

STAINLESS STEEL TUBES

Pennar Group

Pennar Industries Limited is ISO 9001, ISO 14001 & OSHAS 18001, and IATF 16949: 2016 accredited company with a consolidated turnover of over 2500 crores, having seven manufacturing plants located at Patancheru, Isnapur, Velchal, Sadashivpet, Chennai, Tarapur and Hosur.

PIL, established in the year 1978, has grown since then by leaps and bounds widening its spectrum of engineering products. Pennar covers a whole range of products catering to various segments such as ERW Precision Tubes, CDW Tubes and Rail Wagon/ Coach Components, Cold Rolled Strips, Cold Roll Formed Sections, Engineering Components, Preengineered building, Road Safety Barriers, Sheet piles, Water Treatment Solutions, Solar, Engineering services. Facilities include laser cutting, plasma cutting, transfer presses and CNC machines that enable it to make products of very high quality.

Driven by our guiding philosophy of maximizing customer satisfaction with products and services par excellence, today we have successfully established our identity as a Powerhouse of Engineering Excellence.



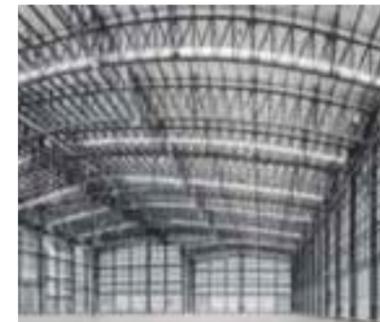
Cold rolled coils



ERW & CDW Tubes



ESP Electrodes



PEB



Pressed Components



Railway Products



Sheet Piles



Solar



Water Treatment

Vision

Our vision is to be a globally reputed engineered metal products company. We endeavour to have a strong and enduring relationship with our customers based on quality and service.

Mission

Our mission is to leverage our modern infrastructure, technical expertise and decades of experience to provide high quality and cost effective metal products to our customers. We are committed to ensure rewarding experience to our customers. We work closely with shareholders, suppliers, customers and employees to ensure attractive economic returns for every shareholder.

Introduction about Stainless Steels

Stainless steels are basically steels which contain high percentage of Chromium which is basically corrosion resistant, hence name called stainless.



Applications

Condensers, Heat Exchanger, Boiler & Pressure vessel, Instrumentation, Hydraulic & Pneumatic systems, Ornaments & Hardware Applications, Thermal & Nuclear Power Plants, Furniture, Dairies, Sugar Industries, Railways, Textile Machinery, Solvent Plant, Defence, Petroleum and petrochemical, Oil & Gas Refineries, Pharmaceutical & Chemical, Fertilizer Industries, Automobile & Locomotive, Chemical Industries, Steel Plant.

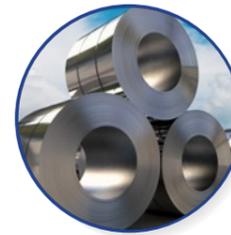
Ferrite Stainless Steel

This group of 400-series steels contains 10.5%–20% chromium for corrosion protection and resistance to scaling at high temperatures. Heat treating won't harden them, and they are always magnetic. Carbon content is low. Ferritic stainless is used in cases where resistance to corrosion is key 12 – 15% chromium, <.1 carbon Properties magnetic, hardened by cooling can't be hardened by heat treatment.

Advantages Corrosion resistance and scaling resistance

Used especially where corrosion resistance is priority without the need of the high strength.

Applications Utensils, Car silencers and Surgical Instruments.



Martensitic Stainless Steel

These steels, also of the 400 series, usually contain 11.5%–18% chromium and have higher levels of carbon than their ferritic counterparts. Heat treatment of these steels can result in a wide range of useful hardness and strength levels 12–18% chromium, .1 to 1.2 % Carbon, Hardened by heat treatment, magnetic, can be cold worked, and machined satisfactorily.

Advantages High strength and hardness than ferric stainless steels.

Applications Ball bearings, gas turbine parts, springs and instruments subjected to high temperature and corrosion conditions.



Austenitic Stainless Steel

Austenitic steels mainly reside in the 200 and 300 series. Austenitic steels are the most specified stainless steel grades thanks to their excellent formability and corrosion resistance. Austenitic stainless steels contain 15%–30% chromium and 2%–20% nickel for better surface quality, corrosion and wear resistance, and workability. They are nonmagnetic when annealed but -- depending on the nickel content and other composition factors --- can become slightly magnetic when cold worked.

You may notice "L" or "H" attached to some of the grades. "L" denotes low carbon content, which equals increased corrosion resistance. "H" denotes high carbon content, a sign of increased strength. 18% chromium, 8 % Nickel, <.1% carbon, Can't be hardened by quenching, But quenching done to minimize the formation of Chromium carbide which reduce corrosion resistance. Increase in hardness can be produced by cold working, non-magnetic.

Applications Aircraft exhaust manifolds, food and chemical processing equipment, utensils and sanitary fittings.

