

sales@titanium.com
+1-888-482-6486
www.titanium.com



Industrial Market Resource Booklet

Pipe and Fittings | Mill Products

Specialty Metals Supply Solutions

Titanium Industries Inc.

Global Metal Supply & Distribution Company

For over 45 years, our team has been dedicated to reliability and complete quality control with a deep commitment to customer service that consistently exceeds expectations.

With strategically positioned inventory across our global service center network Titanium Industries is uniquely designed to process and deliver your supply solutions quickly.

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Titanium Industries, Inc.

Titanium Industries, Incorporated
Corporate Headquarters
18 Green Pond Avenue
Rockaway, New Jersey 07866, USA
T: (973) 983-1185
F: (973) 983 8015
E: sales@titanium.com

www.titanium.com

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Specialty Metals Supply Solutions

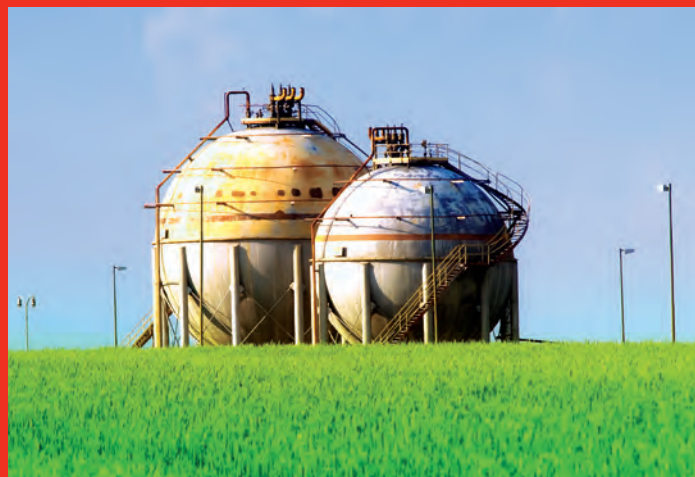


At **Titanium Industries** (T.I.), we utilize our global resources and capabilities on the entire industrial marketplace. We provide specialty metals for critical applications in chemical processing, marine, defense, power generation, pulp & paper, desalinization, automotive, motorsports, consumer products, and many other markets.

T.I. has achieved an extensive range of OEM and subcontractor approvals and accreditations, boasts a strong service portfolio of provider LTA's, ISO 9001:2015 certified, and DOD registered.

We implement global service center inventories with guaranteed quality at competitive prices, utilize the best distribution available, and employ exceptional customer service to all levels of the industrial global supply network.

As a financially stable, privately held business, Titanium Industries is uniquely qualified to be your specialty metals supply solution. With strategic decision making abilities and long-term growth as our focus, T.I. stands ready to partner with you and support your global project requirements.





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1 Industrial Product Line Card

Industrial Alloys

Titanium Alloys

- Grade 1, 2, 3, 4
- Grade 7, 12
- 6Al-4V
- 6Al-4V STA
- 6Al-4V ELI
- 6Al-6V-2Sn
- 6Al-2Sn-4Zr-2Mo
- 6Al-2Sn-4Zr-6Mo
- 7Al-4Mo

Nickel Alloys

- 625
- 718
- 718 STA
- ATI® S-240™
- Monel™
- Nitronic Alloys™
- Waspaloy™

Stainless Steels

- 13-8
- 15-5
- 17-4PH

Ready to add new alloys and products upon request



Holding a wide range of OEM and Tier 1 approvals

T.I. is the global leader in specialty metals supply for the industrial, aerospace, medical and oil & gas markets. Holding the world's most complete inventory of specialty metals across a global service center network, T.I. delivers supply solutions at all levels of sophistication and complexity. With a globally experienced and technically driven team, T.I. has been providing dependable, quality driven service to our customers since 1972.

FIRST STAGE PROCESSING CAPABILITIES

- | | |
|--------------------|-------------------|
| Saw Cutting | Trepanning |
| Shearing | Machining |
| Waterjet Cutting | Heat Treatment |
| Custom Stocking | Chamfering |
| Precision Grinding | Materials Testing |

SAVINGS AND SUPPLY ASSURANCE

- Just In Time 24/7 Delivery
- Cut to Size Nesting Optimization
- Value Pricing
- Commodity Hedging
- Scrap Revert/Tolling
- Conversion Programs
- Demand & Forecast Integration
- Risk Mitigation

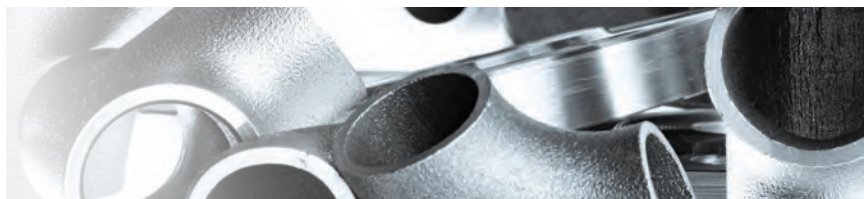
Product Forms IN STOCK FOR IMMEDIATE 24/7 DELIVERY

Mill Products:

- | | |
|--------------|----------------|
| Round Bar | Rectangle Bar |
| Hollow Bar | Plate |
| Hex Bar | Sheet |
| Coil | Block |
| Billet/Ingot | Expanded Metal |
| Weld Wire | |

Pipe and Fittings:

- | | |
|----------------------|-------------------------------|
| Welded/Seamless Pipe | Concentric/Eccentric Reducers |
| Welded/Seamless Tube | Tees |
| Stub Ends | Elliptical/Machined Pipe Caps |
| Flanges | Elbows |



Global Locations Strategically placed to serve the global marketplace

CORPORATE HQ

NJ - Rockaway..... (+1) (973) 983-1185
sales@titanium.com

NORTH AMERICA

CA - Garden Grove..... (+1) (562) 906-8188
sales-losangeles@titanium.com
CT - Tolland..... (+1) (860) 870-3939
sales-hartford@titanium.com
FL - Jacksonville (+1) (904) 288-8300
sales-jacksonville@titanium.com
IL - Naperville..... (+1) (630) 499-9140
sales-chicago@titanium.com
MI - Plymouth..... (+1) (734) 335-2805
sales-michigan@titanium.com
TX - Hillsboro (+1) (254) 580-2849
sales-houston@titanium.com
TX - Houston..... (+1) (713) 256-7201
sales-houston@titanium.com
WA - Woodinville..... (+1) (206) 271-6555
sales-seattle@titanium.com
Canada - Montreal..... (+1) (514) 334-6727
sales-montreal@titanium.com

SOUTH AMERICA

Brazil - Sao Paulo..... (+55) 11 2814 7509
sales-saopaulo@titanium.com

EUROPE

UK - Birmingham (+44) (0) 121 782 9708
sales-birmingham@titanium.com
Germany - Meerbusch (+49) 2132 5100 040
sales-germany@titanium.com
Italy - Verona..... (+39) 045 259 0232
sales-europe@titanium.com

ASIA

China - Shanghai..... (+86) 21 5866 5266
sales-shanghai@titanium.com
Taiwan - Taipei..... (+886) 2 2298 9668
sales-taipei@titanium.com

We are a privately held business with a long-term growth plan and quick decisions making processes. T.I. stands ready to support your global objectives.

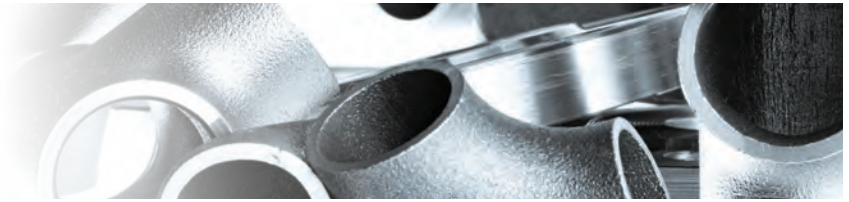


Holding a wide range of OEM and Tier 1 approvals



Please contact your local representative for an immediate quote

Toll free number: 1-888-482-6486



2.1 Titanium Pipe Dimensions

ANSI/ASME B36.19-1985M (for S sizes) B36.10M (for non S sizes)

NPS	O.D.	5	5-S	10	10-S	40	40-S	80	80-S
1/8	0.405			0.049	0.049	0.068	0.068	0.095	0.095
				0.107	0.107	0.141	0.141	0.181	0.181
1/4	0.540			0.065	0.065	0.088	0.088	0.119	0.119
				0.190	0.190	0.244	0.244	0.308	0.308
3/8	0.675			0.065	0.065	0.091	0.091	0.126	0.126
				0.244	0.244	0.327	0.327	0.425	0.425
1/2	0.840	0.065	0.065	0.083	0.083	0.109	0.109	0.147	0.147
		0.310	0.310	0.386	0.386	0.490	0.490	0.626	0.626
3/4	1.050	0.065	0.065	0.083	0.083	0.113	0.113	0.154	0.154
		0.393	0.393	0.493	0.493	0.651	0.651	0.848	0.848
1	1.315	0.065	0.065	0.109	0.109	0.133	0.133	0.179	0.179
		0.499	0.499	0.808	0.808	0.966	0.966	1.250	1.250
1-1/4	1.660	0.065	0.065	0.109	0.109	0.140	0.140	0.191	0.191
		0.637	0.637	1.039	1.039	1.308	1.308	1.724	1.724
1-1/2	1.900	0.065	0.065	0.109	0.109	0.145	0.145	0.200	0.200
		0.733	0.733	1.200	1.200	1.564	1.564	2.089	2.089
2	2.375	0.065	0.065	0.109	0.109	0.154	0.154	0.218	0.218
		0.923	0.923	1.518	1.518	2.102	2.102	2.890	2.890
2-1/2	2.875	0.083	0.083	0.120	0.120	0.203	0.203	0.276	0.276
		1.743	1.743	2.032	2.032	3.333	3.333	4.408	4.408
3	3.500	0.083	0.083	0.120	0.120	0.216	0.216	0.300	0.300
		1.743	1.743	2.492	2.492	4.359	4.359	5.899	5.899
3-1/2	4.000	0.083	0.083	0.120	0.120	0.226	0.226	0.318	0.318
		1.998	1.998	2.861	2.861	5.241	5.241	7.195	7.195
4	4.500	0.083	0.083	0.120	0.120	0.237	0.237	0.337	0.337
		2.253	2.253	3.230	3.230	6.208	6.208	8.621	8.621
5	5.563	0.109	0.109	0.134	0.134	0.258	0.258	0.375	0.375
		3.653	3.653	4.470	4.470	8.411	8.411	11.955	11.955
6	6.625	0.109	0.109	0.134	0.134	0.280	0.280	0.432	0.432
		4.364	4.364	5.345	5.345	10.917	10.917	16.440	16.440
8	8.625	0.109	0.109	0.148	0.148	0.322	0.322	0.500	0.500
		4.364	4.364	7.709	7.709	16.429	16.429	24.964	24.964
10	10.750	0.134	0.134	0.165	0.165	0.365	0.365	0.594	*0.500
		8.741	8.741	10.732	10.732	23.293	23.293	37.012	31.493
12	12.750	0.156	0.156	0.180	0.180	0.406	0.375	0.688	*0.500
		12.073	12.073	13.904	13.904	30.796	28.516	50.925	37.638
14	14.000	0.156	0.156	0.250	*0.188	0.438	*0.375	0.750	*0.500
		13.271	13.271	21.123	15.956	36.421	31.397	61.065	41.478
16	16.000	0.165	0.165	0.250	*0.188	0.500	*0.375	0.844	*0.500
		16.055	16.055	24.196	18.267	47.623	36.006	78.516	47.623
18	18.000	0.165	0.165	0.250	*0.188	0.562	*0.375	0.938	*0.500
		18.083	18.083	27.268	20.577	60.222	40.614	98.246	53.768
20	20.000	0.188	0.188	0.250	*0.218	0.594	*0.375	1.031	*0.500
		22.888	22.888	30.341	26.500	70.718	45.223	120.177	59.913
24	24.000	0.218	0.218	0.250	*0.250	0.688	*0.375	1.219	*0.500
		31.858	31.858	36.486	36.486	98.418	54.441	170.513	72.203

