened layer are needed. Tools need positive rake angles. Welding C-276 is readily welded by GMAW (MIG), GTAW (TIG) and SMAW (manual) processes. Preheat, post heat and post weld heat treatment are not required. The area around the weld must be clean to prevent contamination of the weld pool. Argon shielding gas is used.

FILLER METAL SELECTION (SELF WELDS)		Normal Service	Higher Strength	Best Corrosion Resistance
	Welding electrode	C-276	686CPT	686CPT
	Filler metal	C-276	686CPT	686CPT
	Flux cored wire	N/A	N/A	N/A

Heat Treatment C-276 is annealed at 1150 – 1175°C, cooled by water quenching.

PHYSICAL PROPERTIES

Property	at	value	unit
Density	20°C	8,820	kg/m ³
Melting Range		1325 – 1370	°C
Modulus of Elasticity			
Tension	20°C	205	GPa
Torsion	20°C	79	GPa
Poisson's ratio	20°C	0.307	

Property	at	value	unit
Specific Heat	20°C	427	J/kg . °C
Mean Coefficient of Expansion	100°C	12.2	x 10-6 / °C
Thermal Conductivity	20°C	9.8	W / m . °C
Electrical Resistivity	25°C	1.229	micro-ohm . m

ASTM Product Specifications

Specification	Title
B366	Nickel & nickel alloy fittings
B564	Nickel alloy forgings
B574	Low C Ni-Mo-Cr, low C Ni-Cr-Mo, low C Ni-Cr-Mo-W alloy rod
B575	Low C Ni-Mo-Cr, low C Ni-Cr-Mo, low C Ni-Cr-Mo-W alloy plate, sheet & strip
B619	Welded nickel and nickel cobalt alloy pipe
B622	Seamless nickel and nickel cobalt alloy pipe
B626	Welded nickel and nickel cobalt alloy tube
B751	General requirements for nickel & nickel alloy welded tube
B775	General requirements for nickel & nickel alloy welded pipe

MONEL 400, R-405 UNS N04400

Monel 400 is a versatile nickel copper alloy with good strength and toughness, combined with outstanding corrosion resistance. Monel R-405 is a free cutting version with similar properties.

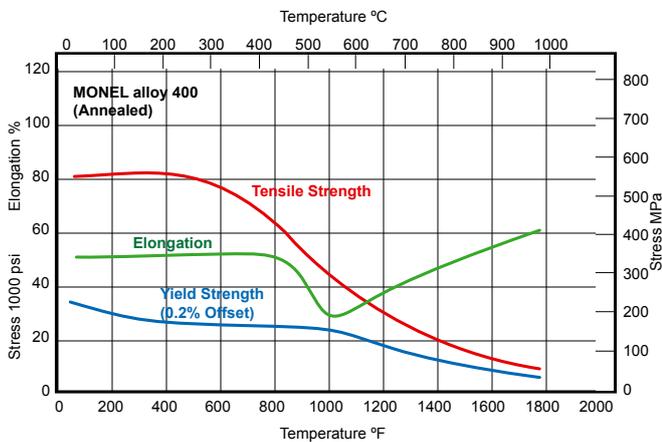
CHEMICAL COMPOSITION (ASTM B127 – PLATE, SHEET & STRIP)	Element	%	Element	%
	Nickel	63.0 min	Manganese	2.0 max
	Copper	28.0 – 34.0	Silicon	0.5 max
	Iron	2.5 max	Carbon	0.3 max
	Sulphur (Monel 400)	0.024 max	Sulphur (Monel R-405)	0.025 – 0.060

SPECIFIED MINIMUM MECHANICAL PROPERTIES (ASTM B127 – PLATE, SHEET & STRIP)		As hot rolled	Annealed	Hard
	0.2% Proof Stress, MPa	275	195	620
	Tensile Strength, MPa	515	485	690
	Elongation, %	25	35	2

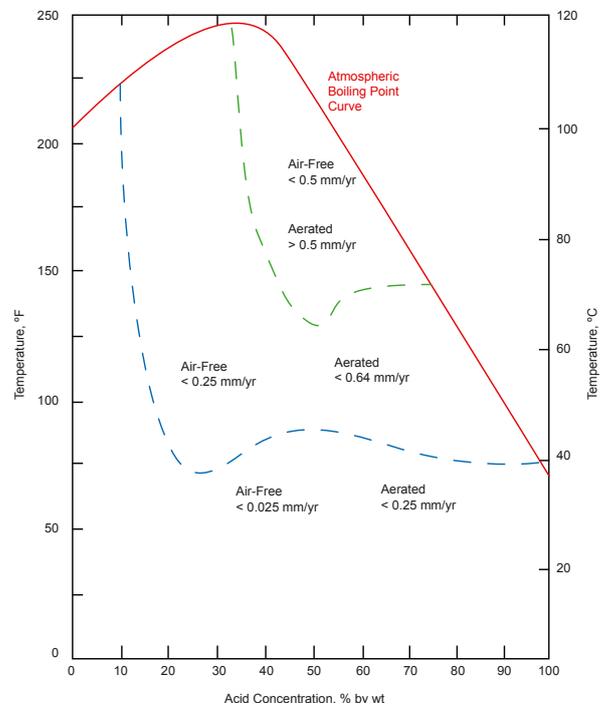
Typical Applications Chemical plant, valves and pumps, pump & propeller shafts, marine fixtures and fasteners, electrical components, springs, gasoline & fresh water tanks, petroleum stills, process vessels & piping, boiler feedwater heaters and other heat exchangers, deaerating heaters.

Description Monel 400 is a nickel copper alloy with good strength and ductility, good weldability and excellent resistance to corrosion. It is tough over a wide range of temperatures. It is often used in marine applications. Corrosion rates in strongly agitated and aerated sea water are extremely low. The alloy has useful properties to 540°C in oxidising atmospheres and higher temperatures in reducing conditions. Monel 400 is readily welded and brazed.

Austral Wright Metals can supply Monel 400 as plate, sheet and strip, rod and bar, seamless and welded tube and pipe, condenser and heat exchanger tube, welding fittings, forgings and forging billet, wire. Monel R-405 is available as rod and bar.



High temperature tensile properties of annealed Monel 400.



Isocorrosion chart of Monel 400 in hydrofluoric acid.

Pressure Vessels AS1210 & ASME Boiler & Pressure Vessel Code pre-qualify Monel 400 for use in pressure vessels up to about 475°C.

Corrosion Resistance Monel 400 is generally more corrosion resistant than both of the major constituents nickel and copper. It is highly resistant to chlorinated solvents, glass etching agents, sulphuric, hydrofluoric and many other acids, and practically all alkalis. The alloy gives excellent service in sea water under high velocity conditions, where resistance to cavitation and erosion are important. Corrosion rates in strongly agitated and aerated sea water are extremely low. It is generally free from chloride stress corrosion cracking, but only annealed material resists stress cracking in the presence of mercury or mercury salts, and in moist, aerated hydrofluoric acid vapour. It should not be used for nitric acid service. Please consult Austral Wright Metals for specific advice on your application.

EQUIVALENT GRADE SPECIFICATIONS	Country	Body	Grade
	USA	UNS	N04400
	France	AFNOR	NU30
	GB	BS	NA13
	Germany	DIN	2.4360, 2.4361

Fabrication Monel 400 can be readily hot worked, with lower forces than many steels. The alloy can easily be cold formed, with forces between those of carbon steel and grade 304 stainless steel.

Machinability Monel 400 is easy to machine (class B). Sharp tools, slow speeds and deep uninterrupted cuts to remove the work hardened layer are needed. Monel R-405 is a free cutting version of Monel 400, for rapid production in automatic screw machines. Toughness, strength and corrosion resistance are very similar to Monel 400.

Welding Monel 400 is readily welded by GMAW (MIG), GTAW (TIG), SMAW (manual) and SAW processes. Preheat, post heat and post weld heat treatment are not required. The area around the weld must be clean to prevent contamination of the weld pool. Argon shielding gas is used.

	Normal Service	Higher Strength	Best Corrosion Resistance
Welding electrode	Monel WE 190	Monel WE 190	Monel WE 190
Filler metal	Monel FM 60	Monel FM 60	Monel FM 60
Flux cored wire	-	Inco-Cored 82DH	-

Heat Treatment Monel 400 is annealed at 870–980°C, cooling rate not critical. Grain growth is rapid in this alloy, so use the lower end of the temperature range and minimal time to retain good strength. Stress relief, if required, is at 540–570°C. Stress equalising cold worked material at 300°C markedly increases the proof stress, without affecting other properties.

Physical Properties (Monel 400 and Monel R-405)

Property	at	value	unit	Property	at	value	unit
Density	20°C	8,800	kg/m ³	Specific Heat	20°C	427	J/kg . °C
Melting Range		1300 – 1350	°C	Mean Coefficient of Expansion	20°C	13.9	x 10 ⁻⁶ / °C
Modulus of Elasticity				Thermal Conductivity	20°C	21.8	W / m . °C
Tension	20°C	179	GPa	Curie Temperature		20 – 50	°C
Torsion	20°C	65.5	GPa	Electrical Resistivity	20°C	0.547	micro-ohm . m
Poisson's ratio	20°C	0.32		Electrical Conductivity	20°C	32	% IACS

ASTM Product Specifications

Specification	Title
B163	Seamless Nickel and Nickel Alloy Condenser and Heat-Exchanger Tubes
B366	Factory-Made Wrought Nickel and Nickel Alloy Fittings
B564	Nickel Alloy Forgings
B127	Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip
B164	Nickel-Copper Alloy Rod, Bar, and Wire
B165	Nickel-Copper Alloy (UNS N04400) Seamless Pipe and Tube
B725	Welded Nickel (UNS N02200/UNS N02201) and Nickel Copper Alloy (UNS N04400) Pipe
B730	Welded Nickel (UNS N02200/UNS N02201) and Nickel Copper Alloy (UNS N04400) Tube

MONEL K-500 UNS N05500

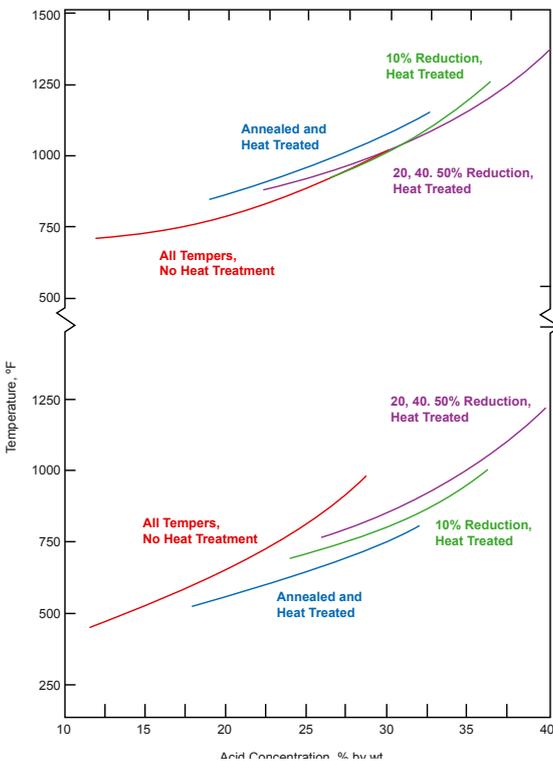
Monel K-500 is a nickel copper alloy combining the excellent corrosion resistance of Monel 400 with greater strength. It is widely used, particularly in marine and chemical processing applications. It has excellent resistance to sea water.

CHEMICAL COMPOSITION (ASTM B865 – BAR, ROD, WIRE, FORGINGS & FORGING STOCK)			
Element	%	Element	%
Nickel	63.0 min	Manganese	1.5 max
Copper	27.0 – 33.0	Silicon	0.50 max
Aluminium	2.30 – 3.15	Carbon	0.18 max
Titanium	0.35 – 0.85	Iron	2.0 max
		Sulphur	0.010 max

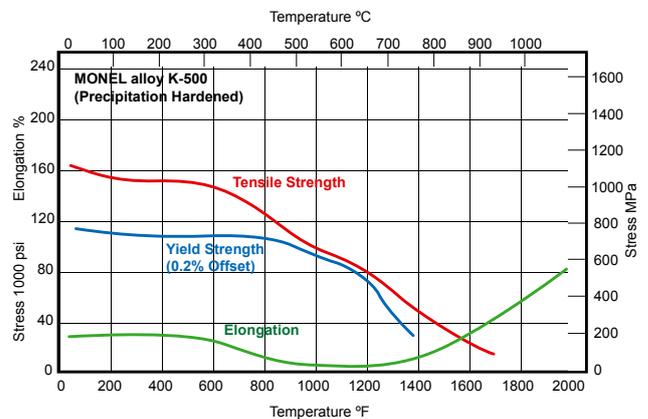
SPECIFIED MINIMUM MECHANICAL PROPERTIES (ASTM B865 – BAR, ROD, WIRE, FORGINGS & FORGING STOCK)	As hot rolled	Annealed	Hard
	0.2% Proof Stress, MPa	275	195
Tensile Strength, MPa	515	485	690
Elongation, %	25	35	2

Typical Applications Pump shafts, propeller shafts, doctor blades and scrapers, springs, valve trim, fasteners.

Description Monel K-500 is a nickel copper alloy with high strength and good ductility, good weldability and excellent resistance to corrosion. It is tough over a wide range of temperatures. It is a precipitation hardening alloy, and a wide range of properties can be obtained by suitable heat treatments. It is often used in marine applications, particularly for pumps and propeller shafts. Corrosion resistance is substantially matches the excellent properties of Monel 400, except for greater susceptibility to stress corrosion cracking in some aggressive environments in the aged condition. Austral Wright Metals can supply Monel K-500 as plate, sheet and strip, rod and bar, tube and pipe, welding fittings, forgings and forging billet, wire.



Tensile property ranges of heat treated Monel K-500.



