

Pipe and Tube



SEAMLESS AND WELDED PIPE – Is available throughout Prochem in accordance with material specification ASTM A312 and dimensional specifications ANSI/ASME B36.10 M ANSI/ASME B36.19 M.

Comprehensive stocks of seamless and welded pipe includes 6NB ($\frac{1}{8}$ "") to 400NB (16") in SCH 10S and SCH 40S. Seamless pipe is also available ex-stock in heavier schedules such as SCH 80S, SCH 160 and XXS.

Larger sizes of both seamless and welded pipe are readily available through our worldwide network of suppliers. All pipe is fully traceable and available in 6m lengths.

SEAMLESS TUBE – Prochem leads the field in the supply of high quality instrument tube which is stocked throughout Australia specifically for use with compression fittings. The tube is dual graded, 316/316L and dual specified A269/A213 to not only cover instrumentation applications, but boiler, superheater and heat exchanger applications as well. All tube in sizes 4.76mm ($\frac{3}{16}$ "") to 25.40mm (1") OD inclusive are dual specified, contain 2.5% minimum molybdenum to provide maximum corrosion protection and are produced to a maximum hardness of RB 80.

Sizes from 1" through 2" are supplied to ASTM A269 TP-316. High quality seamless tube from Prochem is fully certifiable and available in standard 6m lengths although $\frac{1}{8}$ " OD tube is supplied in coils. Other sizes may be supplied in coils if required.

WELDED TUBE – Prochem stock welded tube in a variety of finishes to suit market needs. These include "as welded", "as welded polished", "welded bright annealed", "welded annealed polished", and others on request. Our standard size range covers 12.7mm ($\frac{1}{2}$ "") through 152.4mm (6") OD in 1.6mm WT (16 SWG) and 203.2mm (8") OD in 2.00mm WT (14 SWG).

Materials in stock include 304 and 316 stainless steel to ASTM A269, ASTM A554 and AS1528.1-2001 as standard stock, with other grades, standards or sizes available on request.

HEAT EXCHANGER TUBE – Through our extensive network of overseas suppliers, Prochem offers a comprehensive selection of heat exchanger and condenser tubes in a range of stainless and special alloys.

Whether you require finned tube, u-tube or straight tube, please give us a call. We will be pleased to source your requirements.

Pipe and Tube

COMMON PIPE AND TUBE TERMS USED IN THE AUSTRALIAN INDUSTRY

TUBE: Tube is usually defined by an outside dimension "OD" and a wall thickness.

SECTION TUBE: Section tubing is initially rolled and welded as round tube and then rolled or drawn to its new non-circular cross section. Typical forms are square, rectangular and oval. Many other forms are available. Section tubing is used extensively in architectural and structural applications.

PIPE: Pipe can be defined by nominal pipe size (NPS) under American standards classifications. Alternatively nominal bore (NB) may be specified under British standards classifications along with a schedule (wall thickness). In Australia these terms are usually mixed, with all stock being available to the American system, although enquiries are usually made under the British system, i.e. 50NB schedule 40s pipe, rather than 50NPS Pipe. It should also be noted there are dimensional differences between the American and the British systems. Under the American system size 65 pipe measures 73 mm O.D and under the British system it measures 76.2 mm O.D. European and Japanese manufacturers may define the pipe by its actual outside diameter and wall thickness, in mm, rather than by nominal size and schedule.

AS WELDED (A.W.): Tubing produced directly off a continuous tube welding mill.

AS WELDED ANNEALED (A.W.A.): Tubing produced in the same process as for 'As-Welded' but annealed as a final operation.

COLD WORKED (C.W.) AND COLD WORKED ANNEALED (C.W.A.): Cold Worked tubing is produced in the same process as for 'As-Welded' and then the weld area is subjected to a mechanical cold working process for removal of the weld bead to produce a smooth internal surface. An annealing process is then performed to produce Cold Worked Annealed tube.

WELDED DRAWN (W.D.) AND WELDED DRAWN ANNEALED (W.D.A.): Welded Drawn tube is produced under AWA or CWA conditions and then redrawn through sizing dies and mandrels to achieve close tolerances on outside diameter and wall thickness. An annealing process is then performed to produce Welded Drawn Annealed tube.

