

Comparison ISO / ANSI

Piping System

Driving cost savings without compromise



Why is it preferable to select the ISO Piping standard instead of ANSI?

1. General

Stainless steel pipes are widely used in the pulp and paper industry. The share of stainless steel as a piping material has increased in pulp and paper mills over the last 15 years.

The reasons for this increase has been the use of corrosion aggressive fluids and environmental aspects as processes have become more closed. In the systems the fluid temperatures tend to rise and concentrations of contaminants (slime and limestone) increase. Also the original quality of raw water may be poor (for example a high chlorine content, etc.).

At the most recently built mills all piping is of stainless steel except for steam and condensate pipelines.

2. Stainless steel grades

Normal grades used at pulp and paper mills are EN 1.4307, EN 1.4432 to the Swedish Standard and ANSI/ASTM 304L, ANSI/ASTM 316L to the American Standard. Grades with a higher carbon content (0.08%) 304 and 316 are used to a minor extent in modern processes, see Table 1.

A stainless steel with higher carbon content can be stabilized by using for example titanium, niobium, etc. to improve welding properties. For example steel Wnr. 1.4541 (321) and Wnr. 1.4571 (316Ti) are steels of this kind. Ti-stabilized grades do not bring any technical advantage compared to grades with a C content below 0.05%. This brochure focuses on the ANSI/ASTM 304L and 316L stainless steel grades.

TABLE 1: Nominal chemical composition of common stainless steel grades

OSTP	EN	ASTM	Typical C	Cr	Minimum Ni	Mo	Others	SS	DIN
4301	1.4301	(304)	0.04	17.0	8.5	-		2333	1.4301
4307	1.4307	304L	0.02	18.0	8.0	-		(2352)	(1.4306)
4541	1.4541	321	0.04	17.0	9.0	-	Ti	2337	1.4541
4306	1.4306	304L	0.02	18.0	10.0	-		2352	1.4306
4401	1.4401	316	0.04	16.5	10.0	2.0		(2347)	(1.4401)
4404	1.4404	316L	0.02	16.5	10.0	2.0		(2348)	(1.4404)
4571	1.4571	316Ti	0.04	16.5	10.5	2.0	Ti	2350	1.4571
4436	1.4436	316	0.04	16.5	10.5	2.5		2343	(1.4436)
4432	1.4432	316L	0.02	16.5	10.5	2.5		2343	(1.4435)
4435	1.4435	316L	0.02	17.0	12.5	2.5		2353	1.4435
4438	1.4438	317L	0.02	18.0	13.0	3.0		2367	1.4438

The compositions comply with EN, which not always comply exactly with the old national standards.
Old SS and DIN-designations within brackets specifies a slightly higher Ni-content, that is insignificant for the corrosion resistance.



3. Differences in dimensional standards

3.1 Selection of dimensional standard

Stainless steel piping is standardized in the ISO and ANSI standards. Both of these standards are widely used at pulp and paper mills. The selection of the dimensional standard is partly based on the piping of an existing mill. In larger projects the selection will be made on an economical basis and sometimes based on the “culture” of the package supplier. A comparison between the ISO and ANSI

standards shows that the outside diameters are the same with only minor differences. The pipe wall thickness differ to a great extent. The ISO standard wall thickness series have been densely divided with small steps between thickness with several wall thicknesses for each pipe size. The ANSI standard has three or four wall thicknesses (schedules) per pipe size. See Table 2.

ANSI		ISO		Nominal wall thickness	
Pipe size inch	OD mm	DN Pipe size	OD mm	ANSI SS	ISO stand.
½"	21.30	15	21.30	1.65	1.60
1"	33.40	25	33.70	1.65	1.60
1 ¼"	42.40	32	42.40	1.65	1.60
1 ½"	48.30	40	48.30	1.65	1.60
2"	60.30	50	60.30	1.65	1.60
3"	88.90	80	88.90	2.11	1.60
4"	114.30	100	114.30	2.11	2.00
5"	141.30	125	139.70	2.77	2.00
6"	168.30	150	168.30	2.77	2.00
8"	219.10	200	219.10	2.77	2.00
10"	273.00	250	273.00	3.40	2.00
12"	323.90	300	323.90	3.96	2.60
14"	355.60	350	355.60	3.96	2.60
16"	406.40	400	406.40	4.19	2.60
18"	457.00	450	457.00	4.19	3.20
20"	508.00	500	508.00	4.78	3.20
24"	610.00	600	610.00	5.54	4.00

