Piping Components

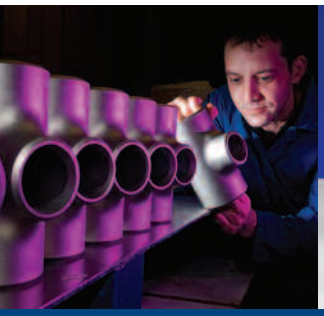
PIPEFITTINGS LTD

- 90° Long Radius Elbows
- 45° Long Radius Elbows
- 180° Long Radius Return Bends
- 90° Short Radius Elbows
- 180° Short Radius Return Bends
- Equal Tees
- Reducing Tees
- Concentric Reducers
- Eccentric Reducers
- End Caps
- Crosses
- Concentric Swaged Nipples
- Eccentric Swaged Nipples
- Manifolds
- Headers
- Lap Joint Stub Ends

Index

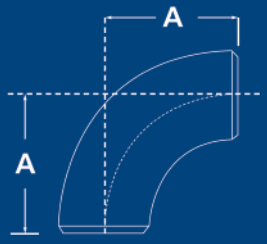
PIPEFITTINGS LTD

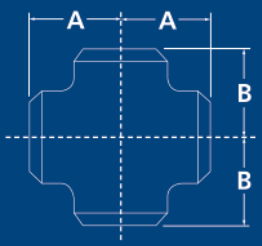
Professionally manufactured from the finest materials

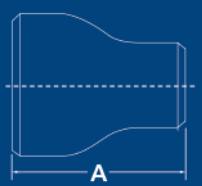


S.S.E. Pipefittings Limited have been manufacturing Butt-weld fittings for over seventy years, establishing a global reputation for excellence and providing an unsurpassed level of manufacturing expertise, quality and service to our customers.

We manufacture Cold Formed Butt-weld Fittings, Extruded Outlets and Manifolds in Austenitic, Duplex, Super Duplex Stainless Steels, Nickel Alloys, 6Moly, Titanium, Copper Nickel and various Aluminium Grades for the Oil, Gas, Nuclear, Petro-Chemical and Process Industries.







S.S.E. Pipefittings Limited has a Quality System approved to **BS EN ISO 9001: 2008** by

- Bureau Veritas Quality International Limited, Certificate Number **22647**

and are an approved manufacturer to requirements of:

- Rolls Royce Nuclear
- T.U.V.
- Norsok
- Exxon Mobil
- PED

and many more.

ISO 9001
BUREAU VERITAS
Certification

No. 22647

Achilles®

Black Country Chamber of Commerce
The Ultimate Business Network
Member

No. SSE45569

FPAL
empowered by Achilles
Registered with First Point

Our Dudley operation includes some of the largest cold extrusion presses in Western Europe, producing professionally manufactured fittings made from metals of the highest standard. Accordingly, we have been awarded Certificates of Quality in recognition of our excellence including NORSOK M-650 Rev.3.

In attaining these standards, S.S.E Pipefittings Limited are the preferred and specified supplier to many nationally and internationally recognised organisations. In continuing to develop our product in line with the demands of these highly complex and technologically advancing industries, we specialise in those hard to find fittings and materials, small batch production with special testing requirements. These combined with our stock program and quick turn-around we maintain a flexibility advantage over our competitors.

We hope the information in this brochure will be of assistance, to our customers express our sincere thanks and we will endeavour to continue to offer a good service, guarantee a high quality product at a competitive price.

The following selection of items are the basis of our range of manufacture.

90 & 45 degree long/short radius elbows & return bends

Dimensions to ASME B16.9 & B16.28

Material to ASTM A403. ASTM A815 ASTM B366

Size up to 12”nb Sch 160

Butt Weld Equal and Reducing Tees

Dimensions to ASME B16.9

Material to ASTM A403. ASTM A815. ASTM B366

Size up to 8”nb Sch 160

Reducers Eccentric and Concentric

Dimensions to ASME B16.9

Material to ASTM A403. ASTM A815. ASTM B366

Large end size up to 12”nb Sch 160

Butt Weld End Caps

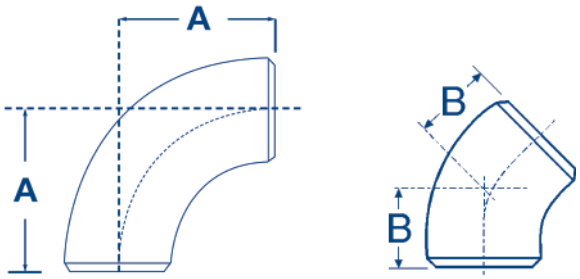
Dimensions to ASME B16.9

Material to ASTM A403. ASTM B424. ASTM B409, ASTM B443

Size up to 18”nb, SCH 40

We manufacture seamless headers/manifolds & specials to customers drawings and specifications - Please see page 13 for more details.

Butt Weld Long Radius Elbows

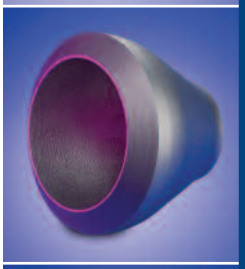


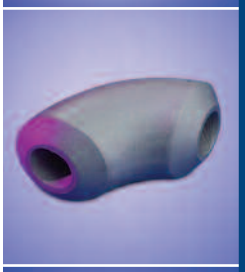
Dimensions (Based on ASME B16.9) and Example Weights for Long Radius Elbows

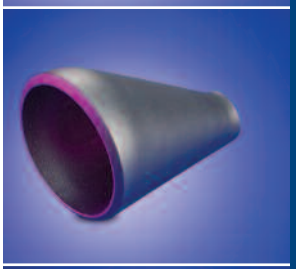
Common			90° elbow			45° elbow		
Nominal Pipe Size	OD at Bevel		A		40S/STD	B		40S/STD
	in	mm	in	mm	kg/piece	in	mm	kg/piece
½	0.84	21	1.50	38	0.08	0.62	16	0.04
¾	1.05	27	1.50	38	0.10	0.75	19	0.05
1	1.32	33	1.50	38	0.15	0.88	22	0.08
1¼	1.66	42	1.88	48	0.26	1.00	25	0.13
1½	1.90	46	2.25	57	0.40	1.12	29	0.20
2	2.38	60	3.00	76	0.70	1.38	35	0.35
2½	2.88	73	3.75	95	1.40	1.75	44	0.70
3	3.50	89	4.50	114	2.50	2.00	51	1.25
3½	4.00	102	5.25	133	3.25	2.25	57	1.63
4	4.50	114	6.00	152	4.00	2.50	64	2.00
5	5.56	141	7.50	190	6.80	3.12	79	3.40
6	6.62	168	9.00	229	11.00	3.75	95	5.50
8	8.62	219	12.00	305	22.00	5.00	127	11.00
10	10.75	273	15.00	381	41.50	6.25	159	20.75
12	12.75	324	18.00	457	60.00	7.50	190	30.00

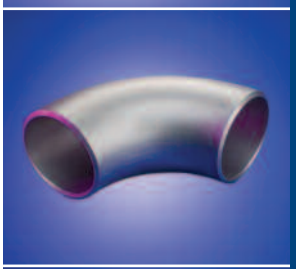
Notes
- Dimensions quoted in mm are 'Nominal' values from ASME B16.9 (i.e. rounded equivalents of the inch dimensions).
  Refer to ASME B16.9 for additional 'Max' and 'Min' metric dimensions.
- For tolerances see page 16.

1 Weights are approximate and based on manufacturers' data (where available) for Schedule 40S/Standard fittings.

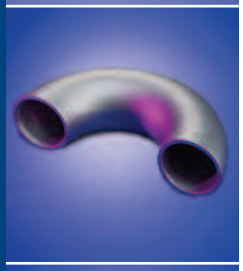
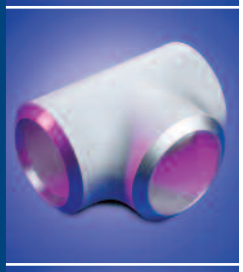
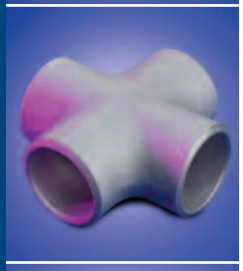


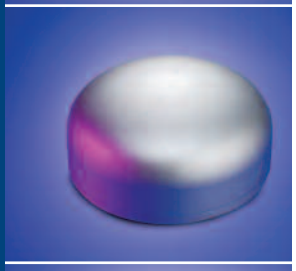


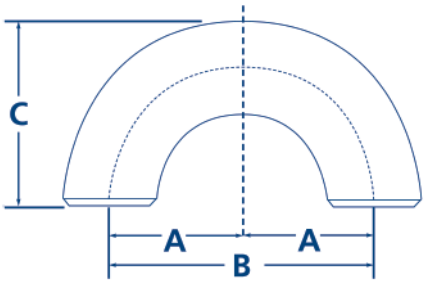




Butt Weld Returns & Short Radius Elbows



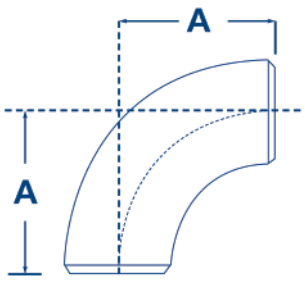


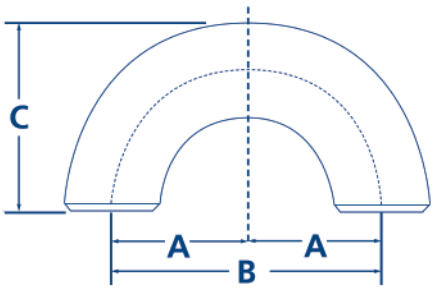
Dimensions (Based on ASME B16.9) and Example Weights for Long Radius Returns

Nominal Pipe Size	OD at Bevel		Centre to End (A)		Face to Back (C)		40S/STD[1]
	in	mm	in	mm	in	mm	kg/piece
½	0.84	21	3	76	1.88	48	0.20
¾	1.05	27	2.25	57	1.69	43	0.16
1	1.32	33	1.5	38	2.2	56	0.30
1¼	1.66	42	1.88	48	2.75	70	0.52
1½	1.90	46	2.25	57	3.26	83	0.80
2	2.38	60	3	76	4.18	106	1.40
2½	2.88	73	3.75	95	5.2	132	2.80
3	3.50	89	4.5	114	6.25	159	5.00
4	4.50	114	6	152	8.25	210	8.00
6	6.62	168	9	229	12.32	313	22.00
8	8.62	219	12	305	16.3	414	44.00

Notes
- Dimensions quoted in mm are 'Nominal' values from ASME B16.9 (i.e., rounded equivalents of the inch dimensions). Refer to ASME B16.9 for additional 'Max' and 'Min' metric dimensions.
- For tolerances see page 16.
- These fittings can also be supplied with dimensions in accordance with DIN 2605

1 Weights are approximate and based on manufacturers' data (where available) for schedule 40S/Standard fittings. B = 2 x A.

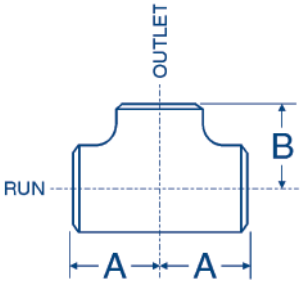




Dimensions (Based on ASME B16.28) and Example Weights for Short Radius Elbows and Returns

Nominal Pipe Size	OD at Bevel		Centre to End (A)		Face to Back (C)		40S/STD[1]
	in	mm	in	mm	in	mm	kg/piece
1	1.32	33	1	25	1.6	41	0.24
1¼	1.66	42	1.25	32	2	52	0.40
1½	1.90	46	1.50	38	2.4	62	0.48
2	2.38	60	2	51	3.2	81	1.02
2½	2.88	73	2.5	64	4	100	2.04
3	3.50	89	3	76	4.76	121	3.00
4	4.50	114	4	102	6.26	159	6.21
6	6.62	168	6	152	9.3	236	15.9
8	8.62	219	9	204	7.95	313	35.5

Butt Weld Equal Tees

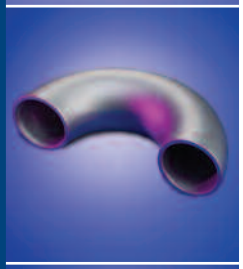


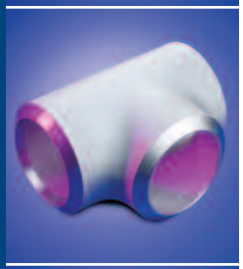
Dimensions (Based on ASME B16.9) and Example Weights Equal Tees

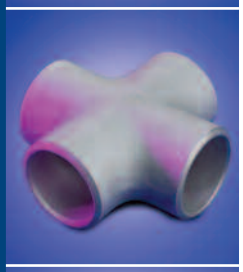
Nominal Pipe Size (NPS)	OD at Bevel		Run		Outlet		Weight
	OD		A		B		40S/STD[1]
	in	mm	in	mm	in	mm	kg/piece
½	0.84	21	1.00	25	1.00	25	0.16
¾	1.05	27	1.12	29	1.12	29	0.23
1	1.32	33	1.50	38	1.50	38	0.35
1¼	1.66	42	1.88	48	1.88	48	0.65
1½	1.90	48	2.25	57	2.25	57	1.35
2	2.38	60	2.50	64	2.50	64	1.70
2½	2.88	73	3.00	76	3.00	76	2.70
3	3.50	89	3.38	86	3.38	86	3.75
3½	4.00	102	3.75	95	3.75	95	5.25
4	4.50	114	4.12	105	4.12	105	6.15
5	5.56	141	4.88	124	4.88	124	10.0
6	6.62	168	5.62	143	5.62	143	16.0
8	8.62	219	7.00	178	7.00	176	27.0

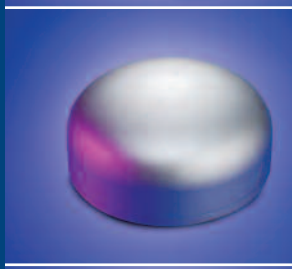
Notes
- Dimensions quoted in mm are 'Nominal' values from ASME B16.9 (i.e., rounded equivalents of the inch dimensions). Refer to ASME B16.9 for additional 'Max' and 'Min' metric dimensions.
- For tolerances see page 16.

