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 plating to enhance the corrosion resistance, or 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 coarse 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. For more information see our About Galvanic Corrosion page.

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 and 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 the low carbon content, stainless steel cannot be hardened. Therefore when compared with regular steel it is slightly stronger than an un-hardened (grade 2) steel fastener but significantly weaker than hardened steel fasteners.

Stainless steel is also 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. For information on 18-8 stainless steel material properties see our Material Grade Identification and Properties Chart.

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. Many other grades exist but are used far less often. The most common grades are Grade 2, Grade 5, Grade 8, and Alloy Steel. Grade 2, 5, and 8 are usually plated with a silver or yellow zinc coating or galvanized to resist corrosion.

Determining Bolt Grade

Bolts of different grades are marked on the head to show what grade bolt they are. For a list of the most common grade markings see our Material Grade Identification and Properties Chart.

Grade 2
Grade 2 is a standard hardware grade steel. This is the most common grade of steel fastener and is the least expensive. Grade 2 bolts have no head marking (sometimes a manufacturer mark is present).

Grade 5
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 8
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.

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 electro-plated with zinc for better corrosion resistance. Fasteners that have been zinc plated have a shiny silver 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 dipped 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 seen in coastal environments.

Chrome

Chrome is used in plating fasteners for its appearance. It provides similar corrosion resistance to zinc plating. The main drawback of chrome is the extremely high cost. If more corrosion resistance is required stainless steel may be chrome plated, preventing any corrosion should the chrome be penetrated.

How Fasteners are Identified

General

Fasteners are identified by four or five attributes; Type, Material, Diameter, Length, and Thread Pitch or Count (machine thread fasteners only). This page describes what these attributes represent. Information on how they are written can be found on our How Fastener Measurements Are Notated page. Also for information on fastener abbreviations please see our Common Fastener Abbreviations page.

Note: With some fasteners, the terms bolt and screw are frequently used interchangeably.

Type

Fastener type can be divided into information on the Category or kind of fastener, Drive Type, and Head Style.

Category

Fasteners are divided into categories based on their function or design. For help identifying different fastener categories see our Fastener Type Chart.
Ex. Wood Screw, Sheet Metal Screw, Hex Bolt, Lag Bolt, etc.

Drive Type

Fasteners in some categories are available with different drive types such as Philips or Slotted. In other categories such as lag bolts there is either only one drive type or the drive type is implied to be of a standard type. For help identifying different fastener drive types see our Fastener Type Chart.
Ex. Philips, Slotted, Allen (a.k.a. Socket), Frearson (similar to Philips), etc.

Fastener Type	Standard or Implied Drive
Bolt	Hex Head
Lag Bolt / Screw	Hex Head
Carriage Bolt / Screw	No Drive
Socket Bolt / Screw	Allen Drive
Button Head	Allen Drive

Head Style

Many categories are also available with different head shapes or styles. For help identifying different fastener head styles see our Fastener Type Chart.
Ex. Flat head, Pan head, Truss head, etc.

Material

Fastener material describes the material from which the fastener was made as well as any material grade. For help identifying different fastener materials please see our About Fastener Materials and Grades page.
Ex. Stainless Steel, Zinc Plated Steel, Silicon Bronze, etc

Diameter

Fasteners diameter is measured either as a size number or as a direct measurement. For information on how to measure fastener diameter please see our Measuring Fastener Diameters page.

Length

How fastener length is measured varies based on the type of head. As a general rule, the length of fasteners is measured from the surface of the material, to the end of the fastener.

For fasteners where the head usually sits above the surface such as hex bolts and pan head screws, the measurement is from directly under the head to the end of the fastener.

For fasteners that are designed to be counter sunk such as flat head screws, the fastener is measured from the point on the head where the surface of the material will be, to the end of the fastener.

For more information please see our Measuring Fastener Length page.

Thread Pitch or Count

Thread pitch or thread count is used only on machine thread fasteners (those that take a nut or thread into a tapped hole). The thread pitch or count describes how fine the threads are. For more information please see our About Thread Pitch and TPI page.

Understanding Fastener Notation

Basic Identification

Below is an example of a full fastener description. This notation includes all of the information needed to identify the fastener.

Fastener description:	Machine screw	Phillips pan	Stainless steel 18-8	1/4 - 20 x 2"
	Fastener type	Head	Material	Size

Fastener Type

Fastener Type is the general type of fastener, such as *wood screws*, *hex bolts*, *machine screws, hex nuts* or *carriage bolts*.