TABLE 2:
Comparison of outside diameters
and wall thicknesses of the ISO
and ANSI dimension standards

3.2 Defining wall thickness

The ISO dimensional standards give a possibility to more exact selection of wall thickness needed for actual design conditions (for example pressure and temperature). The difference in material weight is especially essential in the pulp and paper industry because both the pressure and temperature of the processes are low. At pulp and paper mills pressures are about 3 bar (44 psi) and temperatures below 80°C. Higher pressures

mainly exist at digester plants and power plants. The piping at a power plant is to a great extent of mild steel. The calculation codes for ISO and ANSI pipes differ as for tolerance and welding factor requirements. EN 13480-3 standard allows a higher welding factor for pipes and smaller wall thickness tolerance than ASME B31.3 design code.



Table 3 and 4 have been calculated by using the following factors and design temperature 100°C:

Dimension code:	ANSI	ISO
Calculation code:	ASME B31.3/A312	EN 13480-3/EN 10217-7
Welding factor:	0.8 (single butt seam)	1.0
Welding factor:	0.85 (double butt seam)	1.0
Wall thickness tolerance:	-12,5%	10%
Materials:	TP 304L	EN 1.4307
Design stress:	115 N/mm ²	121 N/mm ²

The difference in pressure strengths of the ISO and ANSI pipes is shown in Table 3 where the minimum wall thickness requirement for pressure classes is presented. The closest nominal wall thickness for the ISO and ANSI pipes is shown in Table 4.



TABLE 3: Theoretical wall thickness, in mm

		Bar PSI	6 87		10 145		16 232		25 363		40 580		
OD in mm													
ANSI	ISO	DN	ANSI	ISO	ANSI	ISO	ANSI	ISO	ANSI	ISO	ANSI	ISO	DN
21.3	21.3	15	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.2	0.5	0.4	15
26.7	26.9	20	0.1	0.1	0.2	0.1	0.2	0.2	0.4	0.3	0.6	0.5	20
33.4	33.7	25	0.1	0.1	0.2	0.2	0.3	0.3	0.5	0.4	0.8	0.6	25
42.2	42.4	32	0.1	0.1	0.3	0.2	0.4	0.3	0.7	0.5	1.0	0.8	32
48.3	48.3	40	0.2	0.1	0.3	0.2	0.5	0.4	0.7	0.6	1.1	0.9	40
60.3	60.3	50	0.2	0.2	0.4	0.3	0.6	0.4	0.9	0.7	1.5	1.1	50
73.0	76.1	65	0.3	0.2	0.5	0.4	0.7	0.6	1.1	0.9	1.8	1.4	65
88.9	88.9	80	0.3	0.2	0.6	0.4	0.9	0.7	1.4	1.0	2.2	1.6	80
114.3	114.3	100	0.4	0.3	0.7	0.5	1.1	0.8	1.8	1.3	2.8	2.1	100
141.3	139.7	125	0.5	0.4	0.9	0.6	1.4	1.0	2.2	1.6	3.4	2.5	125
168.3	168.3	150	0.6	0.5	1.0	0.8	1.7	1.2	2.6	1.9	4.1	3.0	150
219.1	219.1	200	0.8	0.6	1.4	1.0	2.2	1.6	3.4	2.5	5.3	4.0	200
273.0	273.0	250	1.0	0.8	1.7	0.3	2.7	2.0	4.2	3.1	6.7*	4.9	250
323.9	323.9	300	1.2	0.9	2.0	1.5	3.2	2.4	5.0	3.7	7.4*	5.9	300
355.6	355.6	350	1.3	1.0	2.2	1.6	3.5	2.6	5.5	4.0	8.2*	6.4	350
406.4	406.4	400	1.5	1.1	2.5	1.9	4.0	3.0	6.2	4.6	9.3*	7.3	400
457.0	457.0	450	1.7	1.3	2.8	2.1	4.5	3.3	6.6*	5.2	10.9*	8.3	450
508.0	508.0	500	1.9	1.4	3.1	2.3	5.0	3.7	7.3*	5.8	11.7*	9.2	500
610.0	610.0	600	2.3	1.7	3.8	2.8	6.0	4.5	8.8*	6.9	14*	11.0	600
711.0	711.0	700	2.6	2.0	4.4	3.3	6.6*	5.2	10.3*	8.1	16.3*	12.9	700
813.0	813.0	800	3.0	2.2	5.0	3.7	7.5*	6.0	11.7*	9.2	18.7*	14.7	800

