

What is Stainless Steel?

Stainless steel is a corrosion-resistant alloy of iron, chromium and, in some cases, nickel and other metals.

Completely and infinitely recyclable, stainless steel is the “green material” par excellence. In fact, within the construction sector, its actual recovery rate is close to 100%. Stainless steel is also environmentally neutral and inert, and its longevity ensures it meets the needs of sustainable construction. Furthermore, it does not leach compounds that could modify its composition when in contact with elements like water.

In addition to these environmental benefits, stainless steel is also aesthetically appealing, extremely hygienic, easy to maintain, highly durable and offers a wide variety of aspects. As a result, stainless steel can be found in many everyday objects. It also plays a prominent role in an array of industries, including energy, transportation, building, research, medicine, food and logistics.

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Composition of Stainless Steel

Steel is an alloy of iron and carbon. Stainless steels are steels containing at least 10.5% chromium, less than 1.2% carbon and other alloying elements. Stainless steel's corrosion resistance and mechanical properties can be further enhanced by adding other elements, such as nickel, molybdenum, titanium, niobium, manganese, etc.

Reaction to Contact with Air, Humidity or Water

On contact with oxygen, a chromium oxide layer is formed on the surface of the material. This passive layer protects it and has the unique ability to repair itself.

General Properties of Stainless Steel

Aesthetics

Stainless steel has a great variety of surface finishes, from matt to bright and including brushed and engraved. It can be embossed or tinted, making stainless a unique and aesthetic material. It is often used by architects for building envelopes, interior design and street furniture.

Mechanical Properties

Compared to other materials, stainless steel has strong mechanical properties at ambient temperatures – it is steel after all! In particular, it combines ductility, elasticity and hardness, enabling it to be used in difficult metal forming modes (deep stamping, flat bending, extrusion, etc.) while offering resistance to heavy wear (friction, abrasion, impact, elasticity, etc.). Furthermore, it offers good mechanical behaviour at both low and high temperatures.

Resistance to Fire

Stainless steel has the best fire resistance of all metallic materials when used in structural applications, having a critical temperature above 800°C. Stainless steel is ranked A2s1d0 for fire resistance with no toxic fume emissivity.

Corrosion Resistance

With a minimum chromium content of 10.5%, stainless steel is continuously protected by a passive layer of chromium oxide that forms naturally on the surface through the reaction of the chromium with oxygen from air or water. If the surface is scratched, it regenerates itself. This particularity give stainless steels their corrosion resistance.

Cleanability

Stainless steel items are easy to clean, usual cleaning products (detergents, soap powders) are sufficient and do not damage the surface. Stainless steel fully meets the requirements of decoration and cooking utensils that require frequent and effective washing.

Recycling

Stainless steel is the “green material” par excellence and is infinitely recyclable. Within the construction sector, its actual recovery rate is close to 100%. It is environmentally neutral and inert when in contact with elements such as water and it does not leach compounds that might modify their composition. These qualities make stainless steel ideally suited to building applications exposed to adverse weather, such as roofs, facades, rainwater recovery systems and domestic water pipes. Stainless steel’s longevity fulfils the requirements of sustainable construction, and effective erection, installation and low maintenance guarantee the user an unrivalled service life.

Stainless Steel Families

With five categories of stainless steels available – each differentiated by the alloying elements added to iron, carbon and chromium – we offer a complete range of solutions.

Austenitics or 300 series

0.015 to 0.10% carbon, 16 to 21% chromium, 6 to 26% nickel, 0 to 7% molybdenum. The presence of nickel improves corrosion resistance in certain media and makes stainless steel more ductile. The presence of molybdenum further enhances the resistance to corrosion in an acid medium. The most common grades are 304/304L and 316/316L.

Applications

Boiler market, aeronautics, electronic components, railway equipment, tubes, chemical tanks and food vats, marine applications, containers, etc.

Heat resistant steel applications

Heating systems, resistor jackets, furnace equipment.

Austenitics with manganese or 200 series

These are chromium manganese steels, with a low nickel content (always below 5%).

Applications

Asphalt tankers, tubes, food containers, silos, conveyor chains, safety soles, etc.

Ferritics or 400 series: the KARA ferritic offer

0.02 to 0.06% carbon, 10.5 to 30% chromium, 0 to 4% molybdenum. Commonly used internally, these grades are now being developed for envelope and structural products.

KARA is the Aperam brand for ferritic stainless steels

Unlike other stainless steels, the KARA range doesn't contain nickel and is thus immune from the erratic price fluctuations of this alloying element. As a result, prices are more stable over time, giving KARA a strong argument in the construction sector where project cost and economic design are key elements.

