APT

ISO 9001:2015 | OHSAS 18001:2007 | ISO 14001:2015 | PED European Directive 2014/68/EU

APT SHAPING STEEL TO PERFECTION

The expert in stainless steel square, round and rectangular pipes

ANGEL PIPES AND TUBES PVT. LTD

Manufacturer of STAINLESS STEEL PIPES & TUBES

INTRODUCTION

Angel Pipes & Tubes Pvt. Ltd an ISO 9001, ISO 14001, OHSAS 18001 AND PED EUROPEAN DIRECTIVE 2014/68/EU certified company as a professional Manufacturer, Supplier and Exporter of Stainless Steel Pipes & Tubes to highly sophisticated applications Having a manufacturing unit which is been located in Sanchore (Rajasthan) India.

- Specialty Making WELDED Square, Round, Rectangle, and Oval Pipes in Mirror and Glossy Finish.
- Having Manufacturing Capacity of 10,000 MT (current output of approximately 8, 000 MT PA).
- Existing Manufacturing Grades J4, J7, 202, 304, 304L, 316, 316L, 409 And 409L.
- Having Manufacturing Sizes from 6 mm to 600 mm having thickness from 1.00 mm Thick to 8.00 mm Thick.

We also having specialized machinery consists of Gas Fired Furnace, Pickling Plant, Fabrication Machines, Polishing Machines, Hydro Testing Machines and other Testing Machines that give us optimum output and excellent quality.

ABOUT US

Angel Pipes & Tubes Pvt. Ltd, also known as ***APT, INDIA'S LATEST AND MOST MODERN SEAMLESS & WELDED STAINLESS STEEL PIPE & TUBE MANUFACTURER,*** located at Sanchore-Rajasthan about 250 Kms north of Ahmedabad.

APT draws its strength from its technical excellence and a team of highly qualified and well experienced workforce, who strive to make high quality products in a professionally managed environment with transparency, to maintain long term business relations with its customers.

CERTIFICATION & APPROVALS

ISO 9001:2015
ISO 14001:2015
OHSAS 18001:2007
ISO 45001:2018
PED European Directive 2014/68/EU

OUR IDEOLOGY

APT Shaping Steel to Perfection

A very simple idea that means developing a series of strictly controlled manufacturing steps, permanent research activities and consistent investments aiming at higher technological standards, for high quality welded stainless steel pipes & tubes. At APT the ideology has always been a pillar of self -imposed discipline by encouraging all its employees to develop a sense of pride.

OUR VISION

Our vision and persistent quest for excellence ensure quality at every step, helping you reap rich benefits and spurring us on to become a global leader. We aim to continuously exceed our customer's expectations and leverage our opportunities by attempting to attain challenges for breakthrough products and processes.

OUR MISSION

We at APT believe that "THE FUTURE IS STEEL" and are dedicated to increasing business opportunities for our customers. Our mission is to gear up for the future by deploying vast infrastructure, cutting edge technology and development of human resources, giving the Stainless Steel Pipe & Tube Industry a different dimension all together.

OUR ELEMENTS OF SUCCESS

EMPOWER • ENHANCE • EXCEL

These are the stepping stones to our success. The elements have put us in a benchmark position in maintaining a competitive edge through product quality, customer satisfaction and delivery requirements at competitive prices.

OUR QUALITY

Quality has always been our prime concern and accepting challenges and ensuring customer satisfaction are the hallmark of APT. Our work process requires very strict parameters and adherence to quality norms that have helped us attain top-notch quality standards, and to achieve a dominant position as one of the leading manufacturers in the stainless steel industry, by focusing on quality, reliability, precision and professionalism, so as to add value to our customers and their clients. We are able to offer precision heat exchanger and condensers tubes under various international third-party quality inspection agencies.

QUALITY POLICY

We at APT make & supply stainless steel pipes & tubes of various grades & sizes suitable to many industries meeting their requirements continuously and satisfying customers always!

his is achieved through employee involvement and doing it right at the first time & every time!

QUALITY OBJECTIVE

- 100% on-Time Delivery!
- To increase Sales by 10% every year!
- To reduce cycle time of Production Lot by 10%

PRODUCT RANGE

Items	Size / Range
Round	6.35mm OD to 127mm OD / 1/2" NB to 24" NB
Square	12.75 X 12.75, 15 X 15, 20 X 20, 25 X 25, 30 X 30, 40 X 40, 50 X 50, 60 X 60, 75 X 75, 80 X 80, 90 X 90, 100 X100, 150 X 150, 200 X 200, 250 x 250, 300 X 300
Rectangle	10 X 20, 12.75 X 25.4, 10 X 30, 15 X 30, 20 X 40, 20 x 50, 25 X 50, 20 x 60, 40 X 60, 40 X 80, 45 X 75, 50x100, 75 X 50, 100 X 200, 100 X 75, 150 X 75, 150 X 100, 150 X 200, 100 X 300, 200 X 300
Oval	19 X 11, 23 X 12, 33 X 13, 35 X 15, 45 X 19, 65 X 25

GRADES

TP - 304/L/H, TP - 316/L/H/Ti, TP - 317L, TP - 321/H, TP - 347/H, TP - 409/L, TP - 410, TP - 430Ti, TP - 439

PRODUCTION NORMS

ASTM A249 - A269 - A312 - A358 - A409 - A554 - A778 - A789 - A790

TOLERANCES ON LENGTH

Commercial Length: 6000mm +/- 10mm
Fix Length: from 1200 mm up to 12000mm with a tolerance up to -0/+ 5mm

FINISH

Welded
Brushed
Pickled
Solution Annealed and Pickled up to O.D. 219.1mm
Polished Grit 120 - 1200
Mirror Polished

WEIGHT CHART

150x150x4mm = 18.77 per mtrs
150x150x6mm = 27.97 per mtrs
150x150x8mm = 36.74 per mtrs

PRODUCTS

STAINLESS STEEL ROUND PIPES & TUBES

We are considered a noted manufacturer & supplier of a massive compilation of Stainless Steel Round Pipes & Tubes. These are Manufactured in accordance with the set industry guidelines.

We assure our clients that our Stainless Steel Round Pipes & Tubes will give long service life to the user. Superior quality of raw material is used to manufacture our entire product range. We delivered our assignments in a committed time period using customized packaging.