* 0.85, double butt seam



In piping design the ISO and ANSI piping differ in some respects. Because of thinner wall thicknesses reaction forces, for example at equipment connections, are smaller for ISO piping with the same piping geometry. Both ISO and ANSI pipelines are sensitive for vibrations and must be properly supported. Design against full vacuum for larger DN sizes requires reinforcement rings both for ISO and ANSI pipes. The vacuum resistance of pipes without reinforcement rings shall be checked for actual operation conditions.

TABLE 4: Closest nominal wall thickness, in mm

		Bar PSI	6 87		10 145		16 232		25 363		40 580		
OD in mm													
ANSI	ISO	DN	ANSI	ISO	ANSI	ISO	ANSI	ISO	ANSI	ISO	ANSI	ISO	DN
21.3	21.3	15	1.65	1.6	1.65	1.6	1.65	1.6	1.65	1.6	1.65	1.6	15
26.7	26.9	20	1.65	1.6	1.65	1.6	1.65	1.6	1.65	1.6	1.65	1.6	20
33.4	33.7	25	1.65	1.6	1.65	1.6	1.65	1.6	1.65	1.6	1.65	1.6	25
42.2	42.4	32	1.65	1.6	1.65	1.6	1.65	1.6	1.65	1.6	1.65	1.6	32
48.3	48.3	40	1.65	1.6	1.65	1.6	1.65	1.6	1.65	1.6	1.65	1.6	40
60.3	60.3	50	1.65	1.6	1.65	1.6	1.65	1.6	1.65	1.6	1.65	1.6	50
73.0	76.1	65	2.11	1.6	2.11	1.6	2.11	1.6	2.11	1.6	2.11	1.6	65
88.9	88.9	80	2.11	1.6	2.11	1.6	2.11	1.6	2.11	1.6	2.11	1.6	80
114.3	114.3	100	2.11	1.6	2.11	1.6	2.11	2.0	2.11	1.6	2.11	2.0	100
141.3	139.7	125	2.77	2.0	2.77	2.0	2.77	2.0	2.77	2.0	3.40	2.6	125
168.3	168.3	150	2.77	2.0	2.77	2.0	2.77	2.0	2.77	2.0	6.35	3.0	150
219.1	219.1	200	2.77	2.0	2.77	2.0	2.77	2.0	3.76	2.6	6.35	4.0	200
273.0	273.0	250	3.40	2.0	3.40	2.0	3.40	2.0	4.19	3.2	7.80	5.0	250
323.9	323.9	300	3.96	2.0	3.96	2.0	3.96	3.0	6.35	4.0	8.38	6.0	300
355.6	355.6	350	3.96	2.5	3.96	2.5	3.96	3.0	6.35	4.0	9.53	8.0	350
406.4	406.4	400	4.19	3.0	4.19	3.0	4.19	3.0	6.35	5.0	9.53	8.0	400
457.0	457.0	450	4.19	3.0	4.19	3.0	4.78	4.0	7.92	6.0	12.70	10.0	450
508.0	508.0	500	4.78	3.0	4.78	3.0	5.54	4.0	9.53	6.0	12.70	10.0	500
610.0	610.0	600	4.78	3.0	4.78	3.0	6.35	5.0	9.53	8.0	14.27	11.0	600
711.0	711.0	700	6.35	4.0	6.35	4.0	7.92	6.0	12.70	10.0	17.48	14.0	700
813.0	813.0	800	7.92	4.0	7.92	4.0	7.92	6.0	12.70	10.0	19.05	15.0	800



4. Economical aspects

For a typical Pulp Mill with an annual production output of 340,000 t/yr the approximate ISO stainless steel piping need will be some 660 tons and for a Paper Mill with an annual production output of 320,000 t/yr the approximate ISO stainless steel piping need will be some 260 tons. If the piping for these installations is designed and specified in ANSI materials and thicknesses the piping

volumes needed will increase to 880 tons and 350 tons respectively. In both cases ISO designed piping systems will yield approximately 25% material weight and cost savings. Additionally the thinner wall thicknesses of the ISO designed systems will yield fabrication and installation savings as cutting, welding time and foot print savings can be gained.