1. All dimensions are in inches

2. Weight is in pounds based on density of .163 lbs/cubic inch

3. Dimensional tolerances to ASME B36.19M and ASME B36.10M

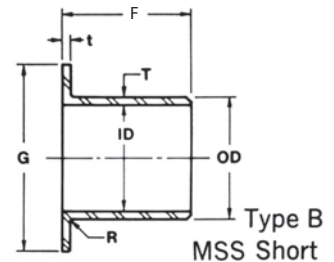
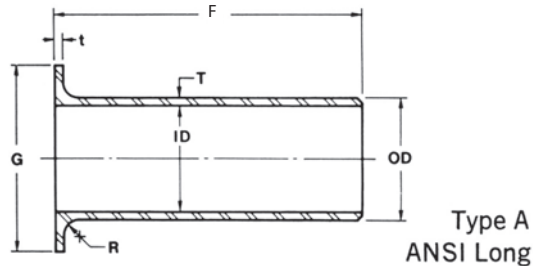
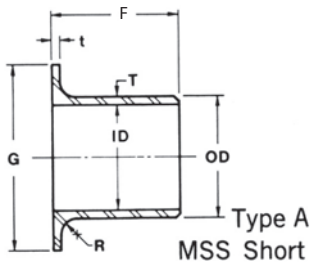
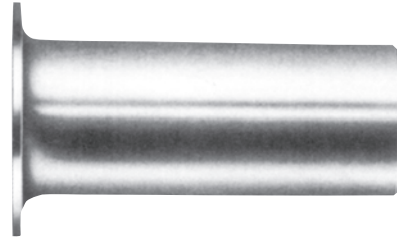
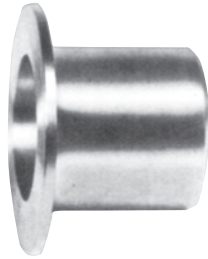
4. *ASME B36.19 wall thickness does not conform to ASME B36.10M.

5. Wall thickness listed is nominal wall thickness

6. Sch-10S and Sch-10 do not permit threading in accordance with ASME B1.20.1

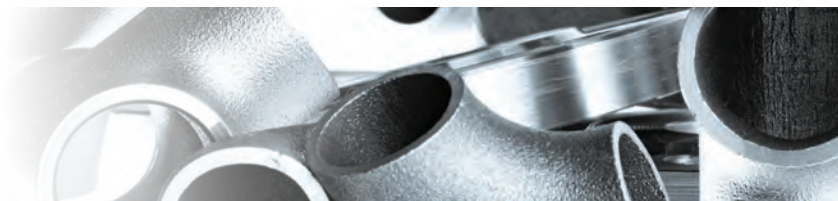


2.2 Stub Ends

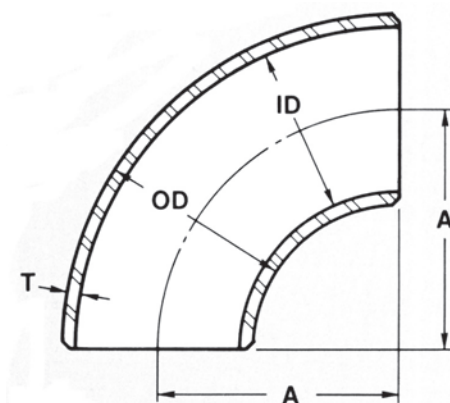


Nom. Pipe Size	Outside Diameter (OD)	Lap Diameter (G)	Length (F)		Radius (R)		Schedule 10S Light N.P.S.			Approx. Wt. in Pounds		Schedule 40S Standard N.P.S.			Approx. Wt. in Pounds	
			Short (MSS)	Long (ANSI)	Type A	Type B	Inside Diameter (ID)	Wall Thickness (T)	Lap Thickness (t) Min.	Short	Long	Inside Diameter (ID)	Wall Thickness (T)	Lap Thickness (t) Min.	Short	Long
1/2	.840	1-3/8	2	3	1/8	1/32	.674	.083	.083	.09	.12	.622	.109	.109	.11	.15
3/4	1.050	1-11/16	2	3	1/8	1/32	.884	.083	.083	.12	.16	.824	.113	.113	.15	.21
1	1.315	2	2	4	1/8	1/32	1.097	.109	.109	.20	.33	1.049	.133	.133	.22	.39
1-1/4	1.660	2-1/2	2	4	3/16	1/32	1.442	.109	.109	.28	.45	1.380	.140	.140	.32	.55
1-1/2	1.900	2-7/8	2	4	1/4	1/32	1.682	.109	.109	.32	.52	1.610	.145	.145	.39	.68
2	2.375	3-5/8	2-1/2	6	5/16	1/32	2.157	.109	.109	.54	.98	2.067	.154	.154	.77	1.29
2-1/2	2.875	4-1/8	2-1/2	6	5/16	1/32	2.635	.120	.120	.71	1.30	2.469	.203	.203	1.01	1.94
3	3.500	5	2-1/2	6	3/8	1/32	3.260	.120	.120	.92	1.65	3.068	.216	.216	1.43	2.66
3-1/2	4.000	5-1/2	3	6	3/8	1/32	3.760	.120	.120	1.09	1.80	3.548	.226	.226	2.05	3.37
4	4.500	6-3/16	3	6	7/16	1/32	4.260	.120	.120	1.37	2.18	4.026	.237	.237	2.36	3.90
5	5.563	7-5/16	3	8	7/16	1/16	5.295	.134	.134	1.86	3.72	5.047	.258	.258	3.52	6.79
6	6.625	8-1/2	3-1/2	8	1/2	1/16	6.357	.134	.134	2.72	5.06	6.065	.280	.280	4.80	8.68
8	8.625	10-5/8	4	8	1/2	1/16	8.329	.148	.148	4.06	6.63	7.981	.322	.322	7.65	13.50
10	10.750	12-3/4	5	10	1/2	1/16	10.420	.165	.165	6.46	11.00	10.020	.365	.365	12.75	22.50
12	12.750	15	6	10	1/2	1/16	12.390	.180	.180	10.25	15.00	12.000	.375	.375	18.00	28.00
14	14.000	16-1/4	6	12	1/2	1/16	13.624	.188	.188	13.75	21.75	13.250	.375	.375	27.50	36.00
16	16.000	18-1/2	6	12	1/2	1/16	15.624	.188	.188	16.00	25.00	15.250	.375	.375	26.00	42.00
18	18.000	21	6	12	1/2	1/16	17.624	.188	.188	22.00	32.00	17.250	.375	.375	34.50	56.50
20	20.000	23	6	12	1/2	1/16	19.564	.218	.218	27.50	40.75	19.250	.375	.375	38.00	62.00
24	24.000	27-1/4	6	12	1/2	1/16	23.500	.250	.250	34.50	52.80	23.250	.375	.375	48.50	79.50

1. All dimensions are in inches
2. Dimensional tolerances conform to ASME B16.9
3. Fitting wall thicknesses conform with standard schedule 10S and 40S ASME B36.19M wall pipe.
4. Stub End Faces are supplied with a serrated spiral finish per ASME B16.5. Other surface finishes can be supplied on special order.
5. Butt welding fittings are permanently marked by electro-chemical etching in accordance with ASME B16.9
6. Estimated fitting weights are based on a density of .163 lbs/cubic inch

