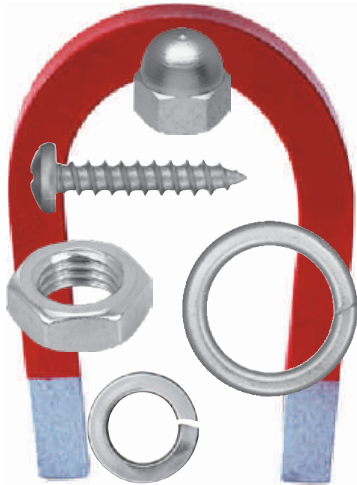


Product Information Report

Magnetic Permeability of Stainless Steel



Assorted stainless steel fasteners with small diameters or thin profiles which can easily be picked up by a magnet.

Overview

A magnet is not the best method to test for stainless steel. It is commonly thought that stainless steel is non-magnetic, but this is not strictly true and the real situation is more complicated. The degree of magnetic response or magnetic permeability is derived from the microstructure of the steel.

The magnetic behavior of stainless steels varies considerably by grade ranging from non-magnetic in fully austenitic grades (302, 304 and 316) to hard or permanent magnetic behavior in hardened martensitic grades (410, 420, 440, etc.).

It is very important to remember that stainless steel is a ferrous metal, which means it contains iron. If you have a strong enough magnet you will be able to get the metal to stick to it, even if it is considered to be non-magnetic. This is especially important to remember when dealing with parts that have thin profiles or small diameters. A small pen magnet generates a strong enough magnetic field to pick up a 1/4" dia. hex head cap screw that is considered "non-magnetic".

Magnetic Permeability

Magnetic permeability is the ability of a material to carry magnetism, indicated by the degree to which it is attracted to a magnet.

Grade 316 has very low magnetic properties and shows almost no response to a magnet after cold working, while 18-8 grades (302, 303, 304) exhibit quite a strong response to a magnet (see Fig. 1). Cold working is the alteration of the shape or size of a metal by wire drawing, rolling, grinding, shot blasting or heavy polishing without the aid of heat.

Stainless steel alloys must be annealed to eliminate or reduce their magnetic properties. This is typically done by tempering the material in an oven and holding it a given temperature.

Grades 301, 302 and 304 have a chromium outer layer which acts as the corrosion and stain barrier. It also acts as a barrier to magnetic fields. However, chromium is not the best resistor to magnetic fields. In order to create a non-magnetic stainless steel fastener, nickel must be added to the alloy. The combination of nickel and chromium (NiCr) gives superior corrosion and staining protection and allows the product to be considered non-magnetic.

NiCr alloys such as Grade 316 are more expensive to produce because of the nature of the alloy and the amount of rework necessary to make the product non-magnetic. For this reason the commodity grades of stainless steel (301, 302 and 304) are made available and are used when magnetism is not an issue.

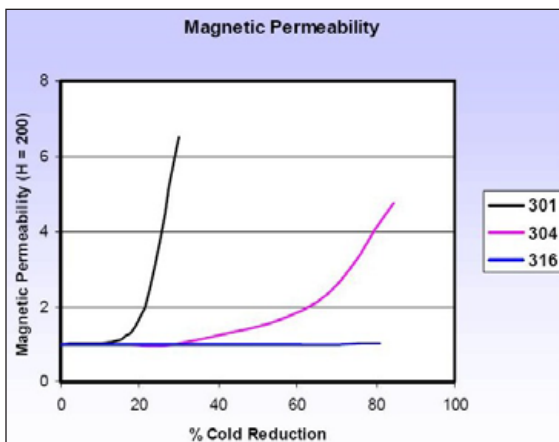


Fig. 1 – Percentage of magnetic permeability based on percentage of reduction of cross sectional area during cold working processes.