1 Weights are approximate and based on manufacturers' data (where available) for schedule 40S/Standard fittings.

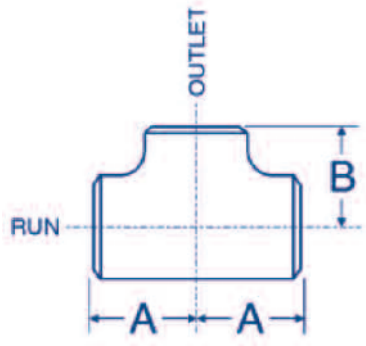








Butt Weld Reducing Tees



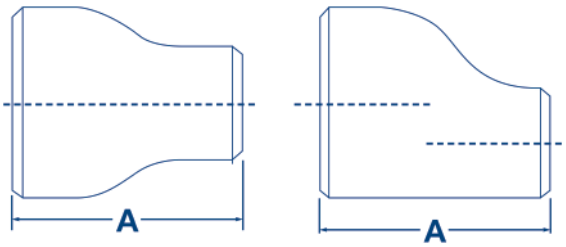
Dimensions (Based on ASME B16.9) and Example Weights Reducing Tees

Nominal Pipe Size (NPS)	Run OD		Outlet OD		Run		Outlet		Weight
	OD at Bevel		OD at Bevel		A		B		40S/STD[1]
	in	mm	in	mm	in	mm	in	mm	kg/piece
½to ⅜	0.84	21	0.68	17	1.00	25	1.00	25	0.16
½ to ¼	0.84	21	0.54	14	1.00	25	1.00	25	0.16
¾ to ½	1.05	27	0.84	21	1.12	29	1.12	29	0.23
¾ to ⅜	1.05	27	0.68	17	1.12	29	1.12	29	0.23
1 to ¾	1.32	33	1.05	27	1.50	38	1.50	38	0.35
1 to ½	1.32	33	0.84	21	1.50	38	1.50	38	0.35
1¼ to 1	1.66	42	1.32	33	1.88	48	1.88	48	0.65
1¼ to ¾	1.66	42	1.05	27	1.88	48	1.88	48	0.65
1¼ to ½	1.66	42	0.84	21	1.88	48	1.88	48	0.65
1½ to 1¼	1.90	48	1.66	42	2.25	57	2.25	57	1.35
1½ to 1	1.90	48	1.32	33	2.25	57	2.25	57	1.35
1½ to ¾	1.90	48	1.05	27	2.25	57	2.25	57	1.35
1½ to ½	1.90	48	0.84	21	2.25	57	2.25	57	1.35
2 to 1½	2.38	60	1.90	48	2.50	64	2.38	60	1.70
2 to 1¼	2.38	60	1.66	42	2.50	64	2.25	57	1.70
2 to 1	2.38	60	1.32	33	2.50	64	2.00	51	1.70
2 to ¾	2.38	60	1.05	27	2.50	64	1.75	44	1.70
2 to ½	2.38	60	0.84	21	2.50	64	2.00	51	1.70
3 to 2	3.50	89	2.38	60	3.38	86	3.00	76	3.75
3 to 1½	3.50	89	1.90	48	3.38	86	2.88	73	3.75
3 to 1	3.50	89	1.66	33	3.38	86	2.75	70	3.75
4 to 3	4.50	114	3.50	89	4.12	105	3.88	98	6.56
4 to 2½	4.50	114	2.88	73	4.12	105	3.75	95	6.56
4 to 2	4.50	114	2.38	60	4.12	105	3.50	89	6.56
4 to 1½	4.50	114	1.90	48	4.12	105	3.38	86	6.56
4 to 1	4.50	114	1.32	33	4.12	105	3.38	86	6.56
5 to 4	5.56	141	4.50	114	4.88	124	4.62	117	10.00
5 to 3	5.56	141	3.50	89	4.88	124	4.38	111	10.00
5 to 2	5.56	141	2.38	60	4.88	124	4.12	105	10.00
6 to 5	6.62	168	5.56	141	5.62	143	5.38	137	35.00
6 to 4	6.62	168	4.50	114	5.62	143	5.12	130	35.00
6 to 3	6.62	168	3.50	89	5.62	143	4.88	124	35.00
6 to 2	6.62	168	2.38	60	5.62	1.43	4.88	124	35.00
8 to 6	8.62	219	6.62	168	7.00	178	6.62	168	50.00
8 to 5	8.62	219	5.56	141	7.00	178	6.38	162	50.00
8 to 4	8.62	219	4.50	114	7.00	178	6.12	156	50.00
8 to 3	8.62	219	3.50	89	7.00	178	6.00	152	50.00

Notes
- Dimensions quoted in mm are 'Nominal' values from ASME B16.9 (i.e., rounded equivalents of the inch dimensions). Refer to ASME B16.9 for additional 'Max' and 'Min' metric dimensions.
- For tolerances see page 16.

1 Weights are approximate and based on manufacturers' data (where available) for schedule 40S/Standard fittings.

Butt Weld Reducers

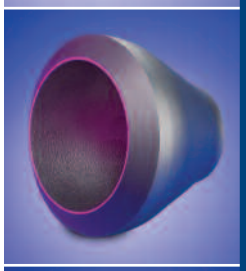


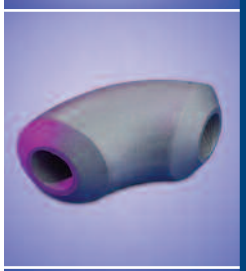
Dimensions (Based on ASME B16.9) and Example Weights for Reducers

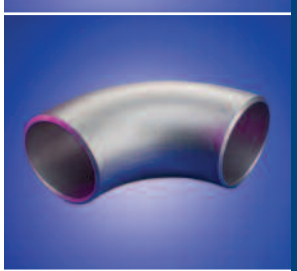
Nominal Pipe Size (NPS)	Large End OD at Bevel		Small End OD at Bevel		End to End A		Weight 40S/STD[1]
	in	mm	in	mm	in	mm	kg/piece
¾ to ½	1.05	27	0.84	21	1.50	38	0.07
¾ to ⅜	1.05	27	0.68	17	1.50	38	0.07
1 to ¾	1.32	33	1.05	27	2.00	51	0.13
1 to ½	1.32	33	0.84	21	2.00	51	0.13
1¼ to 1	1.66	42	1.32	33	2.00	51	0.18
1¼ to ¾	1.66	42	1.05	27	2.00	51	0.18
1½ to 1¼	1.90	42	1.66	42	2.50	64	0.26
1½ to 1	1.90	48	1.32	33	2.50	64	0.26
1½ to ¾	1.90	48	1.05	27	2.50	64	0.26
1½ to ½	1.90	48	0.84	21	2.50	64	0.26
2 to 1½	2.38	60	1.90	48	3.00	76	0.41
2 to 1¼	2.38	60	1.66	42	3.00	76	0.41
2 to 1	2.38	60	1.32	33	3.00	76	0.41
2 to ¾	2.38	60	1.05	27	3.00	76	0.41
2 to ½	2.38	60	0.84	21	3.00	76	0.41
2½ to 2	2.88	73	2.38	60	3.50	89	0.77
2½ to 1½	2.88	73	1.90	48	3.50	89	0.77
2½ to 1¼	2.88	73	1.67	42	3.50	89	0.77
2½ to 1	3.50	89	1.32	33	3.50	89	0.77
3 to 2½	3.50	89	2.88	73	3.50	89	1.00
3 to 2	3.50	89	2.38	60	3.50	89	1.00
3 to 1½	3.50	89	1.90	48	3.50	89	1.00
3 to 1¼	3.50	102	1.67	42	3.50	89	1.00
3 to 1	3.50	89	1.32	33	3.50	89	1.00
4 to 3	4.50	114	3.50	89	4.00	102	1.60
4 to 2½	4.50	114	2.88	73	4.00	102	1.60
4 to 2	4.50	114	2.38	60	4.00	102	1.60
4 to 1½	4.50	114	1.90	48	4.00	102	1.60
5 to 4	5.56	141	4.50	114	5.00	127	2.75
5 to 3	5.56	141	3.50	89	5.00	127	2.75
6 to 5	6.62	168	5.56	141	5.50	140	3.95
6 to 4	6.62	168	4.50	114	5.50	140	3.95
6 to 3	6.62	168	3.50	89	5.50	140	3.95
6 to 2	6.63	168	2.38	60	5.50	127	3.95
8 to 6	8.62	219	6.62	168	6.00	152	6.50
8 to 4	8.62	219	4.50	114	6.00	152	6.50
10 to 8	10.75	273	8.62	219	7.00	178	10.70
10 to 6	10.75	273	6.62	168	7.00	178	10.70
12 to 10	12.75	324	10.75	273	8.00	203	15.0
12 to 8	12.75	324	8.62	219	8.00	203	15.0
12 to 6	12.75	324	6.62	168	8.00	203	15.0

Notes
- Dimensions quoted in mm are 'Nominal' values from ASME B16.9 (i.e., rounded equivalents of the inch dimensions). Refer to ASME B16.9 for additional 'Max' and 'Min' metric dimensions.
- For tolerances see page 16.

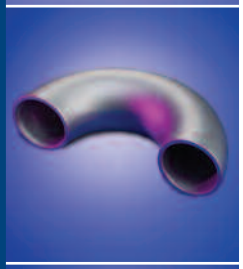
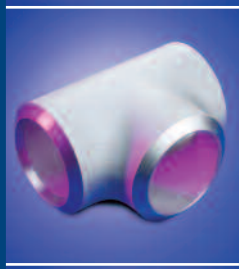
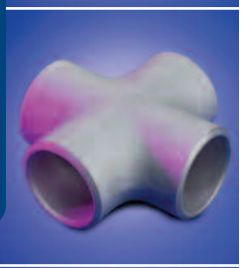
1 Weights are approximate and based on manufacturers' data (where available) for schedule 40S/Standard fittings.



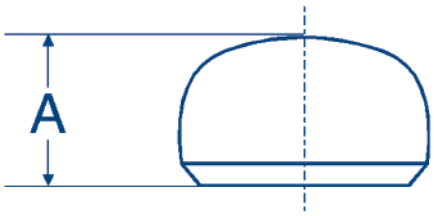




Butt Weld End Caps





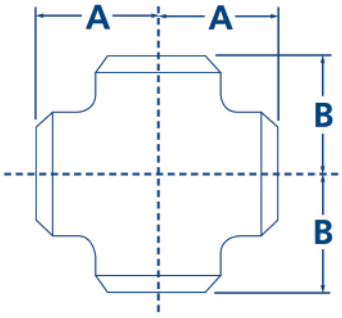
Dimensions (Based on ASME B16.9) and Example Weights

Common			Limiting Wall Thickness		Length for Wall T		Length for Wall >T		Weight
Nominal Pipe Size (NPS)	OD at Bevel		T		A				40S/STD[1]
	in	mm	in	mm	in	mm	in	mm	kg/piece
½	0.84	21	0.147	3.73	1.00	25	1.00	25	0.05
¾	1.05	27	0.15	3.91	1.00	25	1.00	25	0.09
1	1.32	33	0.18	4.55	1.50	38	1.50	38	0.13
1¼	1.66	42	0.19	4.85	1.50	38	1.50	38	0.19
1½	1.90	48	0.20	5.08	1.50	38	1.50	38	0.23
2	2.38	60	0.22	5.54	1.50	38	1.75	44	0.30
2½	2.88	73	0.28	7.01	1.50	38	2.00	51	0.45
3	3.50	89	0.30	7.62	2.00	51	2.50	64	0.85
3½	4.00	102	032	8.08	2.50	64	3.00	76	1.20
4	4.50	114	0.34	8.56	2.50	64	3.00	76	1.60
5	5.56	141	0.38	9.53	3.00	76	3.50	89	2.70
6	6.62	168	0.43	10.97	3.50	89	4.00	102	4.40
8	8.62	219	0.50	12.70	4.00	102	5.00	127	8.35
10	10.75	273	0.50	12.70	5.00	127	6.00	152	13.60
12	12.75	324	0.50	12.70	6.00	152	7.00	178	22.50
14	14	356	0.50	12.70	6.50	165	7.50	191	27.00
16	16	406	0.50	12.70	7.00	178	8.00	203	31.50
18	18	457	0.50	12.70	8.00	203	9.00	229	36.00

Notes
- Dimensions quoted in mm (except T) are 'Nominal' values from ASME B16.9 (rounded equivalents of the inch dimensions).
  Refer to ASME B16.9 for additional 'Max' and 'Min' metric dimensions.
- The shape of caps shall be ellipsoidal and conform to shape requirements in the ASME Boiler and Pressure Code.
- For tolerances see page 16.