ANNEALED: The tube is subjected to heat treatment by either an 'oxygen enriched' furnace or by Bright Annealing in a 'controlled atmosphere' furnace.

POLISHING: Usually for tubing where the quality of the surface finish of the tubing is to be improved. This can be achieved by the use of an abrasive sanding belt or by electropolishing the tube surface. A variety of surface finishes are available e.g. hairline, buff or mirror. Either of the internal or external surfaces can be polished, but external polishing is the more common, being used for many decorative applications.

PASSIVATING: The stainless steel is treated by immersion in a dilute solution of acid, which has the effect of eliminating many types of surface contamination which may cause discolouration or superficial corrosive attack in service. A solution of nitric acid in water is widely used. The removal of residues such as particles of steel from cutting tools from the surface permits the material to re-generate its invisible, protective oxide film as a continuous permanent covering.

PICKLING: The material is immersed in an acid solution for the purpose of removing the oxide scale which is formed after annealing or heat treatment in an 'oxygen enriched environment furnace'. A mixture of nitric and hydrofluoric acid in water is widely used. Where tenacious oxides are present, sulphuric acid can be used to soften the scale prior to dipping the material in the nitric/hydrofluoric acid bath.

Manufacturing Methods

Pipes and tubes are manufactured by either the seamless or welded process. These processes can be broken down into a number of manufacturing subgroups.

SEAMLESS MANUFACTURING PROCESSES

Hot Finished

Prior to extrusion, a short round billet is pierced or bored to form a hollow billet. The billet is then heated and a mandrel is pushed through. The mandrel is then concentrically positioned to a circular die. Elongation is carried out by squeezing the billet through the annular space formed by the die and the mandrel. Elongation of the material then takes place to attain the required dimensions.

Cold Finished

Stainless steel pipe and tube made by the hot finishing process may have some limitations which might create the need for further cold finishing operations. Cold finishing is desirable to achieve:

- (i) closer tolerances of material,
- (ii) cleaner and smoother surfaces,
- (iii) more readily controlled mechanical properties,
- (iv) a far greater range of sizes, particularly small diameters and thin wall thicknesses,
- (v) an almost limitless range of non-circular shapes.

Cold finishing is obtained by drawing a tube with larger outside diameter and wall thickness than the finished product through an external sizing die. The internal size can be controlled by the use of a plug or mandrel.

Centrifugal Cast

The cast tube or pipe is formed by centrifugal force generated as the metal becomes entrained on the inside of a spinning cylindrical metal mould. This gives a tubular casting with the outside diameter and length determined by the mould size and the inside diameter determined by the amount of metal poured. Centrifugal cast materials come in a range of sizes and these are generally limited to a minimum of 65 mm OD and a maximum of 650 mm OD. Lengths to 5 metres are available although 2-4 metres is more common.

Forged and Bored

An ingot or bloom is forged and brought as nearly as practicable to the finished size and shape by hot working. The material is adequately worked under a tool of sufficient capacity to refine the structure in the wall of the finished pipe. After heat treatment the inside and outside diameters are machined to final size.

WELDED MANUFACTURING PROCESSES

Continuously Longitudinal Welded

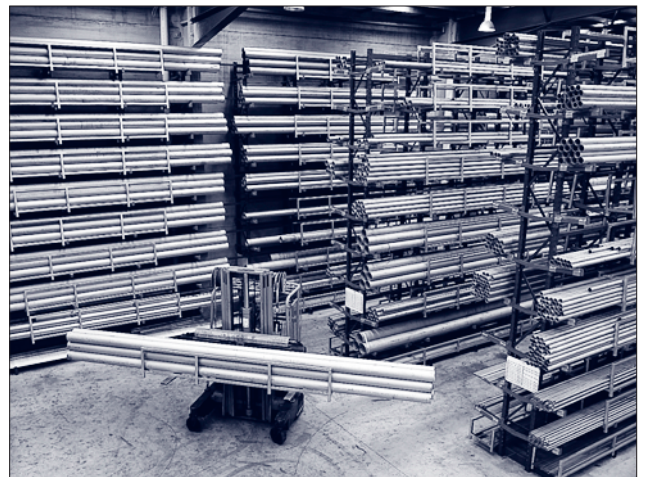
A coil of stainless steel strip is fed into the tube mill. The strip passes through forming rolls which progressively form the material ready for welding. The welding process is then carried out, usually tungsten inert gas (TIG). The product passes under a sanding belt which removes the weld bead on the outside diameter. The product can then be subjected to the proper post-weld treatment to bring it to specification.