High temperature tensile properties of annealed Monel K-500.

Pressure Vessels Monel K-500 is not prequalified by AS1210 or the ASME Boiler & Pressure Vessel Code for use in pressure vessels.

Corrosion Resistance Monel K-500 is generally more corrosion resistant than both of the major constituents nickel and copper. It is highly resistant to chlorinated solvents, glass etching agents, sulphuric, hydrofluoric and many other acids, and practically all alkalis. The alloy gives excellent service in sea water under high velocity conditions, where resistance to cavitation and erosion are important. Corrosion rates in strongly agitated and aerated sea water are extremely low. It is generally free from chloride stress corrosion cracking, but only annealed material resists stress cracking in the presence of mercury or mercury salts. Stress corrosion cracking in hydrofluoric acid vapours has also been encountered. Monel K-500 should not be used for nitric acid service. Please consult Austral Wright Metals for advice on your specific application.

EQUIVALENT GRADE SPECIFICATIONS	Country	Body	Grade
	USA	UNS	N05500
	France	AFNOR	-
	GB	BS	NA18
	Germany	DIN	2.4375

Fabrication Monel K-500 can be readily hot worked, in the range 870°C to no higher than 1150°C. The forging should be water quenched from 790°C or higher. Care is needed in reheating practice. The alloy can be cold formed, with high forces even in the annealed condition, but ductility is good.

Machinability Monel K-500 is best to machined when annealed, but can be finish machined when age hardened. During age hardening there is a slight, uniform contraction.

Welding Monel K-500 is readily welded by GMAW (MIG), GTAW (TIG), SMAW (manual) and SAW processes. Preheat, post heat and post weld heat treatment are not required. The area around the weld must be clean to prevent contamination of the weld pool. Argon shielding gas is used. Welding should be done on annealed material, and the assembly stress relieved before ageing.

FILLER METAL SELECTION (SELF WELDS)		Normal Service	Higher Strength	Best Corrosion Resistance
	Welding electrode	Monel WE 190	Monel WE 190	Monel WE 190
	Filler metal	Monel FM 60	Monel FM 60	Monel FM 60
	Flux cored wire	-	Inco-Cored 82DH	-

Heat Treatment Adequate softening may be obtained by annealing at 760-870°C, but best response to subsequent ageing is achieved by annealing at 980°C for hot finished material and 1040°C for cold drawn products. Work should be water quenched after annealing. Addition of 2% alcohol to the quench water will minimise oxidation and facilitate pickling. The ageing treatment depends on the properties required, and Austral Wright Metals will be pleased to provide advice.

Physical Properties

Property	at	value	unit
Density	20°C	8,440	kg/m ³
Melting Range		1315 – 1350	°C
Modulus of Elasticity			
Tension	20°C	179	GPa
Torsion	20°C	65.5	GPa
Poisson's ratio	20°C	0.32	

Property	at	value	unit
Specific Heat	20°C	419	J/kg . °C
Mean Coefficient of Expansion	20°C	13.7	x 10 ⁻⁶ / °C
Thermal Conductivity	20°C	17.5	W / m . °C
Curie Temperature		- 65	°C
Electrical Resistivity	20°C	0.615	micro-ohm . m
Electrical Conductivity	20°C	2.8	% IACS

ASTM Product Specifications

Specification	Title
B865	Precipitation Hardening Nickel-Copper-Aluminium Alloy (UNS N05500) Bar, Rod, Wire, Forgings, and Forging Stock

INCONEL 600 UNS N06600

Inconel 600 is a solid solution nickel chromium alloy for high temperature applications. Inconel 600 has good mechanical strength and can be used from cryogenic temperatures to 1200°C. It also has good corrosion resistance due to the high nickel content in combination with chromium.

Chemical Composition (ASTM B166 - Bar (Annealed))

Element	%
Nickel	72.0 min
Chromium	14.0 - 17.0
Iron	6.00 - 10.0
Carbon	0.15 max
Manganese	1.00 max
Silicon	0.50 max
Sulphur	0.015 max
Copper	0.50 max

Specified Minimum Properties

(ASTM B166 - Bar (Annealed))

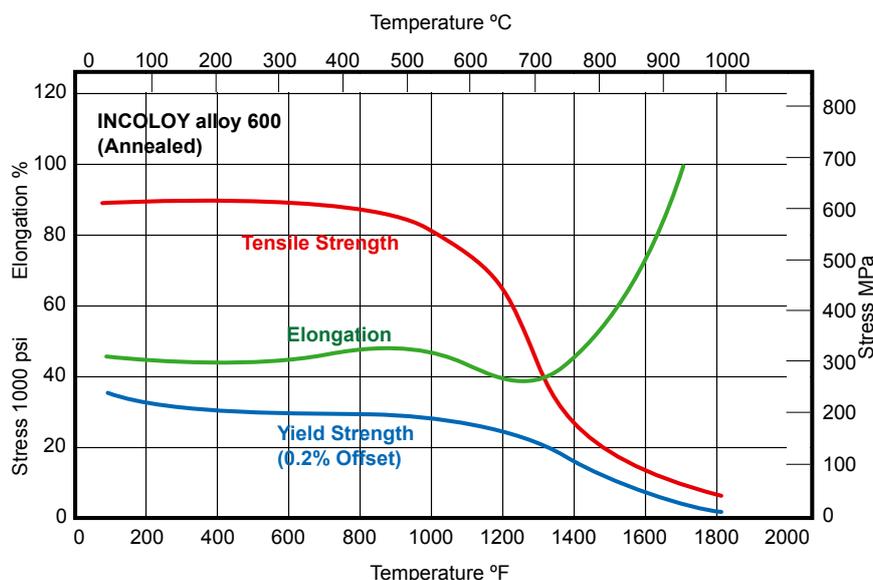
	Specified Minimum
Tensile Strength MPa	550
Yield Strength MPa	240
Elongation %	30

Typical Applications: Heat treating muffles and retorts, heat treating baskets, chlorination equipment to 540°C, pulp mill alkaline digesters. Other applications include heaters, stills, bubble towers, condensers for processing fatty acids, evaporator tubes, tube sheets and flaking trays for sodium sulphite manufacture, springs primary water pumping.

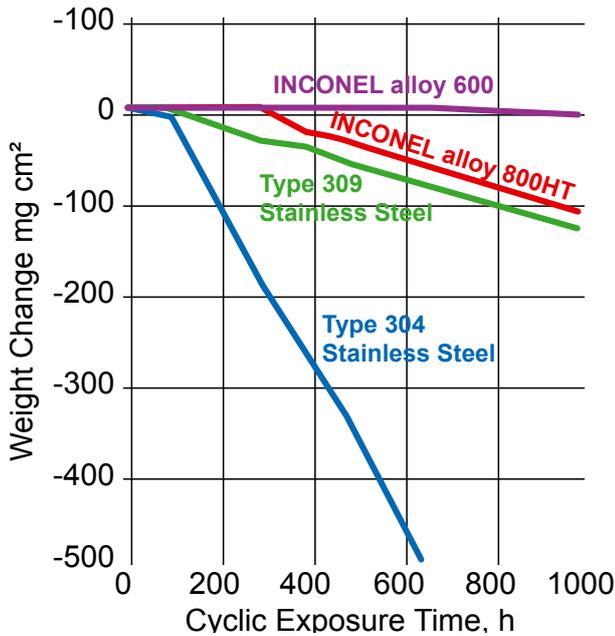
Austral Wright Metals can supply Inconel 600 as plate, sheet and strip, rod and bar, seamless and welded tube and pipe, welding fittings, forgings, forging billet, wire.

High temperature applications: Inconel 600 has excellent resistance to oxidation at high temperatures. It is the standard material for nitriding containers because of its resistance to nitrogen at high temperatures. It also has good resistance to carburisation. Inconel 600 will resist attack by sulphur compounds at moderate temperatures, but is subject to sulphidation at higher temperatures. Lubricants containing molybdenum disulphide should not be used above 425°C. Inconel 600 is not embrittled by long exposures at high temperature.

Pressure vessels: Inconel 600 is approved under AS1210 and ASME boiler and pressure vessel code Sections I (Code case 1827), III, VIII for temperatures up to 650°C.



Variation of tensile properties with temperature



Cyclic oxidation resistance of various alloys at 980°C. Each cycle was 15 minutes of heating, 5 minutes of air cooling.

Physical Properties

Property	at	value	unit
Density	20°C	8,470	kg/m ³
Modulus of Elasticity			
Tension	22°C	214	GPa
Torsion	22°C	80.8	GPa
Poisson's ratio	22°C	0.324	
Electrical Resistivity	20°C	1.03	micro-ohm . m
Relative permeability	200 Oe	1.010	

Property	at	value	unit
Melting Range		1354 - 1413	°C
Specific Heat	20°C	444	J/kg.°C
Coefficient of Expansion	20°C	10.4	x 10 ⁻⁶ /°C
Thermal Conductivity	20°C	14.9	W/m . °C
Curie Temperature		-192	°C

Corrosion Resistance: Inconel 600 has good corrosion resistance to many media. In feed water systems it is practically free of corrosion. It resists flowing sea water, but will corrode in stagnant sea water. The alloy has fair resistance to sulphuric acid at room temperature, but should not be used in this application at elevated temperatures. Resistance to hydrochloric acid is similar to sulphuric acid. The alloy has excellent resistance to phosphoric acid at room temperature in all concentrations, but is rapidly attacked at elevated temperature. Inconel 600 is practically free from chloride ion stress corrosion cracking. Please consult Austral Wright Metals for advice on your specific application.

Oxidation Resistance: Inconel 600 has good resistance to oxidation at high temperature. It out performs all other alloys for resistance to nitridation in cracked ammonia. It should not be used in sulphur containing atmospheres at high temperature, particularly if the conditions are reducing. It resists dry chlorine and hydrochloric acid gas at moderate temperatures.

Fabrication: Inconel 600 can be hot forged. The surface should be clean before heating. Solution annealing after forging is normal. Inconel 600 is readily cold formed by standard processes and equipment. Work hardening in cold forming may require intermediate anneal.

Machinability: Inconel 600 is reasonably easy to machine (class "C" alloy). Heavy machines, sharp tools, slow speeds and deep cuts to remove the work hardened layer are needed.

Welding: Inconel 600 is readily welded by the SMAW (manual), GMAW (MIG), GTAW (TIG) and SAW processes. Preheat, post heat and post weld heat treatment are not needed. Contamination of the weld pool should be avoided. Inconel welding electrode 182 or Inconel filler metal 82 are normally used as welding consumables. Argon is used as the shielding gas.

WELDING CONSUMABLES		Normal Service	Higher Strength	Best Corrosion Resistance
	Welding electrode	Inconel WE 182	Inconel WE 182	Inconel WE 182
	Filler metal	Inconel FM 82	Inconel FM 82	Inconel FM 82
	Flux cored wire	Inco Cored 82DH	Inco Cored 82DH	Inco Cored 82DH

Heat Treatment: Annealing at 1010°C for 15 minutes softens Inconel 600. Solution heat treatment is done at 1090 - 1150°C to dissolve carbides. Care should be taken with heat treatment as it affects corrosion resistance and high temperature properties.

EQUIVALENT GRADE DESIGNATIONS	Country	Body	Designation
	France	AFNOR	NC 15 Fe
	GB	BS	NA 14
	Germany	DIN	2.4816
	USA	UNS	N06600

ASTM Product Specifications

Specification	Title
B163	Seamless Nickel and Nickel Alloy Condenser and Heat-Exchanger Tubes
B166	Nickel-Chromium-Iron Alloys (UNS N06600, N06601, N06690, N06025, and N06045)* and Nickel-Chromium-Cobalt-Molybdenum Alloy (UNS N06617) Rod, Bar, and Wire
B167	Nickel-Chromium-Iron Alloys (UNS N06600, N06601, N06690, N06025, and N06045)* Seamless Pipe and Tube
B168	Nickel-Chromium-Iron Alloys (UNS N06600, N06601, N06690, N06025, and N06045) and Nickel-Chromium-Cobalt-Molybdenum Alloy (UNS N06617) Plate, Sheet, and Strip
B366	Factory-Made Wrought Nickel and Nickel Alloy Fittings
B516	Welded Nickel-Chromium-Iron Alloy (UNS N06600), UNS N06025, and UNS N06045 Tubes
B517	Welded Nickel-Chromium-Iron-Alloy (UNS N06600), UNS N06025, and UNS N06045 Pipe
B564	Nickel Alloy Forgings
B751	General Requirements for Nickel and Nickel Alloy Welded Tube
B775	General Requirements for Nickel and Nickel Alloy Welded Pipe

INCONEL 601 UNS N06601

Inconel 601 is a solid solution nickel chromium heat resisting alloy which gives outstanding performance at temperatures up to about 1200°C. Inconel 601 also has good aqueous corrosion resistance due to the high nickel content in combination with chromium. Strength and toughness are good, and are retained during extended service at high temperature.