1 Weights are approximate and based on manufacturers' data (where available) for Schedule 40S/Standard fittings.

Butt Weld Crosses



Dimensions (Based on ASME B16.9) for Butt Weld Crosses

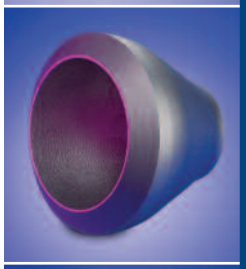
Nominal Pipe Size	OD at Bevel		Centre to End (Run) A		Centre to End (Outlet) B		Weight
	in	mm	in	mm	in	mm	kg/piece
½	0.84	21.3	1	25	1	25	0.13
¾	1.05	26.7	1.12	29	1.12	29	0.25
1	1.32	33.4	1.5	38	1.5	38	0.38
1¼	1.66	42.2	1.88	48	1.88	48	1.75
1½	1.9	48.3	2.25	57	2.25	57	1.50
2	2.38	60.3	2.5	64	2.5	64	1.90

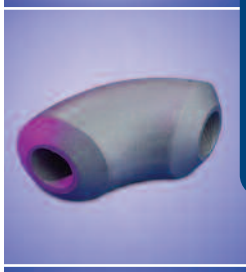
Notes

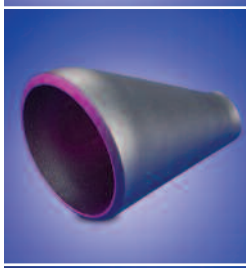
Reducing Crosses are available please contact the sales department for details.

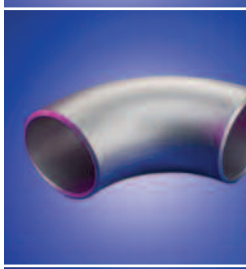
- Dimensions quoted in mm are 'Nominal' values from ASME B16.9 (i.e., rounded equivalents of the inch dimensions). Refer to ASME B16.9 for additional 'Max' and 'Min' metric dimensions.
- For tolerances see page 16.

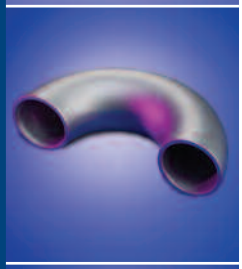
1 Weights are approximate and based on manufacturers' data (where available) for schedule 40S/Standard fittings.

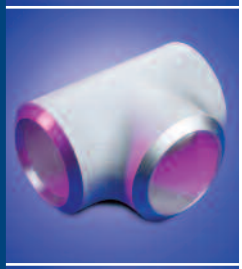


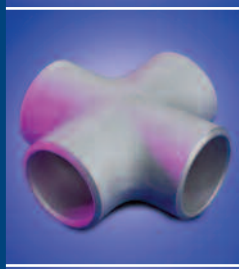




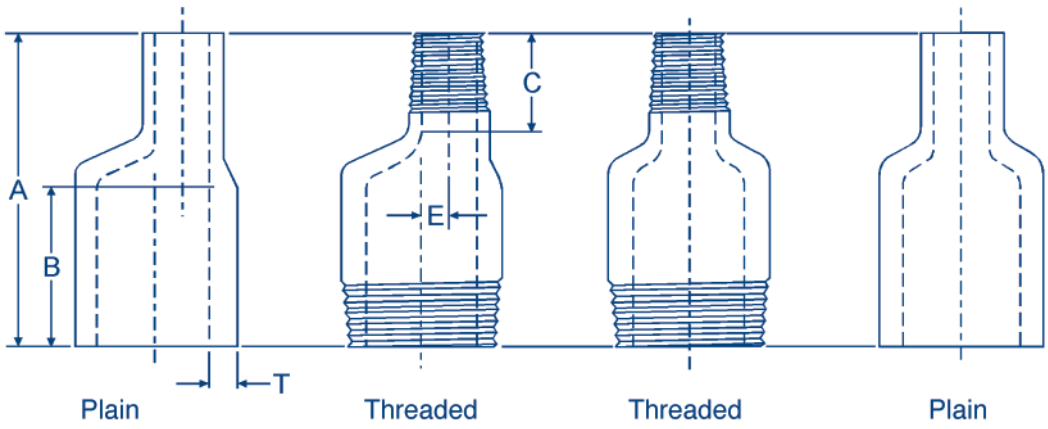








Swage Nipples - BS 3799



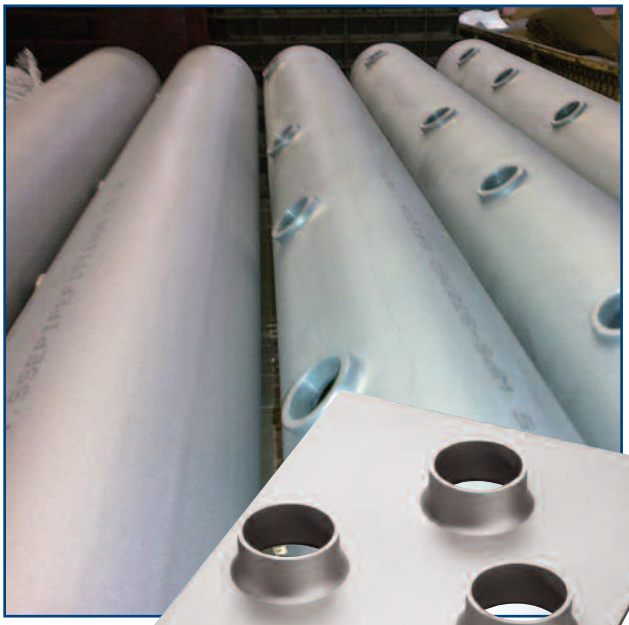
Dimensions of swage nipples (BS 3799:1974)

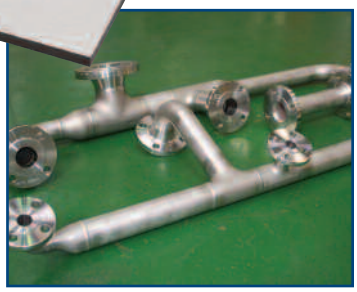
Nominal Size		Parallel Length, min			Eccentricity		Wall Thickness		
		A	B	C	E		T (both ends)		
in	mm	mm	mm	mm	mm	in	Threaded/ Plain	Plain	Threaded
⅜ x ¼	10 x 8	76	48	16	1.6	0.06	Schedule 80	-	-
½ x ⅜	15 x 10	89	56	19	1.6	0.06		-	-
½ x ¼	15 x 8	89	56	19	3.2	0.12		-	-
¾ x ½	20 x 15	95	57	22	2.4	0.09		Schedule 160	XXS
¾ x ⅜	20 x 10	95	57	22	4.0	0.15		-	-
1 x ¾	25 x 20	102	64	22	2.8	0.11			
1 x ½	25 x 15	102	64	22	5.2	0.20			
1½ x 1	40 x 25	114	70	25	6.7	0.26			
1½ x ¾	40 x 20	114	70	25	9.5	0.37			
1½ x ½	40 x 15	114	70	25	11.9	0.46			
2 x 1½	50 x 40	165	108	29	5.8	0.20			
2 x 1	50 x 25	165	108	29	12.7	0.5			
2 x ¾	50 x 20	165	108	29	15.5	0.61		Schedule 160	XXS
2 x ½	50 x 15	165	108	29	17.5	0.68			
2½ x 2	65 x 50	178	114	32	4.8	0.19			
2½ x 1½	65 x 40	178	114	32	10.3	0.40			
3 x 2½	80 x 65	203	133	41	7.1	0.28			
3 x 2	80 x 50	203	133	41	11.9	0.48			
3 x 1½	80 x 40	203	133	41	17.5	0.69			
4 x 3	100 x 80	229	140	48	11.9	0.46			
4 x 2½	100 x 65	229	140	48	19.1	0.75			

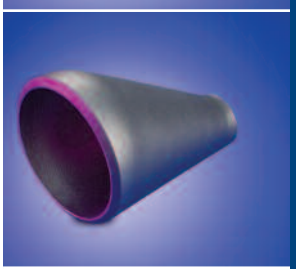
Notes
Swaged Nipples can also be supplied to MSS or customers' specifications

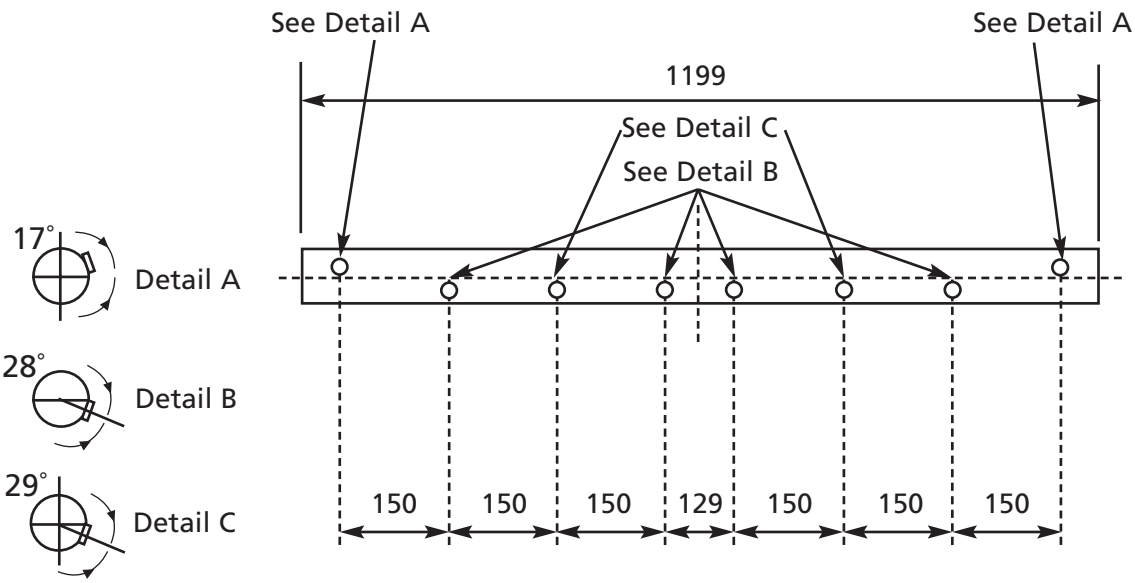
Manifolds and Headers

We manufacture seamless headers/manifolds & specials to customers' drawings and specifications

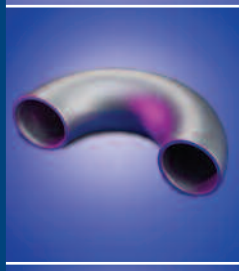


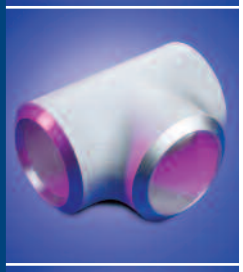


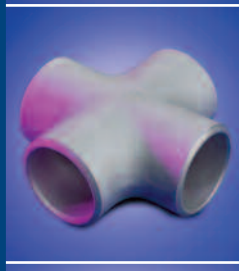


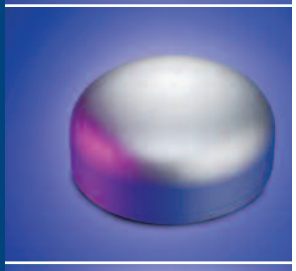


With kind permission of High Tech Fabrications Ltd, Gloucester.

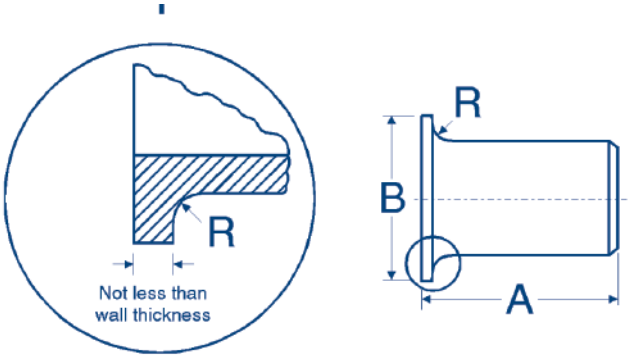








Lap Joint Stub Ends



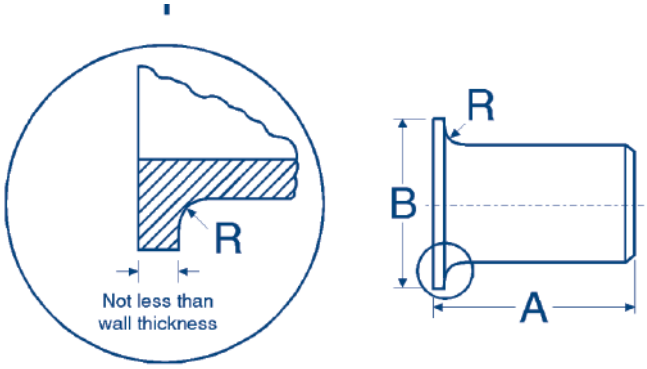
Dimensions (based on ASME B16.9) and example weights