Features

- Ruggedly constructed
- Consistent operation
- Superior in performance
- Easy to maintain
- High grade quality
- Affordable prices

STAINLESS STEEL RECTANGLE PIPES & TUBES

APT is well known Manufacturers, Suppliers & Stockiest of high quality Stainless Steel Seamless & Welded Rectangle Pipes and Tubes.

Worldwide demand for stainless steel is increasing at a rate of about 5% per annum. Annual consumption is now well over 20 million tones and is rising in areas such as the construction industry and household appliances. We continuously producing high quality, Durable & low maintenance SS Rectangular Pipes & Tubes.

We offer a comprehensive range of rectangular stainless steel pipes & tubes to our customers in various industry verticals. Our rectangular stainless steel pipes & tubing is manufactured in compliance with international standards of quality and safety. Stainless steel rectangle pipes & tubes or rectangular pipes are widely used for all kinds of structural applications and fabrication projects where greater strength and superior corrosion resistance is required.

Features

- Dimensionally accurate
- High temperature resistance
- low maintenance and strength
- Attractive appearance
- Corrosion resistance

STAINLESS STEEL OVAL PIPES & TUBES

Being manufacturer of Stainless Steel Oval Pipes and Tubes in various lengths and diameters for meeting the requirement of diverse industrial segments. The strength and durability of our Oval Pipes & Tubes makes them foremost choice of customers based across the globe.

This Oval Pipes & Tubes are extensively used in various industries such as chemical, petrochemical, pharmaceutical and others. These pipes are known for their excellent tensile & material strength, these are in high demand by our clients spread across the globe. These steel pipes are available in various specifications and are ideal for use in heat transfer equipment such as super heaters, boilers and heat exchangers. We fabricated from graded stainless steel and are supplied at reasonable price. The pipes are available in various types, sizes and wail thickness.

Features

- Dimensionally accurate
- High temperature resistance
- low maintenance and strength
- Attractive appearance
- Corrosion resistance

STAINLESS STEEL SQUARE PIPES & TUBES

Apt as a leading Manufacturer & Supplier of Stainless Steel Square Pipes & Tubes & one of the efficient organizations in developing exclusive range of SS Square Pipe & Tubes that can withstand high temperature and pressure.

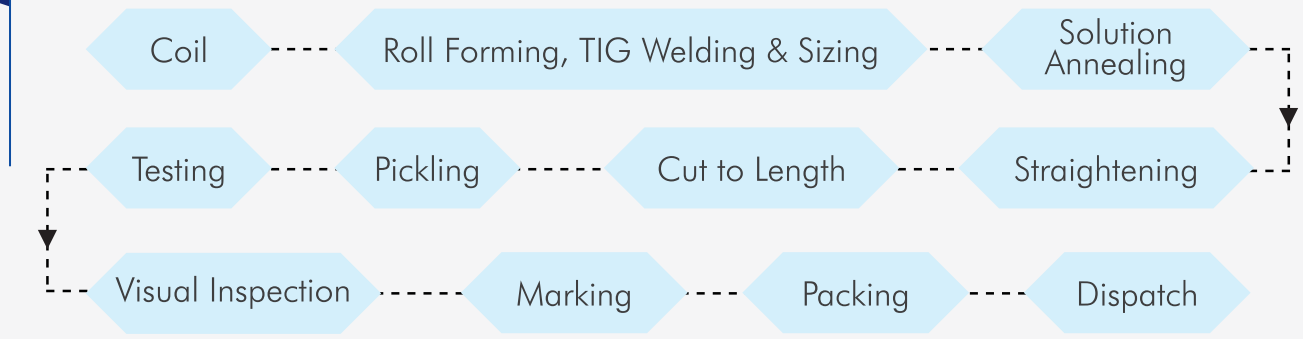
We are the Leading Manufacturer and suppliers of Stainless Steel Square Pipes & Tubes. These products are manufactured by making use of the high quality raw material. Products we offer are very much in demand by our customers due to their optimum performance and long lasting durability.

Catering to the different requirements of our customers for their various industrial application requiremets, we are offering Stainless Steel Square Pipe & Tube in customized designs. Thes Pipes & Tubes are used for pressure operations such as moving liquids and gases in processing operations in the water treatment, chemical, petrochemical, food processing, diary and marine industries. Welded tube is used as hand rails, legs for office, kitchen, and hospital equipment and as architectural supports.

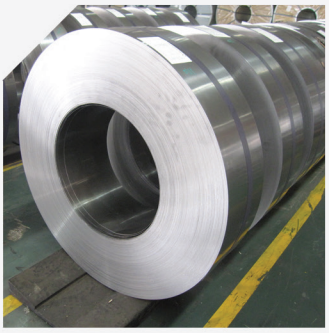
Features

- Dimensionally accurate
- High temperature resistance
- Superior in performance
- High corrosion resistance
- Feasibility of installation
- High grade quality
- easy to sanitize and sterilize

MANUFACTURING PROCESS FLOW CHART-STAINLESS STEEL WELDED TUBULAR PRODUCT



RAW MATERIAL



Raw Material is procured along with the necessary test certificates only from suppliers approved by our quality division.

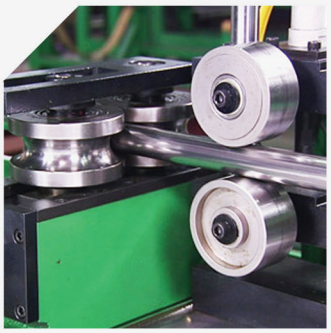
Before transforming the steel, APT carries out a 100% check on incoming material using a portable spectrometer, in order to guarantee the conformance and characteristics of the Steel which is to be used in production.

A laboratory analysis of all incoming raw material completes our inspection and verifies the exact chemical composition of the steel to be used.

Versatility and a wide production range are aided by a large warehouse which allows APT to maintain a constant stock of the different types of coils in the various thicknesses and grades required by our customers.

This enables APT to optimize the feeding of the production lines, thus enhancing the competitiveness of the final product.

ROLL FORMING & WELDING



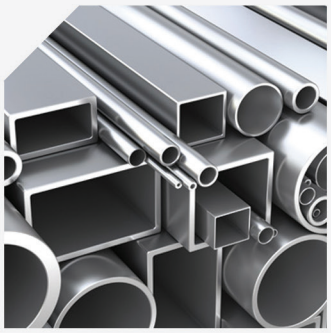
The first stage of the manufacturing process is roll forming along with a state-of-art welding technology. The TIG welding method uses electricity to obtain fusion. The heat-affected zone following TIG welding maintains good mechanical and corrosion-resistance properties than other traditional welding methods.

