



Dawn Kitchen & Bath Products, Inc.

27688 Industrial Blvd, Hayward, CA 94545
Tel: (877) 329-6872 Fax: (510) 723-0099
Http://www.dawnusa.net Email: dp@dawnusa.net

Is Stainless Steel Magnetic?

Here is some information about stainless steel that will help to identify situations in which this alloy exhibits magnetic properties, and when it does not.

First, it is important to understand that stainless steel is not a pure magnetic metal. Stainless steel is a collective name for a steel alloy that is mixed with other metals in order to give it the properties that make the metal compound so desirable: Iron is made into a stainless steel alloy by the addition of chromium, nickel, and carbon. Changing how much of what is added and controlling the steel crystal structure by controlling how the molten alloy is cooled determines the alloy and type of steel.

There are three main types of stainless steels: austenitic, ferritic, and martensitic. These three types of steels are identified by their microstructure or predominant crystal phase.

- Austenitic — Austenitic steels have austenite as their primary phase (face centered cubic crystal). These are alloys containing chromium and nickel (sometimes manganese and nitrogen), structured around the Type 302 composition of iron, 18% chromium, and 8% nickel. Austenitic steels are not magnetic and not hardenable by heat treatment. The most familiar stainless steel is 304 containing 18-20% chromium and 8-10% nickel.
- Ferritic — Ferritic steels have ferrite (body centered cubic crystal) as their main phase. These steels contain iron and chromium. Ferritic steel is somewhat magnetic, less ductile than austenitic steel, and is not hardenable by heat treatment.
- Martensitic — Martensitic steels have orthorhombic martensite as their main phase. Martensitic steels are low carbon steels. They are magnetic, and may be tempered and hardened. Martensite gives steel great hardness, but it also reduces its toughness and makes it brittle.

The presence of the chromium provides stainless steel with the ability to repel permanent stains and keep looking fresh and clean over long periods of time. The chromium essentially creates a protective layer on the alloy that prevents rusting and makes the metal resistant to any real damage. Any scratches to the surface are simply filled in by this protective layer, making it possible to prevent corrosion to occur. *It is the introduction of chromium into the mix that we refer to as stainless steel that makes it possible for the alloy to exhibit magnetic properties.*

The addition of nickel to the stainless steel compound helps to strengthen the protective qualities of the chromium. Generally referred to as a 300 series, stainless steel that contains nickel is not magnetic at all. *It is the presence of the nickel alters the physical structure of the stainless steel and removes or inhibits any magnetic qualities.*

However, magnetic stainless steel does exist. The 400 series, which contains steel and chromium, but without the presence of nickel, does in fact exhibit magnetic qualities. While the degree of magnetic attraction may vary, it is not unusual for items made with the 400 series stainless steel to provide enough attraction to interact with magnets, and in some cases to allow small metal items to adhere to the stainless steel surface. However, magnetic stainless steel in consumer products does not tend to carry a strong magnetic charge, so there are not any practical home uses involving magnetic attraction.



Dawn. **Kitchen & Bath Products, Inc.**

27688 Industrial Blvd, Hayward, CA 94545
Tel: (877) 329-6872 Fax: (510) 723-0099
Http://www.dawnusa.net Email: dp@dawnusa.net

Notes on Austenitic Stainless Steels (300 Series)

Austenitic steels are not magnetic and hence show almost no response to a magnet when in the annealed condition. However, after substantial cold working, such as wire drawing, rolling or even centerless grinding, shot blasting or heavy polishing, Grade 304 may exhibit quite strong response to a magnet, whereas Grade 310 and 316 will in most instances still be almost totally non-responsive.

The change in magnetic response is due to atomic lattice straining and formation of martensite. In general, the higher the nickel to chromium ratio, the more stable is the austenitic structure and the less magnetic response that will be induced by cold work. Magnetic response can therefore be used as a method for sorting grades of stainless steel, but considerable caution needs to be exercised.

Stress Relieving

Any austenitic stainless steel which has developed magnetic response due to cold work can be returned to a non-magnetic condition by stress relieving. In general, this can be readily achieved by briefly heating to approximately 700 - 800°C. However, unless the steel is a stabilized grade, it could become sensitized to carbide precipitation. Full solution treatment at 1000 - 1150°C will remove all magnetic response without danger of reduced corrosion resistance due to carbides.