Common			Long Pattern		Short Pattern		Diameter of Lap		Radius of Fillet		OD of Barrel				Weight
Nominal Pipe Size	OD		A		A		B		R		OD Max		OD Min		40S/STD[1]
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	kg/piece
½	0.84	21	3.00	76	2.00	51	1.38	35	0.12	3	0.90	23	0.81	21	0.14
¾	1.05	27	3.00	76	2.00	51	1.38	43	0.12	3	1.11	28	1.02	26	0.18
1	1.32	33	4.00	102	2.00	51	2.00	51	0.12	3	1.38	35	1.28	33	0.30
1½	1.66	42	4.00	102	2.00	51	2.50	64	0.19	5	1.72	44	1.63	41	0.41
1¼	1.80	48	4.00	102	2.00	51	2.88	73	0.25	6	1.97	50	1.87	47	0.55
2	2.38	60	6.00	152	2.50	64	3.63	92	0.31	8	2.46	62	2.34	60	1.00
2½	2.88	73	6.00	152	2.50	64	4.12	105	0.31	8	2.97	75	2.84	72	1.56
3	3.50	69	6.00	152	2.50	64	5.00	127	0.68	10	3.60	91	3.47	88	2.15
3½	4.00	102	6.00	152	3.00	76	5.50	140	0.38	10	4.10	104	3.97	101	2.60
4	4.50	114	6.00	152	3.00	76	6.19	157	0.44	11	4.59	117	4.47	114	3.05
5	5.56	141	8.00	203	3.00	76	7.31	186	0.44	11	5.68	144	5.53	141	5.30
6	6.62	168	8.00	203	3.50	89	8.50	218	0.50	13	6.74	171	6.59	168	6.90
8	8.62	219	8.00	203	4.00	102	10.62	270	0.50	13	8.74	222	8.59	218	10.45

Notes
- Dimensions quoted in mm are 'Nominal' values from ASME B16.9 (rounded equivalents of the inch dimensions). Refer to ASME B16.9 for additional 'Max' and 'Min' metric dimensions.
- OD of barrel max and min dimensions (in and mm) are rounded. Refer to ASME B16.9 for the exact values.
- Long pattern stub ends are standard. Purchaser should specify if short pattern is required.
  Long pattern stub ends are also known as ASA Stub Ends. Short pattern stub ends are used with larger flanges in Classes 300 and 600, and with most sizes in Class 900 and higher.
  When long pattern stub ends are used with flanges in Classes 1500 and 2500, it may be necessary to increase the length A.
- Additional lap thickness must be provided for special facings (e.g. tongue and groove); this is within length A.
- Dimension B conforms to ASME B16.5, Pipe Flanges and Forged Fittings.
  Gasket face finish shall be accordance with ASME B16.5 for raised face flanges.
- For tolerances see page 16.

1 Long pattern weights are listed (short pattern weights are similar to MSS SP-43 lap joint stub ends, page 15). Weights are approximate and based on manufacturers' data (where available) for Schedule 40S/Standard fittings.

Lap Joint Stub Ends

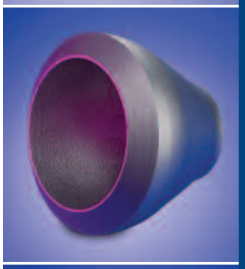


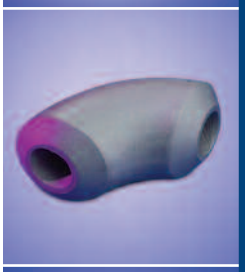
Dimensions (based on MSS SP-43) and example weights

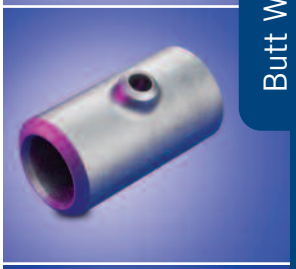
Common			Length		Diameter of Lap		Radius of Fillet				Weight
Nominal Pipe Size	OD		A		B		Type A for Lap Joint Flange R		Type B for Lap Joint Flange		40S/STD[1]
	in	mm	in	mm	in	mm	in	mm	in	mm	kg/piece
½	0.84	21	2.00	51	1.38	35	0.12	3.05	0.03	0.76	0.09
¾	1.05	27	2.00	51	1.69	43	0.12	3.05	0.03	0.76	0.12
1	1.32	33	2.00	51	2.00	51	0.12	3.05	0.03	0.76	0.15
1½	1.66	42	2.00	51	2.50	54	0.19	4.83	0.03	0.76	0.20
1¼	1.90	48	2.00	51	2.88	73	0.25	6.35	0.03	0.76	0.28
2	2.38	60	2.50	64	3.63	92	0.31	7.87	0.03	0.76	0.41
2½	2.88	73	2.50	64	4.13	105	0.31	7.87	0.03	0.76	0.66
3	3.50	89	2.50	64	5.00	127	0.38	9.65	0.03	0.76	0.89
3½	4.00	102	3.00	76	5.50	140	0.38	6.65	0.03	0.76	1.21
4	4.50	114	3.00	76	6.19	157	0.44	11.18	0.03	0.76	1.51
5	5.56	141	3.00	76	7.31	186	0.44	11.18	0.06	1.52	2.66
6	6.63	168	3.50	89	8.50	218	0.50	12.70	0.06	1.52	3.02
8	8.63	219	4.00	102	10.62	270	0.50	12.70	0.06	1.52	5.22

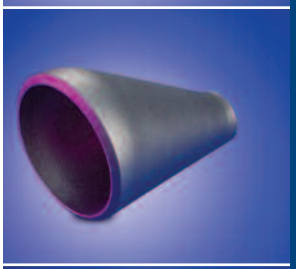
Notes
- Dimensions quoted in mm are equivalents of the inch dimensions (i.e. 25.4 x in). Metric dimensions are not specified in MSS SP-43.
- Length A and Radius R are applicable for Schedule 40S or thinner.
- Contact faces of stub ends shall have a modified spiral or concentric serration.
- For tolerances see page 16.

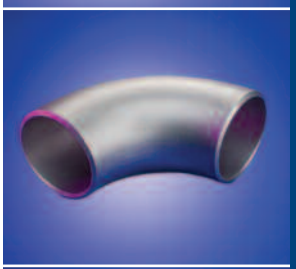
1 Weights are approximate and based on manufacturers' data (where available) for Schedule 40S/Standard fittings.

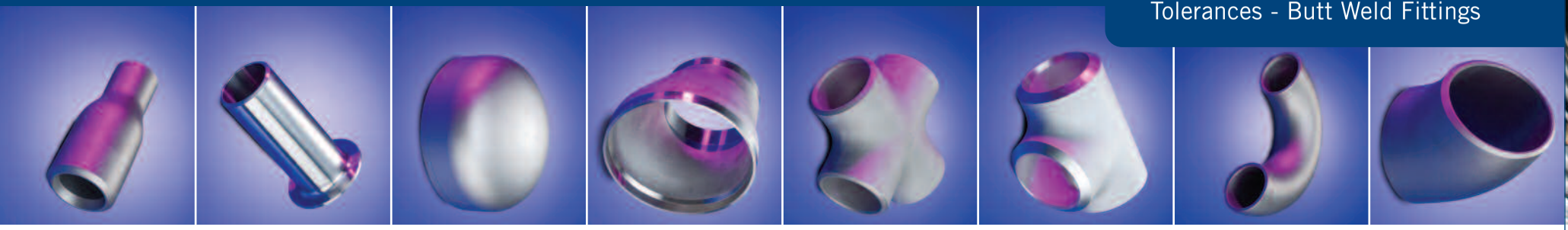






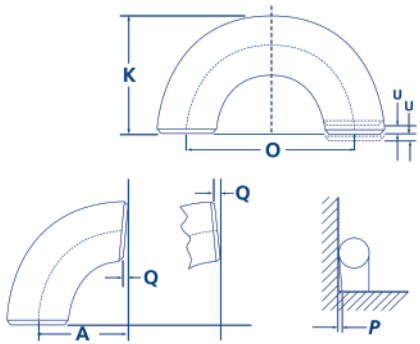




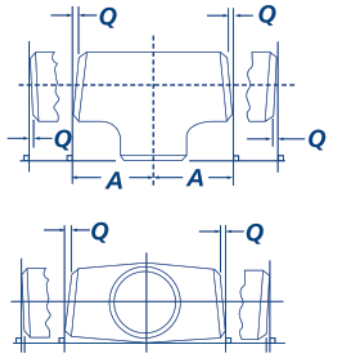


Tolerances

All Fittings					Center-to-end Dimensions of 90° and 45° Elbows and Tees, *A,B,C,M*	Overall Length of Reducers and Lap Joint Stub Ends, *F, H*	Overall Length of Caps, *E*	180° Returns		
Nominal Pipe Size (NPS)	(DN)	Outside Diameter at Bevel, *D* (notes 1 and 2)	Inside Diameter at End (Notes 1, 3, and 4)	Wall Thickness, *t* (Note 3)				Center-to-Center Dimension, *O*	Back-to-Face Dimension, *K*	Alignment of Ends, *U*
½ to 2½	15–65	+1.6–0.8	0.8	Not less than 87.5% of Nominal Thickness	2	2	3	6	6	1
3 to 3½	80–90	+1.6	1.6		2	2	3	6	6	1
4	100	+1.6	1.6		2	2	3	6	6	1
5 to 8	125–200	+2.4–1.6	1.6		2	2	6	6	6	1
10 to 18	250–450	+4.0–3.2	3.2		2	2	6	10	6	2



Nominal Pipe Size (NPS)	(DN)	Lap Joint Stub Ends				Nominal Pipe Size (NPS)	(DN)	Angularity Tolerances	
		Outside Diameter of Lap, *G*	Fillet Radius of Lap, *R*	Outside Diameter of Barrel	Lap Thickness			Off Angle, *Q*	Off Plane, *P*
½ to 2½	15–65	+0–1	+0–1	See pages 14 and 15 for Dimensions	+1.6–0	½ to 4	15–100	1	2
3 to 3½	80–90	+0–1	+0–1		+1.6–0	5 to 8	125–200	2	4
4	100	+0–1	+0–2		+1.6–0	10 to 12	250–300	2	5
5 to 8	125–200	+0–1	+0–2		+1.6–0	14 to 16	350–400	3	6
10 to 18	250–450	+0–2	+0–2		+3.2–0	18 to 24	450–600	4	10



General Notes

a All dimensions are in millimetres

b Tolerances are equal plus and minus except as noted

General Notes

1 Out-of-round is the sum of absolute values of plus and minus tolerances.

2 This tolerance may not apply in localized areas of formed fittings where increased wall thickness is required to meet design requirements of para 2.2. (ASME B16.9)

3 The inside diameter and the nominal wall thicknesses at ends are to be specified by the purchaser.

4 Unless otherwise specified by the purchaser, these tolerances apply to the nominal inside diameter, which equals the difference between the nominal outside diameter and twice the nominal wall thickness

Chemical Compositions - Duplex, Nickel Alloys, Titanium

Chemical Compositions - ASTM B861 Titanium

	Nickel Ni	Carbon C	Hydrogen H	Iron Fe	Oxygen O	Total Impurities Imp	Titanium Ti
Grade 2	0.03	0.08	0.015	0.30	0.25	0.10	Balance

Chemical Compositions - ASTM A790/790M Duplex, Super Duplex

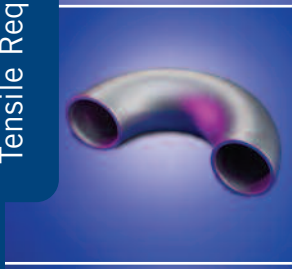
UNS	Composition Percentage, Max or Range								
	Carbon C	Manganese Mn	Phosphorus P	Sulphur S	Silicon Si	Nickel Ni	Chromium Cr	Molybdenum Mo	Nitrogen N
S31803	0.030	2.00	0.030	0.020	1.00	4.5-6.5	21.0-23.0	2.5-3.5	0.08-0.20
S32205	0.03	2.00	0.03	0.02	1.00	4.5-6.5	22.0-23.0	3.0-3.5	0.14-0.20
S32550	0.04	1.50	0.040	0.030	1.00	4.5-6.5	24.0-27.0	2.9-3.9	0.10-0.25
S32750	0.030	1.20	0.035	0.020	0.80	6.0-8.0	24.0-26.0	3.0-5.0	0.24-0.32
S32760	0.05	1.00	0.030	0.010	1.00	6.0-8.0	24.0-26.0	3.0-4.0	0.20-0.30

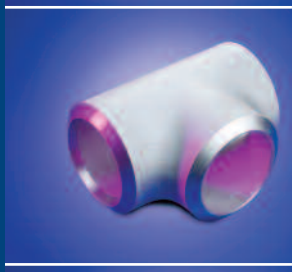
Chemical Compositions - ASTM - Nickel Alloys