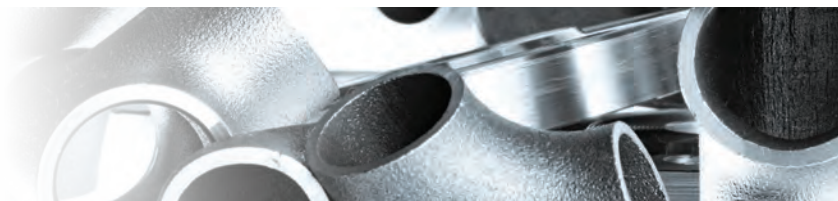


2.3 90° Elbow — Long Radius

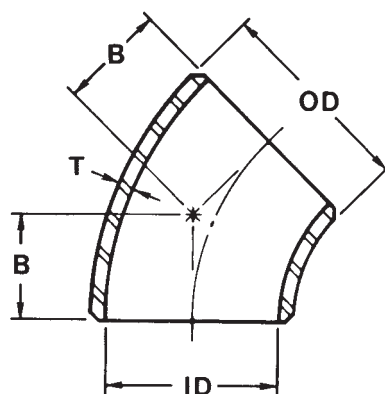


NOM PIPE SIZE	OUTSIDE DIAMETER (OD)	CENTER TO FACE (A)	SCHEDULE 10S Light N.P.S.			SCHEDULE 40S Standard N.P.S.		
			Inside Diameter (ID)	Wall Thickness (T)	Approx. Wt. in Pounds	Inside Diameter (ID)	Wall Thickness (T)	Approx. Wt in Pounds
1/2	.840	1-1/2	.674	.083	.08	.622	.109	.10
3/4	1.050	1-1/8	.884	.083	.09	.824	.113	.11
1	1.315	1-1/2	1.097	.109	.17	1.049	.133	.20
1-1/4	1.660	1-7/8	1.442	.109	.29	1.380	.140	.32
1-1/2	1.900	2-1/4	1.682	.109	.39	1.610	.145	.50
2	2.375	3	2.157	.109	.65	2.067	.154	.89
2-1/2	2.875	3-3/4	2.635	.120	1.08	2.469	.203	1.72
3	3.500	4-1/2	3.260	.120	1.54	3.068	.216	2.75
3-1/2	4.000	5-1/4	3.760	.120	2.14	3.548	.226	3.57
4	4.500	6	4.260	.120	2.72	4.026	.237	5.26
5	5.563	7-1/2	5.295	.134	4.58	5.047	.258	8.65
6	6.625	9	6.357	.134	6.86	6.065	.280	13.75
8	8.625	12	8.329	.148	13.50	7.981	.322	27.00
10	10.750	15	10.420	.165	25.00	10.020	.365	48.50
12	12.750	18	12.390	.180	34.00	12.000	.375	75.00
14	14.000	21	13.624	.188	46.00	13.250	.375	89.00
16	16.000	24	15.624	.188	60.00	15.250	.375	116.00
18	18.000	27	17.624	.188	75.00	17.250	.375	154.00
20	20.000	30	19.564	.218	126.00	19.250	.375	189.00
24	24.000	36	23.500	.250	177.00	23.250	.375	265.00

1. All dimensions are in inches
2. Dimensional tolerances conform to ASME B16.9
3. Fitting wall thicknesses conform with standard schedule 10S and 40S ASME B36.19M wall pipe.
4. Butt welding fittings are permanently marked by electro-chemical etching in accordance with ASME B16.9
5. Estimated fitting weights are based on a density of .163 lbs/cubic inch

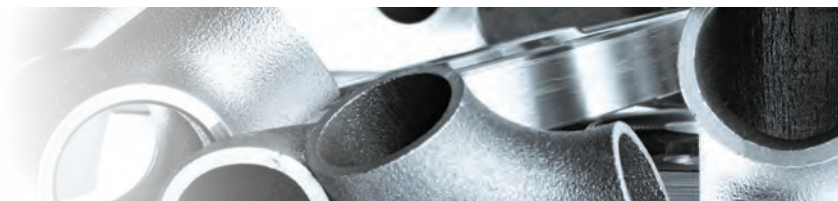


2.4 Elbow — Long Radius

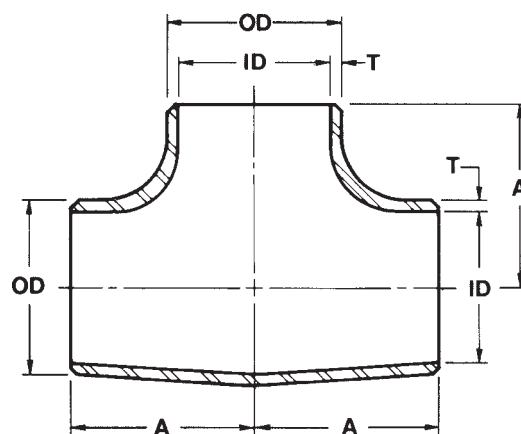


NOM PIPE SIZE	OUTSIDE DIAMETER (OD)	CENTER TO FACE (B)	SCHEDULE 10S Light N.P.S.			SCHEDULE 40S Standard N.P.S.		
			Wall Thickness (T)	Inside Diameter (ID)	Approx. Wt. in Pounds	Wall Thickness (T)	Inside Diameter (ID)	Approx. Wt in Pounds
1/2	.840	5/8	.083	.674	.04	.109	.622	.05
3/4	1.050	7/16	.083	.884	.04	.113	.824	.05
1	1.315	7/8	.109	1.097	.11	.133	1.049	.14
1-1/4	1.660	1	.109	1.442	.14	.140	1.380	.22
1-1/2	1.900	1-1/8	.109	1.682	.22	.145	1.610	.28
2	2.375	1-3/8	.109	2.157	.32	.154	2.067	.50
2-1/2	2.875	1-3/4	.120	2.635	.61	.203	2.469	.97
3	3.500	2	.120	3.260	.79	.216	3.068	1.36
3-1/2	4.000	2-1/4	.120	3.760	.95	.226	3.548	1.79
4	4.500	2-1/2	.120	4.260	1.36	.237	4.026	2.63
5	5.563	3-1/8	.134	5.295	2.29	.258	5.047	4.33
6	6.625	3-3/4	.134	6.357	3.43	.280	6.065	6.86
8	8.625	5	.148	8.329	6.75	.322	7.981	13.50
10	10.750	6-1/4	.165	10.420	12.50	.365	10.020	24.50
12	12.750	7-1/2	.180	12.390	17.00	.375	12.000	37.50
14	14.000	8-3/4	.188	13.624	23.00	.375	13.250	44.50
16	16.000	10	.188	15.624	30.00	.375	15.250	58.00
18	18.000	11-1/4	.188	17.624	38.00	.375	17.250	75.00
20	20.000	12-1/2	.218	19.564	63.00	.375	19.250	94.00
24	24.000	15	.250	23.500	89.00	.375	23.250	133.00

1. All dimensions are in inches
2. Dimensional tolerances conform to ASME B16.9
3. Fitting wall thicknesses conform with standard schedule 10S and 40S ASME B36.19M wall pipe.
4. Butt welding fittings are permanently marked by electro-chemical etching in accordance with ASME B16.9
5. Estimated fitting weights are based on a density of .163 lbs/cubic inch



2.5 Straight Tee

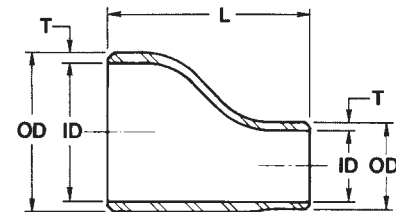
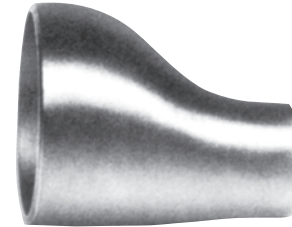
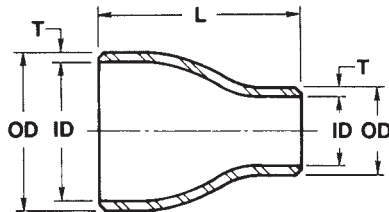
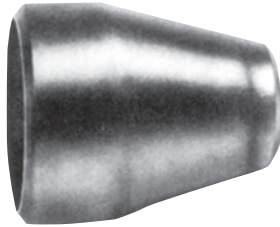


NOM PIPE SIZE	OUTSIDE DIAMETER (OD)	CENTER TO FACE (A)	SCHEDULE 10S Light N.P.S.			SCHEDULE 40S Standard N.P.S.		
			Wall Thickness (T)	Inside Diameter (ID)	Approx. Wt. in Pounds	Wall Thickness (T)	Inside Diameter (ID)	Approx. Wt in Pounds
1/2	.840	1	.083	.674	.12	.109	.622	.13
3/4	1.050	1-1/8	.083	.884	.16	.113	.824	.22
1	1.315	1-1/2	.109	1.097	.36	.133	1.049	.37
1-1/4	1.660	1-7/8	.109	1.442	.63	.140	1.380	.75
1-1/2	1.900	2-1/4	.109	1.682	.86	.145	1.610	1.09
2	2.375	2-1/2	.109	2.157	1.07	.154	2.067	1.62
2-1/2	2.875	3	.120	2.635	1.77	.203	2.469	2.77
3	3.500	3-3/8	.120	3.260	2.23	.216	3.068	4.18
3-1/2	4.000	3-3/4	.120	3.760	3.36	.226	3.548	5.15
4	4.500	4-1/8	.120	4.260	4.36	.237	4.026	6.65
5	5.563	4-7/8	.134	5.295	7.69	.258	5.047	12.00
6	6.625	5-5/8	.134	6.357	10.25	.280	6.065	14.00
8	8.625	7	.148	8.329	14.75	.322	7.981	26.25
10	10.750	8-1/2	.165	10.420	33.75	.365	10.020	45.50
12	12.750	10	.180	12.390	49.75	.375	12.000	78.00
14	14.000	11	.188	13.624	61.25	.375	13.250	100.00
16	16.000	12	.188	15.624	74.25	.375	15.250	126.00
18	18.000	13-1/2	.188	17.624	96.75	.375	17.250	164.00
20	20.000	15	.218	19.564	130.00	.375	19.250	205.00
24	24.000	17	.250	23.500	196.00	.375	23.250	285.00

1. All dimensions are in inches
2. Dimensional tolerances conform to ASME B16.9
3. Fitting wall thicknesses conform with standard schedule 10S and 40S ASME B36.19M wall pipe.
4. Butt welding fittings are permanently marked by electro-chemical etching in accordance with ASME B16.9
5. Estimated fitting weights are based on a density of .163 lbs/cubic inch