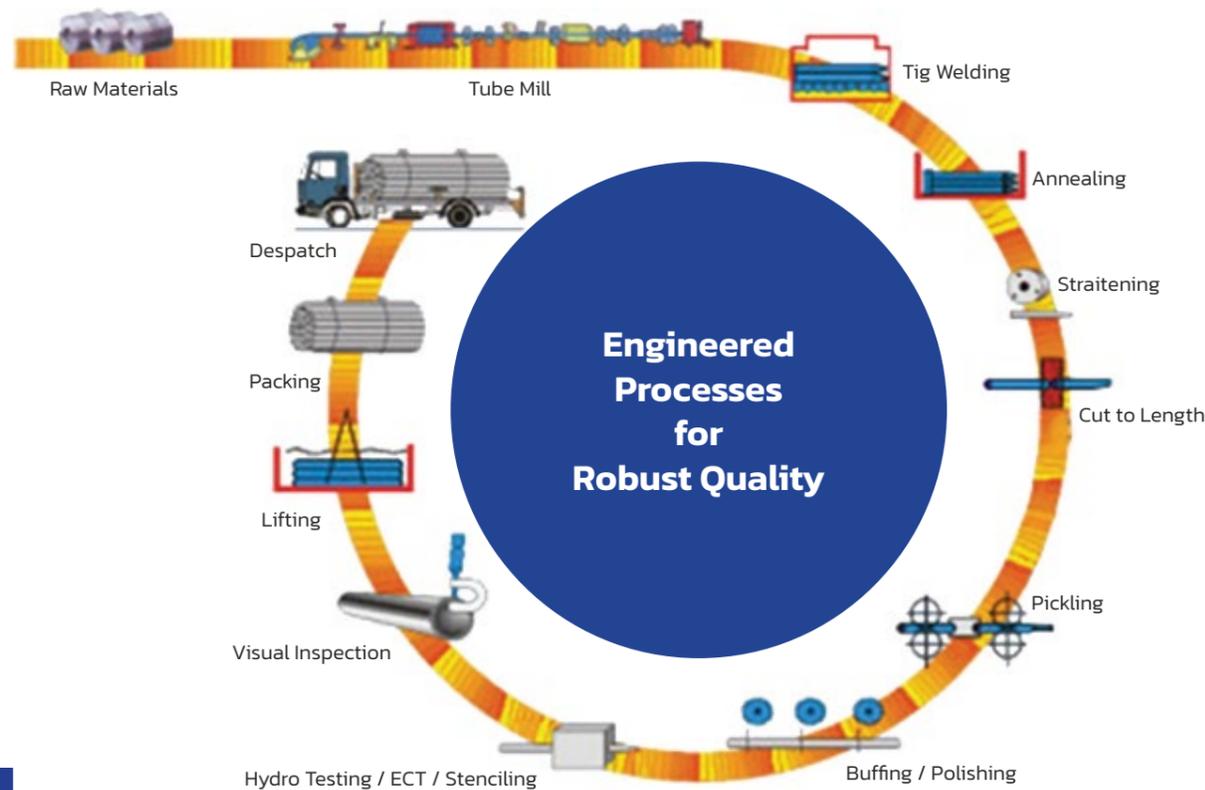
Stainless Steel Grades

The best known grade is Type 304, also known as 18/8 and 18/10 for its composition of 18% chromium and 8%/10% nickel, respectively. The second most common austenitic stainless steel is Type 316. The addition of 2% molybdenum provides greater resistance to acids and to localized corrosion caused by chloride ions.

| STAINLESS STEEL GRADES CHART | | | |
|------------------------------|------------|--|--|
| GRADE | TYPE | TRAITS | USES |
| 3CR12 | Ferritic | Useful corrosion resistance, particularly in wet abrasion environments. Readily welded and formed. | Tanks, flues, bins, chutes, rail wagons |
| 201 | Austenitic | Low nickel, high work hardening. | Cookware, hose clamps |
| 301 | Austenitic | Combination of strength and ductility to withstand severe forming methods. Corrosion resistance comparable to 302. | Rail cars, automotive components |
| 302 | Austenitic | Excellent corrosion resistance. High strength and hardness. | Food and drink, sanitary, cryogenic and pressure applications |
| 303 | Austenitic | Addition of sulphur or selenium gives it best machinability of all austenitic grades, but reduces corrosion resistance compared to 304. | Nuts and bolts, aircraft fittings and gears, bushings |
| 304 | Austenitic | Slightly magnetic when cold worked. Excellent corrosion resistance but susceptible to pitting corrosion in warm chloride environments. Excellent toughness | Architecture, kitchens, food processing |
| 309S | Austenitic | Resistant to oxidation. | Heating, furnace parts |
| 316 | Austenitic | Same mechanical and physical properties as 304 but more resistant to pitting corrosion, especially in warm chloride environments. Virtually non-magnetic. | Marine architectural components, food processing, hot water systems |
| 317L | Austenitic | Improved corrosion resistance over 316. 317L is a variation of 317 suitable for heavy-gauge welding. | Pulp and paper machinery, ink and dyeing processes, acetic acid distillation |
| 321 | Austenitic | Titanium-stabilized. | Aircraft, heat exchangers (up to intermediate temperatures) |
| 400 | Ferritic | Corrosion resistance comparable to 409, better surface finish | Caskets, applications requiring better finish than 409 |
| 409, Aluminized 409 | Ferritic | Resists atmospheric and automotive exhaust gas corrosion. Aluminized version adds salt and cosmetic corrosion resistance. | Auto exhaust systems, heat exchangers, furnace liners |

| GRADE | TYPE | TRAITS | USES |
|------------|---------------------|---|---|
| 410, 410H | Martensitic | Resists dry atmospheres, freshwater, mild alkalis and acids, steam, and hot gases. Must harden for best heat and corrosion resistance. 410H has better hardenability. | Bolts, nuts, screws, pump parts and shafts, turbine parts, mine ladder rungs, cutlery, rulers, cold heading |
| 420, 420HC | Martensitic | Good resistance in hardened condition to atmosphere. Higher-carbon grade. HC offers better hardenability. | Cutlery, surgical instruments, needle valves |
| 430, 430F | Ferritic | Good combination of corrosion resistance, formability, mechanical properties. 430F is suitable for high-speed machining, but corrosion resistance is lower. | Automotive trim, refrigerator doors, element supports, cold-headed fasteners |
| 431 | Martensitic | Excellent resistance to wide variety of corrosive media, approaching that of 304. High tensile, torque strength. | Pump and boat shafts, nuts, bolts, marine hardware |
| 434 | Ferritic | Molybdenum use improves pitting resistance over 430. | Automotive trim components |
| 435 Mod. | Ferritic | Improved formability and weldability. | Automotive trim |
| 436 | Ferritic | Controlled roping. | Automotive trim |
| 439 | Ferritic | Titanium-stabilized. 18% chrome alloy with low carbon content. Corrosion resistance to variety of oxidizing environments. Pitting corrosion resistance. | Nuclear, automotive, power generation, chemical processing, consumer appliances |
| 440 | Martensitic | High-carbon, moderate corrosion resistance, superior strength and hardness. | Knives, ball bearings, gauge blocks, dies |
| 444 | Ferritic | Resistant to oxidation, corrosion, and stress cracking. | Water heaters, engine components, solar panels |
| 904L | Austenitic | 'Super austenitic' grade with very high corrosion resistance, especially to strong acids and chlorides. | Sulphuric acid service |
| 2205 | Ferritic/Austenitic | About 50% ferrite and 50% austenitic. High strength and hardness. Resistant to erosion, fatigue, stress corrosion cracking, and pitting and crevice corrosion. | Marine, chemical, and petrochemical industries |
| 41003 | Ferritic | Excellent weldability, toughness, and fabricating characteristics | Tubing for bus frames, hopper cars, chutes, storage tanks, shipping containers |
| UR52N | Ferritic/Austenitic | 'Super duplex' grade with exceptional resistance to hot chlorides and sulphides. High in strength. | Marine, chemical, and petrochemical industries |