Fabricated Welded

This method utilises sheets or plates of the required thickness and developed width, to manufacture the pipe or tube. The plate is pressed into shape with a press brake, which is equipped with the appropriate tooling. Following the forming operation the product is fed through a series of rolls to ensure the correct cross sectional form during the welding operation which follows. After welding, the product can be subjected to the proper post-weld treatment required to bring it to specification.

Spirally Welded

Spirally welded tube is produced by driving coil strip from a de-coiler, through drive rollers, and into a cylindrical former (or shoe), at a pre-determined angle. The edges of the resulting "spring-like" profile are arc welded as they feed past a fixed welding torch. This process is particularly suitable for making large diameter tubes, with relatively thin wall thicknesses, to close tolerances of straightness and ovality.



Information obtained from the Australian Stainless Steel Development Association.

PIPE DIMENSIONS & WEIGHTS

AMERICAN NATIONAL STANDARD STAINLESS STEEL PIPE

inches mm		Wall thickness in mm		Theoretical inside diameter in mm		Weight in kg/m	
Nominal Bore	Outside Diameter	5S	10S	40S	80S	160	XXS
6	10.3		1.24	1.73	2.41		
1/8	0.405		7.82	6.84	5.48		
			0.28	0.37	0.47		
8	13.7		1.65	2.24	3.02		
1/4	0.540		10.40	9.22	7.66		
			0.49	0.63	0.80		
10	17.1		1.65	2.31	3.2		
3/8	0.675		13.80	12.48	10.70		
			0.63	0.84	1.10		
15	21.34	1.65	2.11	2.77	3.73	4.78	7.47
1/2	0.840	18.04	17.12	15.80	13.88	11.78	6.40
		0.80	1.00	1.27	1.62	1.95	2.55
20	26.7	1.65	2.11	2.87	3.91	5.56	7.82
3/4	1.050	23.40	22.48	20.96	18.88	15.58	11.06
		1.03	1.28	1.69	2.20	2.90	3.64
25	33.4	1.65	2.77	3.38	4.55	6.35	9.09
1	1.315	30.10	27.86	26.64	24.30	20.70	15.22
		1.30	2.09	2.50	3.24	4.24	5.45
32	42.2	1.65	2.77	3.56	4.85	6.35	9.790
1-1/4	1.660	38.90	36.66	35.08	32.50	29.50	22.80
		1.65	2.70	3.39	4.47	5.61	7.77
40	48.2	1.65	2.77	3.68	5.08	7.14	10.15
1-1/2	1.900	44.90	42.66	40.84	38.04	33.92	27.90
		1.91	3.11	4.05	5.41	7.25	9.56
50	60.3	1.65	2.77	3.91	5.54	8.74	11.07
2	2.375	57.00	54.76	52.48	49.22	42.82	38.16
		2.40	3.93	5.44	7.48	11.11	13.44
65	73.0	2.11	3.05	5.16	7.01	9.53	14.02
2-1/2	2.875	68.78	66.90	62.68	58.98	53.94	44.96
		3.69	5.26	8.63	11.41	14.92	20.39
80	88.9	2.11	3.05	5.49	7.62	11.13	15.24
3	3.500	84.68	82.80	77.92	73.66	66.64	58.42
		4.51	6.45	11.29	15.27	21.35	27.68
90	101.6	2.11	3.05	5.74	8.08		
3-1/2	4.000	97.38	95.50	90.12	85.44		
		5.18	7.40	13.57	18.63		
100	114.3	2.11	3.05	6.02	8.56	13.49	
4	4.500	110.08	108.20	102.26	97.18	87.32	
		5.84	8.36	16.07	22.32	33.54	
125	141.3	2.77	3.40	6.55	9.53		
5	5.563	135.76	134.50	128.20	122.24		
		9.47	11.57	21.77	30.97		
150	168.3	2.77	3.40	7.11	10.97		
6	6.625	162.76	161.50	154.08	146.36		
		11.32	13.84	28.26	42.56		
200	219.1	2.77	3.76	8.18	12.70		
8	8.625	213.56	211.58	202.74	193.70		
		14.79	19.96	42.55	64.64		
250	273.1	3.40	4.19	9.27	12.70		
10	10.750	266.30	264.72	254.56	247.70		
		22.63	27.78	60.31	96.01		
300	323.9	3.96	4.57	9.53	12.70		
12	12.750	315.98	314.76	304.84	298.50		
		31.25	36.00	73.88	132.08		
350	355.6	3.96	4.78				
14	14.000	347.68	346.04				
		34.36	41.30				
400	406.4	4.19	4.78				
16	16.000	398.02	396.84				
		41.56	47.29				
450	457.0	4.19	4.78				
18	18.000	448.62	447.44				
		46.81	53.26				
500	508.0	4.78	5.54				
20	20.000	498.44	496.92				
		59.25	68.61				
550	559.0	4.78	5.54				
22	22.000	549.44	547.92				
		65.24	75.53				
600	610.0	5.54	6.35				
24	24.000	598.92	597.30				
		82.47	94.45				
750	762.0	6.35	7.92				
30	30.000	749.30	746.16				
		118.31	147.36				