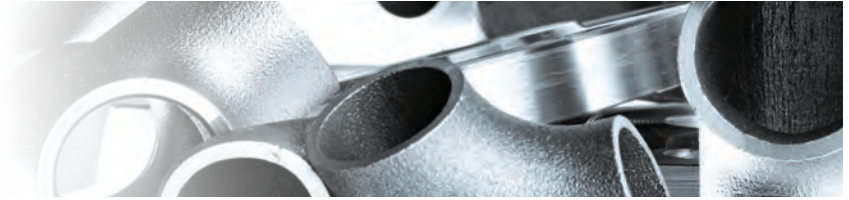


2.6 Concentric and Eccentric Reducers



NOM PIPE SIZE	OUTSIDE DIAMETER		LENGTH (L)	SCHEDULE 10S Light N.P.S.					SCHEDULE 40S Standard N.P.S.				
				LARGE END		SMALL END		Approx. Wt. in Pounds	LARGE END		SMALL END		Approx. Wt. in Pounds
	Large End (OD)	Small End (OD)		Inside Diameter (ID)	Wall Thick. (T)	Inside Diameter (ID)	Wall Thick. (T)		Inside Diameter (ID)	Wall Thick. (T)	Inside Diameter (ID)	Wall Thick. (T)	
3/4 x 1/2	1.050	.840	2	.884	.083	.674	.083	.13	.824	.113	.622	.109	.18
1 x 1/2	1.315	.840	2	1.097	.109	.674	.083	.15	1.049	.133	.622	.109	.19
1 x 3/4	1.315	1.050	2	1.097	.109	.884	.083	.17	1.049	.133	.824	.113	.21
1-1/2 x 1/2	1.900	.840	2-1/2	1.682	.109	.674	.083	.21	1.610	.145	.622	.109	.29
1-1/2 x 3/4	1.900	1.050	2-1/2	1.682	.109	.884	.083	.22	1.610	.145	.824	.113	.30
1-1/2 x 1	1.900	1.315	2-1/2	1.682	.109	1.097	.109	.25	1.610	.145	1.049	.133	.33
2 x 3/4	2.375	1.050	3	2.157	.109	.884	.083	.32	2.067	.154	.824	.113	.46
2 x 1	2.375	1.315	3	2.157	.109	1.097	.109	.35	2.067	.154	1.049	.133	.51
2 x 1-1/2	2.375	1.900	3	2.157	.109	1.682	.109	.39	2.067	.154	1.610	.145	.57
3 x 1	3.500	1.315	3-1/2	3.260	.120	1.097	.109	.59	3.068	.216	1.049	.133	1.04
3 x 2	3.500	2.375	3-1/2	3.260	.120	2.157	.109	.69	3.068	.216	2.067	.154	1.26
4 x 2	4.500	2.375	4	4.260	.120	2.157	.109	.99	4.026	.237	2.067	.154	1.98
4 x 3	4.500	3.500	4	4.260	.120	3.260	.120	1.10	4.026	.237	3.068	.216	2.20
6 x 3	6.625	3.500	5-1/2	6.357	.134	3.260	.120	2.29	6.065	.280	3.068	.216	5.02
6 x 4	6.625	4.500	5-1/2	6.357	.134	4.260	.120	2.47	6.065	.280	4.026	.237	5.14
8 x 4	8.625	4.500	6	8.329	.148	4.260	.120	3.80	7.981	.322	4.026	.237	8.26
8 x 6	8.625	6.625	6	8.329	.148	6.357	.134	4.03	7.981	.322	6.065	.280	8.75
10 x 6	10.750	6.625	7	10.420	.165	6.357	.134	6.31	10.020	.365	6.065	.280	14.00
10 x 8	10.750	6.625	7	10.420	.165	8.329	.148	6.55	10.020	.365	7.981	.322	14.50
12 x 6	12.750	6.625	8	12.390	.180	6.357	.134	9.37	12.000	.375	6.065	.280	19.50
12 x 8	12.750	8.625	8	12.390	.180	8.329	.148	9.67	12.000	.375	7.981	.322	20.00
12 x 10	12.750	10.750	8	12.390	.180	10.420	.165	10.00	12.000	.375	10.020	.365	21.00

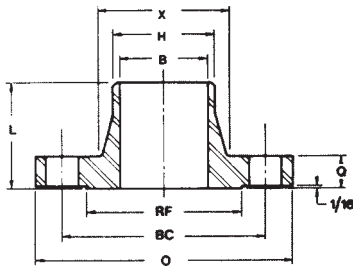
1. All dimensions are in inches
2. Dimensional tolerances conform to ASME B16.9
3. Fitting wall thicknesses conform with standard schedule 10S and 40S ASME B36.19M wall pipe.
4. Butt welding fittings are permanently marked by electro-chemical etching in accordance with ASME B16.9
5. Estimated fitting weights are based on a density of .163 lbs/cubic inch



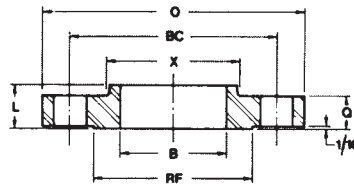
2.7 150 lb. Flanges



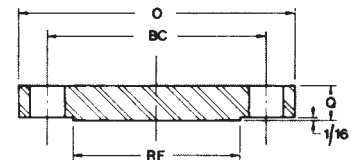
Welding Neck



Slip-On



Blind

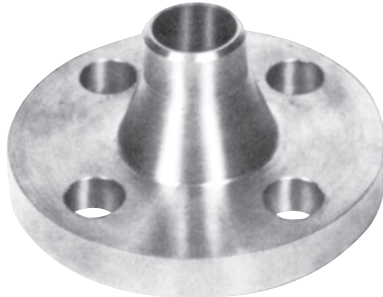


Nom. Pipe Size	Flange Diameter (O)	Flange Thickness (Q)	Hub Dia. At Base (X)	Raised Face Dia. (RF)	Hub Dia. At Welding Point (H)	Bore Diameter (B)		Length Through Hub (L)		Drilling and Bolting			Weight		
						Welding Neck	Slip On	Welding Neck	Slip On	No. of Holes	Dia. of Bolts	Dia. of Bolt Circle (BC)	Welding Neck	Slip On	Blind
1/2	3-1/2	7/16	1-3/16	1-3/8	.84	.62	.88	1-7/8	5/8	4	1/2	2-3/8	.94	.94	1.26
3/4	3-7/8	1/2	1-1/2	1-11/16	1.05	.82	1.09	2-1/16	5/8	4	1/2	2-3/4	1.26	1.26	1.56
1	4-1/4	9/16	1-15/16	2	1.32	1.05	1.36	2-3/16	11/16	4	1/2	3-1/8	1.56	1.56	1.70
1-1/4	4-5/8	5/8	2-5/16	2-1/2	1.66	1.38	1.70	2-1/4	13/16	4	1/2	3-1/2	1.88	1.88	1.88
1-1/2	5	11/16	2-9/16	2-7/8	1.90	1.61	1.95	2-7/16	7/8	4	1/2	3-7/8	2.50	2.50	2.20
2	6	3/4	3-1/16	3-5/8	2.38	2.07	2.44	2-1/2	1	4	5/8	4-3/4	3.76	3.13	2.50
2-1/2	7	7/8	3-9/16	4-1/8	2.88	2.47	2.94	2-3/4	1-1/8	4	5/8	5-1/2	5.02	4.37	4.05
3	7-1/2	15/16	4-1/4	5	3.50	3.07	3.57	2-3/4	1-3/16	4	5/8	6	6.26	5.32	5.63
3-1/2	8-1/2	15/16	4-13/16	5-1/2	4.00	3.55	4.07	2-13/16	1-1/4	8	5/8	7	7.37	6.87	8.45
4	9	15/16	5-5/16	6-3/16	4.50	4.03	4.57	3	1-5/16	8	5/8	7-1/2	9.40	8.13	10.75
5	10	15/16	6-7/16	7-5/16	5.56	5.05	5.66	3-1/2	1-7/16	8	3/4	8-1/2	12.00	9.40	12.00
6	11	1	7-9/16	8-1/2	6.63	6.07	6.72	3-1/2	1-9/16	8	3/4	9-1/2	15.00	12.25	17.00
8	13-1/2	1-1/8	9-11/16	10-5/8	8.63	7.98	8.72	4	1-3/4	8	3/4	11-3/4	24.50	18.25	28.75
10	16	1-3/16	12	12-3/4	10.75	10.02	10.88	4	1-15/16	12	7/8	14-1/4	32.50	25.50	42.50
12	19	1-1/4	14-3/8	15	12.75	12.00	12.88	4-1/2	2-3/16	12	7/8	17	50.00	38.75	67.00
14	21	1-3/8	15-3/4	16-1/4	14.00	13.25	14.14	5	2-1/4	12	1	18-3/4	62.25	52.00	80.00
16	23-1/2	1-7/16	18	18-1/2	16.00	15.25	16.16	5	2-1/2	16	1	21-1/4	78.00	57.00	103.00
18	25	1-9/16	19-7/8	21	18.00	17.25	18.18	5-1/2	2-11/16	16	1-1/8	22-3/4	86.00	74.00	127.00
20	27-1/2	1-11/16	22	23	20.00	19.25	20.20	5-11/16	2-7/8	20	1-1/8	25	104.00	94.00	166.00
24	32	1-7/8	26-1/8	27-1/4	24.00	23.25	24.25	6	3-1/4	20	1-1/4	29-1/2	159.00	128.00	251.00

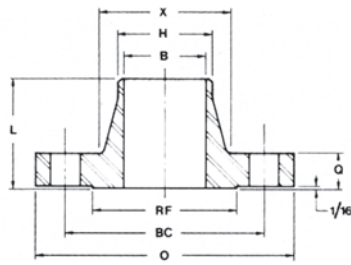
1. All dimensions are in inches
2. Dimensional tolerances conform to ASME B16.5
3. Flange bore diameters agree with standard ASME B36.9M Sch-40S wall pipe. Other bore diameters can be supplied on special order.
4. Flat Face Flanges are supplied with a serrated spiral finish per ASME B16.5 Other gasket surface finishes can be supplied on special order.
5. Flanges are permanently marked by electro-chemical etching in accordance with ASME B16.5
6. Estimated flange weights are based on a density of .163 lbs/cubic inch
7. The 1/16" RF is included in thickness "Q" and length through hub "L".