SOLUTION ANNEALING

The solution annealing process, eliminates the work hardening effect caused by cold working, and also homogenizes the structure of the welded area enhancing corrosion resistance. The different stages of heat treatment are carried out and the duration and speed of the tubes, are constantly monitored in order to achieve a correct solubilization.

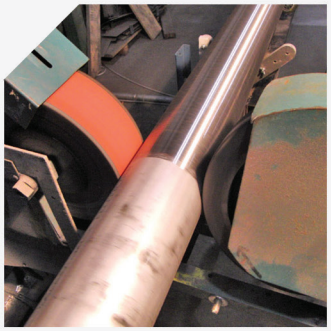
PICKLING

Corrosion and an incorrect roughness on the internal surface of the tubes could cause a problem for the end user. The Pickling process is carried out in a bath of acid solution so as to remove every trace of ferrous & oxidizing contamination. APT is able to pickle tubes in lengths of up to 10 meters.



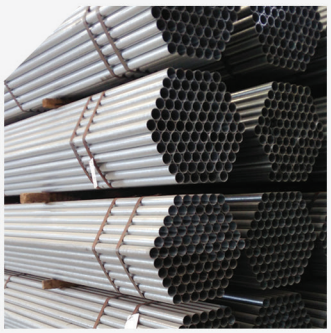
POLISHING

Pipes & Tubes can be supplied with outer polished surface of Grit 120 to Grit 600 or mirror polished surface.



PACKAGING & DELIVERY

Pipes & Tubes are delivered in standard packing secured by nylon straps & self-adhesive tape. Polished Pipes & Tubes are packed individually in plastic sleeves, before being bundled. Upon request, Pipes & Tubes can be delivered in bundles with wooden frames and end covers or in wooden crates or boxes.



TESTING

Chemicals analysis of sample from each coil is carried out in NABL approach laboratories to authenticate the grade and quality. A fully equipped in house laboratory helps check chloride content in the water and daily pickling. Facilities for other tests are also available with us which are carried out by trained professionals on calibrated instruments on regular basis.

MECHANICAL TESTING

According to ASTM standard Tensile, Hardness, Flaring, Flange, Reverse Bend Tests are carried out on regular basis.

Angel Pipes & Tubes Pvt. Ltd. determines the compliance of materials to applicable standards and specifications. We have extensive experience with mechanical testing methodology as well as the interpretation of the results. Our fully equipped machine shop allows us to produce the custom specimens needed for specific mechanical tests. The mechanical testing and material testing we perform may be part of a quality assurance program, manufacturing engineering program, failure analysis or for materials research and development.

Tests are performed to ASTM (or other industry recognized) specifications. All Pipes & Tubes of a non-destructive and / or destructive testing may be subjected. We have the HP-0 approval by the TÜV and also meet many other quality requirements.

HARDNESS TESTINGS

The surface hardness of material is checked with the help of Rockwell Brinell scale on 30T scale.

High pressure boiler tube hardness testing should take into account its mechanical properties, which is related to stainless steel as raw material for the deformation, such as punching, cutting processing performance and quality.

Material hardness testing measures the resistance of a material to a permanent indentation of particular geometry over a specified length of time. Material hardness testing is an effective and efficient means to characterize a material and requires minimal sample preparation. Metallurgical Technologies, Inc. (MTi) offers Rockwell (standard or superficial), Knoop and Vickers Microhardness, and Brinell hardness testing.

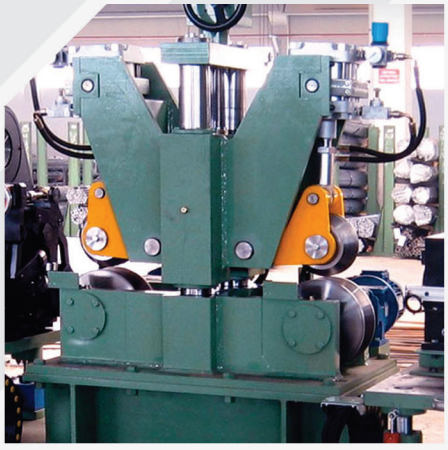
HYDRO TESTING

100% Hydro testing is carried out on all pipes and tubes using a high-pressure pump.

This hydro test can detect leakage of liquid from the inner wall of the case outward can be observed with the naked eye or with a pressure drop to determine. Hydrostatic test cannot be found through-wall defects but very close or very close to the wall thickness in depth but not yet fully penetrated defects. Conducted for each pipe eddy current inspection after the low and medium pressure boiler pipe hydrostatic testing is not necessary to replace the hydrostatic test eddy current testing.

Hydro Test of Pipe & Tubes from 1/4 " to 24" NB, UP TO 5000 psi, we are dedicated to providing the safest, most efficient, most reliable, cost effective and technologically advanced Hydro-testing service. We value our clients and strive for excellence in our project delivery. We conduct our business with utmost honesty and integrity, providing excellence in client service.

EDDY-CURRENT TESTING



This test is carried out on the entire length of the tubes in order to guarantee the integrity of the hole tube wall.

Eddy current testing is a non-destructive testing method widely used to examine tubing in heat exchangers, steam generators, condensers, air coolers and feedwater heaters. Eddy current testing of tubes is an effective way of assessing the condition and lifespan of tubes, particularly in the power generation, petrochemical, chemical, fertilizer and air conditioning industries. The technique is applied to detect corrosion, pitting, cracks, erosion and other changes to both the tube's interior and exterior surfaces.

It is a high-speed inspection method and one of the major advantages is that it can be performed through paint and coatings. The technique is only suitable for non-ferrous material such as stainless steel, copper and titanium. We also perform remote field and magnetic biased eddy current testing on carbon tubing.