Head

Head types contain up to two parts:

Example:

Phillips	Pan
Drive type	Head style

Drive Type

Drive type describes the type of tool used to install the fastener. Common examples are *phillips*, *slotted*, and *square* drives.

Some fasteners, such as *carriage bolts,* do not have a drive and therefore no drive type is specified.

In certain other cases, such as with *hex bolts*, the head and drive type (hexagonal) is implied by the fastener type.

Head Style

Head style describes the shape of the head. Common examples are *pan*, *flat*, *truss*, and *hex*.

A few fastener types, including *set screws* and some *anchors,* do not have a head and the head property will therefore not be present.

Material

The most common parts of a material description are:

Example:	Zinc plated	Grade 8	Steel
	Plating	Grade	Material

Plating

Many fasteners, especially steel fasteners, are plated or coated for corrosion resistance or decorative purposes. Common platings include *zinc plating*, *galvanizing*, and *chrome plating*.

Grade

Some materials, such as steel, come in various grades. The grade specifies an exact set of mechanical properties. Examples of common steel grades include *grade 2*, *grade 8*, and *class 8.8*.

Material

This is the basic underlying material. The most common fastener material is *steel* (including *stainless steels*), often further specified with a grade (grade 8, etc.). However, many other materials are used including, *brass*, *bronze*, and *nylon*.

This property will always be present even if no grade or plating is specified. Thus, a full material description for a fastener might simply be: Brass.

Other Information

Occasionally the material description will contain other information. Examples include fasteners with *painted heads*, colored platings such as *yellow zinc*, or *polished* finishes.

For more information on materials see our Materials page.

Size

For most fasteners, the size consists of two or three parts. For example:

Example:	1/4"	- 20	x 3"
	Diameter	Thread count	Length

Diameter

Diameter is typically measured on the outside of the threads. For US fasteners this is measured in inches (except for small diameters, where diameters are numbered), and for metric fasteners it is measured in millimeters (abbreviated mm or prefixed by M).

For more information on how to measure the diameter of specific fastener types see our Measuring Fastener Diameter page.

Thread Count / Pitch

Only machine threaded fasteners (nuts, and screws/bolts that could take a nut) specify a thread count or thread pitch.

US fasteners specify *threads per inch* (TPI), commonly called *thread count*, so 20 would represent 20 threads per inch. Metric fasteners instead specify a *thread pitch* which is the distance between the threads. Therefore, a 1.5 pitch would have 1.5 millimeters between each thread.

For more information see our Thread Pitch and Thread Count page.

Length

Fastener length is usually measured from where the surface of the material is presumed to be when the fastener is installed, to the end of the fastener. US fasteners are measured in inches, while metric fasteners are measured in millimeters (mm). For more information on how to measure specific fastener types see our Measuring Fastener Length page.

Order and Symbols

Diameter, Thread count/pitch, and Length should always be specified in this order. In addition, slightly different notation is used for US fasteners and Metric fasteners.

In US fasteners, a dash should be used to separate the diameter and thread count (if there is a thread count), while an x is used to separate them from the length. A double quote (") may or may not be present to indicate the measurement is in inches. A number sign (#) indicates a numeric diameter used with smaller screws. Dropping the number sign for these sizes should be avoided as it can easily result in confusion between US and Metric sizes.

In Metric fasteners, an x is used to separate each of the parts of the size. Each part (including the thread pitch) is a measurement in millimeters, so each may be followed by the abbreviation mm. Often this is left off from the thread pitch. Sometimes it is also left off of the other parts of the size. This should be avoided as it can lead to confusion with US fastener sizes. To shorten metric sizes many people use a capital M in front of the diameter, and then leave the units off of the other parts of the size. This method results in a shortened size that is still clearly a metric size.

Examples:

Examples

US Machine thread **1/4 - 20 x 3"**	Metric machine thread **6mm x 1.0 x 30mm**
US Non-machine thread **1/4 x 3"**	Metric non-machine thread **6mm x 30mm**
	Metric alternative **M6 x 1.0 x 30**

Other Properties

Some fasteners have additional special properties. Some examples are special point types (*thread cutting*, *piercing*, *dog point*), integrated washers (*Neoprene sealing washers*, *fixed lock washers*), special thread locking systems (*nylon patch*, *pre-applied thread locke*r), and *vented screws*. These properties are included with the rest of the identification.

Nuts and Washers

Nuts and washers lack many of the properties of other fasteners.