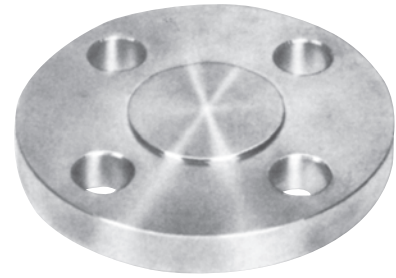
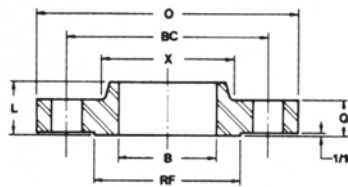
2.8 300 lb. Flanges



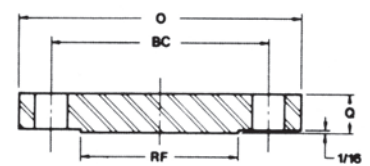
Welding Neck



Slip-On

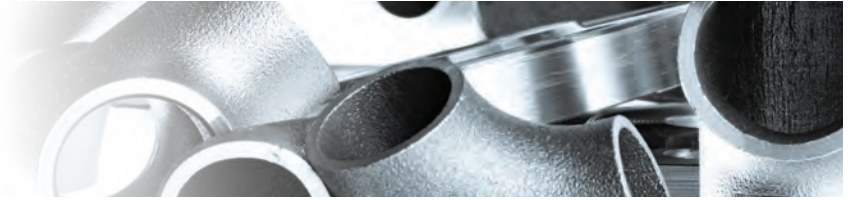


Blind

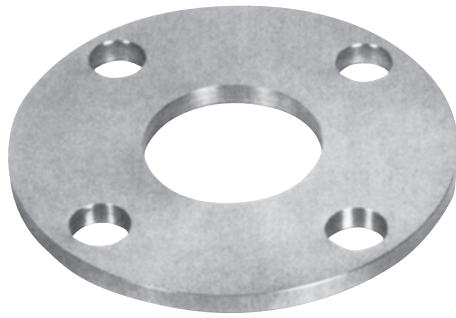


Nom. Pipe Size	Flange Diameter (O)	Flange Thickness (Q)	Hub Dia. At Base (X)	Raised Face Dia. (RF)	Hub Dia. At Welding Point (H)	Bore Diameter (B)		Length Through Hub (L)		Drilling and Bolting			Weight		
						Welding Neck	Slip On	Welding Neck	Slip On	No. of Holes	Dia. of Bolts	Dia. of Bolt Circle (BC)	Welding Neck	Slip On	Blind
1/2	3-3/4	9/16	1-1/2	1-3/8	.84	.62	.88	2-1/16	7/8	4	1/2	2-5/8	1.88	1.26	1.56
3/4	4-5/8	5/8	1-7/8	1-11/16	1.05	.82	1.09	2-1/4	1	4	5/8	2-1/4	2.50	1.56	1.88
1	4-7/8	11/16	2-1/8	2	1.32	1.05	1.36	2-7/16	1-1/16	4	5/8	3-1/2	2.81	1.88	2.50
1-1/4	5-1/4	3/4	2-1/2	2-1/2	1.66	1.38	1.70	2-9/16	1-1/16	4	5/8	3-7/8	3.44	2.50	3.44
1-1/2	6-1/8	13/16	2-3/4	2-7/8	1.90	1.61	1.95	2-11/16	1-3/16	4	3/4	4-1/2	4.69	4.05	4.37
2	6-1/2	7/8	3-5/16	3-5/8	2.38	2.07	2.44	2-3/4	1-5/16	8	5/8	5	5.63	4.37	5.32
2-1/2	7-1/2	1	3-15/16	4-1/8	2.88	2.47	2.94	3	1-1/2	8	3/4	5-7/8	6.87	6.56	7.51
3	8-1/4	1-1/8	4-5/8	5	3.50	3.07	3.57	3-1/8	1-11/16	8	3/4	6-5/8	9.39	8.76	10.00
3-1/2	9	1-3/16	5-1/4	5-1/2	4.00	3.55	4.07	3-3/16	1-3/4	8	3/4	7-1/4	12.00	10.75	12.50
4	10	1-1/4	5-3/4	6-3/16	4.50	4.03	4.57	3-3/8	1-7/8	8	3/4	7-7/8	14.75	13.75	17.50
5	11	1-3/8	7	7-5/16	5.56	5.05	5.66	3-7/8	2	8	3/4	9-1/4	20.75	17.50	22.00
6	12-1/2	1-7/16	8-1/8	8-1/2	6.63	6.07	6.72	3-7/8	2-1/16	12	3/4	10-5/8	27.00	23.75	30.00
8	15	1-5/8	10-1/4	10-5/8	8.63	7.98	8.72	4-3/8	2-7/16	12	7/8	13	42.50	35.75	50.00
10	17-1/2	1-7/8	12-5/8	12-3/4	10.75	10.02	10.88	4-5/8	2-5/8	16	1	15-1/4	55.50	50.75	78.25
12	20-1/2	2	14-3/4	15	12.75	12.00	12.88	5-1/8	2-7/8	16	1-1/8	17-3/4	84.00	69.75	113.00
14	23	2-1/8	16-3/4	16-1/4	14.00	13.25	14.14	5-5/8	3	20	1-1/8	20-1/4	114.00	103.00	144.00
16	25-1/2	2-1/4	19	18-1/2	16.00	15.25	16.16	5-3/4	3-1/4	20	1-1/4	22-1/2	150.00	138.00	188.00
18	28	2-3/8	21	21	18.00	17.25	18.18	6-1/4	3-1/2	24	1-1/4	24-3/4	186.00	175.00	239.00
20	30-1/2	2-1/2	23-1/8	23	20.00	19.25	20.20	6-3/8	3-3/4	24	1-1/4	27	231.00	204.00	300.00
24	36	2-3/4	27-5/8	27-1/4	24.00	23.25	24.25	6-5/8	4-3/16	24	1-1/2	32	333.00	306.00	461.00

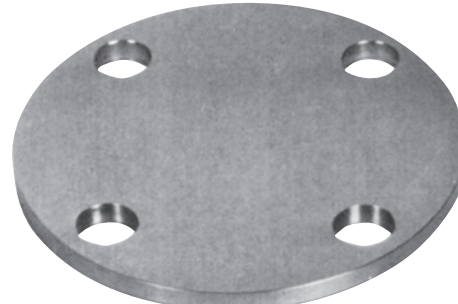
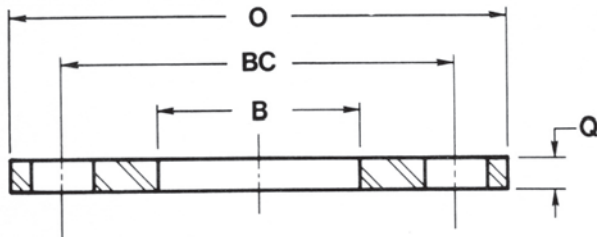
1. All dimensions are in inches
2. Dimensional tolerances conform to ASME B16.5
3. Flange bore diameters agree with standard ASME B36.9M Sch-40S wall pipe. Other bore diameters can be supplied on special order.
4. Flat Face Flanges are supplied with a serrated spiral finish per ASME B16.5 Other gasket surface finishes can be supplied on special order.
5. Flanges are permanently marked by electro-chemical etching in accordance with ASME B16.5
6. Estimated flange weights are based on a density of .163 lbs/cubic inch



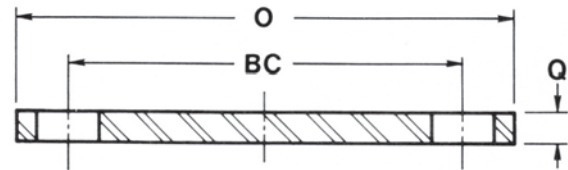
2.9 Low Pressure Plate Flanges



Slip-On

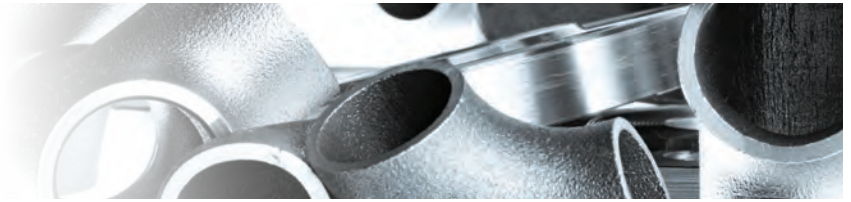


Blind

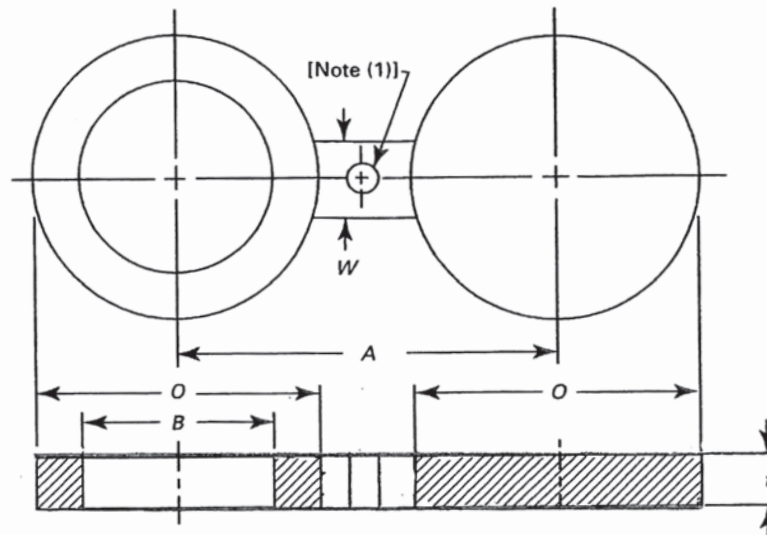


Nominal Pipe Size	Diameter (O)	Bore (B)	Bolt Circle Diameter (BC)	Bolt Diameter	No. of Bolt Holes	Flange Thickness (Q)	Weight in Pounds	
							Slip-On	Blind
1/2	3-1/2	.88	2-3/8	1/2	4	3/8	.48	.51
3/4	3-7/8	1.09	2-3/4	1/2	4	3/8	.59	.65
1	4-1/4	1.36	3-1/8	1/2	4	3/8	.70	.79
1-1/4	4-5/8	1.70	3-1/2	1/2	4	3/8	.81	.95
1-1/2	5	1.95	3-7/8	1/2	4	3/8	.94	1.12
2	6	2.44	4-3/4	5/8	4	3/8	1.33	1.62
2-1/2	7	2.94	5-1/2	5/8	4	1/2	2.44	2.99
3	7-1/2	3.57	6	5/8	4	1/2	2.64	3.46
4	9	4.57	7-1/2	5/8	8	1/2	3.70	4.90
5	10	5.66	8-1/2	3/4	8	5/8	4.95	7.50
6	11	6.72	9-1/2	3/4	8	5/8	5.58	9.20
8	13-1/2	8.72	11-3/4	3/4	8	5/8	8.01	14.00
10	16	10.88	14-1/4	7/8	12	3/4	12.00	24.50
12	19	12.88	17	7/8	12	3/4	17.50	33.50