Chemical Composition

(ASTM B166 – Rod, bar & wire)

Element	%	Element	%
Nickel	58.0 - 63.0	Manganese	1.5 max
Chromium	21.0 - 25.0	Silicon	0.5 max
Iron	~ 16	Sulphur	0.015 max
Aluminium	1.0 – 1.7	Copper	1.0 max
Carbon	0.10 max		

Specified Minimum Properties

(ASTM B166 - Bar - Annealed)

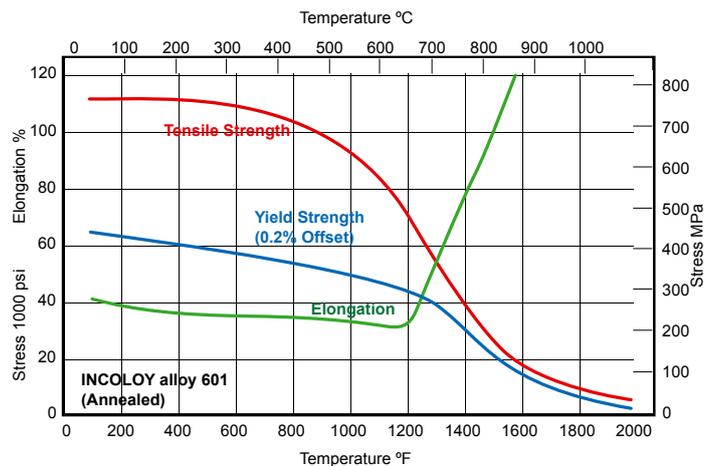
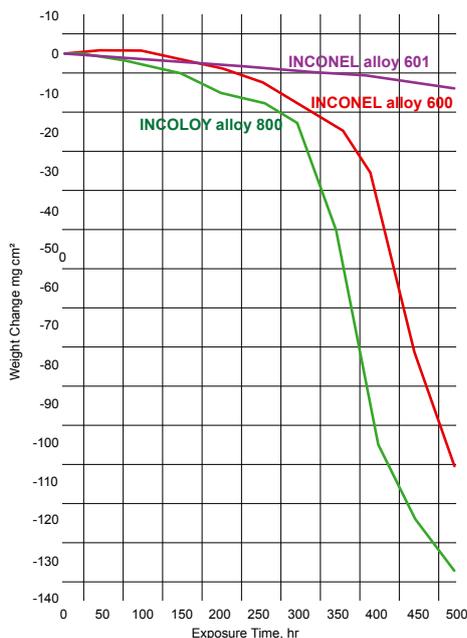
0.2 % Proof Stress MPa	Tensile Strength MPa	Elongation %
205	550	30

Typical Applications Thermal processing equipment - baskets, trays, fixtures, radiant tubes, muffles, retorts, flame shields, woven wire conveyers, burner nozzles and electrical resistance heating wires. Other applications include thermocouple protection tubes, process heaters, condenser tubes, catalyst supports in nitric acid manufacture, exhaust systems in gasoline engines and combustion chambers, superheater tube supports and ash handling in power generation.

Description Inconel 601 is a solid solution nickel chromium alloy for high temperature heat resistance. It has excellent oxidation resistance. Inconel 601 also has good resistance to carburising but should not be used in atmospheres containing sulphur, particularly reducing sulphur. Inconel 601 has good resistance to nitriding in dissociated ammonia, and is only outperformed by Inconel 600 in this application. Inconel 601 has good strength, ductility and toughness, and can be used at cryogenic temperatures.

Austral Wright Metals can supply Inconel 601 as plate, sheet and strip, rod and bar, seamless tube and pipe, wire, forgings and forging stock.

Oxidation Resistance Inconel 601 has outstanding resistance to high temperature oxidation. It resists oxidation and spalling at temperatures as high as 1260°C. The protective oxide coating resists scaling even under severe conditions, and the alloy also has good resistance to carburisation and nitridation. Its resistance to sulphur is poor and it should not be used in atmospheres containing sulphur, particularly reducing sulphur.



Pressure Vessels Inconel 601 is qualified for use in pressure vessels in ASME Section VIII (Code case 1500) to 480°C. It is not pre qualified in AS1210.

Corrosion Resistance Inconel 601 has excellent corrosion resistance to the mineral acids, similar to Inconel 600. Inconel 601 has good resistance to sodium hydroxide solutions and because of the high nickel content good resistance to chloride stress corrosion cracking. As with austenitic stainless steels Inconel 601 can be sensitised to intergranular corrosion in some aggressive media after heating in the temperature range 540 - 760°C. Please consult Austral Wright Metals for your specific application.

Fabrication Inconel 601 is readily hot worked. Inconel 601 must be clean before heating is commenced and should not be heated in an atmosphere high in sulphur. This alloy can be cold formed similarly to austenitic stainless steel. Work hardening in cold forming may require intermediate annealing.

Machinability Inconel 601 as a 'C' class alloy is fairly difficult to machine. Heavy machines, sharp tools, slow speeds and deep cuts to remove the work hardened layer are needed.

Welding Inconel 601 is readily weldable by the SMAW (manual), GMAW (MIG), GTAW (TIG) and SAW processes. Preheat or post weld heat treatment are not needed. Care must be taken to avoid contamination of the weld pool. Argon is used as the shielding gas.

WELDING CONSUMABLES		Normal Service	Higher Strength	Best Corrosion Resistance
	Welding electrode	Inconel WE 182	Inconel WE 117	N/A
	Filler metal	Inconel FM 82	Inconel FM 617	Inconel FM 601
	Flux cored wire	Inco Cored 82DH	N/A	N/A

Heat Treatment Inconel 601 is solution annealed at 1100 - 1180°C, and cooled quickly so as to avoid sensitisation to intergranular corrosion. Annealing time should be short to avoid excessive grain growth.

Physical Properties

Property	at	value	unit
Density	20°C	8,110	Kg/m3
Melting Range		1360 - 1411	°C
Specific Heat	20°C	448	J/kg
Mean Coefficient of Expansion	20°C	13.8	X 10 ⁻⁶ / °C
Thermal Conductivity	20°C	11.2	W/m °C

Property	at	value	unit
Electrical resistivity	20°C	1190	Micro ohm/m
Modulus of Elasticity			
Tension	20°C	207	GPa
Torsion	20°C	81.2	GPa
Poisson's ratio	20°C	0.272	
Curie Temperature		-320	°C

Equivalent Specifications

Country	Body	Grade
USA	UNS	N06601
France	AFNOR	NC 23 FeA
GB	BS	-
Germany	DIN	2.4851

ASTM Product Specifications

Specification	Title
B166	Nickel Chromium Iron and Nickel Chromium Molybdenum Rod, Bar and Wire
B167	Nickel Chromium Iron Seamless Pipe
B168	Nickel Chromium Iron Alloys and Nickel Chromium Cobalt Molybdenum Alloy Plate, Sheet and Strip

INCONEL 625, 625LCF UNS N06625

Inconel 625 is a nickel chromium molybdenum alloy with high strength at elevated temperatures, combined with outstanding corrosion resistance. It has the best all-round combination of strength and corrosion resistance of the Inconel family of alloys. It is pre-qualified for use in pressure vessels up to 815°C. Inconel 625LCF is a special quality of the alloy for use in bellows.

Chemical Composition (ASTM B446 – Bar)

Element	%
Nickel	58.0 min
Chromium	20.0 - 23.0
Molybdenum	8.0 – 10.0
Niobium + Tantalum	3.15 - 4.15
Iron	5.0 max

Element	%
Cobalt (if determined)	1.0 max
Manganese	0.50 max
Carbon (Inconel 625)	0.10 max
Carbon (Inconel 625LCF)	0.03 max
Nitrogen (Inconel 625LCF)	0.02 max

Element	%
Silicon	0.15 max
Phosphorus	0.015 max
Sulphur	0.015 max
Aluminium	0.40 max
Titanium	0.40 max

Specified Minimum Mechanical Properties (ASTM B446 – Bar)

	Grade 1 (Annealed)		Grade 2 (Solution annealed)
	Up to 102 mm	103 to 254 mm	All
Diameter	Up to 102 mm	103 to 254 mm	All
0.2% Proof Stress, MPa	415	345	275
Tensile Strength, MPa	830	760	690
Elongation, %	30	25	30

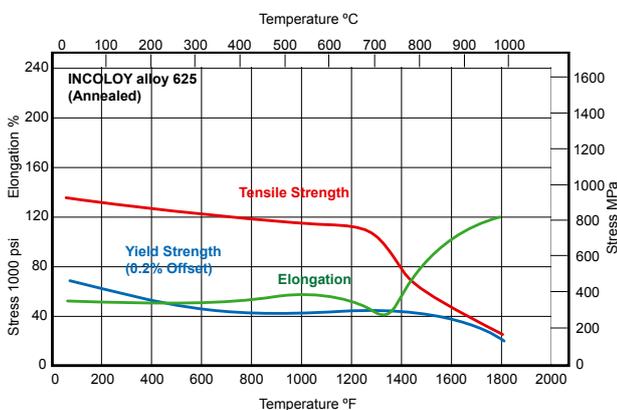
Grade 1 – annealed at 870°C minimum

Grade 2 – solution annealed at 1090°C (min), with or without stabilise anneal at 980°C (min) for sensitisation resistance.

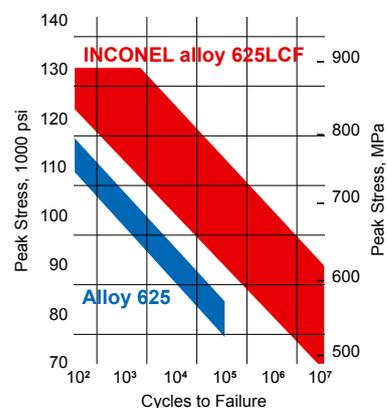
Typical Applications Chemical plant, bellows, submerged marine components, weld overlays, power station scrubber systems, general corrosion applications for aggressive environments, combustion and ducting systems, fuel nozzles, after burners, aerospace components.

Description Inconel 625 is a nickel chromium molybdenum solid solution strengthened high strength alloy, which retains strength to high temperatures. It is used from cryogenic temperatures to 980°C. Fatigue strength is outstanding, particularly as the bellows grade, Inconel 625LCF, where carbon, silicon and nitrogen are controlled to low levels. The alloys have good oxidation resistance and resist corrosion by many corrosive media. When exposed to high temperature for long periods, Inconel 625 will age harden due to the niobium, titanium and aluminium additions. When aged there is an increase in strength and some loss of ductility and toughness.

Austral Wright Metals can supply Inconel 625 as plate, sheet and strip, rod and bar, seamless and welded tube and pipe, welding fittings, forgings and forging billet. Inconel 625LCF is available as annealed sheet and strip from 0.13 mm to 2.54 mm thick, up to 1219 mm wide.



High temperature tensile properties of annealed Inconel 625 sheet.



Low cycle fatigue strength of Inconel 625 and Inconel 625LCF at 480 – 650°C.

Pressure Vessels AS1210 prequalifies Inconel 625 up to 625°C as flat products, and 650°C as bar and forgings. ASME Boiler & Pressure Vessel Code, Section VIII (Code Case 1409-5) allows annealed material to be used to 650°C, solution treated to 815°C.

Corrosion Resistance Inconel 625 has a corrosion resistance to many environments. In mild environments such as atmosphere, fresh water and sea water, neutral salts and alkaline media there is almost no attack. In more aggressive media nickel and chromium resist oxidising attack, while nickel and molybdenum resist reducing environments. Molybdenum provides exceptional resistance to pitting and crevice corrosion, and niobium stabilises against sensitisation and intergranular corrosion. The nickel content makes Inconel 625 essentially free from chloride ion stress corrosion cracking. Inconel 625 also has excellent corrosion fatigue properties. Please consult Austral Wright Metals for specific advice on your application.

Corrosion rates (mm/year) in a municipal waste incinerator at 650 – 700°C after 2050 hours & 6750 hours

Alloy	2050 hours	6750 hours	Alloy	2050 hours	6750 hours
Inconel 625	7	13	SS 310	48	89
Incoloy 800	35	Destroyed	SS 316	71	Destroyed
Incoloy 825	127	Destroyed	SS 446	82	54

EQUIVALENT GRADE SPECIFICATIONS	Country	Body	Grade
	USA	UNS	N06625
	France	AFNOR	NC 22 D Nb
	GB	BS	NA21
	Germany	DIN	2.4856

Fabrication Inconel 625 was developed for hot strength, so resists hot working. It is ductile and can be readily hot worked with high forces. The alloy can also be cold formed with heavy forces. Intermediate annealing may be needed.

Machinability Inconel 625 is difficult to machine (class D-2). Heavy machines, sharp tools, slow speeds and deep uninterrupted cuts to remove the work hardened layer are needed.

Welding Inconel 625 is readily welded by GMAW (MIG), GTAW (TIG), SMAW (manual) and SAW processes. Preheat, post heat and post weld heat treatment are not required. The area around the weld must be clean to prevent contamination of the weld pool. Argon shielding gas is used.

	Normal Service	Higher Strength	Best Corrosion Resistance
Welding electrode	Inconel WE 112	N/A	Inco Weld WE 686CPT
Filler metal	Inconel FM 625	Inco Weld FM725NDUR	Inco Weld FM 686CPT
Flux cored wire	Inco Cored 625DH	N/A	N/A

Heat Treatment Inconel 625 is annealed at 925–1040°C, cooling rate not critical. Solution anneal at 1090–1200°C. Stress relief, if required, is at 590–760°C, or up to 870°C for complete relief.

Physical Properties (Inconel 625 and 625LCF, annealed)

Property	at	value	unit
Density	20°C	8,440	kg/m ³
Melting Range		1290 – 1350	°C
Electrical Resistivity	20°C	1.29	micro-ohm . m
Electrical conductivity	20°C	1.3	% IACS
Modulus of Elasticity (Annealed)			
Tension	20°C	208	GPa
Torsion	20°C	81.4	GPa
Poisson's ratio	20°C	0.278	

Property	at	value	unit
Specific Heat	20°C	410	J/kg . °C
Mean Coefficient of Expansion	20°C	12.8	x 10 ⁻⁶ / °C
Thermal Conductivity	20°C	9.8	W / m . °C
Curie Temperature		< - 196	°C
Modulus of Elasticity (Solution treated)			
Tension	20°C	205	GPa
Torsion	20°C	77.9	GPa
Poisson's ratio	20°C	0.312	

ASTM Product Specifications

Specification	Title
B366	Factory-Made Wrought Nickel and Nickel Alloy Fittings
B443	Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) Plate, Sheet, and Strip
B444	Nickel-Chromium-Molybdenum-Columbium Alloys (UNS N06625) Pipe and Tube
B446	Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) Rod and Bar
B564	Nickel Alloy Forgings
B704	Welded UNS N06625 and UNS N08825 Alloy Tubes
B705	Nickel-Alloy (UNS N06625 and N08825) Welded Pipe
B751	General Requirements for Nickel and Nickel Alloy Welded Tube

Note: the element niobium is called columbium in USA

TITANIUM GRADE 2 UNS R50400

Titanium grade 2 is commercially pure titanium. It has outstanding corrosion resistance and useful strength (similar to austenitic stainless steels) at low density. It has good weldability and is easily formable. It is the most commonly used grade of titanium.