Nuts and washer sizes are the same as the diameter of the fastener they are meant to work with. Thus, a 1/4" washer fits a 1/4" bolt/screw.

Example of a **washer** description:

Example: Flat washer Stainless steel 1/4"

Type Material Size

Example of a **nut** description:

Example: Hex Nut Stainless steel 1/4" - 20

Type Material Size

Types, materials, and sizes are specified as above with the noted exceptions.

Order of Properties

While Bolt Depot uses the order seen at the top of this page, other suppliers may use a different order for the parts that make up the description.

Example:

Instead of
Type Head type Material Size

You might see
Material Type Size Head type

or
Size Material Head type Type

In other cases these various elements may be separated on a label or ordering sheet. As long as all elements are present the fastener can be easily identified.

Abbreviations

Because fastener descriptions can become quite long, abbreviations are often used.

Examples:
WS = Wood Screw
MS = Machine Screw
Phil = Phillips
S/S = Stainless Steel
G8 = Grade 8 Steel

Thus you may see something like this:

Example: WS Phil. Flat S/S #12 x 2

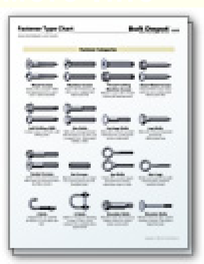
Despite being greatly shortened this contains the full fastener specification.

Many common abbreviations can be found on our Fastener Abbreviations page.

Note: In addition to abbreviations many people will leave out parts of the fastener description that they expect to either be the 'standard' or that they do not care about. For example, leaving off the thread density because they just want 'standard' (coarse) thread, or not specifying a material grade. It is always better to try to obtain this information prior to making a purchase to avoid errors.

Shop Talk

More Info



Our Printable Fastener Type Chart is a comprehensive illustrated guide to fastener types, drive types, head styles and more.

Everyone who works with fasteners eventually starts using their own abbreviations and terminology. Shouting "Grab me some railing anchors" is a lot easier than "Grab me some three eighths sixteen by four inch stainless steel stud anchors". Often this 'Shop Talk' gets handed down to people who never knew another name for the fastener and sometimes even becomes industry or regional slang.

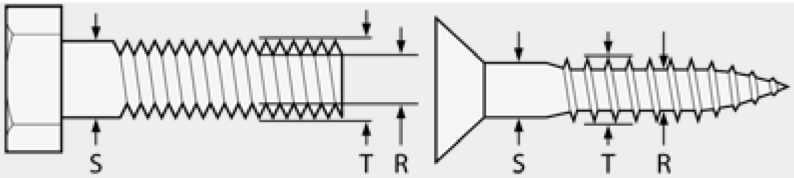
For those times when you can't identify a fastener by name, we have created a Printable Fastener Type Chart. This type chart, in addition illustrations in our catalog, are designed to help guide you through identifying what you need right down to the specific size.

Measuring Fastener Diameter

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

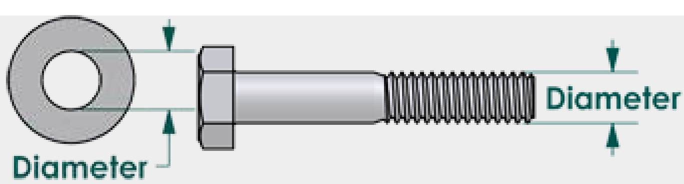
This is incorrect and should be avoided for two reasons.

1. **Miscommunication** can result in getting a much larger bolt than needed.
2. **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.

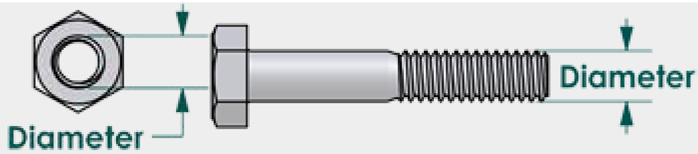
For more information on hex bolt head sizes please see our US Hex Bolt Head/Wrench Size Table or our Metric Bolt Head/Wrench Size Table.

