

PAGE SECTION

STAINLESS STEEL

STAR FASTENERS

A2 vs A4

Stainless steel is widely used in various industries and applications due to its excellent combination of corrosion resistance, strength, durability, and aesthetic appeal. It finds applications in construction, architecture, automotive, aerospace, food processing, medical devices, household appliances, and many other areas where resistance to corrosion and staining is essential.

Define Stainless Steel

A2 and A4 are grades of stainless steel defined by the International Organization for Standardization (ISO) in the ISO 3506 standard. Meanwhile, 304 and 316 are grades defined by the American Society for Testing and Materials (ASTM). Here's a comparison between A2 (equivalent to 304) and A4 (equivalent to 316) stainless steel:

Chemical Composition

A2: Often referred to as 304 or 18/8 stainless.

18/8 refers to the amount of chromium and nickel in the alloy – 18% chromium and 8% nickel, the chromium provides a corrosion and oxidation resistance, however it can be prone to tarnishing.

A4: often referred to as 316, 18/10 and marine grade stainless.

18/10 refers to the chromium and nickel content- 18% chromium and 10% nickel, and 2-3% molybdenum. The molybdenum increases the corrosion resistance to withstand attack from many solvents, for example, sulfuric acid, chlorides, de-icing salts and industrial chemicals. It is considerably more resistant to solutions of bromides, iodides and fatty acids at high temperature.

Corrosion Resistance

A2 (304): Offers good corrosion resistance in most environments, but not as resistant as A4 in corrosive environments like marine or chloride-rich settings.

A4 (316): Provides excellent corrosion resistance, particularly in chloride environments like marine settings or industrial areas with exposure to chemicals.

Strength and Durability

A2 (304): Offers good strength and toughness suitable for many general-purpose applications.

A4 (316): offers the same strength characteristics as A2 but it is more corrosion resistant in demanding environments.

Both A2 and A4 grades are classed as Austenitic stainless steel (sometimes called the 300 series). This means that they have high chemical resistance but cannot be hardened by heat treatment. They can be hardened by cold working.

Molybdenum Content

A2 (304): Does not contain molybdenum.

A4 (316): Contains molybdenum, which enhances its corrosion resistance.

Stainless steel may also contain other alloying elements such as nickel, titanium, copper and manganese, among others, to enhance specific properties like strength, corrosion resistance, and durability. Non-metal additions are also made, the main ones being Carbon and Nitrogen. The exact composition and properties of stainless steel can vary depending

on the specific grade or type.

Common Properties

While A2 (304) and A4 (316) stainless steels share common properties, their differences in composition, particularly the addition of molybdenum in A4 (316), result in variations in corrosion resistance and mechanical properties. As a result, the selection between A2 and A4 stainless steel depends on the specific application requirements, particularly the level of corrosion resistance needed.

Common properties of A2 (304) and A4 (316) stainless steel:

Corrosion Resistance: Both A2 and A4 stainless steels offer good corrosion resistance in many environments due to their chromium content. However, A4 (316) stainless steel provides superior corrosion resistance

High-Temperature Resistance: Austenitic stainless steels, including A2 and A4 grades, retain their strength and integrity at elevated temperatures. They exhibit good resistance to scaling and oxidation at temperatures up to 870°C (1600°F).

Formability and Ductility: A2 and A4 stainless steels are highly formable and have excellent ductility which allows for significant deformation without fracturing, it can be easily fabricated into various shapes using common manufacturing processes. This property makes this material suitable for cold forming processes and applications

requiring intricate shapes.

Non-Magnetic: Austenitic stainless steels, including A2 and A4 grades, are generally non-magnetic in the annealed condition. However, they may become slightly magnetic after cold working or during certain manufacturing processes.

Hygienic Properties: A2 and A4 stainless steels are hygienic materials suitable for use in food processing, pharmaceutical, and medical applications due to their smooth surface finish, corrosion resistance, and ease of cleaning.

