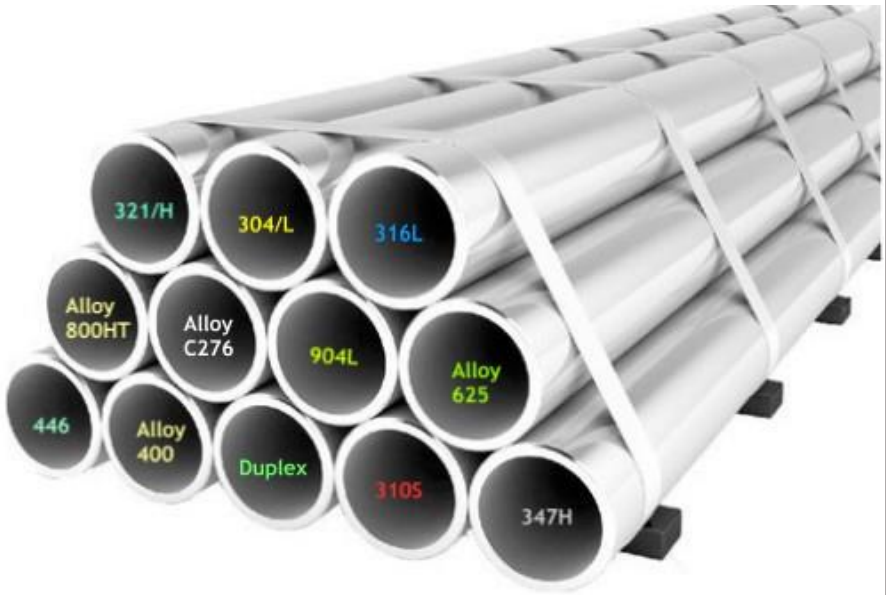
A213 T2, T5, T5B, T9, T91 ALLOY STEEL

Datasheet for A213 T2, T5, T5b, T9, T91 Alloy Steel

- Pipes & Tubes
- Sheets & Plates
- Bars & Rods, Forgings
- Fittings & Flanges
- Nuts & Bolts
- Valves



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Datasheet for Alloy Steel A213 T2, T5, T5b, T9, T91

What is Alloy Steel A213?

- Alloy steels contain alloying elements (e.g. manganese, silicon, nickel, titanium, copper, chromium, and aluminum) in varying proportions in order to manipulate the steel's properties, such as its hardenability, corrosion resistance, strength, formability, weldability or ductility.
- The difference is somewhat uniform, but to make it distinguishable, all steel alloyed with higher than 8% of its weight of elements other than carbon and alloy is considered high-alloy steel.
- Alloyed steels are harder, more durable and more resistant to corrosion. Alloy steels with carbon levels of medium to elevated rates are difficult to weld. However, if the carbon levels are reduced to 1% to 3%, such alloy metals can achieve greater formability and weldability, thus, improved strength.

Alloy Steel A213 T2, T5, T5b, T9, T91 Product Specification

Product	ASTM A213 T2 T5 T5b T9 T91 Seamless Alloy Tubes
Specification	ASTM A213
Type	Seamless
Size	3.2 to 127 mm
Thickness	0.4 to 12.7mm
Length	Single Random Length, Double Random Length, or as customer’s requirement.
Grades	T2, T5, T5b, T9, T91
Test Certificates	Material Test Certificates (MTC) as per EN 10204 3.1 and EN 10204 3.2

Chemical Composition of ASTM A213 T2, T5, T5b, T9, T91 Alloy Steel Heat Exchanger Tubes

Chemical Components (%)												
Grade	C	Mn	P	S	Si	Cr	Mo	V	Nb	N	Al	Others
T2	0.10-0.20	0.30-0.61	≤0.025	≤0.035	0.10-0.30	0.50-0.81	0.44-0.65	-	-	-	-	-
T5	0.15	0.30-0.60	≤0.025	≤0.035	0.5	4.0-6.0	0.44-0.65	-	-	-	-	-
T5b	0.15	0.30-0.60	≤0.025	≤0.035	1.0-2.0	4.0-6.0	0.44-0.65	-	-	-	-	-
T9	0.15	0.30-0.60	≤0.025	≤0.035	0.25-1.0	8.0-10.0	0.90-1.10	-	-	-	-	-
T91	0.07-0.14	0.30-0.60	≤0.010	≤0.010	0.20-0.50	8.0-9.5	0.85-1.05	0.18-0.25	0.06-0.1	0.030-0.070	0.02	Ti 0.01 Zr 0.01

