About Fastener Materials

General

Fasteners are manufactured in a wide range of materials from common steel to titanium, plastic and other exotic materials. Many materials are further separated into different *grades* to describe specific alloy mixtures, hardening processes, etc. In addition, some materials are available with a variety of *coatings* or *platings* to enhance the corrosion resistance or alter the appearance of the fastener.

Fastener material can be important when choosing a fastener due to differences between materials in strength, brittleness, corrosion resistance, galvanic corrosion properties and, of course, cost.

When replacing fasteners, it is generally best to match what you are replacing. Replacing a bolt with a stronger one is not always safe. Harder bolts tend to be more brittle and may fail in specific applications. Also some equipment is designed so that the bolts will fail before more expensive or critical items are damaged. In some environments, such as salt water, galvanic corrosion must also be considered if changing fastener materials.

Materials

Stainless Steel

Stainless steel is an alloy of low carbon steel and chromium for enhanced corrosion characteristics. Stainless steel is highly corrosion resistant for the price. Because the anti-corrosive properties are inherent to the metal, it will not lose this resistance if scratched during installation or use.

It is a common misconception that stainless steel is stronger than regular steel. In fact, due to their low carbon content, many stainless steel alloys cannot be hardened through heat treatment. Therefore, when compared to regular steel, the stainless alloys used in bolts are slightly stronger than an un-hardened (grade 2) steel but

significantly weaker than hardened steel fasteners. Unless great care is taken, stainless fasteners are susceptible to a phenomenon known as *galling*.

Most stainless steel fasteners are much less magnetic than regular steel fasteners though some grades will be slightly magnetic.

18-8 Stainless

18-8 refers to any stainless steel containing approximately 18% chromium and 8% nickel. This is the most common stainless designation for hardware.

Stainless 316

A highly corrosion resistant grade of stainless steel. Ideal in salt water and chlorine environments. More expensive than 18-8.

Stainless 410

A stainless alloy that is harder than 18-8 stainless steel, but not as resistant to corrosion.

Steel

Steel is the most common fastener material. Steel fasteners are available plain as well as with various surface treatments such as zinc plating, galvanization, and chrome plating.

Steel fasteners are commonly available in 4 grades: Grade 2, Grade 5, Grade 8, and Alloy Steel. Many other grades exist but are used far less often. Grade 2, 5, and 8 are usually plated with a slightly blue-ish or yellow zinc coating, or are galvanized, to resist corrosion.

Determining Bolt Grade

Bolts are typically marked on the head to show what grade bolt they are. Note that, in addition to the grade marking, many bolts also have a manufacturer's mark.

Grade 2

Grade 2 is a standard hardware grade steel. This is the most common grade of steel fastener and is the least expensive. Except a possible manufacturer's mark, Grade 2 bolts have no head marking.

Grade 5 / Grade F

Grade 5 bolts are hardened to increase strength and are the most common bolts found in automotive applications. Grade 5 bolts have 3 evenly spaced radial lines on the head.

Grade F is roughly equivalent to Grade 5. Grade F nuts are used with Grade 5 bolts.

Grade 8 / Grade G

Grade 8 bolts have been hardened more than grade 5 bolts. Thus they are stronger and are used in demanding applications such as automotive suspensions. Grade 8 bolts have 6 evenly spaced radial lines on the head.

Grade G is roughly equivalent to Grade 8. Grade G nuts are used with Grade 8 bolts.

Alloy Steel

Alloy steel bolts are made from a high strength steel alloy and are further heat treated. Alloy steel bolts are typically not plated, resulting in a dull black finish. Alloy steel bolts are extremely strong but very brittle.

Silicon Bronze

Silicon bronze, often referred to simply as bronze, is an alloy made mostly of copper and tin with a small amount of silicon. Bronze is used primarily in marine environments. It is preferred over stainless in wooden boat construction and re-fastening due to its superior corrosion resistance, and over brass due to its higher strength. Bronze is similar to copper in color and is also sometimes seen in fine woodworking where it is used for its appearance. The main drawback of bronze is its high cost.

Brass

Brass is an alloy of primarily copper and zinc. Brass is highly corrosion resistant and electrically conductive. However, its use as a fastener is somewhat limited due to its relative softness. It is used primarily for its appearance.

Aluminum

Aluminum is a light, soft, corrosion resistant metal. Like stainless steel, aluminum's corrosion resistance is inherent to the material. Therefore, scratches and nicks will not affect the corrosion resistance.

Fasteners are made from a variety of aluminum alloys, with elements such as manganese, silicon, iron, magnesium, zinc, copper, and silicon being added to increase strength and melting point.

Rivets are often made from aluminum alloys in the 5000-series, which uses magnesium as the primary alloying element.