ASTM STANDARD

Condensed ASTM Specification for Stainless Steel Pipes & Tubes

Specification	Allowable Outside Diameter Variations in mm			Allowable Wall Thickness Variations		Exact Length Tolerances in mm		Testing
	Nominal Diameter	Over	Under	Over %	Under %	Over %	Under %	
ASTM A - 213 Seamless Boiler Superheater and Heat Exchanger Tubes	Under 25.4 25.4-38.1 Incl. 38.1-50.8 excel. 50.8-63.5 excel. 63.5-76.2 excel. 76.2-101.6 Incl.	0.10 0.15 0.20 0.25 0.30 0.38	0.10 0.15 0.20 0.25 0.30 0.38	+20 +20 +22 +22 +22 +22	-0 -0 -0 -0 -0 -0	3.17 3.17 3.17 3.76 4.76 4.76	0 0 0 0 0 0	Tension Test Flattening Test Flare Test Hardness Test 100% Hydrostatic Test Refer to ASTM A - 450
ASTM A - 249 Welded Boiler Superheater, Heat Exchanger and Condenser Tubes	Under 25.4 25.4-38.1 Incl. 38.1-50.8 excel. 50.8-63.5 excel. 63.5-76.2 excel. 76.2-101.6 Incl.	0.10 0.15 0.20 0.25 0.30 0.36	0.10 0.15 0.20 0.25 0.30 0.36	+10 +10 +10 +10 +10 +10	-10 -10 -10 -10 -10 -10	3.17 3.17 3.17 4.76 4.76 4.76	0 0 0 0 0 0	Tension Test Flattening Test Flare Test/Flange Test *Reverse Bend Test Hardness Test 100% Hydrostatic Test * Reverse Flattening Test Refer to ASTM A - 450 *Wherever Applicable
ASTM A-269 Seamless & Welded Tubing for General Service	Upto 12.7 12.7-38.1 excl. 38.1-88.9 excl. 88.9-139.7 excl. 139.7-203.2 excl.	0.13 0.13 0.25 0.38 0.76	0.13 0.13 0.25 0.38 0.76	+15 +10 +10 +10 +10	-15 -10 -10 -10 -10	3.2 3.2 4.8 4.8 4.8	0 0 0 0 0	Flare Test Flange Test (Welded Only) Hardness Test Flattening Test, Reverse Flattening 100% Hydrostatic
ASTM A - 312 Seamless & Welded Pipe	13.70-48.3 incl. 48.3-114.3 incl. 114.3-220 incl.	0.40 0.79 1.60	0.79 0.79 0.79	+12.5	-12.5	6.4 6.4 6.4 (Normaly Random Lengths Ordered)	0 0 0	Tension Test Flattening Test 100% Hydrostatic Test Refer to ASTM A-530
ASTM - 358 Welded Pipe for High Temperature Service.	For all Size 5" NB & Above	+0.5%	-0.5%	-	-0.3mm	Customers Requirements		Transvers Tension Test Transverse guided bend test. Hydrostatic test, radiographic (optional.)
ASTM A - 409 welded austenitic pipe	355.6-750mm	±0.2 to +0.4		-0.46		As per Customer Requirement		Refer to ASTM A 530
ASTM A - 554 Mechanical Steel Tubing	Upto 5" 127 mm	0.1 to 0.5	0.1 to 0.5	+10	-10	1.6 to 4.88	0	As per Customer Requirement

STAINLESS STEEL TUBE : DIMENSION AND WEIGHTS

Outside Diameter (mm)	0.8 (mm)	1 (mm)	1.2 (mm)	1.5 (mm)	2 (mm)	2.5 (mm)	3 (mm)	3.5 (mm)	4 (mm)
6.35	0.111	0.133	-	-	-	-	-	-	-
8	0.144	0.175	-	-	-	-	-	-	-
9.53	0.175	0.213	0.250	0.301	0.377	-	-	-	-
10	0.184	0.225	0.264	0.319	0.400	-	-	-	-
12	0.224	0.275	0.324	0.394	0.500	-	-	-	-
12.7	0.238	0.293	0.345	0.420	0.535	-	-	-	-
15.87	0.301	0.372	0.440	0.539	0.694	-	-	-	-
19.05	0.365	0.451	0.536	0.658	0.853	-	-	-	-
22.20	-	0.530	0630	0.776	1.010	-	-	-	-
25.4	-	0.610	0.726	0.896	1.170	1.431	1.680	-	-
28.57	-	0.689	0.821	1.015	1.329	1.629	1.918	-	-
31.75	-	0.769	0.917	1.134	1.488	1.828	2.156	2.472	-
35	-	0.850	1.014	1.256	1.650	2.031	2.400	2.756	-
38.1	-	0.928	1.107	1.373	1.805	2.225	2.633	3.028	-
42	-	1.025	1.224	1.519	2.000	2.469	2.925	3.396	-
44.45	-	1.086	1.298	1.611	2.123	2.622	3.109	3.583	4.045
45	-	1.100	1.314	1.631	2.150	2.656	3.150	3.631	4.100
50	-	1.225	1.464	1.819	2.400	2.969	3.525	4.069	4.600
50.8	-	1.245	1.488	1.849	2.440	3.019	3.585	4.139	4.680
63.5	-	-	1.869	2.325	3.075	3.813	4.538	5.250	5.950
76.2	-	-	2.250	2.801	3.710	4.606	5.490	6.361	7.220
88.9	-	-	-	3.278	4.345	5.400	6.443	7.473	8.490
101.6	-	-	-	3.754	4.980	6.194	7.395	8.584	9.760
127	-	-	-	4.706	6.250	7.781	9.300	10.806	12.300

RECTANGULAR TUBE DIMENSIONS THEORETICAL WEIGHT IN KG/MTR

Dimensions mm	mm	1.0 mm kg / meter	1.2 mm kg / meter	1.5 mm kg / meter	2.0 mm kg / meter	2.5 mm kg / meter	3.0 mm kg / meter	3.5 mm kg / meter	4.0 mm kg / meter
10	20	0.451	0.536	0.658	0.853	-	-	-	-
12.75	25.4	0.575	0684	0.844	1.100	-	-	-	-
10	30	0.610	0.726	0.895	1.170	-	-	-	-
15	30	0.689	0.821	1.015	1.329	-	-	-	-
20	40	0.928	1.107	1.373	1.805	2.225	2.633	-	-
20	50	1.100	1.314	1.631	2.150	2.656	3.150	-	-
25	50	1.183	1.413	1.755	2.315	2.863	3.380	-	-
20	60	1.245	1.488	1.849	2.440	3.019	3.585	-	-
40	60	-	1.869	2.325	3.075	3.813	4.538	5.250	5.950
40	80	-	2.250	2.801	3.710	4.606	5.490	6.361	7.200
45	75	-	2.224	2.947	3.700	4.594	5.475	6.344	7.200
50	100	-	-	3.506	4.650	5.781	6.900	8.006	9.100