SS Tubes Process Flow



Raw Material Preparation

Raw material is procured along with the necessary test certificates only from suppliers (Jindal stainless Steel Ltd, Steel Authority of India) approved by our quality division. Before transforming the steel, Pennar 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. We provide wide range of different types of coils in the various Grades and Thickness which will be required by our customers. This enables Pennar to optimize the feeding of the production lines.

SS Tube Making



Roll forming and welding

The first stage of manufacturing process is Roll forming along with a state of arc welding technology. The TIG welding method uses electricity to obtain fusion. The heat affected zone following TIG welding maintains good mechanical and corrosion resistance.

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 the speed of the tubes are constantly monitored in order to achieve a correct solubilisation.



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. Pennar is able to pickle tubes in lengths of up to 8 meters.

Straightening

The rolls grip the tube and rotate it while feeding it through the machine until the entire length has been straightened. While passing through the machine, the tube is subjected to two specific straightening forces: pressure straightening and bend (or offset) straightening.



1. Pressure straightening. As the tube passes through restricted gap between rolls, it is subjected to pressure which, if sufficient, will cause the tube walls to be strained past their elastic limit, thereby causing some straightening of the tube
2. Bend, or offset, straightening. One or more pairs of rolls can be adjusted to cause the tube to follow a curved path through the machine. Bending the tube in this manner is the main straightening action that it causes excessive work hardening

SS Tube Making

Buffing

Buffing is a finishing process for smoothing a workpiece's surface using an abrasive and a work wheel or a leather strop. Technically polishing refers to processes that use an abrasive that is glued to the work wheel, while buffing uses a loose abrasive applied to the work wheel, where buffing removes the lines and creates a bright lustre finish. Polishing by abrasive belts or discs is required to level surfaces, remove scratches, pits, scale and polish the surface enough so the cut buff can remove the polishing lines.

Material Testing



NDT Testing (Eddy Current)

Eddy current testing is the process of inducing small electrical currents in an electrically conductive article and observing the resultant reaction between the magnetic fields involved. Equipment: Eddy Current Flaw Detector.



Hydro Testing

After completing all the above process, all pipes transferred to the hydro testing bench. The test pressure shall be given to the pipes as per relevant specification or as per Customer Requirement.



Visual inspection

To check for surface imperfections such as mechanical marks, lamination, tears or any other visual imperfections and also check weld defects such as porosity, undercuts, uneven weld bead, and excess or under fill of weld material. Acceptance of these imperfections is as per applicable ASTM standard.



Marking

Marking on the tubes shall be paint stencilled as stipulated in Standard or as per the customer's requirement, on each length of the tube.



Packaging and delivery

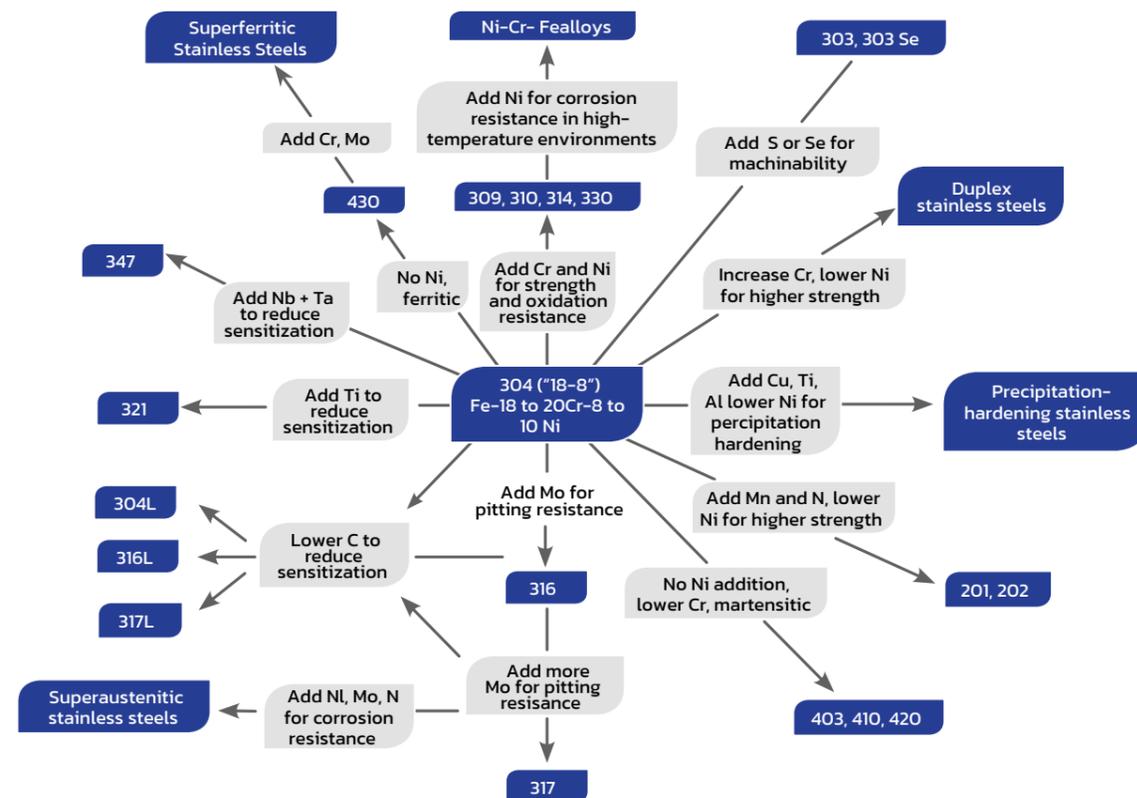
Tubes are delivered in standard packing secured by nylon straps & self-adhesive tape. Polished Tubes are packed individually in plastic sleeves, before being bundled. Upon request, Tubes can be delivered in bundles with wooden frames and end covers or in wooden crates or boxes.