Mechanical Properties of ASTM A213 T2 T5 T5b T9 T91 Alloy Steel Heat Exchanger Tubes

Grade	Tensile	Yield	Elongation	Hardness
	Strength (Mpa)	Strength (Mpa)	(%)	(HRB)
T2	≥415	≥205	≥30	≤85
T5	≥415	≥205	≥30	≤85
T5b	≥415	≥205	≥30	≤89
T9	≥415	≥205	≥30	≤89
T91	≥585	≥415	≥20	≤25

Heat Treatment Requirements for ASTM A213 T2 T5 T5b T9 T91 Alloy Steel Heat Exchanger Tubes

Grade	UNS Number	Heat Treat Type	Austenitizing / Solutioning Temperature, min or range °F [°C]	Subcritical Annealing or Tempering Temperature, Min or range °F [°C]
T2	K11547	full or isothermal anneal normalize and temper subcritical anneal	-	1200 to 1350 [650 to 730]
T5	K41545	full or isothermal anneal normalize and temper	-	1250 [675]
T5b	K51545	full or isothermal anneal normalize and temper	-	1250 [675]
T9	K50400	full or isothermal anneal normalize and temper	-	1250 [675]
T91	K90901	normalize and temper	1900–1975 [1040–1080]	1350–1470 [730–800]

Applications of Alloy Steel

- Alloy steel seamless pipes are widely used for low and medium pressure fluid transportation pipeline, casing tube, boiler pipe, petroleum and natural gas industry, chemistry industry, power generation industry, transformers, agriculture, bearings, general engineering, automotive, hydraulics, railway, mining, construction, aerospace, medical, defense and electric motors.
- Alloy steels grade P91 is mainly used for power industry. For welded construction, the ASME Boiler and Pressure Vessel Code limits the carbon content to less than 0.35%.
- Alloy steel is ideally suited for applications that require higher strength, improved toughness or better wear resistance than standard carbon steel grades.
- Alloy Steels are used in boiler construction because they are inexpensive, readily available, easily formed and welded to the desired shape and, within the broad limits, are oxidation- and corrosion-resistant enough to provide satisfactory service for many years to many industries.
- Alloy Steel is used across a range of highly demanding applications within the aerospace and power (nuclear) industries.
- Alloy Steel is also found in applications where its response to magnetism is important, in transformers and electric motors for example.

Properties of Alloy Steel

- It is the addition of other elements that makes alloy steel extra strong. The elements such as silicon and manganese through heat treatment makes alloy steel with improved characteristics and additional benefits, such as increased corrosion resistance or improved weldability.
- The mechanical properties achievable are dependent on the addition of elements such as nickel, chromium, molybdenum and vanadium. The following is a range of improved properties in alloy steels (as compared to carbon steels): strength, hardness, toughness, wear resistance, corrosion resistance, hardenability, and hot hardness.
- To achieve some of these improved properties the metal may require heat treating. HSLA stands for high-strength low-alloy steel.

Types of Alloy Steel

There are 2 major types of alloy steel.

1. High-Alloy Steel**: -**

High-alloy steels are defined by a high percentage of alloying elements. The most common high-alloy steel is stainless steel, which contains at least 12 percent chromium. Stainless steel is generally split into three basic types: martensitic, ferritic, and austenitic. Martensitic steels contain the least amount of chromium, have a high hardenability, and are typically used for cutlery. Ferritic steels contain 12 to 27 percent chromium and are often used in automobiles and industrial equipment. Austenitic steels contain high levels of nickel, carbon, manganese, or nitrogen and are often used to store corrosive liquids and mining, chemical, or pharmacy equipment.

2. Low-Alloy Steel

Low-alloy steels have a much lower percentage of alloying elements, usually 1 to 5 percent. These steels have very different strengths and uses depending on the chosen alloy. Large diameter flanges manufacturers typically choose alloys for a specific mechanical property. The variety of potential alloys makes low-alloy steel useful for a variety of projects, including seamless rolled ring forging and studding outlet manufacturing.

While there are a lot of different alloying elements that can be used to improve the mechanical properties of steel, certain combinations are used often and there are different types of alloy steel that are more popular than others.