STAINLESS STEEL PIPE : DIMENSION AND WEIGHTS

Nominal Pipe Size		Outside Diameter	SCH-5S Thick	SCH-5S Wt	SCH-10S Thick	SCH-10S Wt	SCH-20S Thick	SCH-20S Wt	SCH-30S Thick	SCH-30S Wt	SCH-40S Thick	SCH-40S Wt	SCH-80S Thick	SCH-80S Wt
(NB)	(inch)	(mm)	(mm)	(mtr.)	(mm)	(mtr.)	(mm)	Mtr.)	(mm)	(mtr.)	(mm)	(mtr.)	(mm)	(mtr.)
15	1/2	21.34	1.65	0.80	2.11	1.00	-	-	-	-	2.77	1.27	3.37	1.67
20	3/4	26.67	1.65	1.02	2.11	1.28	-	-	-	-	2.87	1.68	3.91	2.20
25	1	33.40	1.65	1.30	2.77	2.09	-	-	-	-	3.38	2.50	4.55	3.27
32	1 1/4	42.16	1.65	1.65	2.77	2.69	-	-	-	-	3.56	3.38	4.85	4.46
40	1 1/2	48.26	1.65	1.90	2.77	3.10	-	-	-	-	3.68	4.04	5.08	5.41
50	2	60.33	1.65	2.39	2.77	3.92	-	-	-	-	3.91	5.44	5.54	7.48
65	2 1/2	73.03	2.11	3.71	3.05	5.27	-	-	-	-	5.16	8.65	7.01	11.40
80	3	88.90	2.11	4.51	3.05	6.45	-	-	-	-	5.49	11.27	7.62	15.30
90	3 1/2	101.30	2.11	5.25	3.05	7.40	-	-	-	-	5.74	13.55	8.08	18.60
100	4	114.30	2.11	5.92	3.05	8.35	-	-	-	-	6.02	16.06	8.56	22.30
125	5	141.30	2.77	9.60	3.40	11.56	-	-	-	-	6.55	21.75	9.53	31.10
150	6	168.28	2.77	11.47	3.40	14.04	-	-	-	-	7.11	28.23	10.97	42.50
200	8	219.08	2.77	14.99	3.76	20.26	6.35	33.81	7.04	36.87	8.18	42.48	12.70	64.60
250	10	273.05	3.40	22.97	4.19	28..20	6.35	42.38	7.80	51.10	9.27	61.20	12.70	82.00
300	12	323.85	3.96	31.42	4.57	36.53	6.35	50.45	8.38	65.29	9.53	74.92	12.70	98.00
350	14	355.63	3.96	34.54	4.78	41.41	7.92	68.01	9.53	81.46	9.53	81.46	12.70	108.00
400	16	406.40	4.19	41.80	4.78	47.41	7.92	77.95	9.53	93.41	9.53	93.41	12.70	124.00
450	18	457.20	4.19	47.10	4.78	53.41	7.92	87.88	11.13	122.62	9.53	105.37	12.70	140.00
500	20	508.00	4.76	59.42	5.54	68.75	9.53	117.33	12.70	155.37	9.53	117.33	12.70	156.33
550	22	558.80	4.76	65.41	5.54	76.00	9.53	129.29	12.70	171.30	9.53	129.29	12.70	172.00
600	24	609.60	5.54	-	6.35	95.00	9.53	141.25	14.27	209.83	9.53	141.25	12.70	188.00

SQUARE TUBE DIMENSIONS THEORETICAL WEIGHT IN KG/MTR

Dimensions mm	mm	1.0 mm kg / meter	1.2 mm kg / meter	1.5 mm kg / meter	2.0 mm kg / meter	2.5 mm kg / meter	3.0 mm kg / meter	3.5 mm kg / meter	4.0 mm kg / meter
12.75	12.75	0..373	0.441	0.541	-	-	-	-	-
15	15	0.451	0.536	0.658	-	-	-	-	-
20	20	0.610	0.726	0.896	1.170	-	-	-	-
25	25	0.769	0.917	1.134	1.488	1.828	2.156	-	-
30	30	0.928	1.107	1.373	1.805	2.225	2.633	-	-
40	40	1.245	1.488	1.849	2.440	3.019	3.585	4.139	4.710
50	50	1.563	1.869	2.325	3.075	3.813	4.538	5.250	5.950
60	60	1.880	2.250	2.801	3.710	4.606	5.490	6.361	7.220
75	75	-	-	3.506	4.650	5.781	6.900	8.006	9.100
80	80	-	-	3.754	4.980	6.194	7.395	8.584	9.820
90	90	-	-	4.238	5.625	7.00	8.363	9.713	11.050
100	100	-	-	4.718	6.265	7.800	9.323	10.833	12.300