| PRODUCT | | | | | | | | | | | | | | | |
|--------------|--------|-----------|-----------|------|------|------|------|------|------|------|------|------|------|----------|---------|
| Sl. No | Shape | Outer DIA | Thickness | | | | | | | | | | | | |
| 1 | ROUND | 17.00 | 0.50 | 0.71 | 0.89 | 1.00 | 1.20 | 1.45 | 1.65 | | | | | | |
| 2 | ROUND | 19.05 | 0.50 | 0.71 | 0.89 | 1.00 | 1.20 | 1.45 | 1.65 | | | | | | |
| 3 | ROUND | 20.00 | 0.50 | 0.71 | 0.89 | 1.00 | 1.20 | 1.45 | 1.65 | | | | | | |
| 4 | ROUND | 21.34 | | 0.71 | 0.89 | 1.00 | 1.20 | 1.45 | 1.65 | 2.0 | | | | | |
| 5 | ROUND | 25.00 | | 0.71 | 0.89 | 1.00 | 1.20 | 1.45 | 1.65 | 2.0 | 2.11 | 2.41 | | | |
| 6 | ROUND | 25.40 | | 0.71 | 0.89 | 1.00 | 1.20 | 1.45 | 1.65 | 2.0 | 2.11 | 2.41 | | | |
| 7 | ROUND | 26.67 | | 0.71 | 0.89 | 1.00 | 1.20 | 1.45 | 1.65 | 2.0 | 2.11 | 2.41 | 2.65 | | |
| 8 | ROUND | 31.80 | | | 0.89 | 1.00 | 1.20 | 1.45 | 1.65 | 2.0 | 2.11 | 2.41 | 2.65 | 3.05 | |
| 9 | ROUND | 32.00 | | | 0.89 | 1.00 | 1.20 | 1.45 | 1.65 | 2.0 | 2.11 | 2.41 | 2.65 | 3.05 | |
| 10 | ROUND | 33.40 | | | | 1.00 | 1.20 | 1.45 | 1.65 | 2.0 | 2.11 | 2.41 | 2.65 | 3.05 | |
| 11 | ROUND | 38.10 | | | | | 1.20 | 1.45 | 1.65 | 2.0 | 2.11 | 2.41 | 2.65 | 3.05 | 3.60 |
| 12 | ROUND | 40.00 | | | | | 1.20 | 1.45 | 1.65 | 2.0 | 2.11 | 2.41 | 2.65 | 3.05 | 3.60 |
| 13 | ROUND | 44.50 | | | | | 1.20 | 1.45 | 1.65 | 2.0 | 2.11 | 2.41 | 2.65 | 3.05 | 3.60 |
| 14 | ROUND | 48.30 | | | | | | 1.45 | 1.65 | 2.0 | 2.11 | 2.41 | 2.65 | 3.05 | 3.60 |
| 15 | ROUND | 50.80 | | | | | | 1.45 | 1.65 | 2.0 | 2.11 | 2.41 | 2.65 | 3.05 | 3.60 |
| 16 | ROUND | 51.00 | | | | | | 1.45 | 1.65 | 2.0 | 2.11 | 2.41 | 2.65 | 3.05 | 3.60 |
| 17 | ROUND | 60.30 | | | | | | 1.65 | 2.0 | 2.11 | 2.41 | 2.65 | 3.05 | 3.60 | |
| 18 | ROUND | 63.50 | | | | | | 1.65 | 2.0 | 2.11 | 2.41 | 2.65 | 3.05 | 3.60 | |
| SQUARE WIDTH | | | | | | | | | | | | | | Weld Dia | |
| 19 | SQUARE | 20.00 | | 0.71 | 0.89 | 1.00 | 1.20 | 1.45 | 1.65 | 2.0 | 2.11 | | | | 25.9mm |
| 20 | SQUARE | 20.00 | | 0.71 | 0.89 | 1.00 | 1.20 | 1.45 | 1.65 | 2.0 | 2.11 | 2.41 | 2.65 | 3.05 | 25.9mm |
| 21 | SQUARE | 25.00 | | | 0.89 | 1.00 | 1.20 | 1.45 | 1.65 | 2.0 | 2.11 | 2.41 | 2.65 | 3.05 | 32.00mm |
| 22 | SQUARE | 45.00 | | | | | | | | | | | | | 53.50mm |