1. All dimensions are in inches
2. Dimensional tolerances conform to ASME B16.5
3. Flange bore diameters agree with standard ASME B36.9M Sch-40S wall pipe. Other bore diameters can be supplied on special order.
4. Flat Face Flanges are supplied with a serrated spiral finish per ASME B16.5 Other gasket surface finishes can be supplied on special order.
5. Flanges are permanently marked by electro-chemical etching in accordance with ASME B16.5
6. Estimated flange weights are based on a density of .163 lbs/cubic inch

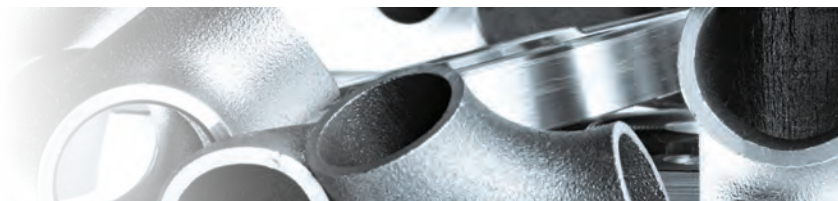


2.10 Flat Face Figure-8 Line Blanks

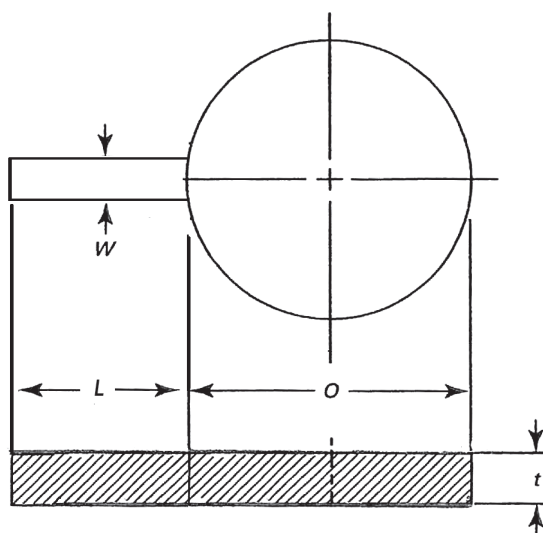


NPS	Inside Diameter, B, in.	Web Width, W, in.	Dimensions of Class 150			Dimensions of Class 300		
			Outside Diameter, O, in.	Centerline Dimension, A, in.	Thickness, t, in.	Outside Diameter, O, in.	Centerline Dimension, A, in.	Thickness, t, in.
1/2	0.62	1.50	1.75	2.38	0.12	2.00	2.62	0.25
3/4	0.82	1.50	2.12	2.75	0.12	2.50	3.25	0.25
1	1.05	1.50	2.50	3.12	0.12	2.75	3.50	0.25
1-1/4	1.66	1.50	2.88	3.50	0.25	3.12	3.88	0.25
1-1/2	1.90	1.50	3.25	3.88	0.25	3.62	4.50	0.25
2	2.38	2.00	4.00	4.75	0.25	4.25	5.00	0.38
2-1/2	2.88	2.00	4.75	5.50	0.25	5.00	5.88	0.38
3	3.50	2.50	5.25	6.00	0.25	5.75	6.62	0.38
3-1/2	4.00	2.50	6.25	7.00	0.38	6.38	7.25	0.50
4	4.50	2.50	6.75	7.50	0.38	7.00	7.88	0.50
5	5.56	3.00	7.62	8.50	0.38	8.38	9.25	0.62
6	6.62	3.00	8.62	9.50	0.50	9.75	10.62	0.62
8	8.62	3.00	10.88	11.75	0.50	12.00	13.00	0.88
10	10.75	4.00	13.25	14.25	0.62	14.12	15.25	1.00
12	12.75	4.00	16.00	17.00	0.75	16.50	17.75	1.12
14	14.00	4.25	17.62	18.75	0.75	19.00	20.25	1.25
16	16.00	4.25	20.12	21.25	0.88	21.12	22.50	1.50
18	18.00	4.50	21.50	22.75	1.00	23.38	24.75	1.62
20	20.00	4.75	23.75	25.00	1.12	25.62	27.00	1.75
24	24.00	5.50	28.12	29.50	1.25	30.38	32.00	2.00

1. Hole size (where required due to bolt spacing) shall be the same as the flange bolt hole and located such that it will not interfere with bolting between two flanges
2. All dimensions are in inches from ASME B16.48
3. Construction - cut from sheet and plate



2.11 Flat Face Paddle Blanks

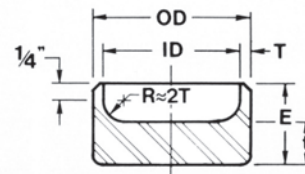
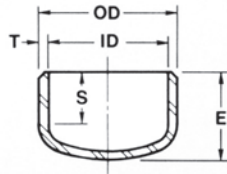


NPS	HANDLE WIDTH <i>W</i>	HANDLE LENGTH <i>L</i>	Dimensions of Class 150		Dimensions of Class 300	
			Outside Diameter, <i>O</i> , in.	Thickness, <i>t</i> , in.	Outside Diameter, <i>O</i> , in.	Thickness, <i>t</i> , in.
1/2	.500	3.00	1.75	0.12	2.00	0.25
3/4	.500	3.00	2.12	0.12	2.50	0.25
1	1.00	4.00	2.50	0.12	2.75	0.25
1-1/4	1.00	4.00	2.88	0.25	3.12	0.25
1-1/2	1.00	4.00	3.25	0.25	3.62	0.25
2	1.00	4.00	4.00	0.25	4.25	0.38
2-1/2	1.00	4.00	4.75	0.25	5.00	0.38
3	1.00	4.00	5.25	0.25	5.75	0.38
3-1/2	1.00	4.00	6.25	0.38	6.38	0.50
4	1.00	4.00	6.75	0.38	7.00	0.50
5	1.00	4.00	7.62	0.38	8.38	0.62
6	1.00	4.00	8.62	0.50	9.75	0.62
8	1.00	4.00	10.88	0.50	12.00	0.88
10	1.00	5.00	13.25	0.62	14.12	1.00
12	1.50	5.00	16.00	0.75	16.50	1.12
14	1.50	5.00	17.62	0.75	19.00	1.25
16	1.50	5.00	20.12	0.88	21.12	1.50
18	1.50	5.00	21.50	1.00	23.38	1.62
20	1.50	5.00	23.75	1.12	25.62	1.75
24	1.50	5.00	28.12	1.25	30.38	2.00

1. All dimensions are in inches
2. Diameter (*O*) and thickness (*t*) are from ASME B16.48
3. (*W*) Handle width and (*L*) length are not specified in ASME B16.48
4. Construction - cut from sheet and plate



2.12 Standard 2:1 Elliptical and Machined Pipe Caps



STANDARD 2:1 ELLIPTICAL PIPE CAP										MACHINED PIPE CAP (*)					
				SCHEDULE 10S Light N.P.S.			SCHEDULE 40S Standard N.P.S.			SCHEDULE 10S Light N.P.S.			SCHEDULE 40S Standard N.P.S.		
Nom. Pipe Size	Outside Diameter (OD)	Tangent Length (S)	Length (E)	Inside Diameter (ID)	Wall Thickness (T)	Approx. Wt. in Pounds	Inside Diameter (ID)	Wall Thickness (T)	Approx. Wt. in Pounds	Length (E)	Head Thickness (t)	Approx. Wt. in Pounds	Length (E)	Head Thickness	Approx. Wt. in Pounds
1/2	.840	.74	1	.674	.083	.05	.622	.109	.06	3/4	.281	.04	13/16	.312	.05
3/4	1.050	.68	1	.884	.083	.07	.824	.113	.07	3/4	.312	.06	7/8	.375	.08
1	1.315	1.10	1-1/2	1.097	.109	.11	1.049	.133	.16	7/8	.406	.12	1	.437	.14
1-1/4	1.660	1.02	1-1/2	1.442	.109	.16	1.380	.140	.22	15/16	.468	.21	1-1/16	.531	.27
1-1/2	1.900	.95	1-1/2	1.682	.109	.18	1.610	.145	.29	1	.500	.28	1-1/8	.562	.33
2	2.375	.83	1-1/2	2.157	.109	.22	2.067	.154	.34	1-1/16	.562	.47	1-1/4	.656	.57
2-1/2	2.875	.68	1-1/2	2.635	.120	.32	2.469	.203	.57	1-3/16	.656	.78	1-1/2	.812	1.04
3	3.500	1.02	2	3.260	.120	.50	3.068	.216	.89	1-1/4	.718	1.23	1-5/8	.937	1.72
3-1/2	4.000	1.40	2-1/2	3.760	.120	.71	3.548	.226	1.29	1-1/4	.750	1.66	1-3/4	1.031	2.43
4	4.500	1.26	2-1/2	4.260	.120	.82	4.026	.237	1.54	1-5/16	.812	2.24	1-7/8	1.125	3.31
5	5.563	1.48	3	5.295	.134	1.29	5.047	.258	2.32	1-1/2	.937	3.91	2-1/16	1.281	5.63
6	6.625	1.70	3-1/2	6.357	.134	1.72	6.065	.280	4.07	1-11/16	1.125	5.82	2-5/16	1.468	9.00
8	8.625	1.68	4	8.329	.148	3.15	7.981	.322	7.15	DIMENSIONS FOR SIZES OVER 6 INCHES TO BE SPECIFIED BY PURCHASER					
10	10.750	2.13	5	10.420	.165	6.18	10.020	.365	11.60						
12	12.750	2.63	6	12.390	.180	8.25	12.000	.375	16.50						
14	14.000	2.81	6-1/2	13.624	.188	10.25	13.250	.375	20.50						
16	16.000	2.81	7	15.624	.188	18.25	15.250	.375	27.75						
18	18.000	3.31	8	17.624	.188	22.75	17.250	.375	34.00						
20	20.000	3.81	9	19.564	.218	34.25	19.250	.375	43.00						
24	24.000	4.31	10-1/2	23.500	.250	43.50	23.250	.375	56.00						

1. All dimensions are in inches
2. Dimensional tolerances conform to ASME B16.9
3. Fitting wall thicknesses conform with standard schedule 10S and 40S ASME B36.19M wall pipe.
4. Butt welding fittings are permanently marked by electro-chemical etching in accordance with ASME B16.9
5. Estimated fitting weights are based on a density of .163 lbs/cubic inch



3 Power Generation

Electricity generation is the process of generating electric power from primary energy sources which can be categorized as energy found in nature that hasn't been subjected to human engineered conversion processes. Production is conducted in power stations or power plants, often generated by electromechanical generators which are driven by heat engines fueled by combustion or nuclear fission. Kinetic energy sources are also viable means of production and are derived from natural resources like wind or solar energy.