CHEMICAL COMPOSITION CHART

Grade AISI	C	Mn	P	S	SI	Cr	Ni	Mo	Other
201	0.15	5.50-7.50	0.060	0.030	1.00	16.00-18.00	3.50-5.50	-	N 0.25
202	**0.15**	**7.50-10.00**	**0.060**	**0.030**	**1.00**	**17.00-19.00**	**4.00-6.00**	**-**	**N 0.25**
301	0.15	2.00	0.045	0.030	1.00	16.00-18.00	6.00-8.00	-	-
302	0.15	2.00	0.045	0.030	0.75	17.00-19.00	8.00-10.00	-	-
303	0.15	2.00	0.20	0.15	1.00	17.00-19.00	8.00-10.00	0.60^{0}	-
303Se	0.15	2.00	0.20	0.060	1.00	17.00-19.00	8.00-10.00	-	-
304	**0.08**	**2.00**	**0.045**	**0.030**	**0.75**	**18.00-20.00**	**8.00-10.50**	**-**	**-**
304 L	**0.03**	**2.00**	**0.045**	**0.030**	**0.75**	**18.00-20.00**	**8.00-12.00**	**-**	**-**
304 H	0.04-0.10	2.00	0.045	0.030	0.75	18.00-20.00	8.00-10.50	-	-
305	0.12	2.00	0.045	0.030	0.75	17.00-19.00	10.50-13.00	-	-
308	0.08	2.00	0.045	0.030	1.00	19.00-21.00	10.00-12.00	-	-
309	0.20	2.00	0.045	0.030	1.00	22.00-24.00	12.00-15.00	-	-
309 S	0.08	2.00	0.045	0.030	0.75	22.00-24.00	12.00-15.00	-	-
310	0.25	2.00	0.045	0.030	1.50	24.00-2600	19.00-22.00	-	-
310 S	0.08	2.00	0.045	0.030	1.50	24.00-26.00	19.00-22.00	-	-
314	0.25	2.00	0.045	0.030	1.50-3.00	23.00-26.00	19.00-22.00	-	-
316	**0.08**	**2.00**	**0.045**	**0.030**	**0.75**	**16.00-18.00**	**10.00-14.00**	**2.00-3.00**	**-**
316 L	**0.03**	**2.00**	**0.045**	**0.030**	**0.75**	**16.00-18.00**	**10.00-15.00**	**2.00-3.00**	**-**
316 H	0.04-0.10	2.00	0.045	0.030	0.75	16.00-18.00	10.00-14.00	-	-
316 Ti	0.08	2.00	0.045	0.030	0.75	16.00-18.00	10.00-14.00	2.00-3.00 T	is*C. Min
317	0.08	2.00	0.045	0.030	0.75	18.00-20.00	11.00-15.00	3.00-4.00	-
317 L	0.03	2.00	0.045	0.030	0.75	18.00-20.00	11.00-15.00	3.00-4.00	-
321	0.08	2.00	0.045	0.030	0.75	17.00-19.00	9.00-12.00	-	Ti 5xC%
321H	0.04-0.10	2.00	0.045	0.030	0.75	17.00-19.00	9.00-12.00	-	Ti 5xC%
347	0.08	2.00	0.045	0.030	0.75	17.00-19.00	9.00-13.00	-	Na+Ta 10xC%
347 H	0.04-0.10	2.00	0.045	0.030	0.75	17.00-19.00	9.00-13.00	-	Na+Ta 10xC%
410	0.15	1.00	0.040	0.030	1.00	11.50-13.50	0.75	-	-
420	0.15	1.00	0.045	0.030	1.00	10.50-15.50	1.0-2.5	-	Mo 0.20-1.20
402 F	0.15	1.25	0.060	0.15					
429	0.12	1.00	0.040	0.030	1.00	14.00-16.00	-	-	-
430	0.12	1.00	0.040	0.030	1.00	16.00-18.00	0.75	-	-
430 Ti	0.12	1.25	0.060	0.15	1.00	16.00-18.00	-	-	Ti 0.75
439	0.03	1.00	0.040	0.030	1.00	17.00-19.00	0.50	-	Ti[0.20+4(C+N)] Min,1.10 max Al 0.15
441	0.03	1.00	0.040	0.030	1.00	17.50-19.50	1.00	-	Ti 0.10 to0.50
444	0.025	1.00	0.040	0.030 1	.00	17.50-19.50	1.00	1.75-2.50	(Ti+Cb [0.20+4(C+N] min,0.80 max

TYPES OF STAINLESS STEEL

Stainless Steel is a name given to a group of steel alloys that contain more than 10.5% Chromium. Chromium has a high affinity for oxygen and forms a stable oxide film on the surface of stainless steel.

The film is called the "passive oxide layer" and forms instantaneously in ordinary atmospheres. The film is self-healing and rebuilds when it has been removed. It is this film that gives stainless steel its corrosion resistance.

AUSTENITIC GRADES

When nickel (Ni) is added to stainless steel in sufficient quantities the crystal structure is changed from ferrite to austenite, hence the term austenitic stainless steel. The basic composition of austenitic stainless steel is 18% chromium (Cr) and 8% nickel (Ni). This is called 304 grade, sometimes referred to as 18/8 or 18/10. If additional corrosion resistance is required 2% molybdenum (Mo) is added to form grade 316.

GRADES:

303 (INDENT ONLY)

Especially developed for machining - especially where it involves extensive machining in automatic screw machines. Sulphur or selenium is added to give excellent free machining and non-seizing properties. As sulphur or selenium is added corrosion resistance is lower than T304. T303 is not recommended for welding. Non-magnetic when annealed but becomes slightly magnetic when cold-worked.

304

The most widely used stainless steel with the best all round performance. Its carbon content is lower and its corrosion resistance after welding is higher than T302. It is less susceptible to intergranular corrosion after welding. Non-magnetic but slightly magnetic when cold worked.

Corrosion Resistance

Excellent in a wide range of atmospheric environments and many corrosive media. Subject to pitting and crevice corrosion in warm chloride environments, and to stress corrosion cracking above about 60 °C. Considered resistant to potable water with up to about 200 mg/L chlorides at ambient temperatures, reducing to about 150 mg/L at 60 °C.

Heat Resistance

Good oxidation resistance in intermittent service to 870 °C and in continuous service to 925 °C. Continuous use of 304 in the 425-860 °C range is not recommended if subsequent aqueous corrosion resistance is important. Grade 304L is more resistant to carbide precipitation and can be heated into the above temperature range.

Heat Treatment

Solution Treatment (Annealing) - Heat to 1010-1120 °C and cool rapidly. These grades cannot be hardened by thermal treatment.

304L

A low carbon stainless steel with general corrosion resistance like T304, but with superior resistance to intergranular corrosion following welding or stress relieving. Highly recommended for parts which are fabricated by welding and which can not be annealed.

Generally limited to temperatures up to 426°C. The physical properties and thermal treatments of T304L are similar but not identical to T304. Non-magnetic when annealed but slightly magnetic when cold-worked.

316

Also known as marine grade stainless steel. T316 has 2-3% molybdenum which improves corrosion resistance. T316 has superior corrosion resistance to other austenitic steels when exposed to many types of chemical corrodents as well as marine environments - T316 also has applications in the chemical, textile, and paper industries. It has better strength and creep resistance at high temperatures than T304 and greater work hardening properties. Non-magnetic but slightly magnetic when cold-worked.

Corrosion Resistance

Excellent in a range of atmospheric environments and many corrosive media - generally more resistant than 304. Subject to pitting and crevice corrosion in warm chloride environments, and to stress corrosion cracking above about 60 °C. Considered resistant to potable water with up to about 1000 mg/L chlorides at ambient temperatures, reducing to about 500 mg/L at 60 °C.

316 is usually regarded as the standard "marine grade stainless steel", but it is not resistant to warm sea water. In many marine environments 316 does exhibit surface corrosion, usually visible as brown staining. This is particularly associated with crevices and rough surface finish.