High strength low alloy (HSLA) steel is an alloy that provides greater atmospheric corrosion resistance and high strength. There are six different classifications of HSLA steel, with varying alloying elements used. Typically, vanadium, niobium, titanium, and copper are used to provide the increased strength, and copper, chromium, phosphorus, and silicon are used to increase corrosion resistance. Due to the high strength of HSLA steels, they can often be harder to form, in some cases calcium or zirconium are added to improve formability. Chrome moly is another common alloy steel. This material is an alloy of chromium and molybdenum, which improves hardenability, increase strength, high temperature resistance, corrosion, and oxidation resistance.

ALLOY	SPECIFICATION	MAXIMUM USEFUL TEMPERATURE

Carbon-steel	SA178, SA192, SA210, SA106, SA515, SA516	850°
Carbon-1/2 Molybdenum	SA209	900°
1 1/4 Chromium- 1/2 Molybdenum	SA213 T-11 SA335 P-11	1025°
2 1/4 Chromium- 1 Molybdenum	SA213 T-22 SA335 P-22	1075°
18 Chromium- 10 Nickel	SA213 TP304(H), 321(H), 347(H)	1500°

Principle Effects of Major Alloying Elements On Alloy Steel

Element	Percentage	Primary function
Aluminium	0.95–1.30	Alloying element in nitriding steels
Bismuth	-	Improves machinability
Boron	0.001–0.003	A powerful hardenability agent
Chromium	0.5–2	Increases hardenability

	4–18	Increases corrosion resistance
Copper	0.1–0.4	Corrosion resistance
Lead	-	Improved machinability
Manganese	0.25–0.40	Combines with sulphur and with phosphorus to reduce the brittleness. Also helps to remove excess oxygen from molten steel.
	>1	Increases hardenability by lowering transformation points and causing transformations to be sluggish
Molybdenum	0.2–5	Stable carbides; inhibits grain growth. Increases the toughness of steel, thus making molybdenum a very valuable alloy metal for making the cutting parts of machine tools and also the turbine blades of turbojet engines. Also used in rocket motors.
Nickel	2–5	Toughener
	12–20	Increases corrosion resistance
Silicon	0.2–0.7	Increases strength
	2	Spring steels
	Higher percentages	Improves magnetic properties
Sulphur	0.08–0.15	Free-machining properties
Titanium	-	Fixes carbon in inert particles; reduces martensitic hardness in chromium steels
Tungsten	-	Also increases the melting point.
Vanadium	0.15	Stable carbides; increases strength while retaining ductility; promotes fine grain structure. Increases the toughness at high temperatures

Standards & Codes Specification

Commonly Used Standards and Codes

Sr. No	Code	Standards
1	ANSI B16.11	Pipe Flanges and Flanged Fittings.
2	ANSI B 16.5	Flanges
3	MSS SP-44	Large Dia Flanges.
4	ASME B 16.47 (SERIES A & B)	Large Dia Flanges.
5	DIN	Flanges
6	BS 4504	Flanges
7	ASTM A105	Forging, Carbon Steel for piping components
8	ASTM A182	Forged & Rolled Alloy Steel Pipe Flanges. Forged Fittings & Valves and parts for high temperature services.
9	ASTM A 350	Carbon & Low Alloy Steel, requiring notch toughness testing for piping components
10	ASTM A 515	Standard specifications for Pressure Vessel-Plates Carbon Steel for intermediate and higher temperature services.
11	ASTM A 516	Standard Specifications for Pressure Vessel Plates Carbon steel for Moderate and lower temperature services.
12	ASTM A 517	Standard specifications for Pressure Vessel Plates Alloy Steel High Strength Quenched & Tempered.
13	ASTM A 333	Standard specification for Seamless & Welded Steel Pipe for Low Temperature Services.
14	ASTM A 335	Standard Specification for Seamless Ferritic Alloy steels pipe for High Temperature Services.

15	IS 2002	Specification for steels Plates for Boilers.
16	IS 2062	Specification for weldable structure steel.
17	IS 1239	Mild Steel Tubes Tubular & other wrought steel fittings specification.
18	IS 3589	Mild Steel Tubes Tubular & other wrought steel fittings specification.

Comparison of Properties of Various Steel at Room Temperature

The table below shows the typical properties of steels at room temperature (25°C). The wide ranges of tensile strength, yield strength, and hardness are largely due to different heat treatment conditions.

