

## What gives stainless steel its properties?

What generally prevents corrosion in stainless steel is the chromium content. The primary element of stainless steel is pure iron. By itself it is unstable and wants to corrode (rust) but the chromium helps to delay this process. Oxygen reacts with the chromium to form a tough, adherent and invisible film layer of chromium oxide on the surface of the steel to protect it from corrosion. Even if the steel is damaged mechanically or chemically, the film is self healing as long as it has enough oxygen.

Stainless steels can be divided into three basic groups based on their crystalline structure: **austenitic**, **ferritic**, and **martensitic**. Another group of stainless steels known as precipitation-hardened steels are a combination of austenitic and martensitic steels.

**Austenitic grades:** stainless steels comprise over 70% of total stainless steel production and are non-magnetic stainless steels that are usually annealed and strengthened through cold working (changing the structure and shape of steel by applying stress at low temperature) instead of by heat treatment. Austenitic steels have excellent corrosion and heat resistance with good mechanical properties over a wide range of temperatures. Ductility (ability to change shape without fracture) is exceptional for the austenitic stainless steels. The two most common grades are type 304 (the most widely specified stainless steel, providing corrosion resistance in numerous standard services) and type 316 (similar to 304 with molybdenum added, to increase opposition to various forms of deterioration).

**Ferritic grades:** The second-largest class of stainless steel, constituting approximately 25% of stainless production. They are magnetic and they contain between 10.5% and 27% chromium and very little nickel, if any. They are not hardenable by heat treatment but are highly corrosion resistance, in particular sea water, and good resistance to stress-corrosion cracking. Their mechanical properties are not as strong as the austenitic grades, however they have better decorative appeal. Type 430 and type 409 are the most commonly used ferritic but far less durable than austenitic grades. Ferritics are best suited for general and high-temperature corrosion applications. They are used in automotive trim and exhaust systems, interior architectural trim, and hot water tanks.

**Martensitic grades:** Martensitic stainless steel contains [chromium](#) (12-14%), [molybdenum](#) (0.2-1%), no [nickel](#), except for 2 grades and about 0.1-1% [carbon](#) (giving it more hardness but making the material a bit more brittle). Martensitic grades are magnetic and can be heat-treated by quenching or tempering. Martensitic steels are not as corrosive resistant as austenitic or ferritic grades, but their hardness levels are among the highest of the all the stainless steels with controlled carbon content. Type 420 is a typical example. The most popular martensitic stainless steel is type 410 (a grade appropriate for non-severe corrosion environments requiring high strength).

There are also other grades of stainless steels worth mentioning, such as precipitation-hardened, duplex, and cast stainless steels. Stainless steel can be produced in a variety of finishes and textures.