The type of electricity produced worldwide and the economic viability varies in accordance with demand, region, and availability. Energy sources can include coal, natural gas, hydroelectric, nuclear, wind generators, oil, solar, tidal, and geothermal.

Whether nuclear, coal, gas powered, or another form of electric generation; titanium is the best choice for tubing. Titanium's naturally occurring oxide film makes the metal impervious to chloride induced corrosion and is highly resilient to other caustic conditions. Because of these characteristics, titanium tubing can also have increased heat transfer efficiencies and thinner walls than traditional metals used in these applications.

Examples of applications for titanium in the power generation industry include turbine blade applications, surface condensers, feed water heaters, nuclear waste reprocessing and disposal, service water piping, and many other areas. The use of Titanium in these applications reduces downtime and maintenance costs.

Additional Titanium uses within the Power Generation Industry:

- Boiler Nozzles, Clamps and Shields in Coal-fired Boilers
- Components for Land-based Gas Turbines and Exhaust Stream
- Scrubbers, Dampers, Duct Work in Flue Gas Processing for Pollution Control
- Heat Exchangers and Condensing Equipment
- Coal Bins and Ash Bins
- Expansion Joints

Processes

- Surface Condensers
- Feed-water Heaters (Low Pressure)
- Geothermal Brine & Flash Systems
- Bearing Water Coolers
- Lube Oil Coolers
- Service Water Piping
- FGD Systems (Flue-gas desulfurization)
- Nuclear Waste Reprocessing & Disposal

Applications

- Shell & Tube Heat Exchangers
- Tube Exchangers
- Pipe, Heat Exchangers, Well Tubulars
- Shell & Tube Heat Exchangers
- Shell & Tube Heat Exchangers
- Piping, Flanges, Fittings
- Ducts (Inlet & Outlet), Stack Liners, Dampers
- Evaporators, Reboilers, Burial Canisters

Alloys/Grades

- CP Titanium:
 - Grades 2, 4
- Titanium Alloys:
 - Grades 7, 12
- Nickel:
 - 625, 718
- Stainless Steels:
 - 13-8, 15-5, 17-7

Product Forms

- Bar
- Pipe
- Tube
- Sheet
- Plate
- Fittings

Specifications

- ASME
- ASTM

More information on specifications can be found in section 10.



4 Chemical Processing

Titanium provides an economically efficient material in many volatile chemical processing environments. The extreme conditions the refining facilities and processing plants demand from systems to defend against corrosion, stress, and extreme pressure and heat makes titanium a natural choice for chemical processing and production applications.

Processing aggressive compounds like nitric acid, organic acids, chlorine dioxide, inhibited reducing acids, hydrogen sulfide and other harsh chemicals makes titanium pipe an excellent material of choice for vessels, heat-exchangers, tanks, agitators, coolers, and piping systems.

As a reactive metal, Titanium's corrosion resistance is due to a protective titanium dioxide film that rapidly forms on the surface. This natural corrosion resistance, high strength-to-weight ratio, and low ductility extends the life cycle of equipment and reduces maintenance costs.

Nickel alloy type 625 is an austenitic or non-magnetic super alloy that also boasts corrosion and oxidations resistances beneficial to chemical processing and production. With exceptional toughness and strength at extremes of both hot and cold temperatures, 625 boasts notable fatigue resistances. The high nickel properties makes this particular alloy immune to many caustic materials.

Stainless steel alloys 13-8, 15-5, 17-7 are also an austenitic set of alloys employed by the chemical processing industry. These metals are known for corrosion resistances, general formability, weldability, and exceptional resiliency at extreme temperatures.

Processes

- Nitric Acid
- Nitrate Fertilizers
- Salt (NaCl, KCl, MgCl₂, CaCl₂)
- Chlorates, Perchlorates
- Hypochlorites, Oxychlorides
- Soda Ash
- Wet Br₂ (Bromine)
- Wet Cl₂ (Chlorine Alkali)

Applications

Piping, Reboilers, Strippers, Gas Coolers

Tail Gas Preheaters & Gas Coolers

Brine Heaters, Piping Crystallizers

Evaporators, Heaters, Coolers, Vessels

Cooling Coils, Pumps, Piping

Still Preheaters, Gas & Absorber Coolers

Strippers, Gas Coolers, Absorbers, Heaters

Dimensionally Stable Anodes (DSA), Piping, Strippers, Brine Heaters, Off-Gas Coolers, Cell Liners, Covers, Absorbers

Alloys/Grades

- CP Titanium:
- Grades 1, 2, 3, 4
- Titanium Alloys:
- Grades 5, 7, 11, 12
- Nickel:
- 625, 718
- Stainless Steels:
- 13-8, 15-5, 17-7

Product Forms

- Bar
- Pipe
- Tube
- Sheet
- Plate
- Fittings

Specifications

- ASME
- ASTM

More information on specifications can be found in section 10.



5 Petro & Organic Production

The petro and organic production industry has many applications where titanium and other high performance metals are used. Though these industries utilize these metals for production and refining, the chemicals produced can be vastly different and vary widely in applicable conditions.

In general, the organic chemicals being refined will be used to form a variety of other chemicals and bi-products within the clothing and textile industries. As an example the organic chemical compound, acetaldehyde, acts as a derivative compound to manufacturing different resins, acids, vinegars, and other solvents.

Due to the vast range of production possibilities within this market subset, it is important to understand the different processes occurring at each facility. Overall, due to the general acidity and caustic tendencies of the production process, titanium and other highly resilient metals are proven to be effective in stripper exchangers, piping, reboilers, heat exchangers, scrubbers and other components within the industry.

Processes

- Urea
- Acetaldehyde (Wacker Process)
- Acetic Acid & Vinyl Acetate
- Acetone & Methyl Ethyl Ketone (MEK)
- Terephthalic Acid (& Purified)
- Ethylene Glycol
- Chlorinated Hydrocarbons

Applications

- Stripper Exchanger
- Piping, Reactors & Gas Coolers
- Strippers, Reboilers, Condensers
- Strippers, Reboilers, Condensers
- Piping, Reactors, Distillation Columns
- Reactor Strippers, Heaters, Coolers
- Strippers, Exchangers, Scrubbers

Alloys/Grades

- CP Titanium:
 - Grades 1, 2, 3, 4
- Titanium Alloys:
 - Grades 5, 7, 11, 12
- Nickel:
 - 625, 718
- Stainless Steels:
 - 13-8, 15-5, 17-7

Product Forms

- Bar
- Pipe
- Tube
- Sheet
- Plate
- Fittings

Specifications

- ASME
- ASTM

More information on specifications can be found in section 10.



6 Metal Extraction & Recovery

Metal extraction and recovery is the process of removing metals from an ore and refining the extracted raw materials into purer forms. To achieve this, these metals must be converted to an oxide or sulphide by using concentrated chemical solvents, leaching (extraction by dissolving), or by smelting operations.

Titanium's traits and performance characteristics function well in these metallurgical environments where oxidizing acids are utilized to extract metals. Titanium has been selected for this application because it offers an extended lifespan, increased energy efficiency, and greater product purity. Certain nickel and stainless steel alloys are utilized in these applications as well.

These factors also promote the usage of titanium electrodes in the electro-winning and electro-refining of metals like copper, gold, manganese and manganese dioxide.

Similar to electro-winning, pressure oxidation is another process used within the industry to extract gold and other precious metals. The most common method for extraction is performed in industrial autoclaves, which use high pressures and temperatures to extract metals from ores.

Processes

- Plating & Galvanizing
- Hydrometallurgy (Leaching/Extraction)
- Metal Recovery [Cu, Ni, Co, Au, Pt, Zn Ores]
- Electro Winning
- Electro Refining of Cu

Applications

Anode Baskets, Heaters, Evaporators

Reactor Vessels (Autoclaves), Baffles, Piping, Weirs

Exchangers, Agitators, Blades, Shafts, Nozzles

Anodes (coated & uncoated), Cathodes

Cathode Starter Sheets

Alloys/Grades

- CP Titanium:
- Grades 4
- Titanium Alloys:
- Grades 7, 12
- Nickel:
- 625, 718

Product Forms

- Bar
- Pipe
- Tube
- Sheet
- Plate
- Fittings

Specifications

- ASME
- ASTM

More information on specifications can be found in section 10.



7 Pulp & Paper

The US is one of the largest consumers of paper in the world. With close to 450 paper mills, accounting for over \$65 billion, the need for reliable materials is paramount. The need for corrosion resistance, reliability in material, and the ability to operate at higher temperatures makes titanium the material of choice in the pulp and paper Industry.

Pulp can be manufactured using mechanical, semi-chemical or fully chemical methods. Because of these varying production methodologies, there are many practical applications for titanium within the industry. Though Titanium is primarily used in equipment within the bleaching facilities of pulp and paper plants, other uses include: heat exchangers, diffusers, drum washers, piping systems, pumps, and many other areas.

The pulp and paper industry, like many others, has come under increased scrutiny over recent years about the environmental impacts of production. As the technology advances in this industry, components and materials have become cheaper, simpler, and produced on larger scales to meet the needs of the industry versus the needs of the environment.