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. For more information on thread density please see our About Thread Pitch and TPI page or How Fastener Measurements are Notated page



1/2" washer fits **1/2" diameter fastener**



1/2" - 13 nut fits **1/2" - 13 fastener**

US Numbered Screw Sizes

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

For information on what these sizes translate to inches see our:

- US Machine Screw Diameter Table
- US Sheet Metal Screw Diameter Table
- US Wood Screw Diameter Table

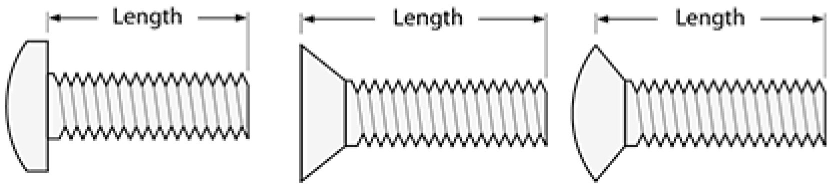
Specific Exceptions

Some fasteners such as *shoulder bolts*, and *many anchors* use a different measurement for diameter. Throughout our catalog you will find images showing exactly where the diameter is measured on each fastener when you are choosing a diameter.

Measuring Fastener Length

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.

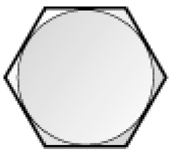
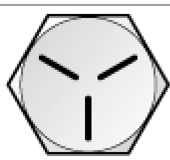
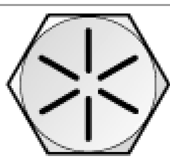


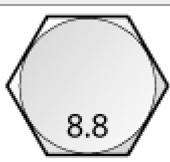
Head Above Surface **Countersunk Head** **Oval Head**

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.

Bolt Grade Markings and Strength Chart

Head Marking	Grade and Material	Nominal Size Range (inches)	Mechanical Properties		
			Proof Load (psi)	Min. Yield Strength (psi)	Min. Tensile Strength (psi)
US Bolts					
 No Markings	**Grade 2** Low or medium carbon steel	1/4 thru 3/4	55,000	57,000	74,000
		Over 3/4 thru 1-1/2	33,000	36,000	60,000
 3 Radial Lines	**Grade 5** Medium Carbon Steel, Quenched and Tempered	1/4 thru 1	85,000	92,000	120,000
		Over 1 thru 1-1/2	74,000	81,000	105,000
 6 Radial Lines	**Grade 8** Medium Carbon Alloy Steel, Quenched and Tempered	1/4 thru 1-1/2	120,000	130,000	150,000
Stainless markings vary. Most stainless is non-magnetic	**18-8 Stainless** Steel alloy with 17-19% Chromium and 8-13% Nickel	1/4 thru 5/8		40,000 Min. 80,000 – 90,000 Typical	100,000 – 125,000 Typical
		3/4 thru 1		40,000 Min. 45,000 – 70,000 Typical	100,000 Typical
		Above 1			80,000 – 90,000 Typical

Head Marking	Class and Material	Nominal Size Range (mm)	Mechanical Properties		
			Proof Load (MPa)	Min. Yield Strength (MPa)	Min. Tensile Strength (MPa)
Metric bolts					
 8.8	**Class 8.8** Medium Carbon Steel, Quenched and Tempered	All Sizes below 16mm	580	640	800
		16mm - 72mm	600	660	830

 10.9	**Class 10.9** Alloy Steel, Quenched and Tempered	5mm - 100mm	830	940	1040
 12.9	**Class 12.9** Alloy Steel, Quenched and Tempered	1.6mm - 100mm	970	1100	1220
Stainless markings vary. Most stainless is non-magnetic. Usually stamped A-2	**A-2 Stainless** Steel alloy with 17-19% Chromium and 8-13% Nickel	All Sizes thru 20mm		210 Min. 450 Typical	500 Min. 700 Typical

Tensile Strength: The maximum load in tension (pulling apart) which a material can withstand before breaking or fracturing.

Yield Strength: The load at which a material exhibits a specific permanent deformation.

Proof Load: An axial tensile load which the product must withstand without evidence of any permanent set.

1MPa = 1N/mm^2 = 145 pounds/inch^2

About Galvanic Corrosion

Galvanic corrosion occurs when dissimilar metals are in electrical contact in water especially salt water. As a small electrical current flows from one metal to the other, one metal will begin corroding faster than normal (the anode) and the other will corrode more slowly than normal (the cathode). The result is that the anode material will be eaten away much more quickly than the cathode material.

Through sound design and material choice galvanic corrosion can be reduced. This involves avoiding dissimilar material combinations. In addition, a dissimilar metal may be purposely used as a ‘sacrificial anode’. This is done by purposely creating a corrosive situation where the metal being corroded faster is simply a meaningless block of metal (often zinc) thus resulting in the important materials corroding more slowly.