ALL DIMENSIONS ARE IN MM

| ASTM STANDARDS | | | | | | | | |
|--|---|------------|------------|-------------------------------------|--------|-------------------------------|--------|--|
| Consider ASTM specification for Stainless Steel Pipes and 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 Welded boiler superheater and heat exchanger tubes | Under 25.4 | 0.10 | 0.10 | +20 | -0 | 3.17 | 0 | Tension Test, Flattening Test, Flare Test, Hardness Test, 100% Hydrostatic test, Refer to ASTM A-450 |
| | 25.4- 38.1 Incl. | 0.15 | 0.15 | +20 | -0 | 3.17 | 0 | |
| | 38.1-50.8 excl. | 0.20 | 0.20 | +22 | -0 | 3.17 | 0 | |
| | 50.8-63.5 excl. | 0.25 | 0.25 | +22 | -0 | 3.76 | 0 | |
| | 63.5-76.2 excl. | 0.30 | 0.30 | +22 | -0 | 4.76 | 0 | |
| | 76.2-101.6 Incl. | 0.38 | 0.38 | +22 | -0 | 4.76 | 0 | |
| ASTM-249 Welded boiler, superheater, heat exchanger and condenser tubes | under 25.4 | 0.10 | 0.10 | +10 | -10 | 3.17 | 0 | Tension Test, Flattening Test, Flare Test, Hardness Test, 100% Hydrostatic test, Refer to ASTM A-450 |
| | 25.4-38.1 Incl. | 0.15 | 0.15 | +10 | -10 | 3.17 | 0 | |
| | 38.1-50.8 excl. | 0.20 | 0.20 | +10 | -10 | 3.17 | 0 | |
| | 50.8-63.5 excl. | 0.25 | 0.25 | +10 | -10 | 3.76 | 0 | |
| | 63.5-76.2 excl. | 0.30 | 0.30 | +10 | -10 | 4.76 | 0 | |
| | 76.2-101.6 Incl. | 0.36 | 0.36 | +10 | -10 | 4.76 | 0 | |
| ASTM A-269 Seamless & welded tubing for general service | upto 12.7 | 0.13 | 0.13 | +15 | -15 | 3.2 | 0 | Flare Test, Flange Test (welded only), Hardness test, Flattening test, Reverse Flattening |
| | 12.7-38.1 excl. | 0.13 | 0.13 | +10 | -10 | 3.2 | 0 | |
| | 38.1-88.9 excl. | 0.25 | 0.25 | +10 | -10 | 4.8 | 0 | |
| | 88.9-139.7 excl. | 0.38 | 0.38 | +10 | -10 | 4.8 | 0 | |
| | 139.7-203.2 excl. | 0.76 | 0.76 | +10 | -10 | 4.8 | 0 | |
| ASTM A-312 Seamless & Welded pipe | 13.70-48.3 Incl. | 0.40 | 0.79 | +12.5 Hydrostatic | -12.5 | 6.4 | 0 | Tension Test, Flattening Test, 100% Hydrostatic test, Refer to ASTM A-530 |
| | 48.3-114.3 Incl. | 0.79 | 0.79 | | | 6.4 | 0 | |
| | 114.4-220 Incl. | 1.60 | 0.79 | | | 6.4 | 0 | |
| ASTM A- 358 Welded pipe for high temperature service | For all 5" NB & Above | +0.5% | -0.5% | - | -0.3 | customers requirement | | transverse tension test, transverse guided bend test, hydrostatic test, radio graphic(optional) |
| ASTM A- 409 Welded austenitic pipe | 355.6-750mm | ±2 to +0.4 | | | -0.46 | As per customer requirement | | Refer to ASTM A530 |
| ASTM A-554 Mechanical steel tubing | Upto 5" to 127 mm | 0.1 to 0.5 | 0.1 to 0.5 | +10 | -10 | 1.6 to 4.88 | 0 | As per customer requirement |