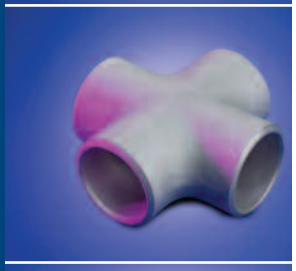
UNS	Composition Percentage, Max or Range													
	Nickel Ni	Chromium Cr	Iron Fe	Manganese Mn	Carbon C	Copper Cu	Silicon Si	Sulphur S	Aluminium Al	Titanium Ti	Columbium Tantalum	Cobalt Co	Nitrogen N	Molybdenum Mo
N02200	99.0 min	-	0.40 max	0.35 max	0.15 max	0.25 max	0.35 max	0.01 max	-	-	-	-	-	-
N04400	63.0 min	-	2.5 max	2.0 max	0.3 max	28.0-34.0	0.5 max	0.024 max	-	-	-	-	-	-
N06600	72.0 min	14.0-17.0	8.0-10.0	1.0 max	0.15 max	0.5 max	0.5 max	0.15 max	-	-	-	-	-	-
N06022	54.5 min	20.0-22.5	2.0-6.0	0.50 max	0.15 max	-	0.08 max	0.02	P 0.02	V 0.35	W 2.5-3.5	2.50 max		12.5-14.5
N06455	Remainder	14.0-8.0	3.0 max	1.0 max	0.015 max	-	0.08 max	0.03 max	-	0.70 max	-	-	-	14.0-17.0
N06625	58.0 min	22.0-23.0	5.0 max	0.5 max	0.10 max	-	0.50 max	0.015 max	0.40 max	0.40 max	3.15-4.15	1.0 max	-	8.0-10.0
N08020	32.0-38.0	19.0-21.0	Balance	2.0 max	0.07	3.0-4.0	1.0 max	0.035	P 0.045	-	-	-	-	2.0-3.0
N08028	32.0-38.0	19.0-21.0	Balance	2.0 max	0.07	0.6-1.40	1.00	0.035	-	-	-	-	-	-
N08810	30.0-35.0	19.0-23.0	39.5 min	1.5 max	0.05-0.10	0.75 max	1.0 max	0.015 max	0.15-0.60	-	-	-	-	-
N08825	38.0-46.0	19.5-23.5	22.0 min	1.0 max	0.05 max	1.5-3.0	0.5 max	0.03 max	0.2 max	0.6-1.2	-	-	-	2.5-3.5
N08904	23.0-28.0	19.0-23.0	Balance	2.0 max	0.020 max	1.2-2.0	1.0 max	0.035 max	-	-	-	-	-	4.0-5.0
N08925	24.0-26.0	19.0-21.0	Balance	1.0 max	0,020 max	0.8-1.5	0.50 max	0.030 max	-	-	-	-	0.1-0.2	6.0-7.0
N08926	24.0-26.0	19.0-21.0	Balance	2.0 max	0.020 max	0.5-1.5	0.5 max	0.01 max	-	-	-	-	0.15-0.25	6.0-7.0
N10276	Remainder	14.5-16.5	4.0-7.0	1.0 max	0.010 max	2.5 max	0.08 max	0.03 max	-	-	-	-	-	15.0-17.0
N10665	Remainder	1.0 max	2.0 max	1.0 max	0.02 max	1.0 max	0.10 max	0.03 max	-	-	-	-	-	26.0-30.0

Chemical Compositions - ASTM A403 - 6.Mo

UNS	Composition Percentage, Max or Range									
	Carbon C	Manganese Mn	Phosphorus P	Sulphur S	Silicon Si	Nickel Ni	Chromium Cr	Molybdenum Mo	Nitrogen N	Copper Cu
S32154	0.02	1.00	0.30	0.01	0.80	17.50-18.50	19.50-20.50	6.00-6.50	0.18-0.22	0.50-1.00







Tensile Requirements

Tensile Requirements - Nickel Pipe

Grade	UNS	Tensile Strength min		Yield Strength min		Elongation in 2 in (50mm or 4D min %
		ksi	MPa	ksi	MPa	
ASTM B161	N02200	55	380	11.6	80	40
ASTM B165	N04400	70	480	28	195	35
ASTM B167	N06600	80	550	35	240	30
ASTM B407	N08810	65	450	25	170	30
ASTM B423	N08825	75	517	25	172	30
ASTM B444	N06625	120	827	60	414	30
ASTM B622	N06022	100	690	45	310	45
ASTM B622	N06455	100	690	40	276	40
ASTM B622	N10276	100	690	41	283	40
ASTM B622	N10665	110	760	51	350	40
ASTM B668	N08028	73	500	31	214	40
ASTM B677	N08904	71	490	31	220	35
ASTM B677	N08925	87	600	43	300	40
ASTM B677	N08926	94	650	43	295	35
ASTM B729	N08020	80	550	35	240	30

Tensile and Hardness Requirements - Duplex, Super Duplex & 6.Mo Fittings ASTM

Grade	UNS	Tensile Strength min		Yield Strength min		Elongation in 2 in (50mm or 4D min %	Brinell Hardness BHN max
		ksi	MPa	ksi	MPa		
A815	S31803	90	620	65	450	25	290
A815	S32550	112	700	80	550	15	302
A815	S32750	116-140	800-965	80	550	15	310
A815	S32760	109-130	750-895	80	550	25	270
A815	S32205	95	655	70	485	15	290
A403	S31254	94-119	650-820	44	300	28	-

Tensile Requirements - Stainless Steel

Grade	UNS	Tensile Strength min		Yield Strength min		Elongation in 2 in (50mm or 4D min %
	ksi	ksi	MPa	ksi	MPa	
All	All	75	515	30	205	35
All = All grades listed in the chemical composition table except those listed below						
TP304L	S30403	70	485	25	170	35
TP304N	S30451	80	550	35	240	35
	S31272	65	450	29	200	35
TP316L	S31603	70	485	25	170	35
TP316N	S31651	80	550	35	240	35
TP321	S32100	75	515	30	205	35
TP321H	S32109	75	515	30	205	35
	S31803	90	620	65	450	25
	S32550	112	700	80	550	15
	S32750	116	800	80	550	15
	S32760	109	750	80	550	25
	S31254	98	675	45	310	28

Tensile Requirements - Titanium Pipe

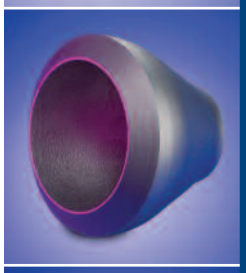
Grade	Tensile Strength min		Yield Strength min		Elongation in 2 in (50mm or 4D min %
	ksi	MPa	ksi	MPa	
Grade 2	50	345	40-80	275-480	20

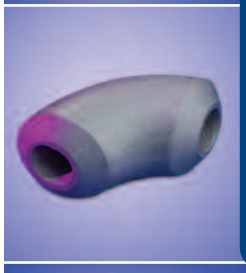
Chemical Compositions - Stainless Steel

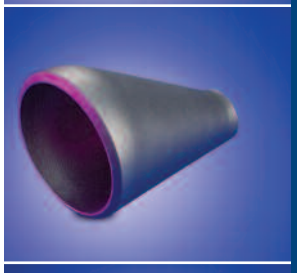
PIPEFITTINGS LTD

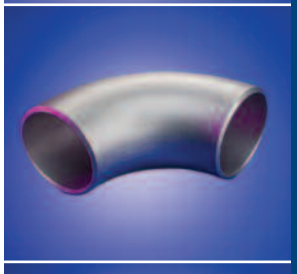
Chemical Compositions - ASTM A312/A312M

Grade	UNS	Composition Percentage, Max or Range											
		Carbon C	Manganese Mn	Phosphorus P	Sulphur S	Silicon Si	Nickel Ni	Chromium Cr	Molybdenum Mo	Titanium Ti	Niobium Nb	Nitrogen N	Aluminium Al
304	S30400	0.07	2.00	0.045	0.030	0.75	8.00-10.50	17.50-19.50	-	-	-	0.10	-
304L	S30403	0.03	2.00	0.045	0.030	0.75	8.00-12.00	17.50-19.50	-	-	-	0.10	-
304H	S30409	0.04-0.10	2.00	0.045	0.030	1.00	8.00-11.00	18.00-20.00	-	-	-	-	-
310S	S30908	0.08	2.00	0.045	0.030	0.75	12.00-15.00	22.00-24.00	-	-	-	-	-
310H	S31008	0.08	2.00	0.045	0.030	0.75	19.00-22.00	24.00-26.00	-	-	-	-	-
316	S31009	0.04-0.10	2.00	0.045	0.030	0.75	19.00-22.00	24.00-26.00	2.00-3.00	-	-	-	-
316H	S31600	0.08	2.00	0.045	0.030	0.75	10.00-14.00	16.00-18.00	2.00-3.00	-	-	0.10	-
316L	S31603	0.03	2.00	0.045	0.030	0.75	10.00-14.00	16.00-18.00	2.00-3.00	-	-	0.10	-
316H	S31609	0.04-0.10	2.00	0.045	0.030	0.75	10.00-14.00	16.00-18.00	2.00-3.00	-	-	-	-
316Ti	S31635	0.08	2.00	0.045	0.030	0.75	10.00-14.00	16.00-18.00	2.00-3.00	-	-	0.10	-
317	S31700	0.08	2.00	0.045	0.030	0.75	10.00-15.00	18.00-20.00	3.00-4.00	-	-	0.10	-
317L	S31703	0.03	2.00	0.045	0.030	0.75	11.00-15.00	18.00-20.00	3.00-4.00	-	-	0.10	-
321	S32100	0.08	2.00	0.045	0.030	0.75	9.00-12.00	17.00-19.00	-	5x(C+N) min, 0.70 max	-	0.10	-
321H	S32109	0.04-0.10	2.00	0.045	0.030	1.00	9.00-12.00	17.00-19.00		5xC min, 0.60 max			
347	S34700	0.08	2.00	0.045	0.030	0.75	9.00-13.00	17.00-19.00	-	-	10xC min, 1.00 max	-	-
----	S32654	0.020	2.00-4.00	0.030	0.005	0.50	21.00-23.00	24.00-25.00	7.00-8.00			0.45-0.55	Cu 0.30-0.60
6Mo	S31254	0.020	1.00	0.030	0.010	0.80	17.50-18.50	19.50-20.50	6.00-6.50			0.18-0.22	Cu 0.50-1.00

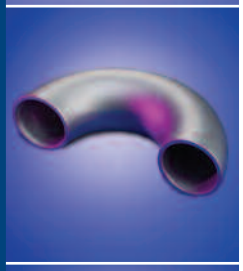
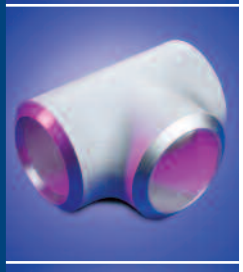
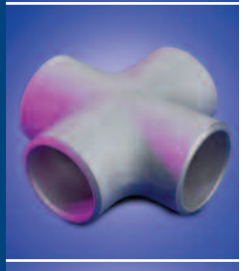


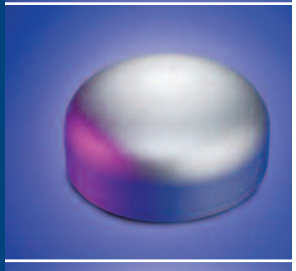






ASTM Pipe

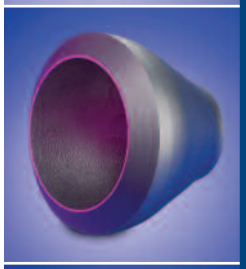


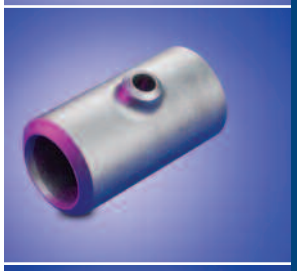
Dimensions and Weights per Metre - Stainless Steel Pipe - ASME B36.19

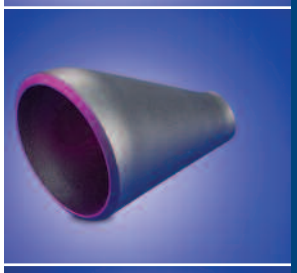
Nominal Pipe Size (NPS)	OD		Schedule 10S			Schedule 40S			Schedule 80S		
	in	mm	in	mm	kg/m	in	mm	kg/m	in	mm	kg/m
⅛	0.405	10.3	0.049	1.24	0.28	0.058	1.73	0.37	0.095	2.41	0.47
¼	0.540	13.7	0.065	1.65	0.49	0.088	2.24	0.63	0.119	3.02	0.80
⅜	0.675	17.1	0.065	1.65	0.63	0.091	2.31	0.84	0.126	3.20	1.10
½	0.840	21.3	0.083	2.11	1.00	0.109	2.77	1.27	0.147	3.73	1.62
¾	1.050	26.7	0.083	2.11	1.28	0.133	2.87	1.69	0.154	3.91	2.20
1	1.315	33.4	0.109	2.77	2.09	0.133	3.38	2.50	0.179	4.55	3.24
1½	1.660	42.2	0.109	2.77	2.70	0.140	3.56	3.39	0.191	4.85	4.17
1¼	1.900	48.3	0.109	2.77	3.11	0.145	3.68	4.05	0.200	5.08	5.41
2	2.375	60.3	0.109	2.77	3.93	0.154	3.91	5.44	0.218	5.54	7.48
2½	2.875	79.0	0.120	3.05	5.26	0.203	5.16	8.63	0.276	7.01	11.41
3	3.500	88.9	0.120	3.05	6.45	0.216	5.49	11.29	0.300	7.62	15.27
3½	4.000	101.0	0.120	3.05	7.40	0.226	5.74	13.57	0.318	8.08	18.63
4	4.500	114.3	0.120	3.05	8.36	0.237	6.02	16.07	0.37	8.58	22.32
5	5.563	141.3	0.134	3.40	11.57	0.258	6.55	21.77	0.375	9.53	30.97
6	6.625	168.3	0.134	3.40	13.84	0.280	7.11	28.26	0.432	10.97	42.56
8	8.625	219.1	0.148	3.76	19.96	0.322	8.18	42.55	0.500	12.70	64.61
10	10.750	273.1	0.165	4.19	27.78	0.365	9.27	60.31	0.500	12.70	96.01
12	12.750	323.9	0.180	4.57	36.00	0.375	9.53	73.88	0.500	12.70	132.08

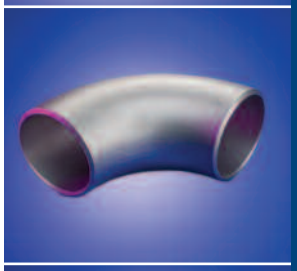
Dimensions and Weights per Metre - Steel Pipe - ASME B36.10