Heat Resistance

Good oxidation resistance in intermittent service to 870 °C and in continuous service to 925 °C. Continuous use of 316 in the 425-860 °C range is not recommended if subsequent aqueous corrosion resistance is important. Grade 316L is more resistant to carbide precipitation and can be used in the above temperature range. Grade 316H has higher strength at elevated temperatures and is sometimes used for structural and pressure-containing applications at temperatures above about 500 °C.

Heat Treatment

Solution Treatment (Annealing) - Heat to 1010-1120 °C and cool rapidly. These grades cannot be hardened by thermal treatment.

316L

Has lower carbon than T316, with corrosion resistance similar to T316, but superior resistance to intergranular corrosion following welding or stress relieving. It is recommended for parts which cannot be subsequently annealed. Service temperatures up to 426°C. The physical properties and thermal treatments of type 316L are similar but not identical to type 316. Non-magnetic when annealed but slightly magnetic when cold-worked.

MARTENSITIC GRADES

This grade contains 12%-18% chromium and 0.08%-1.00% carbon. The high carbon content allows the stainless steel to respond well to heat treatment to give various mechanical strengths such as hardness. However the carbon is detrimental when welding and care must be taken.

Grades 410, 420 and 431 are typical martensitic grades.

410

Grade 410 stainless steels are general-purpose martensitic stainless steels containing 11.5% chromium, which provide good corrosion resistance properties. However, the corrosion resistance of grade 410 steels can be further enhanced by a series of processes such as hardening, tempering and polishing. Quenching and tempering can harden grade 410 steels. They are generally used for applications involving mild corrosion, heat resistance and high strength.

Martensitic stainless steels are fabricated using techniques that require final heat treatment. These grades are less resistant to corrosion when compared to that of austenitic grades. Their operating temperatures are often affected by their loss of strength at high temperatures, due to over-tempering and loss of ductility at sub-zero temperatures.

Corrosion Resistance

Grade 410 stainless steels are resistant to hot gases, steam, food, mild acids and alkalies, fresh water and dry air. These steels obtain maximum corrosion and heat resistance through hardening. However, grade 410 steels are less corrosion resistant than austenitic grades and grade 430 ferritic alloys containing 17% chromium. Smooth surface finish offers improved performance of steels.

FERRITIC GRADES

These are nickel free. They have varying chromium content of 12%-22% but a lower carbon content than the martensitic grades. The increased chromium increases corrosion resistance at elevated temperatures, however the lack of mechanical properties due to the fact that it cannot be heat-treated limits its application.

430

A corrosion and heat resisting stainless steel with superior corrosion and heat resistance compared to type 410. Type 430 is non hardenable and possesses only mild cold-working properties due to the high chromium content. Its weldability is excellent and does not require subsequent annealing. Magnetic in all conditions. Common uses include builders hardware, domestic appliances (driers, dishwashers) and automotive trim.

409

Grade 409 stainless steel is a Ferritic steel that offers good mechanical properties and high-temperature corrosion resistance. It is commonly considered as a chromium stainless

steel, with applications in exhaust systems of automobiles and applications that demand weldability.

Grade 409 steels are also available in highly stabilized forms, such as grades S40930, S40920 and S40910. The stability of these grades is provided by the presence of niobium, titanium, or both, in the composition of steels.

Heat Resistance

Grade 409 stainless steels offer scaling resistance at temperatures up to 675°C during continuous operation, and up to 815°C under intermittent conditions. These temperatures pertain to specific service environments.

DUPLEX STAINLESS STEEL

Duplex stainless steels have a structure of approximately equal amounts of ferrite and austenitie and therefore may be referred to as ferritic-austenitic stainless steel.

The chromium varies from 18%-28% and a nickel content of 4.5% to 8% is insufficient to develop a fully austenitic crystal structure. Most grades contain molybdenum in the 2.5%-4% range, plus a small nitrogen addition which enables both strength and pitting resistance. Common uses include applications such as heat exchanger panels and tubes, tanks and vessels where high chloride concentrations are present e.g. sea water cooling, desalination, food pickling plants and aggressive marine waters.

Duplex 2205:

Duplex 2205 stainless steel (both ferritic and austenitic) is used extensively in applications that require good corrosion resistance and strength. The S31803 grade stainless steel has undergone a number of modifications resulting in UNS S32205 and was endorsed in the year 1996. This grade offers higher resistance to corrosion.

At temperatures above 300°C, the brittle micro-constituents of this grade undergo precipitation, and at temperatures below -50°C the micro-constituents undergo ductile-to-brittle transition; hence this grade of stainless steel is not suitable for use at these temperatures.

Corrosion Resistance

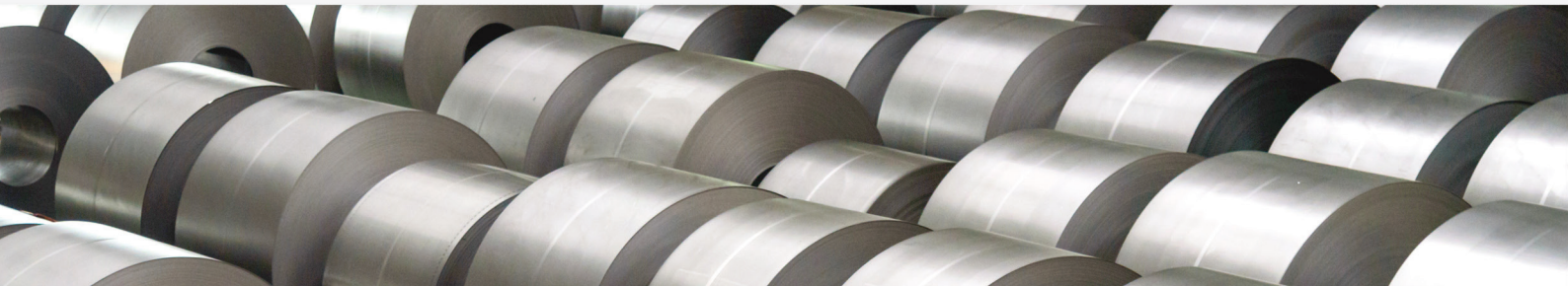
Grade 2205 stainless steel exhibits excellent corrosion resistance, much higher than that of grade 316. It resists localized corrosion types like intergranular, crevice and pitting. The CPT of this type of stainless steel is around 35°C. This grade is resistant to chloride stress corrosion cracking (SCC) at temperatures of 150°C. Grade 2205 stainless steels are apt replacements to austenitic grades, especially in premature failure environments and marine environments.