Properties	Carbon Steels	Alloy Steels	Stainless Steels	Tool Steels
Density (1000 kg/m3)	7.85	7.85	7.75-8.1	7.72-8.0
Elastic Modulus (GPa)	190-210	190-210	190-210	190-210
Poisson's Ratio	0.27-0.3	0.27-0.3	0.27-0.3	0.27-0.3
Thermal Expansion (10-6/K)	11-16.6	9.0-15	9.0-20.7	9.4-15.1
Melting Point (°C)			1371-1454	
Thermal Conductivity (W/m-K)	24.3-65.2	26-48.6	11.2-36.7	19.9-48.3
Specific Heat (J/kg-K)	450-2081	452-1499	420-500	
Electrical Resistivity (10-9W-m)	130-1250	210-1251	75.7-1020	
Tensile Strength (MPa)	276-1882	758-1882	515-827	640-2000
Yield Strength (MPa)	186-758	366-1793	207-552	380-440
Percent Elongation (%)	10-32	4-31	12-40	5-25
Hardness (Brinell 3000kg)	86-388	149-627	137-595	210-620

[Image Source: From Web]

Manufacturing Alloy Steel Pipes & Tubes in ASTM A209 T1, T1a, T1b

Alloy Steel Pipes	Alloy Steel Seamless Pipes

Alloy Steel Welded Pipes	Alloy Steel High Temperature Pipes
Alloy Steel Flanges	Alloy Steel Buttweld Fittings
Alloy Steel Forged Fittings	Alloy Steel Socket Weld Pipe Fittings
Alloy Threaded Fittings	Alloy Steel High Pressure Pipes
Alloy Steel Nuts & Bolts	Alloy Steel U Bends & Tubes
Alloy Steel Forgings	Alloy Steel Tubes
Alloy Steel Boiler Tubes	Alloy Steel Seamless Tubing
Alloy Steel Heat Exchanger Tubes	Alloy Steel Large Diameter Pipes

About Metallica Metals – The Steel Pipes Factory

- Established in 1975, the Metallica Metals Group (The Steel Pipes Factory) has its operations spread across major cities in India. We are a pioneer in the stainless steel pipes, nickel alloy products, titanium products, carbon steel pipes and alloy steel pipes manufacturing and processing industry. Our products including pipe fittings, flanges, pipes, sheet plates and valves are exported to over 70 countries across the world, while in India we have supplied to even the remote areas. With over 250 tons of sale in stainless steel and carbon steel pipes every day, Metallica has emerged as a prominent vendor for many buyers in India and Overseas
- More than 3000 tons ready from stock and new production ready in just a few weeks.
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Our Key Products

STAINLESS STEEL & NICKEL ALLOYS	INSTRUMENTATION TUBES & FITTINGS	PRODUCTS
Pure Nickel Alloys	Instrumentation Tube	Steel Sheet & Plate
Monel Alloys (Ni-Cu Alloys)	Hydraulic Tubing	Steel Coil & Strip
Inconel (Ni-Cr-Mo) Alloys	Seamless Tubing	Steel Pipes
Incoloy Alloys (Ni-Cr-Fe)	Instrumentation Tube Fittings	Steel Tubes
Hastelloy Alloys	Double Compression Tube Fittings	Electropolish Tube

Stainless Steel 304/304L
Stainless Steel 309S/309H
Stainless Steel 310/310S
Stainless Steel 316/316L
Stainless Steel 316Ti
Stainless Steel 317/317L
Stainless Steel 321/321H
Stainless Steel 347/347H
Stainless Steel 904L
Duplex Steels (UNS S32205, UNS S31803)
Super Duplex Steels (UNS S32760 / UNS S32750)
Stainless Steel 254 SMO (UNS S31254 / 1.4547)

Precision Pipe Fittings
Needle & Guage Valves
Manifold Valves

Heat Exchanger Tubes
Steel Bars/Rods & Wire
Fasteners (Nut, Bolt, Washer)
Steel Angle Bars
Hex Steel Bars
Round Steel Bars & Rod
Flat Steel Bars
Forgings, Rings & Forged Blocks
Stainless Steel Pipe
Stainless Steel Seamless Pipe
Stainless Steel Welded Pipe
Stainless Steel Tubes
Stainless Steel Furnace Tubes
Stainless Steel Seamless Tubing
Stainless Steel Heat Exchanger Tubes
Large Diameter Pipe

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