Unified Numbering System (UNS) for Metals and Alloys



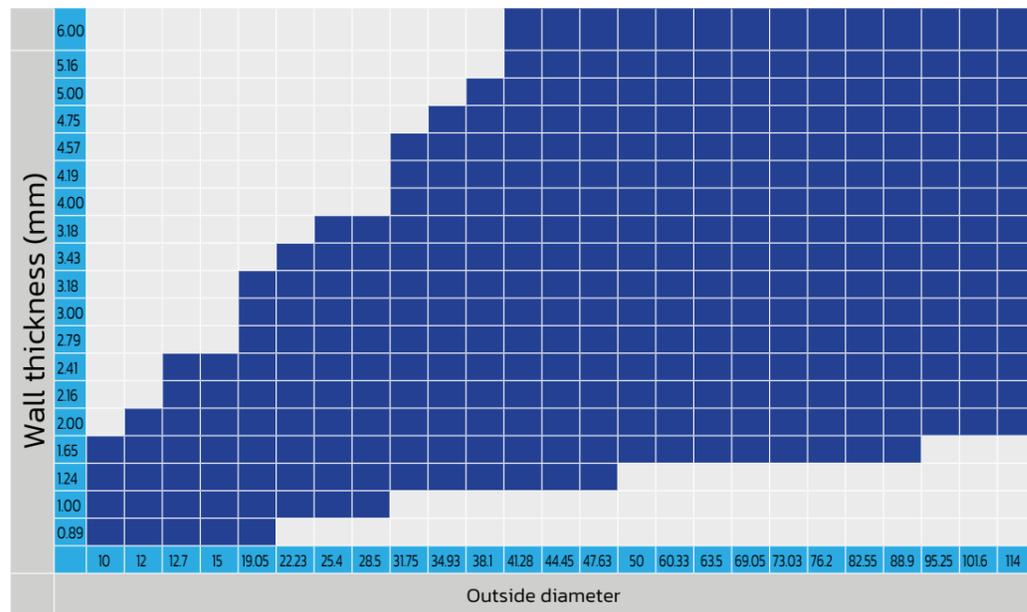
| CHEMICAL & MECHANICAL PROPERTIES | | | | | | | | | | | | | | | | | | | |
|---|-----------------|-----------|------------------------------|-------------------------------|-----------|----------|-----------|-------|---------------|-----------|-----------|---------|---|--|--------------------------------|-----------------------|----------------------|------------------|--|
| CHEMICAL COMPOSITION OF STAINLESS STEEL | | | | | | | | | | | | | | MECHANICAL PROPERTIES OF STAINLESS STEEL | | | | | |
| USA, JAPAN | | | | EUROPE | | | | | | | | | | | | | | | |
| SAE designation | UNS designation | JIS Grade | ENIDIN Numerical Designation | ENIDIN Symbolical Designation | %C | %Mn | %Si | %P | %S | %N | %Cr | %Ni | Other | TENSILE STR (Mpa) Min | YIELD STR 0.2% PROOF (Mpa) Min | BONG (% IN 50m m) Min | Rockwell B (HR B)Max | Brinell (HB) Max | |
| Austenitic | | | | | | | | | | | | | | | | | | | |
| 201 | S20100 | SUS 201 | 14372 (EN) | X12CrMnNiN17-7-5 | 0.15 | 5.5-7.5 | 0.75 | 0.06 | 0.03 | 0.25 | 16-18 | 3.5-5.5 | - | 685 | 292 | 56 | 85 | 241 | |
| 202 | S20200 | SUS 202 | | | 0.15 | 7.5-10.0 | 0.75 | 0.06 | 0.03 | 0.25 | 17-19 | 4-6 | | 515 | 275 | 40 | 90 | 241 | |
| 205 | S20500 | | | | 0.12-0.25 | 14-15.5 | 0.75 | 0.06 | 0.03 | 0.32-0.40 | 16.5-18 | 1-1.75 | - | 790-830 | 450-475 | 40 | 100 | | |
| 254 | S31254 | | | | 0.02 max | - | - | - | - | 0.2 | 20 | 18 | 6 Mo, 0.75 Cu, "Super austenitic"; All values | 680 | 300 | 50 | | 210 | |
| 301 | S30100 | SUS 301 | 1431 (EN) | X10CrNi18-7 | 0.15 | 2 | 0.75 | 0.045 | 0.03 | 0.1 | 16-18 | 6-8 | | 758 | 276 | 60 | 85 | 270 | |
| 301L | S30103 | | 1431B (EN) | X2CrNi18-7 | 0.03 | 2 | 1 | 0.045 | 0.03 | 0.2 | 16-18 | 6-8 | | 515 | 205 | 40 | 100 | 241 | |
| 301LN | S30153 | | | | 0.03 | 2 | 1 | 0.045 | 0.015 | 0.07-0.20 | 16.5-18.5 | 6-8 | | 765 | 350 | 47 | 95 | 217 | |
| 302 | S30200 | SUS 302 | 14319 (EN) | X10CrNi18-9 | 0.15 | 2 | 0.75 | 0.045 | 0.03 | 0.1 | 17-19 | 8-10 | - | 620 | 275 | 55 | 85 | 201 | |
| 302B | S30215 | | | | 0.15 | 2 | 2.0-3.0 | 0.045 | 0.03 | | 17-19 | 8-10 | - | | | | | | |
| 303 | S30300 | SUS 303 | 14305 (EN) | | 0.15 | 2 | 1 | 0.2 | 0.15 min | - | 17-19 | 8-10 | Pb 0.60 (optional) | 650 | 300 | 45 | | 262 | |
| 303Se | S30323 | SUS 303Se | | X10CrNi18-9 | 0.15 | 2 | 1 | 0.2 | 0.06 | - | 17-19 | 8-10 | 0.15 Se min | 620 | 240 | 50 | | | |
| 304 | S30400 | SUS 304 | 14301 (EN) | X6CrNi18-10 | 0.08 | 2 | 0.75 | 0.045 | 0.03 | 0.1 | 18-20 | 8-10.50 | - | 515 | 205 | 40 | 92 | 201 | |
| 304L | S30403 | SUS 304L | 14306 (EN) | X2CrNi19-11 | 0.03 | 2 | 0.75 | 0.045 | 0.03 | 0.1 | 18-20 | 8-12 | - | 485 | 170 | 40 | 92 | 201 | |
| 304H | S30409 | SUS 304H | 14948 | X8CrNi19-10 | 0.04-0.10 | 2 | 0.75 | 0.045 | 0.03 | | 18-20 | 8-10.5 | | 515 | 205 | 40 | 92 | 201 | |
| 304Cu | S30430 | SUS XM7 | | | 0.08 | 2 | 0.75 | 0.045 | 0.03 | - | 17-19 | 8-10 | 3-4 Cu | 450-650 | 175 | 45 | | 215 | |
| 304N | S30451 | SUS 304N | | X5CrNi18-10 | 0.08 | 2 | 0.75 | 0.045 | 0.03 | 0.10-0.16 | 18-20 | 8-10.50 | - | 620 | 330 | 45 | 85 | 217 | |
| 305 | S30500 | SUS 305 | 14303 (EN) | X8CrNi18-12 | 0.12 | 2 | 0.75 | 0.045 | 0.03 | - | 17-19 | 10.3-12 | - | 585 | 260 | 50 | 45 | 80 | |
| 308 | S30800 | | | | 0.08 | 2 | 1 | 0.045 | 0.03 | - | 19-21 | 10-12 | - | 585 | 240 | 50 | 80 | 135 | |
| 309 | S30900 | | 14828 (EN) | X15CrNi23-13 | 0.2 | 2 | 1 | 0.045 | 0.03 | - | 22-24 | 12-15 | - | 620 | 310 | 45 | 85 | 147 | |
| 309S | S30908 | SUS 309S | 14828 (EN) | XCrNiSi20-12 | 0.08 | 2 | 1 | 0.045 | 0.03 | - | 22-24 | 12-15 | - | 620 | 310 | 50 | 85 | 147 | |
| 310 | S31000 | | 14842 | X615CrNiSi25-20 | 0.25 | 2 | 15 | 0.045 | 0.03 | - | 24-26 | 19-22 | - | 515 | 205 | 40 | 95 | 217 | |
| 310S | S31008 | SUS 310S | 14842 | X6CrNi25-20 | 0.08 | 2 | 15 | 0.045 | 0.03 | - | 24-26 | 19-22 | - | 515 | 205 | 40 | 95 | 217 | |
| 310H | S31009 | | 14845 | | 0.04-0.10 | 2 | 0.75 | 0.045 | 0.03 | | 24-26.0 | 19.22 | | 515 | 205 | 40 | 95 | 217 | |
| 314 | S31400 | SUS 314 | 14841 (EN) | X1CrNiSi25-20 | 0.25 | 2 | 15-3.0 | 0.045 | 0.03 | - | 23-26 | 19-22 | - | | | | | | |
| 316 | S31600 | SUS 316 | 14436 (EN) | X3CrNiMo17-13-3 | 0.08 | 2 | 0.75 | 0.045 | 0.03 | 0.1 | 16-18 | 10-14 | 2.0-3.0 Mo | 515 | 205 | 40 | 95 | 217 | |
| 316L | S31603 | SUS 316L | 14404 (EN) | X2CrNiMo17-12-2 | 0.03 | 2 | 0.75 | 0.045 | 0.03 | 0.1 | 16-18 | 10-14 | 2.0-3.0 Mo | 485 | 170 | 40 | 95 | 217 | |
| 316H | S31603 | SUS 316H | 14919 | X6CrNiMo17-12 | 0.04-0.10 | 2 | 0.75 | 0.045 | 0.03 | | 16-18 | 10-14 | | 515 | 205 | 40 | 95 | 217 | |
| 316F | S31620 | SUS 316F | 14427 | X6CrNiMoS18-11 | 0.08 | 2 | 1 | 0.2 | 0.10 min | - | 16-18 | 10-14 | 1.75-2.5 Mo | 585 | 260 | 60 | 85 | | |
| 316N | S31651 | SUS 316N | 14406 (EN) | X2CrNiMoN17-11-2 | 0.08 | 2 | 0.75 | 0.045 | 0.03 | 0.10-0.16 | 16-18 | 10-14 | 2.0-3.0 Mo | 620-1160 | 270-870 | 9-39 | | 190-350 | |
| 317 | S31700 | SUS 317 | | | 0.08 | 2 | 0.75 | 0.045 | 0.03 | 0.10 max | 18-20 | 11-15 | 3.0-0.4 Mo | 620 | 275 | 45 | 85 | 160 | |
| 317L | S31703 | SUS 317L | 14438 (EN) | X2CrNiMo18-15-4 | 0.03 | 2 | 0.75 | 0.045 | 0.03 | 0.10 max | 18-20 | 11-15 | 3.0-4.0 Mo | 595 | 260 | 55 | 85 | 270 | |
| 321 | S32100 | SUS 321 | 14541 (EN) | X6CrNi18-10 | 0.08 | 2 | 0.75 | 0.045 | 0.03 | 0.10 max | 17-19 | 9-12 | Ti 5(C+N) min, 0.70 max | 515 | 205 | 40 | 95 | 217 | |
| 321H | S32109 | SUS 321H | 14878 | X12CrNiTi18-9 | 0.04-0.10 | 2 | 0.75 | 0.045 | 0.03 | | 17-19 | 9-12 | Ti 5(C+N) min, 0.70 max | 515 | 205 | 40 | 95 | 217 | |
| 329 | S32900 | | | | 0.08 | 2 | 0.75 | 0.04 | 0.03 | - | 23-28 | 2.5-5 | 1-2 Mo | 725 | 550 | 25 | 96 | 230 | |
| 330 | N08330 | | | | 0.08 | 2 | 0.75-1.50 | 0.04 | 0.03 | - | 17-20 | 34-37 | | 550 | 260 | 40 | | 223 | |
| 347 | S34700 | SUS 347 | 14550 (EN) | X6CrNiNb18-10 | 0.08 | 2 | 0.75 | 0.045 | 0.03 Nb + Ta, | - | 17-19 | 9-13 | 10 x C min, 1 | 515 | 205 | 40 | 95 | 217 | |
| 321 | S32100 | SUS 321 | 14541 (EN) | X6CrNi18-10 | 0.08 | 2 | 0.75 | 0.045 | 0.03 | 0.10 max | 17-19 | 9-12 | Ti 5(C+N) min, 0.70 max | 515 | 205 | 40 | 95 | 217 | |
| 348 | S34800 | | 14878 | | 0.08 | 2 | 0.75 | 0.045 | 0.03 | - | 17-19 | 9-13 | Nb + Ta, 10 x C min, 1 max, but | 655 | 275 | 45 | 85 | 147 | |
| 384 | S38400 | | | | 0.08 | 2 | 1 | 0.045 | 0.03 | - | 15-17 | 17-19 | | 515 | 240 | 55 | 70 | 123 | |