Aesthetic Appeal: Both A2 and A4 stainless steels can either be polished to a bright, shiny appearance or brushed to create a matt finish which makes them aesthetically pleasing materials for architectural, decorative, and consumer products.

Does Stainless Steel Differ from Carbon Steel

Both stainless steel and carbon steel are important materials in various industries but their differences in composition, corrosion resistance, strength, and applications make each suitable for specific uses and environments.

The specific composition of carbon steel can vary depending on the desired properties and intended application. Carbon steel is available in various grades and forms, ranging from low-carbon steel with minimal carbon content to high-carbon steel with higher carbon content, each offering different mechanical properties suited to specific applications.

Carbon steel primarily consists of iron (Fe) and carbon (C). Carbon is the most significant alloying element in carbon steel, typically ranging from 0.05% to 2.0% by weight. The carbon content influences the strength, hardness, and other mechanical properties of the steel.

Depending on the manufacturing process, carbon steel may contain trace amounts of other elements including manganese, phosphorus, sulphur, and silicon. Depending on the source of the raw materials and the manufacturing process it may

also include oxygen, nitrogen, and residual elements from the steel making process.

Carbon steel is generally prone to rust and corrosion when exposed to moisture and oxygen unless it is coated, plated, or protected in some way. Stainless steel typically has lower strength and hardness compared to carbon steel making carbon steel more suitable for applications where high strength and wear resistance are required, however, certain stainless steel grades can be cold formed to improve their mechanical properties.

Applications

Stainless steel is widely used in various industries and applications due to its excellent combination of corrosion resistance, strength, durability, and aesthetic appeal. It finds applications in construction, architecture, automotive, aerospace, food processing, medical devices, household appliances, and many other areas where resistance to corrosion and staining is essential.

A2 (304): Commonly used in applications where moderate corrosion resistance is required, such as indoor appliances, kitchen equipment, architectural trim, and food processing equipment.

A4 (316): Used in numerous applications across various industries where corrosion resistance is critical. Some common uses of A4 stainless steel include:

Marine Applications: A4 stainless steel is extensively used in marine environments due to its exceptional resistance to corrosion from seawater and salt spray. It is used for marine hardware, such as boat fittings, rigging components, marine fasteners, and yacht fixtures.

Chemical Processing: In industries involving chemical processing, A4 stainless steel is preferred for equipment and components that come into contact with corrosive chemicals. It is used for valves,

pumps, tanks, pipelines, and fittings in chemical plants, refineries, and petrochemical facilities.

Food and Beverage Industry: A4 stainless steel is suitable for food processing equipment and food handling environments where cleanliness, hygiene, and corrosion resistance are essential. It is used for food processing machinery, conveyor systems, storage tanks, and kitchen equipment.

Medical Devices and Pharmaceutical Industry: A4 stainless steel is utilized in medical and surgical instruments, implants, and equipment due to its biocompatibility, corrosion resistance, and sterilization capabilities. It is commonly used for surgical instruments, orthopaedic implants, dental tools, and medical device components.

Architectural Applications: A4 stainless steel is favoured in architectural and construction projects where durability, aesthetic appeal, and corrosion resistance are desired. It is used for exterior cladding, handrails, balustrades, roofing, structural components, and decorative elements.

Water Treatment: A4 stainless steel is used in water treatment plants and systems where it is exposed to chlorides, acids, and other corrosive substances. It is employed for valves, pumps, piping, filters, and other equipment in water treatment facilities.

Automotive Industry: A4 stainless steel is utilized in automotive applications where corrosion resistance is required, such as exhaust systems, catalytic converters, fuel lines, and automotive fasteners.

In summary, while both A2 (304) and A4 (316) stainless steels offer corrosion resistance and are widely used, the choice between them depends on the specific application requirements. A4 (316) is generally preferred for applications where superior corrosion resistance, particularly in harsh environments is essential.



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