Typical Applications Most of the applications of this grade are in the chemical industries. The most common uses are reactor autoclaves, piping and fittings, valves, heat exchangers and condensers.

CHEMICAL COMPOSITION (ASTM B338 – SEAMLESS & WELDED TITANIUM & TITANIUM ALLOY TUBES FOR CONDENSERS & HEAT EXCHANGERS)	Element	%	Element	%
	Titanium	Balance	Iron	0.30 max
	Nitrogen	0.03 max	Oxygen	0.25 max
	Carbon	0.08 max	Residuals, each	0.1 max
	Hydrogen	0.015 max	Residuals, total	0.4 max

SPECIFIED MINIMUM MECHANICAL PROPERTIES (ASTM B338 – SEAMLESS & WELDED TITANIUM & TITANIUM ALLOY TUBES FOR CONDENSERS & HEAT EXCHANGERS)	Annealed	
	0.2% Proof Stress, MPa	275 – 450
	Tensile Strength, MPa	345
	Elongation, %	20

Description Titanium grade 2 is a commercially pure grades. It has excellent corrosion resistance in oxidising conditions, and is effectively immune from stress corrosion cracking, pitting corrosion and crevice corrosion in chloride solutions below 70°C. Titanium grade 2 is widely used in heat exchangers, where despite the low thermal conductivity of titanium the efficiency of heat transfer is high due to good strength, high resistance to erosion corrosion and the fouling resistance of the hard, smooth surface.

At room temperature grade 2 is an alpha alloy. It transforms to beta phase at 913 ±15°C, and the alpha phase returns on cooling 890 ±15°C.

Titanium is reactive, with a very high affinity for oxygen, which forms a skin of very stable and highly adherent oxide. The skin gives excellent corrosion resistance, despite the reactivity of the metal. The oxide layer forms spontaneously and rapidly on exposure to the atmosphere. However, when new parent metal is exposed to anhydrous conditions or in the absence of air, rapid corrosion may occur. Care should also be taken if titanium is to operate in contact with hydrogen, as hydrogen embrittlement from hydride formation can increase strength, with loss of ductility.

Austral Wright Metals can supply this alloy as plate, sheet and strip, rod and bar, seamless and welded pipe, weld fittings, seamless and welded tube, forging billet and forgings. It is widely used as tube in condensers and heat exchangers.

Pressure Vessels AS1210 & ASME Boiler & Pressure Vessel Code pre-qualify titanium 2 for use in pressure vessels up to 300°C. AS4041 Pressure Piping qualifies the alloy to 325°C.

Corrosion Resistance Titanium has excellent resistance to general corrosion, with low or negligible loss rates in many media. See Austral Wright Metals data sheet “Corrosion of Titanium and alloys” for more detail. The table at the end of this data sheet illustrates the excellent erosion corrosion performance of grade 2 in sea water.

Physical Properties

Property	at	value	unit	Property	at	Value	unit
Density	20°C	4,507	kg/m ³	Specific Heat	20°C	519	J/kg . °C
Melting Range		1668 ± 10	°C	Mean Coefficient of Expansion	20°C	8.41	x 10 ⁻⁶ / °C
Modulus of Elasticity				Thermal Conductivity	20°C	11.4	W / m . °C
Tension	20°C	103	GPa	Electrical Resistivity	20°C	0.420	micro-ohm . m

Erosion corrosion rates of unalloyed titanium, grade 2.

Location	Flow Rate m/sec	Type of Test	Test Duration mths	Erosion Corrosion Rate mm/year
Brixham Sea	9.8	Model condenser	12	0.003
Kure Beach, NC	1	Ducting	54	7.5 x 10 ⁻⁷
Kure Beach, NC	8.5	Rotating disc	2	1.3 x 10 ⁻⁴
Kure Beach, NC	9	Micarta wheel	2	2.8 x 10 ⁻⁴
Kure Beach, NC	7.2	Jet impingement	1	5.0 x 10 ⁻⁴
Wrightsville Beach, NC	1.3	–	6	1.0 x 10 ⁻⁴
Wrightsville Beach, NC	9	Micarta wheel	2	1.8 x 10 ⁻⁴
Mediterranean Sea	7.2	Jet impingement	0.5	0.5 mg/day
Dead Sea	7.2	Jet impingement	0.5	0.5 mg/day

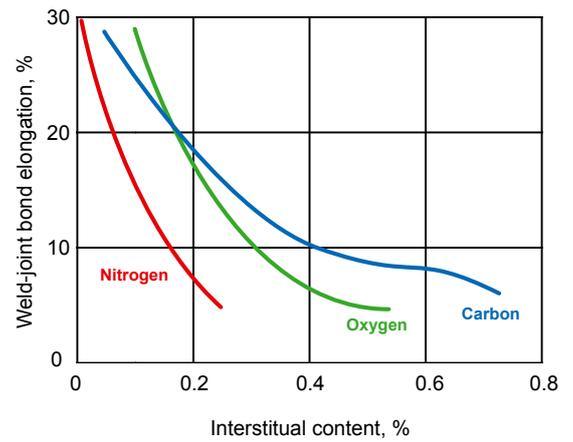
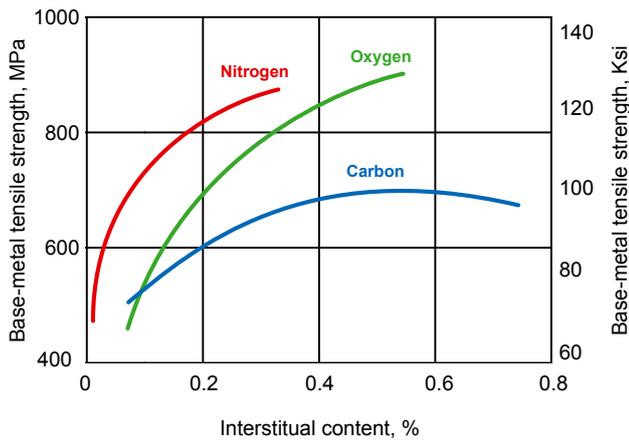
Fabrication Titanium grade 2 is forged by conventional processes within the narrow temperature range 815 - 900°C. Titanium and its alloys generally are more difficult to forge than both aluminium and alloy steels, due to the narrow temperature range, and high strain rate and temperature dependence of strength. Hot forging leaves a thick, extremely hard layer of titanium oxide on the surface, called “alpha case”. It is usually removed by pickling in a mixture of nitric and hydrofluoric acids. As supplied, titanium alloys are usually annealed, and can be readily cold formed in conventional machines using standard methods. When cold formed the alpha case does not form and pickling is not needed, except to remove embedded carbon steel pickup, which can cause pitting corrosion.

Machinability Titanium grade 2 is readily machinable by conventional methods. It is similar to austenitic stainless steels for machinability. Like stainless steel, titanium has a low thermal conductivity and heat dissipation is poor, so generous use of coolant is recommended. Sharp tools are essential. Cuts should be deep and continuous, with low cutting speeds.

Welding Titanium grade 2 is readily weldable by GMAW and GTAW processes. Preheat or post weld heat treatment are not needed. The area immediately surrounding the welds must be CLEAN, free from all grease and shop dirt, including pencil marks. Abrasive cleaning can be used, or solvent cleaning or pickling with a mixture of nitric and hydrofluoric acids. A trailing gas shield must be applied to all areas above 450°C in addition to the normal welding torch gas shield, to prevent heavy oxidation during cooling. Matching filler metal to AWS ERTi-2 is used. The gas shield must be low in hydrogen, oxygen and nitrogen, all of which readily dissolve in titanium and cause embrittlement.

Heat Treatment Titanium grade 7 is annealed at 650 - 760°C, still air cooled. Pickling to remove the alpha case may be needed before further fabrication or machining. Stress relief at 480 – 595°C, air cooled, may be required to improve dimensional stability for critical components.

Effects of interstitial elements on the strength and ductility of unalloyed aluminium



ASTM Product Specifications

Specification	Title
B265	Titanium and Titanium Alloy Strip, Sheet and Plate
B381	Titanium and Titanium Alloy Forgings
B348	Titanium and Titanium Alloy Bars and Billets
B337	Seamless and Welded Titanium and Titanium Alloy Pipe
B338	Seamless and Welded Titanium and Titanium Alloy Tubes for Condensers and Heat Exchangers
B363	Seamless and Welded Unalloyed Titanium and Titanium Alloy Welding Fittings
B367	Titanium and Titanium Alloy Castings

TITANIUM GRADE 12 UNS R53400

Titanium Grade 12 has outstanding corrosion resistance and a combination of high strength and low density, with good ductility. Small additions of nickel and molybdenum have been made to this alloy resulting increase in corrosion resistance and high strength. It is particularly suitable for use in mildly reducing conditions, or where conditions vary from oxidising to reducing. It is particularly resistant to crevice corrosion in hot brines.

CHEMICAL COMPOSITION (ASTM B265 – TITANIUM & TITANIUM ALLOY STRIP, SHEET & PLATE)	Element	%	Element	%
	Titanium	Balance	Iron	0.30 max
	Nitrogen	0.03 max	Oxygen	0.25 max
	Carbon	0.08 max	Molybdenum	0.2 – 0.4
	Hydrogen	0.015 max	Nickel	0.6 – 0.9
	Residuals, each	0.1	Residuals, total	0.4

SPECIFIED MINIMUM MECHANICAL PROPERTIES (ASTM B265 – TITANIUM & TITANIUM ALLOY STRIP, SHEET & PLATE)		Annealed
	0.2% Proof Stress, MPa	345
	Tensile Strength, MPa	483
	Elongation, %	18

Typical Applications Many of the applications of grade 12 titanium are in the chemical industries. The common uses in Australia are in chemical processing, where titanium grade 12 is used for reactor autoclaves, piping and fittings, valves, heat exchanges and condensers.

Description Titanium Grade 12 is a highly corrosion resistant alloy containing small additions of nickel and molybdenum, which enhance corrosion resistance and increase the strength of the alloy to give better mechanical properties than the commercially pure grades. It is used in mildly reducing or fluctuating conditions. In particular, it is used instead of the commercial purity grades (e.g. grade 2) for better resistance to crevice corrosion in hot brines, and where the extra strength allows the use of lighter sections. At room temperature it is an alpha alloy, and may contain minor amounts of beta phase. It transforms to beta phase at $890^{\circ}\text{C} \pm 15^{\circ}\text{C}$

Titanium is reactive, and has a very high affinity for oxygen, which forms a skin of very stable and highly adherent oxide. The skin gives excellent corrosion resistance, despite the reactivity of the metal. The oxide layer forms spontaneously and on exposure to the atmosphere. However, when new parent metal is exposed to anhydrous conditions or in the absence of air, rapid corrosion may occur. Care should also be taken if titanium is to operate in contact with hydrogen, as hydrogen embrittlement from hydride formation can increase strength, with loss of ductility.

Austral Wright Metals can supply titanium 12 as plate, sheet and strip, rod and bar, seamless and welded pipe, weld fittings, seamless and welded tube, forging billet and forgings.

Pressure Vessels AS1210 & ASME Boiler & Pressure Vessel Code pre-qualify Titanium 12 for use in pressure vessels up to 300°C .

Corrosion Resistance Titanium alloys are usually used in Australia for their excellent corrosion resistance, especially to chloride solutions. The small additions of nickel and molybdenum to grade 12 titanium give a more corrosion resistant metal than the commercial purity grade 2 alloy, with a marked increase in strength. The overall corrosion resistance of this grade is not as good as the palladium alloyed lean grade 7, except for resistance to crevice corrosion in hot chloride solutions. Titanium has excellent resistance to general corrosion, with loss rates of less than 0.04mm/year being typical. The Austral Wright Metals Product Data Sheet “Corrosion of Titanium and Titanium Alloys” or your local office should be consulted more details.

Environment	Typical Corrosion Rate mm/year	Environment	Typical Corrosion Rate mm/year	Environment	Typical Corrosion Rate mm/year
Wet Cl ₂ gas	0.000 89	50% citric acid	0.013	88 – 90% formic acid	0 – 0.56
5% NaOCl + 2% NaCl + 4% NaOH†	0.06	10% sulphamic acid	11.6	90% formic acid‡	0.56
70% zinc chloride	0.005 – 0.007 5	45% formic acid	Nil	10% oxalic acid	104

† no crevice corrosion in metal-to-metal or metal-to-Teflon crevices ‡ anodised specimens

Source: Metals Handbook, vol 2, ASM

Fabrication Titanium Grade 12 is forged conventionally, within the narrow temperature range 815 - 900°C. Titanium and its alloys are generally more difficult to forge than both aluminium and alloy steels, due to their high strain rate sensitivity and rapid increase of strength with falling temperature. Hot forging leaves a thick, hard outer layer of titanium oxide on the surface. This layer is called “Alpha Case” and is usually removed by pickling in a mixture of nitric and hydrofluoric acids. As supplied, titanium alloys are usually annealed and pickled, and can be readily cold formed in conventional machines using standard methods. In cold forming the “alpha case” does not form and further pickling is not needed, except to remove any carbon steel embedded in the surface, which can cause pitting corrosion.

Machinability Titanium Grade 12 is readily machinable by conventional methods. Like stainless steel, titanium has a low thermal conductivity and heat dissipation is inhibited, so copious amounts of coolant should be used. Sharp carbide tools are used. Deep, continuous cuts are best.