| CHEMICAL COMPOSITION OF STAINLESS STEEL | | | | | | | | | | | | | | MECHANICAL PROPERTIES OF STAINLESS STEEL | | | | | |
|---|-----------------|-----------|------------------------------|-------------------------------|-----------|---------|-----|-------|-------------|----|------------|-----------|---|--|----------|------|-------|-----|--|
| SAE designation | UNS designation | JIS Grade | ENIDIN Numerical Designation | ENIDIN Symbolical Designation | %C | %Mn | %Si | %P | %S | %N | %Cr | %Ni | Other | | | | | | |
| Ferritic | | | | | | | | | | | | | | | | | | | |
| 405 | S40500 | SUS 405 | | | 0.08 | 1 | 1 | 0.04 | 0.03 | - | 11.5-14.5 | -0.1-0.3 | Al 0.60 max | 448 | 276 | 25 | 75 | 131 | |
| 409 | S40900 | | | | 0.08 | 1 | 1 | 0.045 | 0.03 | - | 10.5-11.75 | 0.05 | Ti6x (C+N) | 380 | 170 | 20 | 95 | 207 | |
| 429 | S42900 | SUS 429 | | | 0.12 | 1 | 1 | 0.04 | 0.03 | - | 14-16 | 0.75 | | | | | | | |
| 430 | S43000 | SUS 430 | 14016(EN) | X6Cr17 | 0.12 | 1 | 1 | 0.04 | 0.03 | - | 16-18 | 0.75 | - | 450 | 205 | 22 | 89 | 183 | |
| 430F | S43020 | SUS 430F | | | 0.12 | 1.25 | 1 | 0.06 | 0.15min | - | 16-18 | - | 0.60 Mo (optional) | 552 | 379 | 25 | 86 | 170 | |
| 430FSe | S43023 | | | | 0.12 | 1.25 | 1 | 0.06 | 0.06 | - | 16-18 | - | 0.15 Se min | 655 | 586 | 20 | 92 | | |
| 434 | S43400 | SUS 434 | 14113 | X6CrMo17-1 | 0.12 | 1 | 1 | 0.04 | 0.03 | - | 16-18 | - | 0.75-1.25 Mo | 531 | 365 | 23 | 83 | | |
| 436 | S43600 | | 14536 | | 0.12 | 1 | 1 | 0.04 | 0.03 | - | 16-18 | - | 0.75-1.25 Mo; Nb+Ta 5 x C min, 0.70 max | 538 | 441 | 32 | 89 | | |
| 442 | S44200 | | | | 0.2 | 1 | 1 | 0.04 | 0.03 | - | 18-23 | - | - | 515-550 | 275-310 | 20 | 90-95 | | |
| 446 | S44600 | SUS 446 | 14749 | X18Cr28 | 0.2 | 1.5 | 1 | 0.04 | 0.03 | - | 23-27 | 0.25 | | 550 | 345 | 20 | 83 | 159 | |
| Martensitic | | | | | | | | | | | | | | | | | | | |
| 403 | S40300 | | | | 0.15 | 1 | 0.5 | 0.04 | 0.03 | - | 11.5-13.0 | 0.6 | - | 485 | 310 | 25 | 80 | 139 | |
| 410 | S41000 | | | | 0.15 | 1 | 1 | 0.04 | 0.03 | - | 11.5-13.5 | 0.75 | - | 480 | 275 | 16 | | | |
| 414 | S41400 | | | | 0.15 | 1 | 1 | 0.04 | 0.03 | - | 11.5-13.5 | 1.25-2.50 | - | 1795 | 1013 | 15 | 48 | 459 | |
| 416 | S41600 | | | | 0.15 | 1.25 | 1 | 0.06 | 0.15min | - | 12-14 | - | (opti 60.00 ONAL Mo | 517 | 275 | 30 | | 262 | |
| 416Se | S41623 | | | | 0.15 | 1.25 | 1 | 0.06 | 0.06 | - | 12-14 | - | 0.15 Se min | 517 | 276 | 30 | 82 | | |
| 420 | S42000 | | | | 0.15 min | 1 | 1 | 0.04 | 0.03 | - | 12-14 | - | | 655 | 345 | 25 | 92 | 241 | |
| 420F | S42020 | | | | 0.15 min | 1.25 | 1 | 0.06 | 0.15 0. min | - | 12-14 | - | 0.60 Mo max (optional) | 655 | 380 | 22 | 18 | 220 | |
| 422 | S42200 | | | | 0.20-0.25 | 0.5-1.0 | 0.5 | 0.025 | 0.025 | - | 11.0-12.5 | 0.50-1.0 | 0.90-1.25 Mo; 0.20-0.30 V; 0.90-1.25 W | | | 862 | 18 | 320 | |
| 431 | S41623 | | | | 0.2 | 1 | 1 | 0.04 | 0.03 | - | 15-17 | 1.25-2.50 | | 862 | 655 | 20 | | 285 | |
| 440A | S44002 | | 14522 | | 0.60-0.75 | 1 | 1 | 0.04 | 0.03 | - | 16-18 | - | 0.75 Mo | 725-1790 | 415-1650 | 5-20 | 95 | | |
| 440B | S44003 | | | | 0.75-0.95 | 1 | 1 | 0.04 | 0.03 | - | 16-18 | - | 0.75 Mo | 738 | 427 | 20 | 96 | | |
| 440C | S44004 | | | | 0.95-1.20 | 1 | 1 | 0.04 | 0.03 | - | 16-18 | - | 0.75 Mo | 758-1970 | 448-1900 | 14 | 97 | | |
| Heat resisting | | | | | | | | | | | | | | | | | | | |
| 501 | S50100 | | | | 0.10 min | 1 | 1 | 0.04 | 0.03 | - | 4-6 | - | 0.40-0.65 Mo | 485 | 275 | 20 | | | |
| 502 | S50200 | | | | 0.1 | 1 | 1 | 0.04 | 0.03 | - | 4-6 | - | 0.40-0.65 Mo | 485 | 205 | 30 | | | |
| Martensitic precipitation hardening | | | | | | | | | | | | | | | | | | | |
| 630 | S17400 | | 14542(en) | rNiCuNbX5Cl6-4 | 0.07 | 1 | 1 | 0.04 | 0.03 | - | 15-17 | 3-5 | Cu 3-5, Ta 0.15-0.45 | 1105 | 1000 | 15 | 38 | 363 | |