Nominal Pipe Size (NPS)	OD		Schedule 100			Schedule 120			Schedule 160		
	in	mm	in	mm	kg/m	in	mm	kg/m	in	mm	kg/m
¼	0.840	21.3	-	-	-	-	-	-	0.188	4.78	1.97
⅜	1.050	26.7	-	-	-	-	-	-	0.219	5.56	2.94
1	1.315	33.1	-	-	-	-	-	-	0.250	6.35	4.26
1¼	1.660	42.2	-	-	-	-	-	-	0.250	60.35	5.68
1½	1.900	48.3	-	-	-	-	-	-	0.281	7.14	7.35
2	2.375	60.3	-	-	-	-	-	-	0.344	8.74	11.26
2½	2.875	73.0	-	-	-	-	-	-	0.375	9.53	15.12
3	3.500	88.9	-	-	-	-	-	-	0.438	11.13	21.64
4	4.500	114.3	-	-	-	0.438	11.13	28.72	0.531	13.49	34.00
5	5.563	141.3	-	-	-	0.500	12.70	40.84	0.625	15.88	49.79
6	6.625	168.3	-	-	-	0.562	14.27	54.96	0.719	18.26	68.50
8	8.625	219	0.594	15.09	76.98	0.719	18.26	91.70	0.906	23.01	112.82
10	10.750	273.0	0.719	18.26	116.35	0.844	21.44	134.92	1.125	28.58	174.74
12	12.750	323.8	0.844	21.44	162.15	1.000	25.40	189.58	1.312	33.32	242.10









Standard Cross-Section and Weight Tolerances (ATSM A530/A530M)

Nominal Pipe Size (NPS)	Outside Diameter (OD)[1]				Wall thickness (t)[2]		Weight[3]	
	Under		Over		Under	Over	Under	Over
	in	mm	in	mm	%	%	%	%
⅛ to 1½	0.031	0.8	0.015	0.4	12.5	20	3.5	10
>1½ to 4	0.031	0.8	0.031	0.8	12.5	20	3.5	10
>4 to 8	0.031	0.8	0.062	1.6	12.5	22.5	3.5	10
>8 to 12	0.031	0.8	0.093	2.4	12.5	22.5	3.5	10

Notes
1 Includes ovality tolerance except for thin wall pipe (i.e. t>3% OD).
2 Min wall thickness = Nominal wall thickness (t) x 0.875. Not applicable if filler metal added.
3 For non standard pipes W(lb/ft) = 10.68(OD-t)t, or W (kg/m) = 0.02466(OD-t) t

Standard Cut Lengths. Pipe ordering alternatives are:

Random. Standard lengths are in the range 5.2m to 8.4m. Shorter lengths as agreed with the purchaser.
Specified Lengths. Cut lengths as specified, with end finish also specified.

Length tolerances. No pipe shall be shorter than specified. No pipe shall be more than ¼ in (6mm) longer than specified. Tighter tolerances may be specified, e.g. for bevelled pipe.

Straightness. All finished pipe shall be reasonably straight. For metal-arc welded pipe maximum deviation from straight = ⅛ in (3.2mm) in 10 ft (3 m).

Seamless and Welded Austenitic Stainless Steel Pipes

This specification covers austenitic steel pipe intended for high temperature and general corrosive
H grades in the chemical composition table are specifically for high temperature service.

Manufacture

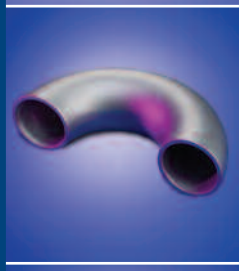
Manufacture. In order to comply with this specification welded pipe must be manufactured by an automatic welding process using no filler metal, or it must be a seamless pipe. If a welded pipe has a nominal pipe size greater than 14" then it may be constructed from two longitudinal sections, and hence have two longitudinal welds. The pipe may be either hot finished or cold finished.

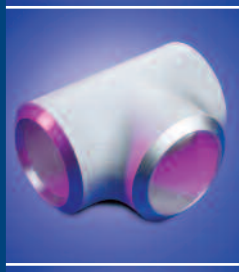
Finish and Repair

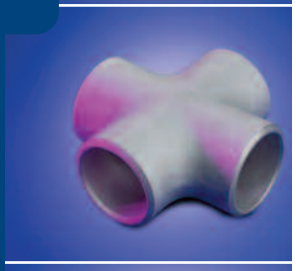
Finish. The surface of the pipe must be clean and free of scale and contaminating iron particles.
It can be bright annealed but may be pickled, blasted or can be passivated.

Repair by welding. Permitted on ≤20% of the weld seam length of welded pipe if ≥NPS 6 and having a wall thickness ≥0.200 in (mm). Tungsten-arc welding process is used for repairs, with filler metal to a grade as specified in A 312. Weld repairs must be identified on the pipe and in test certificate.
No welding repairs carried out by S.S.E. Pipefittings Limited.

Specifications







Applicable Specifications

Specifications applicable to Butt Welding fittings are as follows:

- ASME B16.9-2007 - Factory-made wrought Steel Butt Welding fittings.
- ASME B16.28-1994 - Wrought Steel Butt Welding Short Radius Elbows and Returns.
  (Withdrawn, but fittings to this standard are still available)
- MSS SP-43 1991, Reaffirmed 1996 - Wrought stainless steel butt welding fittings. This applies to 5S, 10S, and 40S wall thicknesses only.
- ASME B16.25-1997 - Butt Welding Ends. This defines various weld bevel designs and dimensions, beyond the scope of this manual.
- Wall Thicknesses. Fittings are manufactured to match the wall thicknesses of pipe.
- Weights quoted in the fitting tables are based on manufacturers' data and are approximate. Actual weights may vary from those quoted depending on the type of construction.

Manufacture and Test

- Materials and Manufacture. ASME and MSS stainless steel butt welding fittings are most commonly manufactured to ASTM A403, ASTM A815 and ASTM B366
- Production Testing. Test requirements are defined in ASTM A430.
- ASME Test Requirements. B16.9 and B16.28 do not require production testing of fittings although they must be capable of withstanding the rated pressure:

  - Pressure Ratings. The rated pressure is as for straight seamless pipe of equivalent NPS, wall thickness and material.

  - Proof Testing to qualify the fitting design comprises a bursting strength test. The fitting is required to withstand, without rupture, 105% of the pressure given by: P = (2St) / D (Burst test data is available for all fittings.)

  where

  S = Actual ultimate tensile strength of a specimen from a representative fitting.
  t = Nominal wall thickness
  D = Outside diameter

- MSS SP-43 Test Requirements. SP-43 does not require hydrostatic testing of fittings although they must be capable of withstanding 1.5 times the pressure ratings at 100 °F:

  - Pressure Ratings. Fittings produced to MSS SP-43 have the pressure ratings shown in this table.

Testing will be carried out to Norsok, Shell, BP, Project or National / International specifications.

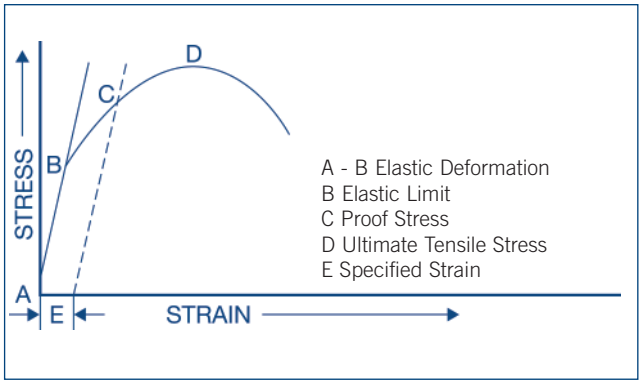
Notes
The longitudinal specimen may be a full size tubular section with metal plugs fitted in the ends to allow gripping by the test machine, or for larger tube sizes a strip may be cut from the tube. Transverse tension tests may also be performed using a ring expansion method or for larger tube sizes (e.g. greater than 8 in NPS) a transverse strip may be cut/flattened.

Testing

There are two main categories of tests: destructive tests in which the parent material or representative samples of the product are tested, and non-destructive tests performed on the finished product.

Tensile Test

This is probably the most revealing of the mechanical tests that can be performed upon a specimen of pipe or tubular product material. A longitudinal specimen 1 of known cross sectional area is taken from the material and gripped at each end, and then pulled apart until fracture occurs. By recording the gradually increasing load applied and the extension during loading a Stress-Strain Graph can be plotted (see diagram).



Notes

Stress = Force per unit area,

Example units: Pounds per square inch (psi or lbf/in^2)

Newtons per square metre (N/m^2)

Pascal (Pa).

1 ksi = 1x103 psi, 1 Pa = 1 N/m^2;

1 MPa = 1x106 Pa.

Strain = Increase in length per unit length

Initially the graph is a straight line, and the material can be expected to return to its original dimensions when the load is removed.

The graph deviates from the straight line at point B, when it enters the plastic region. The deformation is permanent after this load has been applied.

The test piece continues to stretch and also weakens so that the elongation increases even though the load is decreased. Eventually the test piece fractures.

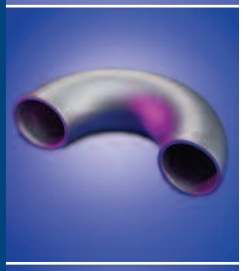
From this graph the following values can be computed.

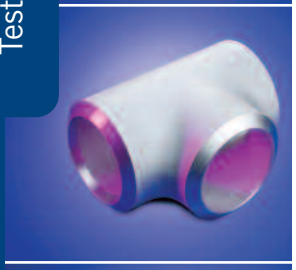
- Tensile Strength (D). The maximum tensile stress that the material is capable of sustaining.
- Yield Strength or Proof Stress (C). The load at which the sample is permanently elongated by a specific percentage of the original length. The percentage elongation (corresponding to the distance E on the graph) is commonly set at 0.2% The dotted line to C on the graph is drawn parallel to line A-B.)
- Elongation. This is a measure of the extension of the test piece at the point of fracture. The fractured test piece is carefully fitted together and the distance between gauge marks on the test piece is measured and compared with original gauge length. The increase in length is expressed as a percentage of the original length.
- Elastic Limit or Yield Point (B). The stress at which the test piece is permanently deformed.
- Modulus of Elasticity. In the tensile test, the ratio between Stress and Strain within the elastic deformation range (A-B) is known as Young's Modulus of Elasticity.
- Reduction of Area. This is the reduction in cross sectional area of the test piece after tensile fracture expressed as a percentage of the original cross-sectional area.

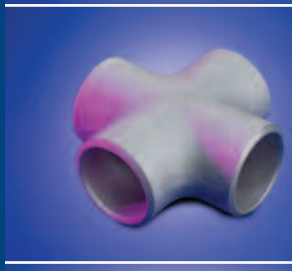
Notes

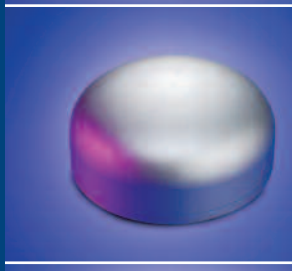
The longitudinal specimen may be a full size tubular section with metal plugs fitted in the ends to allow gripping by the test machine, or for larger tube sizes a strip may be cut from the tube. Transverse tension tests may also be performed using a ring expansion method or for larger tube sizes (e.g. greater than 8 in NPS) a transverse strip may be cut/flattened.

Testing









Hardness Tests

- Brinell Hardness Test. A standard size hardened steel ball is indented into the surface of material by an applied standard load. The diameter of the impression is measured accurately by microscope and converted to a hardness value using tables.

- Vickers Diamond Hardness Test. This determines hardness by measuring the impression left in material by a diamond pyramid under a standard load. The impression is accurately measured, and its area calculated. The Vickers Hardness Number is calculated by dividing the load (kg) by the area of impression (mm^2).

- Rockwell Hardness Test. This determines hardness by measuring the depth to which a diamond cone or hardened steel ball, under specific load, penetrates the material. Two loads are used, a minor load (10 kgf) and then a major load (100 or 150 kgf), the difference in indentation being used by the machine to determine the Rockwell number. The number increases with increasing hardness and is displayed or printed by the machine. Two scales are most frequently used, a B scale with a 100 kgf load and 1.588mm steel ball, and a C scale with a 150 kgf load and diamond cone.

  A Rockwell superficial hardness machine is used for testing very thin wall thicknesses, the minor load used being 3 kgf and the major load being 15, 30 or 45 kgf. The superficial hardness scales used are then 15T, 30T or 45T with a 1.588mm steel ball, or 15N, 30N or 45N with a diamond cone.

For heavy wall fittings, Hardness Tests across the wall thickness are available on request.

Impact Tests

In this type of test, a sample is subjected to sudden force to measure its toughness or resistance to shock.

- Charpy Impact Test. In this test a specimen is supported at both ends and subjected to a blow by a Pendulum immediately behind a prepared notch, either 'U' or 'V' shape in cross section. The energy absorbed in fracturing the specimen is measured by the height to which the pendulum rises after breaking the test piece. These tests can be carried out at various temperatures to determine the performance of material at either elevated or cryogenic temperatures.

  At higher temperature specimens fracture by a ductile mechanism, absorbing much energy. At low temperatures they fracture in a brittle manner absorbing less energy. Within the transition range a mixture of ductile and brittle fracture is observed. Minimum test results for absorbed energy, fracture appearance, lateral expansion or a combination of these, may be specified.

Manipulating Tests

These tests prove the ductility of certain tubular products and confirm the soundness of welds.

