Fasteners

This page is under development.

Introduction

This webpage is unique in that it combines information on the many types of fasteners with information on how to determine their strengths. This extends to joint strengths as well since the parts being fastened together are often weaker than the fastener itself. This is especially true when the objects are relatively thin sheets of metal, a common occurance in aircraft.

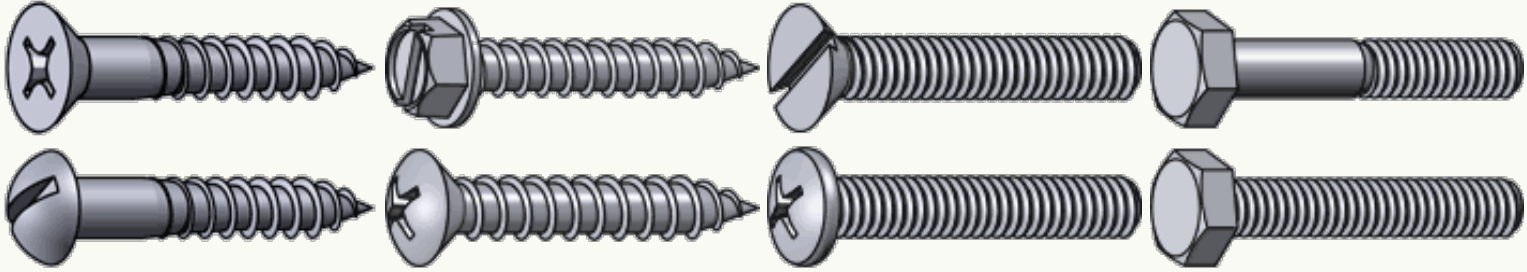
http://macgyverisms.wonderhowto.com/how-to/make-macgyver-style-chess-set-using-just-nuts-bolts-0144591/

The page begins by reviewing the many fastener categories, focusing on those used in the American aircraft industry. It progresses to....., and concludes with fastener and joint strength analysis methods.

The Difference Between a Bolt and a Screw

A bolt is designed to be inserted through a smooth hole and secured with a nut, while a screw is designed to be used in a threaded hole—sometimes along with a nut. To learn more, see the American Society of Mechanical Engineers (ASME) standard B18.2.1 (1996).

Types of Fasteners

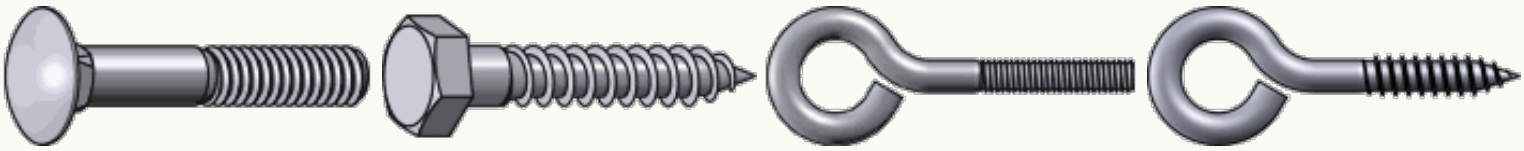


Wood Screws
Screws with a smooth shank and tapered point for use in wood.
Abbreviated WS

Sheet Metal Screws
Fully threaded screws with a point for use in sheet metal.
Abbreviated SMS

Machine Screws
Screws with threads for use with a nut or tapped hole.
Abbreviated MS

Hex Bolts
Bolts with a hexagonal head with threads for use with a nut or tapped hole.
Abbreviated HHMB or HXBT



Carriage Bolts
Bolts with a smooth rounded head that has a small square section underneath.

Lag Bolts
Bolts with a wood thread
and pointed tip.
Abbreviated Lag

Eye Bolts
A bolt with a circular ring on the head end. Used for attaching rope or chain.

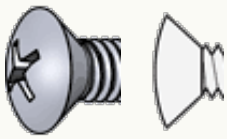
Eye Lags
Similar to an eye bolt but with wood threads instead of machine thread.

U-Bolts
Bolts in U shape for attaching to pipe or other round surfaces. Also available with a square bend.

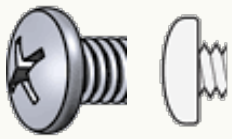
J-Bolts
J shaped bolts are used for tie-downs or as an open eye bolt.

Head Styles

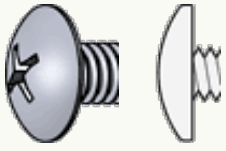
Flat
A countersunk head with a flat top.
Abbreviated FH



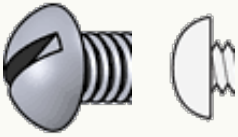
Oval
A countersunk head with a rounded top.
Abbreviated OH or OV



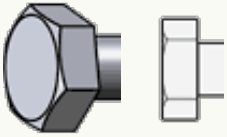
Pan
A slightly rounded head with short vertical sides.
Abbreviated PN



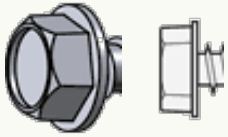
Truss
An extra wide head with a rounded top.



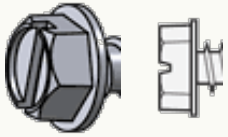
Round
A domed head.
Abbreviated RH



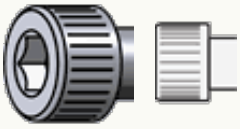
Hex
A hexagonal Head.
Abbreviated HH or HX



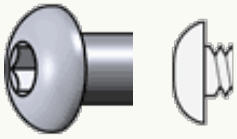
Hex Washer
A hex head with built in washer.



Slotted Hex Washer
A hex head with built in washer and a slot.



Socket Cap
A small cylindrical head using a socket drive.



Button
A low profile rounded head using a socket drive.

Tension Bolt Markings and Strength

Blah, Blah, Blah...

Head Marking	Grade and Material	Nominal Size Range (inches)	Mechanical Properties		
			Proof Load (psi)	Min. Yield Strength (psi)	Min. Tensile Strength (psi)
 No Markings	Grade 2 Low or medium carbon steel	1/4 thru 3/4	55,000	57,000	74,000
		>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
		>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	100,000 Typical
					80,000 -

		Above 1		Typical	90,000 Typical

Proof Load: Tensile load which the bolt must withstand without any evidence of permanent set.

Yield Strength: Load at which the bolt exhibits a specific permanent deformation.

Tensile Strength: Maximum tensile load which the bolt can withstand before breaking or failing.

Reference: http://www.boltdepot.com/fastener-information/Materials-and-Grades/Bolt-Grade-Chart.aspx

$$R = \frac{\rho L}{A}$$

Theoretical Gauge Factor Values

It turns out that gauge factors can be estimated from the $R = \rho L/A$ relationship by first determining dR/dL as follows

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Electrical Circuits - Wheatstone Bridge

Acknowledgements

Many photographs and sketches shown here were taken from the internet and found via Google searches. Each such image has been referenced in order to give credit to its source. I especially want to acknowledge www.boltdepot.com as a primary source of information here.

Also, thanks very much to Chuck Boulware and Bill Dunmon for contributing to this page.