Welding Titanium Grade 12 is readily weldable by GMAW (MIG) and GTAW (TIG) processes. Preheat or post weld heat treatment are not needed. The area to be welded must be CLEAN, free from all grease and shop dirt, including marking pencil marks. A trailing gas shield is used in addition to the normal welding torch gas shield, to prevent heavy oxidation during cooling. Matching filler metal to AWS specification ERTi-12 is used. The gas shield must be low in hydrogen, oxygen and nitrogen, all of which readily dissolve in titanium and cause embrittlement.

Heat Treatment Titanium Grade 12 is normally supplied in the annealed condition. After fabrication, stress relief at 480 – 595°C, air cooled, may be required to improve dimensional stability.

Physical Properties

Property	At	value	unit	Property	at	Value	unit
Density	20°C	4,507	kg/m ³	Specific Heat	20°C	519	J/kg . °C
Melting Range		1668 ± 10	°C	Mean Coefficient of Expansion	20°C	8.41	x 10-6 / °C
Modulus of Elasticity				Thermal Conductivity	20°C	11.4	W / m . °C
Tension	20°C	103	GPa	Electrical Resistivity	20°C	0.420	micro-ohm . m

ASTM Product Specifications

Specification	Title
B265	Titanium and Titanium Alloy Strip, Sheet and Plate
B381	Titanium and Titanium Alloy Forgings
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B338	Seamless and Welded Titanium and Titanium Alloy Tubes for Condensers and Heat Exchangers

STAINLESS STEEL GRADES 310, 310S UNS S31000, S31008

Grade 310 is a medium carbon austenitic stainless steel, for high temperature applications such as furnace parts and heat treatment equipment. It is used at temperatures up to 1150°C in continuous service, and 1035°C in intermittent service. Grade 310S is a low carbon version of grade 310.

CHEMICAL COMPOSITION, % (AS1449 / ASTM A240 – FLAT PRODUCTS)							
	Carbon	Manganese	Silicon	Phosphorus	Sulphur	Chromium	Nickel
310	0.25 max	2.00 max	1.50 max	0.045 max	0.030 max	24.00 - 26.00	19.00 - 22.00
310S	0.08 max	2.00 max	1.50 max	0.045 max	0.030 max	24.00 - 26.00	19.00 - 22.00

MECHANICAL PROPERTIES (AS1449 / ASTM A240 – FLAT PRODUCTS)				
	Grade 0.2% Proof Stress MPa (min)	Tensile Strength MPa (min)	Elongation % (min)	Hardness HV (max)
310 / 310S	205	520	40	225

Typical Applications Grade 310/310S is used in fluidised bed combustors, kilns, radiant tubes, tube hangers for petroleum refining and steam boilers, coal gasifier internal components, lead pots, thermowells, refractory anchor bolts, burners and combustion chambers, retorts, muffles, annealing covers, saggars, food processing equipment, cryogenic structures.

Description These grades contain 25% chromium and 20% nickel, making them highly resistant to oxidation and corrosion. Grade 310S is a lower carbon version, less prone to embrittlement and sensitisation in service. The high chromium and medium nickel content make these steels capable for applications in reducing sulphur atmospheres containing H₂S. They are widely used in moderately carburising atmospheres, as encountered in petrochemical environments. For more severe carburising atmospheres other heat resisting alloys should be selected. Grade 310 is not recommended for frequent liquid quenching as it suffers from thermal shock. The grade is often used in cryogenic applications, due to its toughness and low magnetic permeability.

In common with other austenitic stainless steels, these grades cannot be hardened by heat treatment. They can be hardened by cold work, but this is rarely practiced.

Austral Wright Metals can supply these grades as plate, sheet and strip, bar and rod, seamless tube and pipe, welded tube and pipe, forgings and forging billet, tube and pipe fittings, wire. Corrosion Resistance Grade 310/310S is generally not used for corrosive liquid service, although the high chromium and nickel content give corrosion resistance superior to grade 304. The alloy does not contain molybdenum, so pitting resistance is quite poor. Grade 310/310S will be sensitised to intergranular corrosion after service at temperatures in range 550 - 800°C. Chloride stress corrosion cracking may take place in corrosive liquids containing chlorides at temperatures exceeding 100°C.

Heat Resistance Grades 310/310S have good resistance to oxidation in intermittent service in air up to 1035°C and 1050°C in continuous service. The grades are resistant to oxidation, sulphidation and carburisation.

PHYSICAL PROPERTIES (TYPICAL ANNEALED)							
Property	at	Value	Unit	Property	At	Value	Unit
Density		8,000	Kg/m ³	Melting Range		1400-1450	°C
Electrical Conductivity	25°C	1.25	% IACS	Specific Heat		500	J/kg. °C
Electrical Resistivity	25°C	0.78	Micro ohm . m	Relative Magnetic Permeability		1.02	
				Coefficient of Expansion	0 – 100°C	15.9	/ °C
Modulus of Elasticity	20°C	200	GPa		0 – 315°C	16.2	/ °C
Shear Modulus	20°C	77	GPa		0 – 540°C	17.0	/ °C
Poisson's Ratio	20°C	0.30		Thermal Conductivity	100°C	14.2	W / m . °C

Pressure Vessels AS1210, Pressure Vessels, allows the use of grade 310 up to 800°C.

Fabrication Grades 310/310S are forged in the temperature range 975 - 1175°C. Heavy work is carried out down to 1050°C and a light finish is applied to the bottom of the range. After forging annealing is recommended to relieve all stresses from the forging process. The alloys can be readily cold formed by standard methods and equipment.

Machinability Grades 310/310S are similar in machinability to type 304. Work hardening can be a problem and it is normal to remove the work hardened layer by using slow speeds and heavy cuts, with sharp tools and good lubrication. Powerful machines and heavy, rigid tools are used.

Welding Grades 310/310S are welded with matching electrodes and filler metals. The alloys are readily welded by SMAW (manual), GMAW (MIG), GTAW (TIG) and SAW. Electrodes to AWS A5.4 E310-XX and A 5.22 E310T-X, and filler metal AWS A5.9 ER310 are used. Argon is shielding gas.

Preheat and post heat are not required, but for corrosion service in liquids full post weld solution annealing treatment is essential.

Pickling and passivation of the surface to remove high temperature oxides are essential to restore full aqueous corrosion resistance after welding. This treatment is not required for high temperature service, but welding slag should be thoroughly removed.

Heat Treatment Type 310/310S are solution annealed by heating to temperature range 1040 -1065°C, holding at temperature until thoroughly soaked, then water quenching.

EFFECT OF EXPOSURE AT 480-650°C ON ROOM TEMPERATURE TOUGHNESS AND HARDNESS				
Temperature °C	Exposure Time			
	1,000 hours		10,000 hours	
	Charpy Impact J	Hardness HB	Charpy Impact J	Hardness HB
Unexposed	102	124	102	124
480		119	84	152
565	65	119	39	174
650	39	130	3	269

MECHANICAL PROPERTIES AT CRYOGENIC TEMPERATURES				
Temperature °C	Yield Strength MPa	Tensile Strength MPa	Elongation %	Izod Impact J
-40	269	655	57	149
-62	276	689	55	149
-196	510	1048	54	115
-252	745	1213	56	

COMPARISON BETWEEN HEAT-RESISTANT STAINLESS STEEL GRADES 253MA AND 310/310S

Introduction

Stainless steels are widely used at elevated temperatures when carbon and low-alloy steels do not provide adequate corrosion resistance and/or sufficient strength.

Corrosion resistance is often the first criterion used to select stainless steel for a particular application. However, strength is also a significant factor in a majority of elevated-temperature applications and may even be the key factor governing the choice of stainless steel.

The stainless steels used in applications where high temperature strength is important are sometimes referred to as heat-resistant steels.

The various process stages in the metallurgical industry, right through from ore to the finished, rolled or forged product, usually takes place at high temperatures. The production equipment used in these processes is subjected to intense heat from hot gases or from red-hot or molten materials, which make heavy demands on the construction materials used for that equipment.

The following information is a comparison between two of the more widely used grades of heat-resistant steels, 253MA and 310/310S.

Background

253MA

253MA (UNS S30815) is a grade combining excellent service properties at high temperatures with ease of fabrication. It resists oxidation at temperatures up to 1150°C and can provide good service in carbon, nitrogen and sulphur containing atmospheres.

253MA is not recognised in AS1210 “Pressure Vessels”.

310/310S

Grade 310 (UNS S31000), combining excellent high temperature properties with good ductility and weldability, is designed for high temperature service. It resists oxidation in continuous service at temperatures up to 1150°C provided reducing sulphur gases (eg. H₂S) are not present. It is also used for intermittent service at temperatures up to 1040°C.

Grade 310S (UNS S31008) is used when the application environment involves moist corrodents in a temperature range lower than that which is normally considered “high temperature” service. The lower carbon content of 310S reduces its high temperature strength compared to 310, which is recognised in AS1210 “Pressure Vessels”.

Key Properties

The properties outlined below for each of the grades are specified for flat rolled product (plate, sheet and coil).

Grade	UNS
253MA	S30815
310	S31000
310S	S31008

1. Composition

The compositional ranges for 253MA, 310 and 310S, given in Table 1, are specified in ASTM A240/A240M.

Table 1: Composition of 253MA, 310 and 310S

Grade		C %	Mn %	Si %	P %	S %	Cr %	Ni %	N %	Ce %
253MA (S30815)	Min.	0.05	-	1.40	-	-	20.0	10.0	0.14	0.03
	Max.	0.10	0.80	2.00	0.04	0.03	22.0	12.0	0.20	0.08
310 (S31000)	Min.	-	-	-	-	-	24.0	19.0	-	-
	Max.	0.25	2.00	1.50	0.045	0.03	26.0	22.0	-	-
310S (S31008)	Min.	-	-	-	-	-	24.0	19.0	-	-
	Max.	0.08	2.00	1.50	0.045	0.03	26.0	22.0	-	-

Key: C = Carbon; Mn = Manganese; Si = Silicon; P = Phosphorus; S = Sulphur; Cr = Chromium; Ni = Nickel; N = Nitrogen; Ce = Cerium

2. Mechanical Properties

The mechanical properties for 253MA, 310 and 310S, given in Table 2, are specified in ASTM A240/A240M for plate, sheet and strip in the annealed condition.

Table 2: Mechanical properties of 253MA, 310 and 310S

Grade	Tensile Strength (MPa) min	Yield Strength 0.2% Proof (MPa) min	Elongation (% in 50mm) min	Hardness	
				Rockwell B (HRB) max	Brinell (HB) max
253MA (S30815)	600	310	40	95	217
310 (S31000)	517	207	40	95	217
310S (S31008)	517	207	40	95	217

3. Physical Properties

Table 3: Physical properties of 253MA

Grade	253MA	
Density (kg/m ³)	7800	
Elastic Modulus (GPa)	200	
Mean Coefficient of Thermal Expansion (µm/m/°C)	20-100°C	17.0
	20-600°C	18.5
	20-1000°C	19.5
Thermal Conductivity (W/m.K)	at 20°C	15.0
	at 600°C	22.5
	at 1000°C	29.0
Specific Heat (J/kg.K)	0-100°C	500
Electrical Resistivity (nΩ.m)	at 20°C	850

Table 4: Physical properties of 310 and 310S

Grade	310 & 310S	
Density (kg/m ³)	7750	
Elastic Modulus (GPa)	200	
Mean Coefficient of Thermal Expansion (µm/m/°C)	0-100°C	15.9
	0-649°C	17.5
	0-982°C	19.1
Thermal Conductivity (W/m.K)	at 100°C	14.2
	at 500°C	18.7
Specific Heat (J/kg.K)	0-100°C	500
Electrical Resistivity (nΩ.m)	at 20°C	720

4. Heat Resistance

253MA

Good oxidation resistance in air at temperatures up to 1150°C. At high temperatures the steel quickly forms a thin, highly adherent and elastic oxide. This oxide provides good protection even under cyclic conditions. This grade performs well in oxidising conditions, but alloys with higher nickel content (such as 310 and 310S) perform much better in carburising (ie reducing) atmospheres. 253MA has good resistance to sulphur-bearing gases in an oxidising atmosphere, even if only traces of oxygen are present. Reducing gases prevent the protective oxide forming. 253MA has high strength at elevated temperatures so is often used for structural and pressure-containing applications at temperatures above about 500°C and up to about 900°C. 253MA will become sensitised in the temperature range 425-860°C, though this is not a problem for high temperature applications, but will result in reduced aqueous corrosion resistance.

310/310S

Good resistance to oxidation in intermittent service in air at temperatures up to 1040°C and 1150°C in continuous service. They have good resistance to thermal fatigue and cyclic heating. These grades are widely used where sulphur dioxide gas is encountered at elevated temperatures. Continuous use in 425-860°C range not recommended due to carbon precipitation (which causes sensitisation to intergranular corrosion) if subsequent aqueous corrosion resistance is needed. The grade performs well in temperatures above and below this range. Grade 310 is generally used at temperatures starting from about 800 or 900°C.

5. Corrosion Resistance

253MA

The high chromium and nitrogen contents give the grade a pitting resistance similar to 316. 253MA has a high carbon content so is highly susceptible to sensitisation from welding or service exposure.

310/310S

The high chromium content, intended to increase high temperature properties, also gives these grades good aqueous corrosion resistance. The Pitting Resistance Equivalent (PRE) is approximately 25, and seawater resistance about 22°C, similar to that of grade 316. 310 and 310S also have a high carbon content so are also susceptible to sensitisation from welding or service exposure. 310 is particularly susceptible due to its much higher carbon content. Both 253MA and 310/310S are subject to stress corrosion cracking but more resistant than grades 304 or 316.

6. Heat Treatment

253MA

Solution Treatment (Annealing): Heat up to 1050-1150°C and cool rapidly. It is recommended that the material be solution treated after 10-20% cold work to achieve maximum creep strength in service. 253MA cannot be hardened by thermal treatment.