Coatings

Zinc Plating

Many steel fasteners are electroplated with zinc for better corrosion resistance. Fasteners that have been zinc plated have a shiny, silvery or golden appearance, referred to as clear or yellow zinc respectively. They are fairly corrosion resistant but will rust if the coating is destroyed or if exposed to a marine environment.

Hot Dip Galvanizing

Galvanizing is another coating involving the application of a layer of zinc. Hot dip galvanizing puts the thickest possible coating on the metal, resulting in superior corrosion resistance. Due to the thickness of the coating hot dipped galvanized bolts are not compatible with other nuts. Galvanized nuts are tapped slightly larger than other nuts to accommodate this coating.
Hot dipped galvanized fasteners are frequently used outdoors, especially in coastal environments.

Chrome

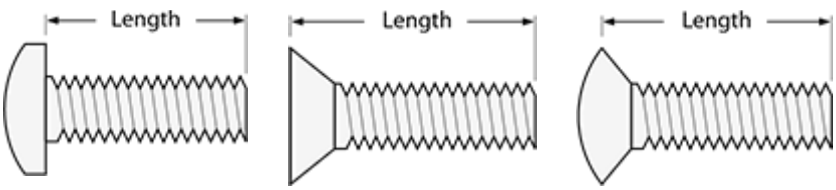
Fasteners are chrome plated and polished for appearance. Chrome plating provides similar corrosion resistance to zinc plating. The main drawback of polished chrome is its high cost. If more corrosion resistance is required, stainless steel may be chrome plated, preventing any corrosion should the chrome be penetrated.

Measuring Fastener Length

Print this page

General

Fastener length is generally measured from the point where the **surface of the material** will be when the fastener is installed to the **end of the fastener**. Thus, fasteners with heads that sit above the surface are measured from under the head to the end of the fastener, while fasteners that sit flush with the surface are measured from the top of the head to the end of the fastener.



Head Above Surface **Countersunk Head** **Oval Head**

Specific Fasteners

There are some 'oddball' fasteners like U-bolts, hanger bolts, and shoulder bolts where length is measured differently. Throughout our catalog you will find detailed drawings indicating where measurements are taken when selecting a fastener.

Measuring Fastener Diameter

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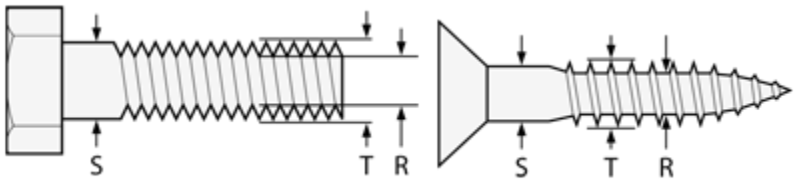
General

There are several different locations on a fastener where one can measure the diameter.

The most commonly used diameters are:



- **Thread Diameter** (T). Also called major diameter.
- **Shank Diameter** (S).
- **Root Diameter** (R). Also called minor diameter.

The fastener diameter is almost always the **Thread Diameter** (or major diameter).

Head Diameter

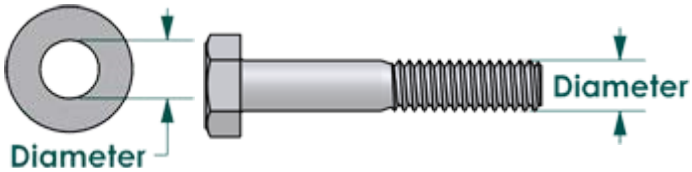
It is common for people to refer to hex bolts by the size of the head measured accross the flats (this is also the size wrench the bolt uses).

This is incorrect and should be avoided for two reasons.

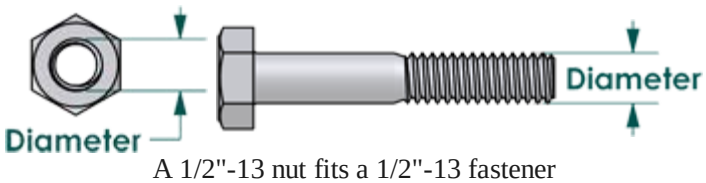
- **Miscommunication** can result in getting a much larger bolt than needed.
- **Head size can vary** for the same thread diameter, especially in metric bolts, so even comparing heads to heads you may get an incompatible bolt.

Nuts and Washers

Both nuts and washers are sized by the fastener they fit. For example a 1/2 inch washer fits a 1/2 inch bolt. With a nut the thread density must also match.



A 1/2" washer fits a 1/2" diameter fastener



A 1/2"-13 nut fits a 1/2"-13 fastener

US Numbered Screw Sizes

US fasteners below 1/4" are typically referred to by a numbered size (often preceded by a number sign) rather than a fractional size. The smaller the number the smaller the diameter of the fastener.