Because of this movement and the requirement to minimize maintenance shutdowns, better performance metals are being requested at much higher paces than many other industries. These requirements for longer lasting product are currently phasing most carbon steels from the marketplace and demand for titanium and stainless steels.

The reduction of water usage and emission controls have forced the industry to develop new techniques to reduce iron contamination in tandem with materials that reduce instances of corrosion that cause shutdowns.

Titanium, nickel, and stainless steel products have become the material of choice for this industry as it develops.

Processes

- ClO₂ Generation
- Bleach Tanks & Diffusion
- Wet Cl₂ Systems
- Hypochlorite Storage

Applications

Evaporator/Crystallizer Vessels, Piping, Mixers, Valves, Reboilers, Steam Ejectors, Heat Exchangers, Filters

Tanks, Internals, Walls, Piping, Pumps, Drum Filters & Washers

Exchangers, Tanks, Coolers, Pumps

Piping, Pumps, Vessels

Alloys/Grades

- CP Titanium:
- Grades 1, 2, 4
- Titanium Alloys:
- Grades 7, 11, 12
- Nickel:
- 625

- Stainless Steels:
- 303, 304, 304L, 316, 316L, 321, 347, 410 & many others

Product Forms

- Bar
- Pipe
- Tube
- Sheet
- Plate
- Fittings

Specifications

- ASME
- ASTM

More information on specifications can be found in section 10.



8 Oil Refining

Oil or petroleum refining is an industrial process where crude oil is transformed and refined into more useful products. Those products can include gasoline, diesel fuel, asphalt bases, heating oils, kerosene, jet fuel and others. These facilities are generally large industrial complexes with extensive piping that carry fluids between chemical processing units, and in many ways, can be compared to other chemical plants.

Because of the vast size of these plants, many different processes and auxiliary facilities can be involved with each plant having a unique arrangement and combination of refining processes, determinant by the refineries location, desired product, and economic considerations. According to the Oil and Gas Journal there are over 640 refineries operating worldwide comprising of a market valued over \$6 trillion.

The volatile, corrosive nature of this industries refining applications makes Titanium and other high performance metals, such as certain Nickel and Stainless Steels alloys, excellent materials to utilize within oil refining. Applications including fluid catalytic cracking used to convert high-boiling, high-molecular weight hydrocarbons into gasolines and other products.

Other uses for Titanium and performance metals include desulfurization methods, hydrogen purifiers, and subsequent water treatment facilities. Components within these subset applications include MEA exchangers, reboilers, overhead condensers, coolers and other similar fixtures.

Processes

- Catalytic Cracking
- Desulfurization
- Fuel Gas
- Hydro-refiner
- Unsaturated Splitter
- Power Former
- Polymerization
- Pipe Still
Crude Distillation
- Hydrogen Purification

Applications

Overhead Condensers,
Coolers

MEA Exchangers
Reboilers, Overhead
Condensers

MEA Coolers

Overhead Condensers

Overhead Condensers

Inter-stage Coolers,
Splitter Condensers

MEA/DEA Overhead,
Condensers/Coolers

Overhead Condensers,
Bottom Coolers

Gas Coolers, Freon
Condensers

Alloys/Grades

- CP Titanium:
- Grade 4
- Titanium Alloys:
- Grades 7, 11
- Nickel:
- 625, 718

Product Forms

- Bar
- Pipe
- Tube
- Sheet
- Plate
- Fittings

Specifications

- ASME
- ASTM

More information on specifications can be found in section 10.



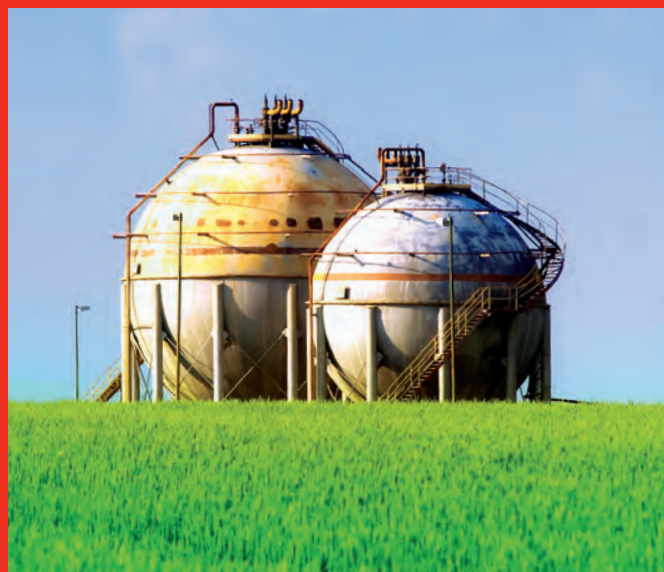
9 Desalination

Desalination is a process that removes mineral components from saline water, or water that contains a high concentration of dissolved salts. Generally this process refers to the removal of those salts and minerals from target substances like soil desalination, which is an issue for agricultural industries.

There are two basic technological categories for desalination systems. Reverse osmosis and thermal distillation, otherwise known as evaporation. Titanium and certain Nickel alloys are primarily used in thermal distillation where these metals are used for tubing, valves, and water-storage vessels. In contrast, titanium and nickel products have limited applications in reverse osmosis systems. Pump heads are the primary component that utilizes titanium or nickel alloys in reverse osmosis plants.

Because of the high corrosion resistances and anti-erosions properties, titanium and certain nickel alloys are used in these multi-stage evaporation plants. Though nickel can be used, titanium is a great cost competitive material used in condensers within desalination plants due to the aforementioned corrossions resistances and the allowance for thinner walled tubing than copper-nickel tubing.

Titanium's life span is virtually unlimited compared to other metals as well. Issues with corrosion to steels have been eliminated with the adoption of titanium in piping for fire and water services, and low pressure ballasts.



Alloys/Grades

CP Titanium:

- Grades 1, 2, 3, 4

Titanium Alloys:

- Grades 5, 7, 11, 12

Nickel:

- 625, 718

Stainless Steels:

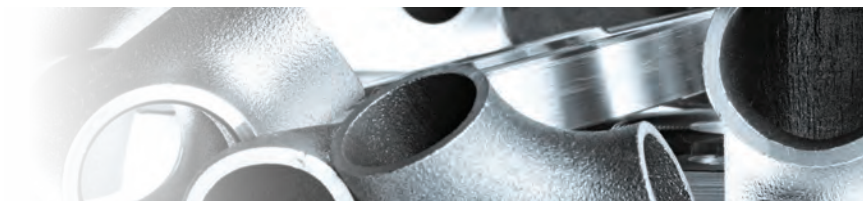
- 13-8, 15-5, 17-7

Product Forms

- Bar
- Pipe
- Tube
- Sheet
- Plate
- Fittings

Specifications

- ASME
- ASTM



10 Industrial Specifications

ASTM B 265 GR 1	Sheet/Strip/Plate Commercially Pure 25 KSI min YS
AMS-T-9046	Sheet/Strip/Plate 6AL4V
ASTM B 265 GR 2	Sheet/Strip/Plate Commercially Pure 40 KSI min YS
ASTM B 265 GR 3	Sheet/Strip/Plate Commercially Pure 55 KSI min YS
ASTM B 265 GR 4	Sheet/Strip/Plate Commercially Pure 70 KSI min YS
ASTM B 265 GR 5	Sheet/Strip/Plate 6AL4V
ASTM B 265 GR 23	Sheet/Strip/Plate 6AL4V Eli
ASTM B 861	Seamless Pipe
ASTM B 862	Welded Pipe
ASTM B 338 Grade 2	Seamless and Welding Tubing Commercially Pure 40 KSI min YS
ASTM B 348 GR 1	Bars and Billets Commercially Pure 25 KSI min YS
ASTM B 348 GR 2	Bars and Billets Commercially Pure 40 KSI min YS
ASTM B 348 GR 3	Bars and Billets Commercially Pure 50 KSI min YS
ASTM B 348 GR 4	Bars and Billets Commercially Pure 70 KSI min YS
ASTM B 348 GR 5	Bars and Billets 6AL4V
ASTM B 363	Fittings
ASTM B 367	Castings
ASTM B381	Forgings
ASME SB 265	Sheet/Strip/Plate Commercially Pure and Alloyed
ASME SB 861	Seamless Pipe
ASME SB 862	Welded Pipe
ASME SB 348	Bars and Billets Commercially Pure and Alloyed

Notes

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Notes

Notes

Global Locations

Strategically placed to serve the global marketplace

CORPORATE HQ

NJ - Rockaway..... (+1) (973) 983-1185
sales@titanium.com

NORTH AMERICA

CA - Garden Grove..... (+1) (562) 906-8188
sales-losangeles@titanium.com

CT - Tolland..... (+1) (860) 870-3939
sales-hartford@titanium.com

FL - Jacksonville (+1) (904) 288-8300
sales-jacksonville@titanium.com

IL - Naperville..... (+1) (630) 499-9140
sales-chicago@titanium.com

MI - Plymouth..... (+1) (734) 335-2805
sales-michigan@titanium.com

TX - Hillsboro (+1) (254) 580-2849
sales-houston@titanium.com

TX - Houston..... (+1) (713) 256-7201
sales-houston@titanium.com

WA - Woodinville..... (+1) (206) 271-6555
sales-seattle@titanium.com

Canada - Montreal..... (+1) (514) 334-6727
sales-montreal@titanium.com

SOUTH AMERICA

Brazil - Sao Paulo (+55) 11 2814 7509
sales-saopaulo@titanium.com

EUROPE

UK - Birmingham (+44) (0) 121 782 9708
sales-birmingham@titanium.com

Germany - Meerbusch (+49) 2132 5100 040
sales-germany@titanium.com

Italy - Verona..... (+39) 045 259 0232
sales-europe@titanium.com

ASIA

China - Shanghai..... (+86) 21 5866 5266
sales-shanghai@titanium.com

Taiwan - Taipei..... (+886) 2 2298 9668
sales-taipei@titanium.com

We are a privately held business with a long-term growth plan and quick decisions making processes. T.I. stands ready to support your global objectives.



Holding a wide range of OEM and Tier 1 approvals

Please contact your local representative for an immediate quote.