310/310S

Solution Treatment (Annealing): Heat up to 1040-1150°C and cool rapidly for maximum corrosion resistance. This treatment is also recommended to restore ductility after each 1000 hours of service above 650°C, due to long term precipitation of brittle sigma phase. 310 and 310S cannot be hardened by thermal treatment.

7. Welding

253MA

Good weldability by all standard fusion methods, using matching filler materials. AS1554.6 pre-qualifies welding of 253MA with Grade 22.12HT rods or electrodes. Grade 309 fillers can be used if lower creep strength can be tolerated. Pure argon shielding gas should be used.

310/310S

Good characteristics suited to all standard methods. Grade 310S electrodes generally recommended for fusion welding. AS1554.6 pre-qualifies welding of 310 with Grade 310 rods or electrodes.

CORROSION OF TITANIUM & TITANIUM ALLOYS

Introduction

Titanium and titanium alloys owe their excellent corrosion resistance to a stable, protective surface layer of titanium oxide. Titanium metal is highly reactive with oxygen, and the surface oxide forms spontaneously and instantaneously in contact with air and most media. Damage to the oxide film usually heals rapidly if the environment contains oxygen or moisture at the parts per million level. Hence titanium alloys are highly resistant to corrosion, usually corrode at negligible rates and require no corrosion allowance. However, anhydrous or highly reducing conditions may prevent the formation or healing of the oxide film, and corrosion may then become rapid.

This form of corrosion resistance is similar to that of aluminium and magnesium alloys, and of stainless steels, which also rely on a protective oxide film on the surface of a reactive metal.

Alloy Composition Effects

All the commercial purity grades corrode at very low rates while the metal remains in the passive condition. Small contents (< 2 – 3%) of the elements normally present have little effect on the oxide film, and hence on corrosion resistance. However, where the corrosion resistance is marginal (i.e. corrosion rates above about 0.13 mm/year), small amounts of elements such as sulphur and iron accelerate the corrosion rate of the alloy. Minor additions of other elements, such as palladium and nickel, can greatly reduce corrosion under these conditions, and made to highly corrosion resistant alloys such as grade 7.

Weldments of the lean alloys generally show the same corrosion resistance as the unwelded parent metal, without surface treatment. In marginal or active conditions attack may be accelerated at the weld, due to a higher content of impurity elements such as sulphur, iron, oxygen and nitrogen.

General Corrosion

When titanium is fully passive, corrosion rates are typically lower than 0.04 mm/year, due to the highly stable surface protective film. In many environments the film may thicken, which gives interference colours and a slight weight gain. General corrosion may be encountered in reducing acid conditions, particularly at elevated temperatures. In strong and hot reducing acids the titanium oxide film can dissolve, and the unprotected titanium metal be taken rapidly into solution.

Crevice Corrosion

Titanium alloys may suffer crevice corrosion attack by a similar mechanism to that encountered in stainless steels: oxygen depleted reducing acid conditions develop within tight crevices isolated from the bulk corrosion media. Crevice corrosion may be encountered in hot (>70°C) solutions containing chlorides, bromides, fluorides, iodides or sulphates. It can stem from metal to metal joints such as tube to tubesheet joints or badly designed welds, at gaskets, or at surface deposits.

Pitting Corrosion

Titanium alloys are highly resistant to pitting corrosion, and it is rarely encountered.

Hydrogen Damage

Titanium alloys are widely used in environments containing hydrogen, and where impressed currents or galvanic couples generate hydrogen. Hydrogen embrittlement of the titanium may result due to the formation of titanium hydride precipitates, usually without significant reduction of the performance of the alloy. Embrittlement is loss of ductility and toughness of the alloy.

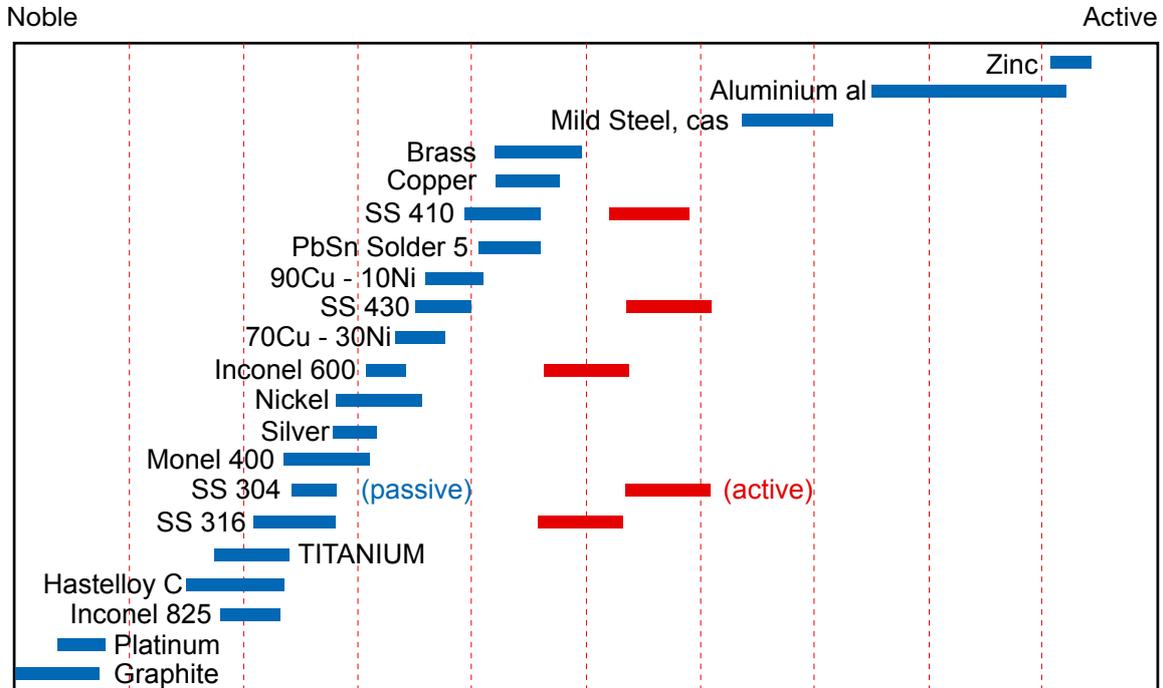
The surface oxide film is a highly effective barrier to the passage of hydrogen, and only traces of moisture or oxygen are effective in maintaining the oxide film. Hence hydrogen embrittlement can usually be avoided. It is unlikely to be encountered at temperatures below about 80°C, or at solution pH between 3 and 12.

The usual cause of hydrogen damage is excessive hydrogen charging from an impressed current corrosion protection system, or a galvanic couple (see below) with a more active metal, such as aluminium, zinc or magnesium. Metals which remain passive, such as other titanium alloys, stainless steels, copper alloys and nickel alloys, are unlikely to cause this problem.

Galvanic Couples

Titanium rarely suffers accelerated corrosion on coupling with other metals, but it may accelerate the corrosion of a more active metal coupled to it. The rate of attack depends on many factors, including solution chemistry and temperature, and the cathode to anode surface area ratio.

Galvanic series in flowing sea water (2.5 - 4 m/sec, 10 - 27°C)



Stress Corrosion Cracking

The commercially pure titanium alloys (grades 1, 2, 7, 11, 12) are immune to SCC except in a few environments, such as anhydrous methanol solutions containing halides, nitrogen tetroxide and red fuming nitric acid. The higher strength alloys have been found susceptible to SCC in aqueous chloride solutions at high stress levels in laboratory tests, but the problem is rarely encountered in practice.

Erosion Corrosion

The hardness of the surface oxide film gives excellent resistance to erosion corrosion, which is outstanding compared to most other candidates for heat exchanger service. High flow rates (30m/sec) can be used without problems due to inlet turbulence or pump cavitation effects.

Corrosion Fatigue

The highly protective surface oxide film results in insignificant reductions in fatigue strength in water, sea water and most chloride solutions where corrosion is not active.

Water & Sea Water

Titanium alloys corrode negligibly in sea water at temperatures up to 260°C. Even under biofouling and deposits, pitting and crevice corrosion are not encountered. Marine atmospheres, splash and tidal zones, and soils also have no effect. Corrosion at tight design crevices may be seen in waters with higher than about 1000 ppm of chlorides at temperatures above about 75°C.

Oxidising Media

Titanium alloys are highly resistant to oxidising acids, with corrosion rates typically less than 0.03 mm/year.

SECTION 6

PRODUCT

SPECIFICATIONS



WALL THICKNESSES – METRIC – SCHEDULES

NB Size	O.D	Sch 5s	Sch 10s	Sch 10	Sch 20	Sch 30	Sch 40s	Std Wall	Sch 40	Sch 60	Sch 80s	XS	Sch 80	Sch 100	Sch 120	Sch 140	Sch 160	XXS
6	10,29	-	1,24	-	-	-	1,73	1,73	1,73	-	2,41	2,41	2,41	-	-	-	-	-
8	13,72	-	1,65	-	-	-	2,24	2,24	2,24	-	3,02	3,02	3,02	-	-	-	-	-
10	17,15	-	1,65	-	-	-	2,31	2,31	2,31	-	3,20	3,20	3,20	-	-	-	-	-
15	21,34	1,65	2,11	-	-	-	2,77	2,77	2,77	-	3,73	3,73	3,73	-	-	-	4,78	7,47
20	26,67	1,65	2,11	-	-	-	2,87	2,87	2,87	-	3,91	3,91	3,91	-	-	-	5,56	7,82
25	33,40	1,65	2,77	-	-	-	3,38	3,38	3,38	-	4,55	4,55	4,55	-	-	-	6,35	9,09
32	42,16	1,65	2,77	-	-	-	3,56	3,56	3,56	-	4,85	4,85	4,85	-	-	-	6,35	9,70
40	48,26	1,65	2,77	-	-	-	3,68	3,68	3,68	-	5,08	5,08	5,08	-	-	-	7,14	10,16
50	60,33	1,65	2,77	-	-	-	3,91	3,91	3,91	-	5,54	5,54	5,54	-	-	-	8,74	11,07
65	73,03	2,11	3,05	-	-	-	5,16	5,16	5,16	-	7,01	7,01	7,01	-	-	-	9,53	14,02
80	88,90	2,11	3,05	-	-	-	5,49	5,49	5,49	-	7,62	7,62	7,62	-	-	-	11,13	15,24
90	101,60	2,11	3,05	-	-	-	5,74	5,74	5,74	-	8,08	8,08	8,08	-	-	-	-	-
100	114,30	2,11	3,05	-	-	-	6,02	6,02	6,02	-	8,56	8,56	8,56	-	11,13	-	13,49	17,12
125	141,30	2,77	3,40	-	-	-	6,55	6,55	6,55	-	9,53	9,53	9,53	-	12,70	-	15,88	19,05
150	168,28	2,77	3,40	-	-	-	7,11	7,11	7,11	-	10,97	10,97	10,97	-	14,27	-	18,26	21,95
200	219,08	2,77	3,76	-	6,35	7,04	8,18	8,18	8,18	10,31	12,70	12,70	12,70	15,09	18,26	20,62	23,01	22,23
250	273,05	3,40	4,19	-	6,35	7,80	9,27	9,27	9,27	12,70	12,70	12,70	15,09	18,26	21,44	25,40	28,58	25,40
300	323,85	3,96	4,57	-	6,35	8,38	9,53	10,31	10,31	14,27	12,70	12,70	17,48	21,44	25,40	28,58	33,32	25,40
350	355,60	3,96	4,78	6,35	7,92	9,53	-	11,13	11,13	15,09	-	12,70	19,05	23,83	27,79	31,75	35,71	-
400	406,40	4,19	4,78	6,35	7,92	9,53	-	12,70	12,70	16,66	-	12,70	21,44	26,19	30,96	36,53	40,49	-
450	457,20	4,19	4,78	6,35	7,92	11,13	-	14,27	14,27	19,05	-	12,70	23,83	29,36	34,93	39,67	45,24	-
500	508,00	4,78	5,54	6,35	9,53	12,70	-	15,09	15,09	20,62	-	12,70	26,19	32,54	38,10	44,45	50,01	-
550	558,80	4,78	5,54	6,35	9,53	12,70	-	15,88	15,88	22,23	-	12,70	28,58	34,93	41,28	47,63	53,98	-
600	609,60	5,54	6,35	6,35	9,53	14,27	-	17,48	17,48	24,61	-	12,70	30,96	38,89	46,02	52,37	59,54	-
650	660,40	-	-	7,92	12,70	-	-	-	-	-	-	12,70	-	-	-	-	-	-
700	711,20	-	-	7,92	12,70	15,88	-	-	-	-	-	12,70	-	-	-	-	-	-
750	762,00	6,35	7,92	7,92	12,70	15,88	-	-	-	-	-	12,70	-	-	-	-	-	-
800	812,80	-	-	7,92	12,70	15,88	-	-	17,48	-	-	12,70	-	-	-	-	-	-
850	863,60	-	-	7,92	12,70	18,88	-	-	17,48	-	-	12,70	-	-	-	-	-	-
900	914,40	-	2	7,92	12,70	15,88	-	19,05	19,05	-	-	12,70	-	-	-	-	-	-

SCHEDULES TO BS1600 (ANSI B36.10 AND ANSI B36.19)