- Bend Tests. A bend test involves bending a sufficient length of full size pipe through 90° or 180° degrees around a mandrel having 12 or 8 times the nominal pipe diameter. This checks the ductility and weld soundness of pipe (2 in and under) used for coiling. Transverse guided bend tests may also be specified to check the ductility of fusion welds. These involve bending the root or face of the weld in a specimen against a plunger.

- Flange Test. This tests the ability of boiler tubes to withstand bending into a tube sheet. It involves the tube having a flange turned over a right angles to the tube body.

- Flattening Test. This is usually applied to tube and involves flattening a sample of tube between two parallel faces without the tube showing flaws or cracks.

  The length of the test piece and degree to which it is to be flattened (i.e. the distance between the parallel faces) are specified.

- Flare or Drift Test. This is an alternative to the flange test for certain types of pressure tube. A cone is forced into the end of the tube. The end of the tube is expanded by a specified increase in diameter without splits or cracks. The included angle of drift is also specified.

Corrosion Testing

Various corrosion tests are available using different corrosive environments to indicate the performance of material under heavy duty applications.

- Weld Decay Test. This test detects inter-crystalline corrosion and involves the use of boiling copper sulphate/ sulphuric acid solution. Test samples are first sensitised and then immersed in the solution for 72 hours. After the immersion the samples are bent through 90 degrees and are considered satisfactory if no cracks are present.
- Strauss Test. This test detects inter-crystalline corrosion and involves the use of boiling copper sulphate / sulphuric acid solution which must contain solid electrolytic copper. The test samples are immersed in the solution for 15 hours. After immersion the samples are bent through 90 degrees and are considered resistant to inter-crystalline corrosion if they bend without cracking.
- Huey Test. This test detects the susceptibility of a material to intergranular attack and involves the use of boiling nitric acid. The test samples are immersed in the solution at a concentration of 65% by weight for five 48 hour periods. The effect of the acid on the material is measured by the loss in weight after each period and the corrosion rate assessed as a thickness loss in a given time.
- Potentiostat Test This is a method of determining the corrosion properties of stainless steel by producing polarisation curves which relate electrode potentials and a current flow. The shapes of the curves, which are very sensitive to microstructure and composition, provide a critical method of assessing the corrosion properties of stainless steel.

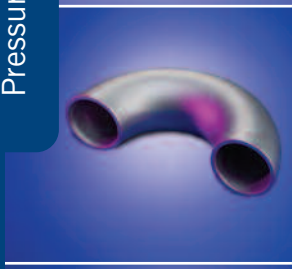
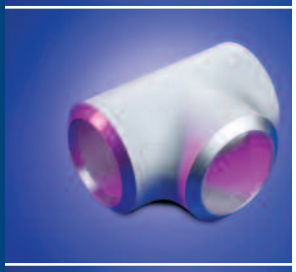
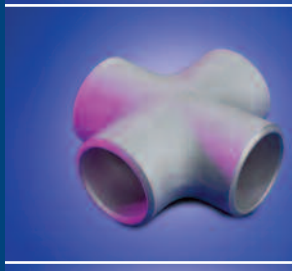
Other tests are available to meet Shell, BP, Exxon Mobil, Norsk and many other companies' regulations

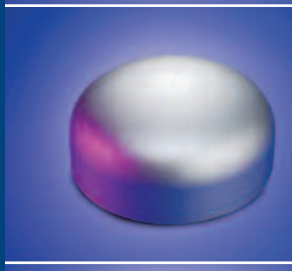
Non-Destructive Tests

Non-destructive tests do not damage the material or product being tested. Frequently they are built into production processes, as is the case with pipe tested using eddy current equipment.

- Ultrasonic Testing. This test involves ultrasonic sound waves being aimed, via a coupling medium, at the material to be tested. A proportion are bounced back at the interface but the remainder enter the material and bounce from the internal surface, to the external surface, where a transducer converts them into electrical energy. This is the monitored on a cathode ray tube where results are compared with those from a calibration standard. Any deviations from the standard are visible, thus indicating cracks or internal defects.
- Eddy-Current Testing. This involves inducing eddy currents into the material by exciting a coil which surmounts two narrow search coils surrounding the material. Any discontinuities in material are found by comparing the electrical conditions that exist in the two search coils. The fault signals are amplified and can be shown on a cathode ray tube or as an audible signal.
- Hydrostatic Testing. This is used to test the manufactured items under a pressure equivalent to or greater than pressure to be encountered in service. It involves filling the tube with water, which cannot be compressed, and increasing the pressure inside the tube to that specified.
- Magnetic Particle Testing. This method of testing is used when trying to detect discontinuities in material of ferromagnetic structure. The method is based on the principle that an imperfection will cause a distortion in the magnetic field pattern of a magnetised component. The imperfection can be revealed by applying magnetic particles to the component during or after magnetisation.
- Radiographic (X-Ray) Testing. This is usually used to determine whether a weld is sound. It involves subjecting a weld or weld area to an X-Ray source with an X-Ray sensitive film plate on the under side of the weld. The results are shown on the developed film (a photomicrograph) and interpreted according to specification.
- Dye-Penetrant Test. This is used to detect cracks and involves spraying a dye on the area to be tested. After allowing time for penetration the surplus dye is removed and the area is then sprayed with a white developer. Any faults are revealed as coloured lines or spots caused by the developer absorbing the dye seeping from the cracks. If more sensitive results are required, a fluorescent dye is used and the same process is followed. When viewed under ultraviolet light any defects show as a highly fluorescent line or spot.

Pressure Ratings



Pressure Ratings for Pipes, Tubes and Fittings

Wall thickness calculations for straight pipe under internal pressure

The following equations and tables are based on those provided in the Process Piping Specification, ASME B31.3a-2008, ASME Code for Pressure Piping (see Notes for references to source paragraphs and tables in this specification).

Firstly, any one of the following four equations may be used to calculate the 'pressure design wall thickness' (t) of a straight pipe subject to internal pressure.

The equations assume t<D/6 (for pipe with t >D/6 or P/SE >0.385 additional factors need to be considered).

The four alternative equations are:

$$t = \frac{PD}{2(SE + PY)} \qquad t = \frac{PD}{2SE} \qquad t = \frac{D}{2}\left(1 - \sqrt{\frac{SE - P}{SE + P}}\right) \qquad t = \frac{P(d + 2c)}{2[SE - P(1 - Y)]}$$

where:

t = Pressure design thickness

d = Inside diameter of pipe. For pressure design calculation, the inside diameter of the pipe is the maximum value allowable under the purchase specification.

P = Internal design pressure.

D = Outside diameter pipe as listed in tables of standards or specifications or as measured.

E = Quality factor. See the table "Basic quality factors 'E' for longitudinal weld joints in stainless steel pipes, tubes and fittings" on page 27.

S = Stress value for material from the table "Basic allowable stresses 'S' in tension for stainless steels" on pages 28-29.

Y = Coefficient from table "Values of coefficient 'Y' for t<D/6" on pages 28-29.

Secondly, the minimum required wall thickness tm of straight sections of pipe is determined in accordance with the following equation.

$$t_m = t + c$$

where:

tm = Minimum required thickness, including mechanical, corrosion and erosion allowances.

c = The sum of the mechanical allowances (thread or groove depth) plus corrosion and erosion allowances. For threaded components, the nominal thread depth (dimension h of ASME B1.20.1, or equivalent) shall apply. For machined surfaces or grooves where the tolerance is not specified, the tolerance shall be assumed to be 0.5 mm (0.02 in) in addition to the specified depth of the cut.

The actual minimum thickness for the pipe selected, considering manufacturer's tolerance, shall not be less than tm.

Units of Measure for Calculations

It is important to use compatible units for pressure calculations. ASTM and ASME specifications are based upon imperial sizes.

Pipe Bends

The equations above may also be used for pipe bends provided the requirement for minimum wall thickness (tm) is met.

Further Information

Refer to ASME B31.3a-2008 paragraph 304 for further details relating to pressure rating and wall thickness calculations applicable to elbows, branch connections, closures, flanges, reducers and other components.

Values of Coefficient ‘Y’ for t<D/6

Materials	Temperature, °F (°C)					
	≤900 (≤482)	950 (510)	1000 (538)	1050 (566)	1100 (593)	≥1150 (≥621)
Ferritic Steels	0.4	0.5	0.7	0.7	0.7	0.7
Austenitic Steels	0.4	0.4	0.4	0.4	0.5	0.4
Cast Iron	0.0	-	-	-	-	-

Notes
The above table and the equations are based on paragraph 304.1 of ASME B31.3a-2008
The value for Y may be interpolated for intermediate temperatures. For t > D/6:

$$Y = \frac{d + 2c}{D + d + 2c}$$

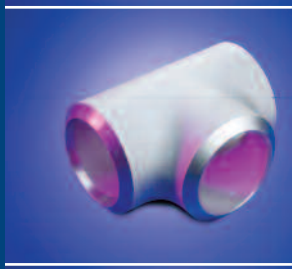
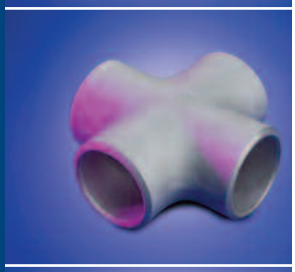
Basic Quality Factors ‘E’ for Longitudinal Weld Joints in Stainless Steel Pipes, Tubes and Fittings

Spec no.	Class (or Type)	Description	E	Notes
A182	-	Forgings and Fittings	1.00	-
A268	-	Seamless Tube	1.00	-
	-	Electric Fusion Welded Tube, Double Butt Seam	0.85	-
	-	Electric Fusion Welded Tube, Single Butt Seam	0.80	-
A269	-	Seamless Tube	1.00	-
	-	Electric Fusion Welded Tube, Double Butt Seam	0.85	-
	-	Electric Fusion Welded Tube, Single Butt Seam	0.80	-
A312	-	Seamless Pipe	1.00	-
	-	Electric Fusion Welded Pipe, Double Butt Seam	0.85	-
	-	Electric Fusion Welded Pipe, Single Butt Seam	0.80	-
A358	1,3,1	Electric Fusion Welded Pipe, 100% radiographed	1.00	-
	5	Electric Fusion Welded Pipe, Spot radiographed	0.90	-
	2	Electric Fusion Welded Pipe, Double Butt Seam	0.85	-
A376	-	Seamless Pipe	1.00	-
A403	-	Seamless Fittings	1.00	-
	-	Welded Fitting, 100% radiographed	1.00	1
	-	Welded Fitting, Double Butt Seam	0.85	-
	-	Welded Fitting, Single Butt Seam	0.80	-
A409	-	Electric Fusion Welded Pipe, Double Butt Seam	0.85	-
	-	Electric Fusion Welded Pipe, Single Butt Seam	0.80	-
A430	-	Seamless Pip	1.00	-
A789	-	Seamless	1.00	-
	-	Electric Fusion Welded Pipe, 100% radiographed	1.00	-
	-	Electric Fusion Welded Tube, Double Butt Seam	0.85	-
	-	Electric Fusion Welded Tube, Single Butt Seam	0.80	-
A790	-	Seamless	1.00	-
	-	Electric Fusion Welded Pipe, 100% radiographed	1.00	-
	-	Electric Fusion Welded Pipe, Double Butt Seam	0.85	-
	-	Electric Fusion Welded Pipe, Single Butt Seam	0.80	-

Notes
- This table is based on Table A-1B of ASME B31.3a-2008
1 An E factor of 1.00 may be applied only if all welds, including welds in the base material, have passed 100% radiographic examination. Substitution of ultrasonic examination for radiography is not permitted for the purpose of obtaining an E of 1.00.