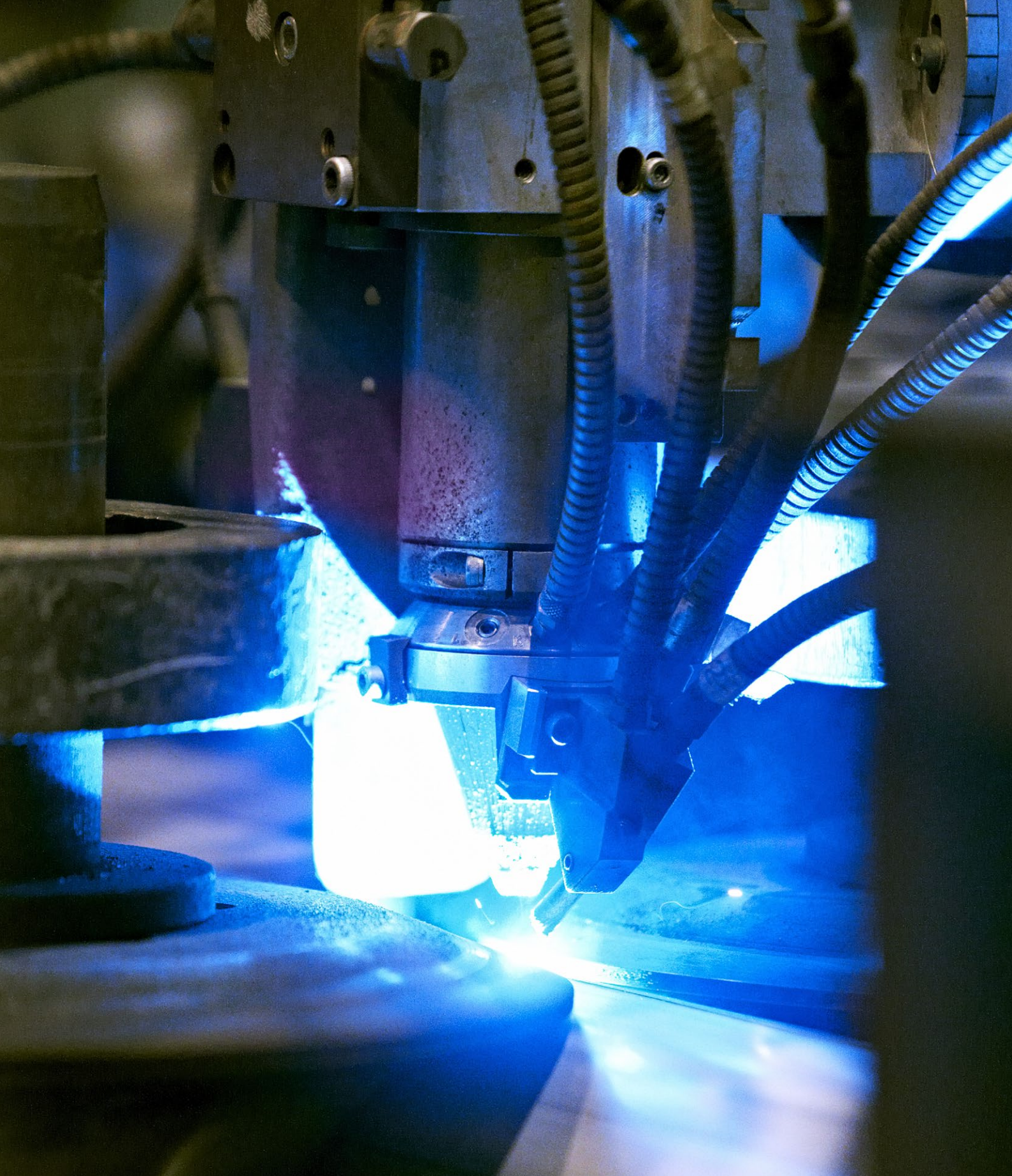
Paper Mill SS pipe consumption

DN	ISO		Pipe		Fittings	
	Do	s (mm)	304L (kg)	316L (kg)	304L (kg)	316L (kg)
15	21.30	1.60	246	659	56	150
26	33.70	1.60	1745	1428	398	326
32	42.40	1.60	1871	404	427	92
40	48.30	1.60	36	903	8	206
50	60.30	1.60	2999	4112	684	938
80	88.90	1.60	1939	5502	442	1255
100	114.30	2.00	4267	3829	973	873
125	139.70	2.00	1836	2035	419	464
150	168.30	2.00	8294	13284	1891	3029
150	168.30	5.00		1121		256
200	219.10	2.00	19358	12064	4414	2761
200	219.10	3.00		1974		450
250	273.00	2.00	10364	10147	2363	2314
250	273.00	3.00		1787		407
300	323.90	2.60	3149	10156	718	2315
300	323.90	3.00		769		175
350	355.60	2.60	137	7538	31	1719
350	255.60	3.00		3142		716
400	406.40	2.60	524	8203	120	1870
400	406.40	3.00		1662		379
450	457.00	3.20		917		209
450	457.00	5.00		1072		244
500	508.00	3.20		21439		4888
600	610.00	4.00		21542		4912
700	711.00	4.00		7060		1810
800	813.00	4.00		687		157
800	813.00	6.00		2115		482
900	914.00	4.00				
1000	1016.00	4.00		4194		956
1000	1016.00	10.00		502		115
1200	1220.00	8.00		5083		1159

Pulp Mill SS pipe consumption

DN	ISO		Pipe		Fittings	
	Do	s (mm)	304L (kg)	316L (kg)	304L (kg)	316L (kg)
15	21.30	1.60	1622	800	362	178
25	33.70	1.60	4250	1515	948	338
25	33.70	4.00		430		96
32	42.40	1.60	2832	318	632	71
40	48.30	1.60	2033	1667	453	372
50	60.30	1.60	12897	5470	2876	1220
50	60.30	4.00		478		107
80	88.90	1.60	10359	7433	2310	1658
80	88.90	3.00		2226		498