WEIGHTS OF PIPE IN KG/M

N.B Size	O.D	Sch 5s	Sch 10s	Sch 10	Sch 20	Sch 30	Sch 40s	Std. Wall	Sch 40	Sch 60	Sch 80s	XS	Sch 80	Sch 100	Sch 120	Sch 140	Sch 160	XXS
6	10.29	-	0.28	-	-	-	0.36	0.37	0.37		0.48	0.47	0.47	-	-	-	-	-
8	13.72	-	0.51	-	-	-	0.64	0.63	0.63		0.82	0.80	0.80	-	-	-	-	-
10	17.15	-	0.64	-	-	-	0.86	0.84	0.84		1.12	1.10	1.10	-	-	-	-	-
15	21.34	0.82	1.01	-	-	-	1.30	1.27	1.27		1.65	1.62	1.62	-	-	-	1.95	2.55
20	26.67	1.04	1.31	-	-	-	1.71	1.69	1.69		2.24	2.20	2.20	-	-	-	2.90	3.64
25	33.40	1.33	2.13	-	-	-	2.55	2.50	2.50		3.29	3.24	3.24	-	-	-	4.24	5.45
32	42.16	1.68	2.76	-	-	-	3.46	3.39	3.39		4.56	4.47	4.47	-	-	-	5.61	7.77
40	48.26	1.95	3.17	-	-	-	4.13	4.05	4.05		5.51	5.41	5.41	-	-	-	7.25	9.56
50	60.33	2.44	4.01	-	-	-	5.54	5.44	5.44		7.63	7.48	7.48	-	-	-	11.11	13.44
65	73.03	3.77	5.36	-	-	-	8.81	8.63	8.63		11.64	11.41	11.41	-	-	-	14.92	20.39
80	88.90	4.60	6.59	-	-	-	11.52	11.29	11.29		15.59	15.27	15.27	-	-	-	21.35	27.68
90	101.60	5.29	7.55	-	-	-	13.84	13.57	13.57		19.01	18.63	18.63	-	-	-	-	-
100	114.30	5.96	8.52	-	-	-	16.40	16.07	16.07		22.77	22.32	22.32	-	28.32	-	33.54	41.03
125	141.30	9.67	11.82	-	-	-	22.20	21.77	21.77		31.59	30.97	30.97	-	40.28	-	49.11	57.43
150	168.28	11.55	14.13	-	-	-	28.83	28.26	28.26	-	43.42	42.56	42.56	-	54.20	-	67.56	79.22
200	219.08	15.09	20.37	-	33.31	36.81	43.39	42.55	42.55	53.08	65.95	64.64	64.64	75.92	90.44	100.92	111.27	107.92
250	273.05	23.08	28.34	-	41.77	51.03	61.52	60.31	60.31	81.55	83.19	81.55	96.01	114.75	133.06	155.15	172.33	155.15
300	323.85	31.89	36.73	-	49.73	65.20	75.32	73.88	79.73	108.96	99.43	97.46	132.08	159.91	186.97	208.14	238.76	186.97
350	355.60	35.06	42.14	54.69	67.90	81.33	-	81.33	94.55	126.71	-	107.39	158.10	194.96	224.65	253.56	281.70	-
400	406.40	42.41	48.26	62.64	77.83	93.27	-	93.27	123.30	160.12	-	123.30	203.53	245.56	286.64	333.19	365.35	-
450	457.20	47.77	54.36	70.57	87.71	122.38	-	105.16	155.80	205.74	-	139.15	254.55	309.62	363.56	408.26	459.37	-
500	508.00	60.46	70.00	78.55	117.15	155.12	-	117.15	183.42	247.83	-	155.12	311.17	381.53	441.49	508.11	564.81	-
550	558.80	66.57	77.06	86.54	129.13	171.09	-	129.13	-	294.25	-	171.09	373.83	451.42	527.02	600.63	627.26	-
600	609.60	84.16	96.37	94.53	141.12	209.64	-	141.12	255.41	355.26	-	187.06	442.08	547.71	640.03	720.15	808.22	-
650	660.40	-	-	127.36	202.72	-	-	152.87	-	-	-	202.72	-	-	-	-	-	-
700	711.20	-	-	137.32	218.69	271.21	-	164.85	-	-	-	218.69	-	-	-	-	-	-
750	762.00	120.72	150.36	147.28	234.67	292.18	-	176.84	-	-	-	234.67	-	-	-	-	-	-
800	812.80	-	-	157.24	250.64	312.15	-	188.82	342.91	-	-	250.64	-	-	-	-	-	-
850	863.60	-	-	167.20	266.61	332.12	-	200.31	364.90	-	-	266.61	-	-	-	-	-	-
900	914.40	-	-	176.96	282.27	351.70	-	212.56	420.42	-	-	282.27	-	-	-	-	-	-

CLASS 150 FLANGES (inches)

N.B	A	B	C	D	E	F	G	H	J	K	L	M*	N	O	P	R	T	No. of Holes
½	3.50	0.44	0.06	1.38	0.62	1.19	0.88	0.38	0.84	-	1.88	0.62	0.62	0.90	2.38	0.12	0.62	4
¾	3.88	0.50	0.06	1.69	0.62	1.50	1.09	0.44	1.05	-	2.06	0.62	0.62	1.11	2.75	0.12	0.62	4
1	4.25	0.56	0.06	2.00	0.69	1.94	1.36	0.50	1.32	-	2.19	0.69	0.69	1.38	3.12	0.12	0.62	4
1¼	4.62	0.62	0.06	2.50	0.81	2.31	1.70	0.56	1.66	-	2.25	0.81	0.81	1.72	3.50	0.19	0.62	4
1½	5.00	0.69	0.06	2.88	0.88	2.56	1.95	0.62	1.90	-	2.44	0.88	0.88	1.97	3.88	0.25	0.62	4
2	6.00	0.75	0.06	3.62	1.00	3.06	2.44	0.69	2.38	-	2.5	1.00	1.00	2.46	4.75	0.31	0.75	4
2½	7.00	0.88	0.06	4.12	1.12	3.56	2.94	0.75	2.88	-	2.75	1.12	1.12	2.97	5.50	0.31	0.75	4
3	7.50	0.94	0.06	5.00	1.19	4.25	3.57	0.81	3.50	-	2.75	1.19	1.19	3.60	6.00	0.38	0.75	4
3½	8.50	0.94	0.06	5.50	1.25	4.81	4.07	-	4.00	-	2.81	1.25	1.25	4.10	7.00	0.38	0.75	8
4	9.00	0.94	0.06	6.19	1.31	5.31	4.57	-	4.50	-	3.00	1.31	1.31	4.60	7.50	0.44	0.75	8
5	10.00	0.94	0.06	7.31	1.44	6.44	5.66	-	5.56	-	3.50	1.44	1.44	5.69	8.50	0.44	0.88	8
6	11.00	1.00	0.06	8.50	1.56	7.56	6.72	-	6.63	-	3.50	1.56	1.56	6.75	9.50	0.50	0.88	8
8	13.50	1.12	0.06	10.62	1.75	9.69	8.72	-	8.63	-	4.00	1.75	1.75	8.75	11.75	0.50	0.88	8
10	16.00	1.19	0.06	12.75	1.94	12.00	10.88	-	10.75	-	4.00	1.94	1.94	10.92	14.25	0.50	1.00	12
12	19.00	1.25	0.06	15.00	2.19	14.38	12.88	-	12.75	-	4.50	2.19	2.19	12.92	17.00	0.50	1.00	12
14	21.00	1.38	0.06	16.25	2.25	15.75	14.14	-	14.00	-	5.00	2.25	3.12	14.18	18.75	0.50	1.12	12
16	23.50	1.44	0.06	18.50	2.50	18.00	16.16	-	16.00	-	5.00	2.50	3.44	16.19	21.25	0.50	1.12	16
18	25.00	1.56	0.06	21.00	2.69	19.88	18.18	-	18.00	-	5.50	2.69	3.81	18.20	22.75	0.50	1.25	16
20	27.50	1.69	0.06	23.00	2.88	22.00	20.20	-	20.00	-	5.69	2.88	4.06	20.25	25.00	0.50	1.25	20
24	32.00	1.88	0.06	27.25	3.25	26.12	24.25	-	24.00	-	6.00	3.25	4.38	24.25	29.50	0.50	1.38	20

* Minimum length

CLASS 150 FLANGES (metric)

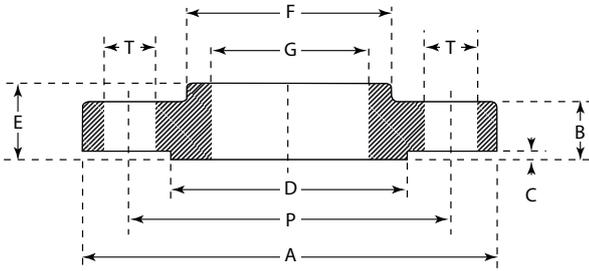
N.B	A	B	C	D	E	F	G	H	J	K	L	M*	N	O	P	R	T	No. of Holes
15	89	11.1	1.6	35	16	30	22.4	9.5	21.3	-	48	16	16	23.0	60.3	3.0	15.9	4
20	98	12.7	1.6	43	16	38	27.7	11.0	26.7	-	52	16	16	28.0	69.8	3.0	15.9	4
25	108	14.3	1.6	51	17	49	34.5	12.5	33.4	-	56	17	17	35.0	79.4	3.0	15.9	4
32	117	15.9	1.6	64	21	59	43.2	14.5	42.2	-	57	21	21	43.5	88.9	5.0	15.9	4
40	127	17.5	1.6	73	22	65	49.5	16.0	48.3	-	62	22	22	50.0	98.4	6.5	15.9	4
50	152	19.0	1.6	92	25	78	62.0	17.5	60.3	-	64	29	25	62.5	120.6	8.0	19.0	4
65	178	22.2	1.6	105	29	90	74.7	19.0	73.0	-	70	32	29	75.5	139.7	8.0	19.0	4
80	190	23.8	1.6	127	30	108	90.7	20.5	88.9	-	70	32	30	91.5	152.4	9.5	19.0	4
90	216	23.8	1.6	140	32	122	103.4	-	101.6	-	71	37	32	104.0	177.8	9.5	19.0	8
100	229	23.8	1.6	157	33	135	116.1	-	114.3	-	76	37	33	117.0	190.5	11.0	19.0	8
125	254	23.8	1.6	186	37	164	143.8	-	141.3	-	89	43	37	145.0	215.9	11.0	22.2	8
150	279	25.4	1.6	216	40	192	170.7	-	168.3	-	89	46	40	171.0	241.3	12.5	22.2	8
200	343	28.6	1.6	270	44	246	221.5	-	219.1	-	102	51	44	222.0	298.4	12.5	22.2	8
250	406	30.2	1.6	324	49	305	276.4	-	173.0	-	102	56	49	277.0	362.0	12.5	25.4	12
300	483	31.8	1.6	381	56	365	327.2	-	323.9	-	114	60	56	328.0	431.8	12.5	25.4	12
350	533	34.9	1.6	413	57	400	359.2	-	355.6	-	127	64	79	360.0	476.2	12.5	28.6	12
400	597	36.5	1.6	470	64	457	410.5	-	406.4	-	127	68	87	411.0	539.8	12.5	28.6	16
450	635	39.7	1.6	533	68	505	461.8	-	457.2	-	140	70	97	462.0	577.8	12.5	31.8	16
500	698	42.9	1.6	584	73	559	513.1	-	508.0	-	144	73	103	514.0	635.0	12.5	31.8	20
600	813	47.6	1.6	692	83	664	616.0	-	609.6	-	152	83	111	616.0	749.3	12.5	34.9	20

* Minimum length

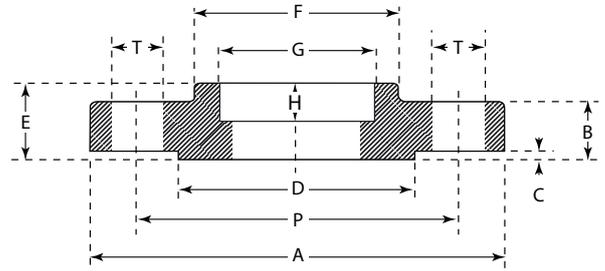


CLASS 150 FLANGES

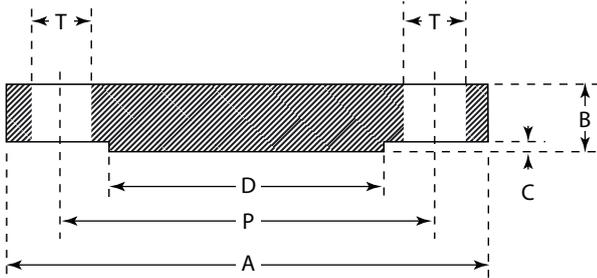
SLIP-ON



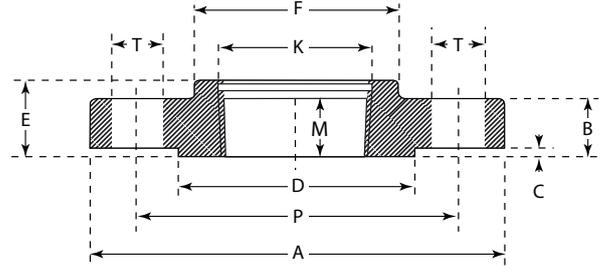
SOCKET WELD



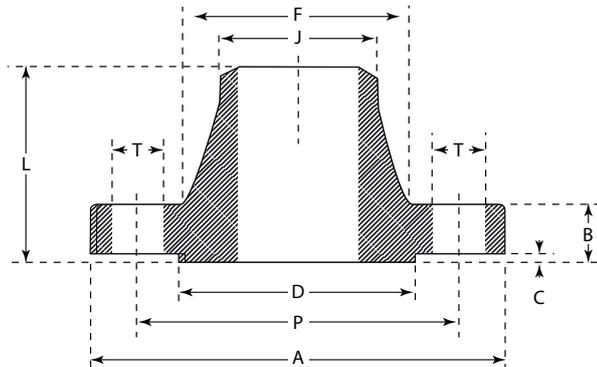
BLIND



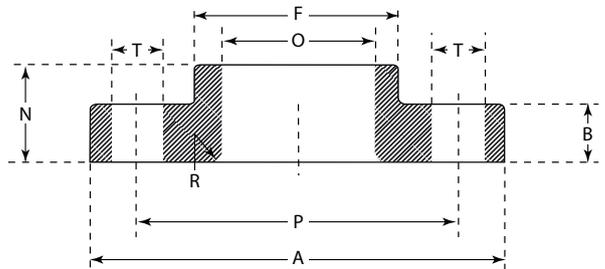
SCREWED



WELD NECK



LAPPED



AMERICAN SOCIETY OF TESTING MATERIALS SPECIFICATIONS

Abbreviations

ASA	-	American Standards Published by the Association
ASTM	-	American Society of Testing Materials
ASME	-	American Society of Mechanical Engineers
API	-	American Petroleum Institute
ASA B31.1	-	Code of Pressure Piping
ASA B31.3	-	Code for Pressure Piping: Petroleum Refinery Piping.
ASA B31.8	-	Gas Transmission and Distributing Piping Systems
API STD 5A	-	API Specification for Casing, Tubing and Drill Pipe.
API STD 5L	-	API Specification for Line Pipe
API STD 5LX	-	API Specification for High Test Line Pipe

DIMENSIONAL PIPE SPECIFICATIONS

ASA B36.10	-	Wrought Steel and Wrought-Iron Pipe
		covers diameters and wall thicknesses of pipe ¼" to 36" with the exception of Schedules 5S and 10S
ASA B36.19	-	Stainless Steel Pipe covers diameters and wall thicknesses of Stainless Steel pipe in Schedules 5S, 10S, 40S, and 80S in sizes " to 30".