Dimensions according to ANSI/ASME B36. 19 for Stainless Steel Pipe.
 Dimensions according to ANSI/ASME B36. 10 for Welded and Seamless Wrought Steel Pipe.
 Weights are given in kilograms per meter and are for carbon steel pipe with plain ends. The different grades of stainless steel permit considerable variations in weight. The austenitic stainless steels may be about 2% greater, and the ferritic stainless steels about 5% less than the values shown in the table.

TUBE WEIGHTS & WORKING PRESSURES MPA & PSI

Approximate Weight and Theoretical Working Pressure for Seamless Tube

TUBE O.D.		TUBE WALL THICKNESS									
O.D. mm	O.D. inch	0.45 mm 26 SWG	0.51 mm 25 SWG	0.61 mm 23 SWG	0.71 mm 22 SWG	0.91 mm 20 SWG	1.22 mm 18 SWG	1.63 mm 16 SWG	2.10 mm 14 SWG	2.64 mm 12 SWG	3.25 mm 10 SWG
3.18	1/8	0.030	0.034	0.039	0.043	0.051					
		36.70	42.20	51.71	61.71	83.29					
		5324	6120	7500	8950	12080					
4.76	3/16	0.034	0.053	0.073	0.093	0.113					
		23.68	27.09	32.91	38.91	51.51					
		3435	3929	4773	5644	7471					
6.35	1/4	0.065	0.073	0.086	0.099	0.122	0.154	0.190			
		17.45	19.91	24.09	28.37	37.22	51.80	72.90			
		2531	2888	3494	4114	5399	7514	10573			
7.94	5/16	0.083	0.093	0.110	0.127	0.158	0.202	0.254			
		13.82	15.74	19.00	22.32	29.14	40.22	55.93			
		2004	2284	2756	3237	4226	5834	8112			
9.53	3/8	0.101	0.113	0.134	0.154	0.193	0.250	0.318			
		11.44	13.02	15.69	18.40	23.94	32.87	45.37			
		1659	1888	2275	2668	3472	4768	6581			
12.70	1/2	0.136	0.153	0.182	0.210	0.265	0.345	0.445	0.549		
		8.51	9.68	11.64	13.62	17.66	24.09	32.96	43.67		
		1234	1404	1688	1976	2561	3494	4781	6334		
15.88	5/8		0.193	0.230	0.266	0.336	0.441	0.573	0.714		
			8.16	9.81	11.47	14.84	20.18	27.51	36.28		
			1184	1422	1663	2152	2928	3990	5262		
19.05	3/4		0.233	0.277	0.321	0.407	0.536	0.700	0.878	1.068	1.266
			6.78	8.14	9.51	12.28	16.66	22.63	29.72	38.21	48.27
			983	1180	1379	1781	2417	3283	4311	5542	7002
22.23	7/8		0.273	0.325	0.377	0.478	0.632	0.828	1.042	1.275	1.521
			5.79	6.95	8.11	10.47	14.18	19.21	25.16	32.23	40.56
			840	1008	1177	1518	2057	2787	3649	4675	5882
25.40	1		0.313	0.373	0.432	0.550	0.727	0.955	1.207	1.482	1.775
			5.06	6.07	7.08	9.13	12.35	16.70	21.82	27.88	34.98
			733	880	1027	1324	1791	2422	3165	4044	5074
28.58	1-1/8				0.488	0.621	0.823	1.083	1.371	1.689	2.030
					6.28	8.09	10.93	14.76	19.26	24.56	30.74
					911	1173	1585	2141	2793	3562	4459
31.75	1-1/4				0.543	0.692	0.919	1.211	1.535	1.895	2.284
					5.64	7.26	9.81	13.23	17.24	21.95	27.43
					818	1054	1423	1919	2500	3184	3978
38.10	1-1/2					0.835	1.110	1.466	1.864	2.309	2.793
						6.03	8.14	10.96	14.25	18.10	22.56
						875	1180	1589	2066	2625	3272
44.45	1-3/4					0.977	1.301	1.721	2.193	2.722	3.302
						5.16	6.95	9.35	12.14	15.40	19.16
						748	1008	1356	1761	2234	2778
50.80	2					1.120	1.492	1.976	2.522	3.135	3.811
						4.50	6.07	8.15	10.58	13.40	16.65
						653	880	1182	1534	1944	2414
63.50	2-1/2						1.874	2.487	3.180	3.962	4.829
							4.84	6.49	8.41	10.64	13.19
							701	941	1220	1543	1913
76.20	3						2.256	2.997	3.837	4.789	5.847
							4.02	5.39	6.98	8.82	10.92
							583	782	1012	1279	1584
88.90	3-1/2							3.508	4.495	5.616	6.864
								4.61	5.96	7.53	9.32
								669	865	1092	1352
101.60	4							4.018	5.153	6.443	7.882
								4.03	5.21	6.57	8.13
								584	755	953	1179
127.00	5							5.039	6.468	8.096	9.918
								3.22	4.15	5.24	6.47
								466	602	760	939
152.40	6							6.060	7.783	9.750	11.954
								2.68	3.45	4.35	5.38
								388	501	631	780
203.20	8							8.102	10.414	13.057	16.025
								2.00	2.58	3.26	4.02
								290	375	472	582