Pressure Ratings



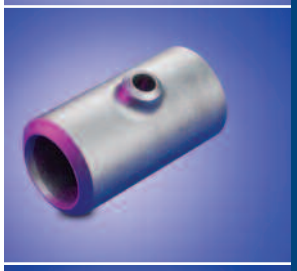


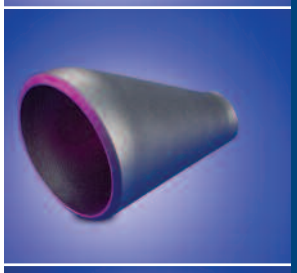
Basic Allowable Stresses 'S' in Tension for Stainless Steels

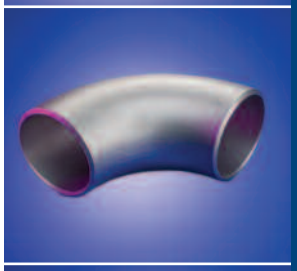
ASTM Spec No.	Grade	Min Temp °F (for °C see notes)	Metal Temperature, °F (°C)										Notes
			Min Temp to 100 (37.8)	300 (149)	500 (260)	700 (371)	850 (454)	1000 (538)	1150 (621)	1300 (704)	1400 (760)	1500 (816)	
			Basic Allowable Stress, S ksi										
A312	TP321	-325	16.7	16.7	16.1	14.6	14.0	13.5	5.0	1.7	0.8	0.3	1,2
A376	TP321	-325	16.7	16.7	16.1	14.6	14.0	13.5	5.0	1.7	0.8	0.3	1,2
A269	TP304L	-425	16.7	16.7	14.8	13.5	12.8	7.8	4.0	2.1	1.1	0.9	2,3
A312	TP304L	-425	16.7	16.7	14.8	13.5	12.8	7.8	4.0	2.1	1.1	0.9	-
A358	304L	-425	16.7	16.7	14.8	13.5	12.8	7.8	4.0	2.1	1.1	0.9	2
A269	TP316L	-325	16.7	16.7	14.4	12.9	12.1	11.2	8.8	3.5	1.8	1.0	2,3
A312	TP316L	-325	16.7	16.7	14.4	12.9	12.1	11.2	8.8	3.5	1.8	1.0	-
A358	316L	-325	16.7	16.7	14.4	12.9	12.1	11.2	8.8	3.5	1.8	1.0	2
A312	TP321	-325	16.7	16.7	16.1	14.6	14.0	13.5	6.9	3.2	1.9	1.1	1,2,4
A376	TP321	-325	16.7	16.7	16.1	14.6	14.0	13.5	6.9	3.2	1.9	1.1	1,2,4
A312	TP321H	-325	16.7	16.7	16.1	14.6	14.0	13.5	6.9	3.2	1.9	1.1	1,2
A376	TP321H	-325	16.7	16.7	16.1	14.6	14.0	13.5	6.9	3.2	1.9	1.1	-
A268	TP409	-20	20.0	-	-	-	-	-	-	-	-	-	6
A268	TP430Ti	-20	20.0	-	-	-	-	-	-	-	-	-	6,7
A376	16-8-2H	-325	20.0	-	-	-	-	-	-	-	-	-	5,6,8
A268	TP405	-20	20.0	17.7	17.2	16.2	10.4	4.0	-	-	-	-	6
A268	TP410	-20	20.0	17.7	17.2	16.2	10.4	6.4	1.8	-	-	-	6
A268	TO430	-20	20.0	19.6	19.0	17.6	10.4	6.5	2.4	-	-	-	6,7
A312	TP317L	-325	20.0	20.0	17.7	16.2	15.2	-	-	-	-	-	-
A312	TP310	-325	20.0	20.0	20.0	18.3	14.6	11.0	3.6	0.8	0.4	0.2	4,6,10
A358	310S	-325	20.0	20.0	20.0	18.3	14.6	11.0	3.6	0.8	0.4	0.2	2,4,5,6
A409	TP310	-325	20.0	20.0	20.0	18.3	14.6	11.0	3.6	0.8	0.4	0.2	2,4,5,6,10
A312	TP321	-325	20.0	20.0	19.3	17.5	16.7	16.2	5.0	1.7	0.8	0.3	1
A358	321	-325	20.0	20.0	19.3	17.5	16.7	16.2	5.0	1.7	0.8	0.3	1,2
A376	TP321	-325	20.0	20.0	19.3	17.5	16.7	16.2	5.0	1.7	0.8	0.3	1,2
A409	TP321	-325	20.0	20.0	19.3	17.5	16.7	16.2	5.0	1.7	0.8	0.3	1,2
A312	TP309	-325	20.0	20.0	20.0	18.3	14.6	10.5	5.0	2.3	1.3	0.7	4,6,10
A358	309S	-325	20.0	20.0	20.0	18.3	14.6	10.5	5.0	2.3	1.3	0.7	4,5,6,2
A409	TP309	-325	20.0	20.0	20.0	18.3	14.6	10.5	5.0	2.3	1.3	0.7	2,4,5,6,10
A312	TP347	-425	20.0	20.0	19.9	18.6	18.2	18.0	6.1	2.2	1.2	0.8	-
A358	347	-425	20.0	20.0	19.9	18.6	18.2	18.0	6.1	2.2	1.2	0.8	1,2
A376	TP347	-425	20.0	20.0	19.9	18.6	18.2	18.0	6.1	2.2	1.2	0.8	1,2
A409	TP347	-425	20.0	20.0	19.9	18.6	18.2	18.0	6.1	2.2	1.2	0.8	1,2
A312	TP348	-325	20.0	20.0	19.9	18.6	18.2	18.0	6.1	2.2	1.2	0.8	-
A358	348	-325	20.0	20.0	19.9	18.6	18.2	18.0	6.1	2.2	1.2	0.8	1,2
A376	TP348	-325	20.0	20.0	19.9	18.6	18.2	18.0	6.1	2.2	1.2	0.8	1,2
A409	TP348	-325	20.0	20.0	19.9	18.6	18.2	18.0	6.1	2.2	1.2	0.8	1,2
A312	TP310	-325	20.0	20.0	20.0	18.3	14.6	11.0	7.3	3.5	1.6	0.8	4,6,10,11
A358	310S	-325	20.0	20.0	20.0	18.3	14.6	11.0	7.3	3.5	1.6	0.8	2,4,5,6,11
A430	FP321	-325	20.0	20.0	19.3	17.5	16.7	16.2	6.9	3.2	1.9	1.1	1,2
A312	TP321	-325	20.0	20.0	19.3	17.5	16.7	16.2	6.9	3.2	1.9	1.1	1,4
A358	321	-325	20.0	20.0	19.3	17.5	16.7	16.2	6.9	3.2	1.9	1.1	1,2,4
A376	TP321	-325	20.0	20.0	19.3	17.5	16.7	16.2	6.9	3.2	1.9	1.1	1,2,4
A409	TP321	-325	20.0	20.0	19.3	17.5	16.7	16.2	6.9	3.2	1.9	1.1	1,2,4
A430	FP321H	-325	20.0	20.0	19.3	17.5	16.7	16.2	6.9	3.2	1.9	1.1	1,2
A376	FP321H	-325	20.0	20.0	19.3	17.5	16.7	16.2	6.9	3.2	1.9	1.1	1,2
A312	FP321H	-325	20.0	20.0	19.3	17.5	16.7	16.2	6.9	3.2	1.9	1.1	-
A430	FP316	-425	20.0	20.0	17.9	16.3	15.7	15.3	9.8	4.1	2.3	1.3	2,5,8
A430	FP316H	-325	20.0	20.0	17.9	16.3	15.7	15.3	9.8	4.1	2.3	1.3	2,5,8
A269	TP316	-425	20.0	20.0	17.9	16.3	15.7	15.3	9.8	4.1	2.3	1.3	2,3,4,5,8
A312	TP316	-425	20.0	20.0	17.9	16.3	15.7	15.3	9.8	4.1	2.3	1.3	4,8
A358	316	-425	20.0	20.0	17.9	16.3	15.7	15.3	9.8	4.1	2.3	1.3	2,4,5,8
A376	TP316	-425	20.0	20.0	17.9	16.3	15.7	15.3	9.8	4.1	2.3	1.3	2,4,5,8
A409	TP316	-425	20.0	20.0	17.9	16.3	15.7	15.3	9.8	4.1	2.3	1.3	2,4,5,8
A312	TP317	-325	20.0	20.0	17.9	16.3	15.7	15.3	9.8	4.1	2.3	1.3	4,6
A409	TP317	-325	20.0	20.0	17.9	16.3	15.7	15.3	9.8	4.1	2.3	1.3	2,4,5,8
A312	316Ti	-325	20.0	20.0	17.9	16.3	15.7	15.3	9.8	4.1	2.3	1.3	2,4,5,8

Pressure Ratings

PIPEFITTINGS LTD







Basic Allowable Stresses 'S' in Tension for Stainless Steels

ASTM Spec No.	Grade	Min Temp °F (for °C see notes)	Metal Temperature, °F (°C)										Notes
			Min Temp to 100 (37.8)	300 (149)	500 (260)	700 (371)	850 (454)	1000 (538)	1150 (621)	1300 (704)	1400 (760)	1500 (816)	
			Basic Allowable Stress, S ksi										
A376	TP316H	-325	20.0	20.0	17.9	16.3	15.7	15.3	9.8	4.1	2.5	1.3	2,5,8
A312	TP316H	-325	20.0	20.0	17.9	16.3	15.7	15.3	9.8	4.1	2.5	1.3	8
A430	FP347	-425	20.0	20.0	18.6	18.2	18.2	18.0	10.5	4.4	2.5	1.3	1,2
A430	FP347H	-325	20.0	20.0	18.6	18.2	18.2	18.0	10.5	4.4	2.5	1.3	1,2
A376	TP347H	-325	20.0	20.0	19.9	18.6	18.2	18.0	10.5	4.4	2.5	1.3	1,2
A312	TP347	-425	20.0	20.0	19.9	18.6	18.2	18.0	10.5	4.4	2.5	1.3	4
A358	347	-425	20.0	20.0	19.9	18.6	18.2	18.0	10.5	4.4	2.5	1.3	1,2,4
A376	TP347	-425	20.0	20.0	19.9	18.6	18.2	18.0	10.5	4.4	2.5	1.3	1,2,4
A409	TP347	-425	20.0	20.0	19.9	18.6	18.2	18.0	10.5	4.4	2.5	1.3	1,2,4
A312	TP348	-325	20.0	20.0	19.9	18.6	18.2	18.0	10.5	4.4	2.5	1.3	4
A358	348	-325	20.0	20.0	19.9	18.6	18.2	18.0	10.5	4.4	2.5	1.3	1,2,4
A376	TP348	-325	20.0	20.0	19.9	18.6	18.2	18.0	10.5	4.4	2.5	1.3	1,2,4
A409	TP348	-325	20.0	20.0	19.9	18.6	18.2	18.0	10.5	4.4	2.5	1.3	1,2,4
A312	TP347H	-325	20.0	20.0	19.9	18.6	18.2	18.0	10.5	4.4	2.5	1.3	-
A312	TP348H	-325	20.0	20.0	19.9	18.6	18.2	18.0	10.5	4.4	2.5	1.3	-
A430	FP304	-425	20.0	20.0	17.5	16.0	14.9	13.8	7.7	3.7	2.3	1.4	2,5,8
A430	FP304H	-325	20.0	20.0	17.5	16.0	14.9	13.8	7.7	3.7	2.3	1.4	2,5,8
A269	FP304	-425	20.0	20.0	17.5	16.0	14.9	13.8	7.7	3.7	2.3	1.4	2,3,4,5,8
A312	FP304	-425	20.0	20.0	17.5	16.0	14.9	13.8	7.7	3.7	2.3	1.4	4,8
A358	304	-425	20.0	20.0	17.5	16.0	14.9	13.8	7.7	3.7	2.3	1.4	2,4,5
A376	TP304	-425	20.0	20.0	17.5	16.0	14.9	13.8	7.7	3.7	2.3	1.4	2,4,5,8
A376	TP304H	-325	20.0	20.0	17.5	16.0	14.9	13.8	7.7	3.7	2.3	1.4	2,5,8
A409	TP304	-425	20.0	20.0	17.5	16.0	14.9	13.8	7.7	3.7	2.3	1.4	2,4,5,8
A312	TP304H	-325	20.0	20.0	17.5	16.0	14.9	13.8	7.7	3.7	2.3	1.4	8
A268	TP443	-20	23.3	21.4	19.4	17.5	15.1	4.5	-	-	-	-	6
A268	TP446	-20	23.3	21.4	19.4	17.5	15.1	4.5	-	-	-	-	6
A789	S32304	-60	29.0	26.3	24.9	-	-	-	-	-	-	-	9
A790	S32304	-60	29.0	26.3	24.9	-	-	-	-	-	-	-	9
A789	S31803	-60	30.0	28.9	27.2	-	-	-	-	-	-	-	9
A790	S31803	-60	30.0	28.9	27.2	-	-	-	-	-	-	-	9
A789	S32900	-20	30.0	-	-	-	-	-	-	-	-	-	9
A790	S32900	-20	30.0	-	-	-	-	-	-	-	-	-	9
A789	S32750	-20	38.7	33.1	31.4	-	-	-	-	-	-	-	9
A790	S32750	-20	38.7	33.1	31.4	-	-	-	-	-	-	-	9

Notes

- This table is based on Table A-1A of ASME B31.3a-2008.
- For specified minimum tensile and yield strengths refer to the individual ASTM specifications in Sections 1, 2, 3 & 5.
- Minimum temperatures in °C: -20°F = -29°C, -60°F = -51°C, -325°F = -199°C, -425°F = -254°C

1 For temperatures above 538°C (1000°F), these stress values may be used only if the material has been heat treated at a temperature of 1093°C (2000°F) minimum.

2 When the material has not been solution heat treated, the minimum temperature shall be -29°C (-20°F) unless the material is impact tested.

3 Must be verified by tensile test.

4 For temperatures above 538°C (1000°F), these stress values apply only when the carbon content is 0.04% or higher.

5 For temperatures above 538°C (1000°F), these stress values may be used only if the material has been heat treated by heating to a minimum temperature of 1038°C (1900°F) and quenching in water or rapidly cooling by other means.

6 This steel is intended for use at high temperatures; it may have low ductility and/or low impact properties at room temperature after being used a higher temperatures.

7 If the chemical composition of this Grade is such as to render it hardenable, qualification under P-No. 6 is required.

8 Increasingly tends to precipitate intergranular carbides as the carbon content increases above 0.03%.

9 This steel may develop embrittlement after service at approximately 316°C (600°F) and higher temperature.

10 This material when used below -29°C (-20°F) shall be impact tested if the carbon content is above 0.10%.

11 The stress values above 538°C (1000°F) shall be used only when the micrograin size, is No. 6 or less (coarser grain). Otherwise, the lower stress values listed for the same material, specification, and grade shall be used.

Notes:

SSE
PIPEFITTINGS LTD

Visit our website:
www.ssepipefittings.co.uk





S.S.E. Pipefittings Limited
Pedmore Road
Woodside
Dudley
DY2 0RE

Tel: (01384) 480 333
Fax: (01384) 480 805
Email: sales@ssepipefittings.co.uk

Issue 1 (May 2011)

Designed and produced by Squarefox Design Limited www.squarefox.co.uk