ASTM-A161

This specification covers seamless, hot-finished and cold-drawn, low carbon and carbon-molybdenum steel still tubes, for use in carrying fluids at elevated temperatures and pressures in various types of heaters, in which the tubes may be subjected to a furnace temperature higher than that of the contained fluid.

ASTM-A178

This specification covers electric-resistance-welded tubes made of carbon steel and intended for use as boiler tubes, boiler flues, superheater flues, and safe ends and covers tubes ½ in. to 5 in. incl. (12.70 mm to 127.00 mm) in outside diameter and 0.035 in. to 0.320 in. incl. (0.89 mm to 8.13 mm) in minimum wall thickness.

ASTM-A179

Seamless Cold Drawn Low-Carbon Steel Heat Exchanger and Condenser Tubes. – in. to 3 in. inclusive (3.18 mm to 76.20 mm) in outside diameter and specifies minimum wall thickness.

ASTM-A199

This specification covers several grades of chromium-molybdenum and chromium-molybdenum-silicon seamless cold-drawn intermediate alloy steel tubes for heat exchanger, condensers and similar heat transfer apparatus and covers tubes in. to 3 in. incl. (3.18 mm to 76.20 mm) in outside diameter. Grade covered as in A199 are T3b-T4-T5-T7-T9-T11-T21-T22.

ASTM-A200

This specification covers several grades of chromium molybdenum and chromium-molybdenum-silicon seamless, hot-finished and cold-drawn, intermediate alloy steel still tubes, for use in carrying fluids at elevated temperatures and pressures in various types of heaters in which the tubes may be subjected to a furnace temperature higher than that of the contained fluid and covers tubes 2 in. to 9 in. inclusive (50.80 mm to 228.60 mm) in outside diameter and over 0.220 in. (5.59 mm) in minimum wall thickness.

ASTM-A209

This specification covers several grades of seamless carbon-molybdenum alloy-steel boiler and superheater tubes and covers ½ in. to 5 in. incl. (12.70 mm to 127.00 mm) in outside diameter and 0.035 in. to 0.500 in. inclusive (0.89 mm to 12.70 mm) in minimum wall thickness.

ASTM-A210

This specification covers seamless medium-carbon steel boiler tubes and boiler flues, including safe ends, arch and stay tubes, and superheater tubes, and covers tubes ½ in. to 5 in. incl. (12.70 mm to 127.00 mm) in outside diameter and 0.035 in. to 0.500 in. inclusive (0.89 mm to 12.70 mm) in minimum wall thickness.

ASTM-A213

Seamless Ferritic and Austenitic Alloy-Steel Boiler, Super-Heater and Heat Exchanger Tubes. ½ in. to 5 in. inclusive (12.70 mm to 127.00 mm) in outside diameter having wall thicknesses of 0.035 in. to 0.500 in. inclusive (0.89 mm to 12.70 mm) in minimum wall thickness. The steels covered include 12 grades of ferritic in the chromium-molybdenum range as well as a similar range of stainless steels as detailed in ASTM-A249 with the exception of TP305, TP309 and TP317.

ASTM-A249

Welded Austenitic Steel Boiler, Super-Heater, Heat Exchanger and Condenser Tubes ½ in. to 5 in. inclusive (12.70mm to 127.00mm) in outside diameter and 0.035 in. to 0.320 in. (0.89 mm to 8.13 mm) and specified minimum wall thickness. The grades covered by this specification include those listed under A269 plus additional grades such as TP304H, TP305, TP309, TP310, TP316H, TP321H, TP347H and TP348H. Specification lays down that subsequent to welding and final heat-treatment, the tube shall be cold-worked to ensure that optimum corrosion resistance in the welded area and base metal will be developed during heat treatment.

ASTM-a268

This specification covers eight grades of stainless steel tubing for general corrosion-resisting and high-temperature service. These grades are commonly known as the “straight-chromium” types and are characterized by being ferromagnetic. Two of these grades, TP410 and TP329, are amenable to hardening by heat treatment, and the high-chromium, ferritic alloys are sensitive to notch-brittleness on slow cooling to ordinary temperatures. These features should be recognised in the use of these materials. Grade T409 may be ordered with no final heat treatment provided certain requirements are met. Modification 1 of TP340 is used primarily for hot water tank service and does not require post weld heat treatment to prevent attack of the heat-affected zone.

ASTM-A269

Seamless and Welded Austenitic Stainless Steel Tubing for General Service, from ½ in. to 8 in. (3.18 mm to 203.20 mm) O.D. and specific average wall thickness. This specification covers grades of stainless steel tubing for general corrosion resistance and low or high temperature service in the following grades:
TP304-TP304L-TP316-TP316L-TP317-TP321-TP347-TP348.

ASTM-A270

This specification covers a grade of seamless and welded austenitic stainless steel sanitary tubing intended for use in the dairy and food industry and having special surface finishes and covers tubes in sizes up to and including 4 in. (101.60 mm) in outside diameter.

ASTM-A271

This specification covers grades of seamless, hot-finished and cold finished, austenitic chromium-nickel steel still tubes for use in carrying fluids at elevated temperatures and pressures in various types of heaters, in which the tubes may be subjected to a furnace temperature higher than that of the contained fluid. The specification covers tubes 2 to 9 in. inc. (50.80 to 228.60 mm) in outside diameter and over 0.220 in. (5.59 mm) in minimum wall thickness.

ASTM-A312

This specification covers seamless and welded austenitic steel pipe intended for high-temperature and general corrosive service. Sixteen grades are covered. The grades of austenitic stainless steel pipe furnished in accordance with this specification have been found suitable for low-temperature service down to -325°F (-198°C), where Charpy notched bar impact values of 15 ft-lb (2.07 m-kj), minimum, are required, and need not be impact-tested.

ASTM-A333

This specification covers nominal (average) wall seamless and welded carbon and alloy steel pipe intended for use at low temperatures. All Pipe furnished under this specification must be tested for impact resistance at the minimum temperature ranging from -50°F (-46°C) for Grade 1. to -100°F (-73°C) for Grade 9.

ASTM-A334

This specification covers several grades of seamless and welded carbon and alloy-steel tubes intended for use at low temperatures.

ASTM-A335

This specification covers nominal (average) wall seamless alloy-steel pipe intended for high-temperature service. Pipe ordered to this specification shall be suitable for bending, flanging (van-stoning), and similar forming operations, and for fusion welding. Selection will depend upon design, service conditions, mechanical properties, and high temperature characteristics.

Grades covered:

P1-P2-P5-P5b-P5c-P7-P9-P11-P12-P15-P21-P22

ASTM-A358

This specification covers electric fusion-welded austenitic chromium-nickel alloy steel pipe suitable for corrosive or high-temperature service, or both. Commercial practice is commonly limited to sizes not less than 8 in. (203 mm) nominal diameter and covers seven grades of alloy steel.

ASTM-A376

This specification covers seamless austenitic steel pipe intended for high-temperature and central station service. Among the ten grades covered are five H grades which are specifically intended for high-temperature service.

ASTM-A312

This specification covers seamless and welded austenitic steel pipe intended for high-temperature and general corrosive service. Sixteen grades are covered. The grades of austenitic stainless steel pipe furnished in accordance with this specification have been found suitable for low-temperature service down to -325°F (-198°C), where Charpy notched bar impact values of 15 ft-lb (2.07 m-kj), minimum, are required, and need not be impact-tested.

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ASTM-A334

This specification covers several grades of seamless and welded carbon and alloy-steel tubes intended for use at low temperatures.

ASTM-A335

This specification covers nominal (average) wall seamless alloy-steel pipe intended for high-temperature service. Pipe ordered to this specification shall be suitable for bending, flanging (van-stoning), and similar forming operations, and for fusion welding. Selection will depend upon design, service conditions, mechanical properties, and high temperature characteristics.

Grades covered:

P1-P2-P5-P5b-P5c-P7-P9-P11-P12-P15-P21-P22

ASTM-A358

This specification covers electric fusion-welded austenitic chromium-nickel alloy steel pipe suitable for corrosive or high-temperature service, or both.

Commercial practice is commonly limited to sizes not less than 8 in. (203 mm) nominal diameter and covers seven grades of alloy steel.

ASTM-A376

This specification covers seamless austenitic steel pipe intended for high-temperature and central station service. Among the ten grades covered are five H grades which are specifically intended for high-temperature service.

ASTM-A381

This specification covers straight seam, double submerged-arc-welded steel pipe suitable for high-pressure transmission service, 16 in. (406 mm) to 42 in. (1077 mm), incl., in outside diameter, with wall thicknesses 5/16 in. to 1½ in. (7.9 to 38mm) incl. The pipe is intended for carrying liquid, gas or vapor. Pipe shall be suitable for bending, flanging (van-stoning), corrugating, and similar operations.

ASTM-A498

SEAMLESS AND WELDED CARBON, FERRITIC, AND AUSTENITIC ALLOY STEEL HEAT-EXCHANGER TUBES WITH INTEGRAL FINNS

This specification covers external helical, integral finned, Seamless or welded low-carbon steel, alloy steel, and stainless steel tubes for use in tubular heat exchangers, surface condensers, evaporators, super-heaters, and similar heat-transfer apparatus in unfinned end diameter up to 2 in. inclusive. The finned tubes shall be manufactured from plain tubes which conform to one of the following specifications of the American Society for Testing and Materials: A179-A199-A213-A214-A249-A334.

ASTM-A511

SEAMLESS STAINLESS STEEL MECHANICAL TUBING

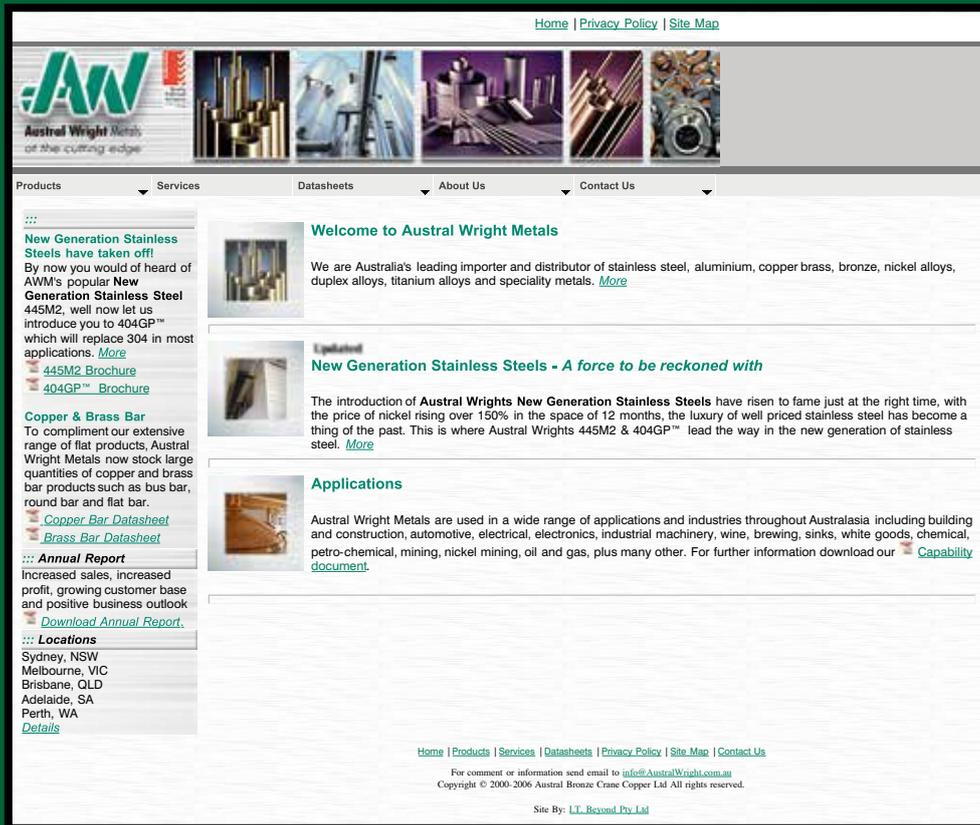
This specification covers seamless stainless tubing for use in mechanical applications where corrosion resistant or high temperature strength is needed. This specification covers seamless cold-finished mechanical tubing and seamless hot-finished mechanical tubing in sizes up to 12¾ in. (323.85mm) in outside diameter (for round tubing) with wall thickness as required.

ASTM-A554

This specification covers welded stainless steel tubing for mechanical applications where appearance, mechanical properties or corrosion resistance is needed and covers as-welded or cold-reduced mechanical tubing in sizes to 16in. (406.40mm) outside diameter, incl. (for round tubing) and in wall thicknesses 0.020 in. (0.51mm) and over.

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