1. Figures shown in shaded are the **THEORETICAL WEIGHT** of tube, calculated using the nominal outside diameter and wall thickness as in the formula:

$$W = C(d-t)t \quad \text{Where: } W = \text{Weight (kg/m)} \quad C = 0.02466$$

$$d = \text{Specified O.D. (mm)} \quad t = \text{Specified W.T. (mm)}$$

2. Figures shown are the **THEORETICAL WORKING PRESSURE (MPa)** of Grade 316, 304 and 321 seamless tube, calculated using the ASME B31.3 formula.
Where $P = \frac{2tSE}{D-2tY}$ $P = \text{Internal gauge pressure; } S = \text{Stress value for material (ie: 137.89 MPa); } E = \text{Quality factor} = 1; D = \text{Outside Diameter of the tube;}$
 $Y = \text{Coefficient} = 0.4; t = \text{Wall Thickness (Where 'D' is 3.18 to 12.7 inclusive, } t \times 0.85 \text{ and 'D'} > 12.7, t \times 0.9 \text{ to make allowances for}$
 $\text{Wall Thickness Tolerance allowable in accordance with Standard ASTM A269}$

3. Figures shown are the **THEORETICAL WORKING PRESSURE (PSI)** of Grade 316, 304, and 321 seamless tube, calculated using the ASME B31.3 formula.
Where $P = \frac{2tSE}{D-2tY}$ $P = \text{Internal gauge pressure; } S = \text{Stress value for material (ie: 20000 PSI); } E = \text{Quality factor} = 1; D = \text{Outside Diameter of the Tube;}$
 $Y = \text{Coefficient} = 0.4; t = \text{Wall Thickness (Where 'D' is 3.18 to 12.7 inclusive, } t \times 0.85 \text{ and 'D'} > 12.7, t \times 0.9 \text{ to make allowances for}$
 $\text{Wall Thickness Tolerance allowable in accordance with the Standard ASTM A269}$