Heat Resistance

The high oxidation resistance property of Grade 2205 is marred by its embrittlement above 300°C. This embrittlement can be modified by a full solution annealing treatment. This grade performs well at temperatures below 300°C.

Heat Treatment

The best suited heat treatment for this grade is solution treatment (annealing), between 1020 - 1100°C, followed by rapid cooling. Grade 2205 can be work hardened but cannot be hardened by thermal methods.



Recycling and the long-term life of stainless steel

Stainless steel is playing an important role in sustainable design and alternative energy evolution. Ultimately, the most environmentally friendly materials are corrosion resistant and durable, have high-recycled content and recapture rates, provide long service life and reduce resource use. Stainless steel provides all of these benefits. If the correct stainless steel is selected and properly maintained, it will last the life of the project.

Today, where environmental issues are so important in saving and preserving our world, stainless steel can emerge as an excellent recyclable material.

Stainless steel is theoretically 100% recyclability and its long term life makes it an ideal environmental performer much better than many other materials. Stainless steel products are designed to have a long life; often spanning over several decades. This long term life generally is the reason for choosing stainless steel in the first place. However of course there will be a time when the stainless steel does come to the end of its useful life. The end of life may be reached due to fashion changes (product still functions but the design is out-dated), technological redundancy (product is replaced by a more efficient technology) or the product reaches the end of its design life.

Even though the end of life is reached, this does not mean that the stainless steel is not useful as a recyclable product. The main alloying elements of stainless steel (chromium, nickel and molybdenum) are all highly valuable and can be easily be recovered and separated from other materials.

"Did you know that any stainless steel object has an approximate recycled content of 60%"

In 2007, around 27 million tonnes of stainless steel were produced, taking approximately 16 million tonnes of recycled stainless steel and other materials to generate this quantity. The amount of recycled stainless steel in any stainless object is approximately 60%, this will increase however as the use of stainless steel expands as stainless steel produced today will not necessarily be recycled for 20-30 years.

"Stainless steel is made up of:

25% Old scrap such as end of life products

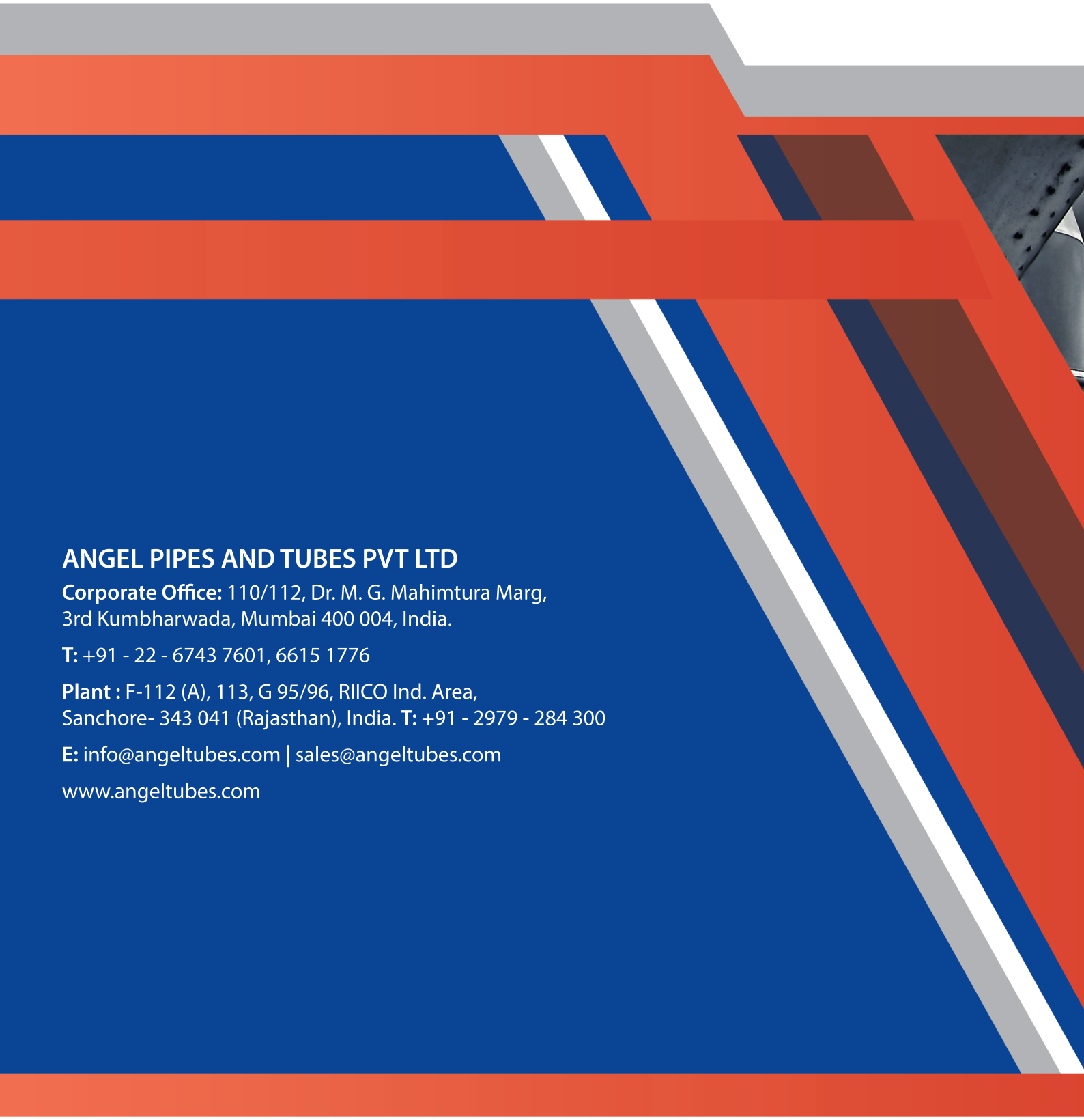
35% New scrap which is returning from production

40% New raw materials added"

Despite the very high recyclability properties of stainless steel, in some circumstances stainless steel will still find its way into disposal sites etc. Unlike many other metals, in this situation stainless steel will have no damaging effects on the soil and water.

So how does stainless steel improve modern day life?

Stainless steel has many environmental and social benefits. Stainless steel products enable us to lead a healthier life and are cleaner for the environment as well.



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