100	114.30	2.00	19736	11607	4401	2566
125	139.70	2.00	3113	5846	694	1326
150	168.30	2.00	33222	25822	7409	5758
150	168.30	5.00	20		5	
200	219.10	2.00	23282	24887	5192	5545
200	219.10	4.00	8552	64	1907	14
200	219.10	5.00	53		12	
250	273.00	2.00	13665	16896	3045	3768
250	273.00	3.20	10733	1552	2393	346
250	273.00	5.00	3178		709	
250	273.00	6.30	713		159	
300	323.90	2.60	10512	12041	2344	2685
300	323.90	3.20	2536	2487	566	577
300	323.90	5.00		1111		248
300	323.90	5.60	11637		2595	
300	323.90	5.30	11238		2506	
350	355.60	2.60	22446	11847	5006	2642
350	355.60	3.20	394		88	
350	406.40	5.60	7290		1626	
400	406.40	2.60	17548	28331	3913	6318
400	406.40	3.20	2448		546	
400	406.40	5.00		19009		4239
400	406.40	6.30		1825	27	407
450	457.00	3.20	121	4597	2574	1025
500	508.00	3.20	11543	17927	180	3998
500	508.00	3.20	806		830	
500	508.00	4.00	3724			
500	508.00	8.00		15277	108	3407
600	610.00	4.00	484	26887		5996
600	610.00	10.00		17973	1338	4008
700	711.00	4.00	6001	5076		1132
700	711.00	7.10		2370		529
700	711.00	11.00		969		216
800	813.00	4.00		1648	203	368
900	914.00	4.00	909	3907		871
1000	1016.00	4.00				
1200	1220.00	6.30				





OSTP is a joint-venture between Tubinoxia and Outokumpu Group. OSTP manufactures the broadest range of stainless steel tubular products:

PROCESS PIPES

- Jakobstad, Finland
- Riyadh, Saudi Arabia

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- Storfors, Sweden

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