CDW Tube Making

Tubes requiring high precision dimensional tolerances, higher strength, controlled mechanical properties and special smooth inner surface finishes are produced by Cold Drawing process, popularly known as Cold Drawn Welded Tubes (CDW).

ERW tubes are annealed and prepared for pointed ends through cold swaging / push pointing operations. End prepared tubes are drawn through a high precision close machined die which controls the outer diameter over a plug (placed inside the tube, coaxial with outer die) which controls the inner diameter of the tube. The tubes are further processed by the downstream facilities for a variety of applications. Uniform sectional thickness, close dimensional tolerances, superior inner surface finish and consistently higher mechanical properties make CDW tubes suitable for a wide variety of applications.



Quality Assurance

Each of Pennar's products undergoes a series of comprehensive mandatory and customer- specified supplementary tests at in-house testing facilities by qualified personnel in accordance with various international standards/ specifications. and testing, reads like 'who's who' The list of third party inspection agencies (TPIA), with whom Pennar have had privilege to carry our detailed stage wise inspection directory of TPAI's. Inspection by customer's own survey can also be offered.



Testing Facility

- Mechanical Testing, Chemical Testing
- Fully equipped laboratory for Corrosion Testing, chloride contamination testing
- Micro structure examination/ analysis
- Laboratory spectrometer and portable spectrometer
- Positive material identification(PMI) tester
- Ferrite content and surface finish
- Non Destructive Testing offered
 - Eddy current testing
 - Hydro Testing



Hydro testing



Universal Testing Machine



Eddy Current Testing



Micro Structure Examination

Certification & Approvals



- ISO 9001: 2015 by DNV-GL
- ISO 14001: 2015 by DNV-GL
- IATF 16949: 2016 by TVU NORD
- OHSAS 18001: 2007 by DNV-GL
- "WELL KNOWN TUBE MAKER" status by Central Boilers Board- INDIA



Patancheru (Telangana)



PEBS (Telangana)



Chennai (Tamil Nadu)



Velchal (Telangana)



Isnapur (Telangana)



Tarapur (Thane)

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