Applications

Car exhaust systems, conveyor chains, cooking utensils, boilers, domestic appliances, trim, dishware, heating, hot water tanks, tubes, etc.

Austeno-ferritics or Duplex

0.02% carbon, 0 to 4% molybdenum, 1 to 7% nickel and 21 to 26% chromium. These stainless steels not only offer excellent quality, because of their low nickel content – a material that suffers from highly speculative prices – they are also very cost effective.

Applications

Oil, gas, pulp and paper, desalination sectors, chemical industry, etc.

Martensitics

0.1% carbon, 10.5 to 17% chromium.

Applications

Cutlery, cutting tools, hand tools, springs, etc.

APPLICATION OF STAINLESS STEEL

- 200 Series - Austenitic Chromium-Nickel-Manganese Alloys
- 300 Series - Austenitic Chromium-Nickel Alloys
- Type 301 - Highly ductile, for formed products. Also hardens rapidly during mechanical working. Good weldability. Better wear resistance and fatigue strength than 304.
- Type 302 - Same corrosion resistance as 304, with slightly higher strength due to additional carbon.
- Type 303 - Easier machining version of 304 via addition of sulfur and phosphorus. Also referred to as "A1" in accordance with International Organization for Standardization ISO 3506
- Type 304 - The most common grade; the classic 18/8 stainless steel. Also referred to as "A2" in accordance with International Organization for Standardization ISO 3506.
- Type 309 - Better temperature resistance than 304
- Type 316 - The second most common grade (after 304); for food and surgical stainless steel uses; Alloy addition of molybdenum prevents specific forms of corrosion. Also known as "marine grade" stainless steel due to its increased resistance to chloride corrosion compared to type 304. SS316 is often used for building nuclear reprocessing plants. Most watches that are made of stainless steel are made of this grade. Rolex is an exception in that they use Type 904L. 18/10 stainless often corresponds to this grade. Also referred to as "A4" in accordance with International Organization for Standardization ISO 3506.
- Type 321 - Similar to 304 but lower risk of weld decay due to addition of titanium. See also 347 with addition of niobium for desensitization during welding.

- 400 Series - Ferritic and Martensitic Chromium Alloys
- Type 408 - heat-resistant; poor corrosion resistance; 11% Chromium, 8% Nickel.
- Type 409 - cheapest type; used for automobile exhausts; ferritic (iron/chromium only).
- Type 410 - martensitic (high-strength iron/chromium). Wear resistant, but less corrosion resistant.
- Type 416 - easy to machine due to additional sulfur
- Type 420 - "Cutlery Grade" martensitic; similar to the Brearley's original "rustless steel". Also known as "surgical steel". Excellent polishability.
- Type 430 - decorative, e.g., for automotive trim; ferritic. Good formability, but with reduced temperature and corrosion resistance.
- Type 440 - a higher grade of cutlery steel, with more carbon in it, which allows for much better edge retention when the steel is heat treated properly. It can be hardened to Rockwell 58 hardness, making it one of the hardest stainless steels. Also known as "razor blade steel". Available in three grades 440A, 440B, 440C (more common) and 440F (free machinable).
- 500 Series - Heat Resisting Chromium Alloys
- 600 Series - Martensitics Precipitation Hardening Alloys
- Type 630 - most common PH stainless, better known as 17-4; 17% Chromium, 4% Nickel

Stainless Steel Alloy 2304, Duplex 2304

Duplex 2304, also called Alloy 2304, is a molybdenum-free duplex stainless steel. It has a structure that is a balance of ferritic and austenitic and is often used as a replacement for Alloys 304L and 316L. Some of Duplex 2304 stainless steel's other properties include:

- Outstanding corrosion resistance
- Yield strength (twice that of 304L/316L)
- Suitable for applications covering -50°C/+300°C temperature range
- Resistance to pitting and crevice corrosion
- Improved machinability and weldability

Because of these positive qualities Duplex 2304 is commonly used in a range of applications for a variety of industries. These include:

- Pulp and paper industry (pipes, storage tanks)
- Food industry
- Pressure vessels

- Mining
- Exposure to caustic solutions and organic acids
- Water treatment
- Construction and architecture

For a stainless steel to be labeled Duplex 2304, it must contain a number of different components including:

- Fe Balanced
- Cr 21.5-24.5%
- Ni 3.0-3.5%
- Mn 2.5% max
- Cu .05%-2.0%
- N .05-2.0%
- Si 1% max

Continental Steel offers a wide range of forms and sizes of Duplex 2304, all of which meet the leading industry standards like ASTM, ASME, EURONORM, and DIN.