

Take the Mystery Out of Fasteners

By Joe Davis, Product Manager, TESSCO

Understanding hardware such as screws bolts, nuts, and washers can be somewhat confusing from time to time. This article is to assist you in the selection of what fastener you should use and hopefully make them easier to understand. There are basically two types of screws, wood and sheet metal. In this article we will discuss the metal screws. The main difference between them is the thread in the screw. Sheet metal screws have sharper and more pronounced threads to enable them to better penetrate metal surfaces. Both types of screws are measured in the same manner and are identical in all other aspects. Screws usually come in lengths ranging from ¼ inch to 3 inches. Diameters are indicated by gauge numbers. Many length and gauge combinations are available. When buying screws, state the length and gauge number you want. Use stainless steel or aluminum screws for a project that will be exposed to moisture and brass or bronze ones to match hardware. Otherwise, you will save by using plain, plated, or galvanized screws.

SCREWS

Sheet Metal Screws

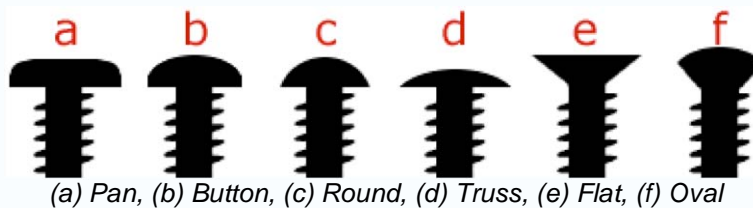
- *Phillips Flat head.* These are countersunk into the material for a smooth surface area.
 - *Applications and uses:*
 - *Mounting plywood in Telco closets so that screw heads won't interfere with mounting of hardware.*
 - *Areas where a smooth surface is wanted*
- *Phillips Oval head.* Oval head screws are similar to flat head but have a slightly rounded top for more of a finished look.
 - *Applications and use:*
 - *Connecting of metal-to-metal products where appearance and esthetics are important.*
 - *Mounting of rack supports and hardware in shelters*
- *Phillips Truss head.* The truss head protrudes above the surface to be fastened but with a larger surface area under the head.
 - *Applications and uses:*
 - *Areas where it is necessary to have a larger head on the screw to achieve strength in mounting, but not to have the head of the screw so big that it interferes with other mounting hardware.*
 - *Used to mount racks in enclosures.*
- *Phillips Pan head.* A pan head screw protrudes above the surfaces to be fastened.
 - *Applications and uses*
 - *When attaching to metal where the appearance of the head does not interfere with the function of the screw.*
 - *Attaching mounting hardware to metal surfaces*
- *Phillips Pan head self-drilling.* This is a sheet metal screw with a drill point which creates its own hole and a Phillips pan head.
 - *Applications and uses:*
 - *Attachment of hardware where there is a pilot hole started and no need for a bolt on the other end of the screw*
 - *Mounting of items in vehicles*

- *Hex Washer Head.* This is a sheet metal screw with a hex head and washer attached. Has a slotted head also.
 - *Application and uses:*
 - *Attachment of metal where there is a pilot hole started.*
 - *Provides flexibility of tools where a screwdriver or wrench can be used*
- *Hex Washer Head self-drilling.* This is a sheet metal screw with a hex washer head and a self-drilling drill point.
 - *Application and uses:*
 - *Attachment of metal where there is no pilot hole. Drills its own hole.*
 - *Provides screw and washer in one unit.*

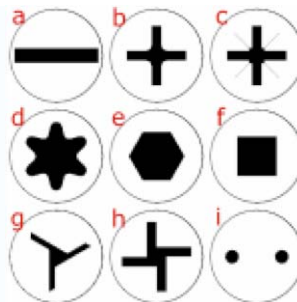
Machine Screws

- *Phillips Flat Head.* Flathead screws are countersunk into the material for a smooth surface area.
 - *Application and uses*
 - *Machine screws are used when there are threads present in the materials being connected or when there is a nut used to secure them.*
 - *Allows for head of screw to be flush with surface.*
- *Phillips Pan head.* A pan head screw protrudes above the surface of the material to be fastened.
 - *Application and uses:*
 - *Ideal when building or maintaining equipment cabinets where there is a need to occasionally move or re configure components.*
- *Slotted Flat Head.* Flathead screws are countersunk into the material for a smooth surface area.
 - *Application and uses*
 - *Machine screws are used when there are threads present in the materials being connected or when there is a nut used to secure them.*
 - *Allows for head of screw to be flush with surface.*
- *Phillips Oval Head.* Oval head screws are similar to flat head, but have a slightly rounded top for a more finished look.
 - *Application and uses:*
 - *Connecting of metal-to-metal products where appearance and esthetics are important.*
 - *Mounting of rack supports and hardware in shelters*
- *Slotted Oval Head.* Oval head screws are similar to flat head, but have a slightly rounded top for a more finished look.
 - *Application and uses:*
 - *Similar to above with exception that it has a slotted head instead of Phillips.*
- *Combination Round Head.* These are the same as round head except for the option of using either a slotted or Phillips screwdriver.
 - *Application and uses:*
 - *All purpose screw that can be used with either a slotted head or Phillips screwdriver*
 - *Allows for flexibility of tools used to tighten or un tighten*
- *Combination Truss Head.* Combination truss has a low profile head, which takes either a Phillips or slotted screwdriver.
 - *Application and uses:*

- *Truss heads has low profile, which makes it unobtrusive.*
- *Does not interfere with placement of other parts or attachments*
- *Can be used with either a slotted head or Phillips screwdriver*
- **Slotted Round Head.** A slotted screw with a head that protrudes above the surface of the material fastened.
 - *Application and uses:*
 - *A general-purpose screw that can be used for various fastening tasks.*
- **Phillips Truss Head.** Phillips truss head protrudes above the surface to be fastened but with a larger surface area under the head.
 - *Application and uses:*
 - *Truss heads has low profile, which makes it unobtrusive.*
 - *Does not interfere with placement of other parts or attachments*
- **Slotted Truss Head.** Slotted truss head protrudes above the surface to be fastened but with a larger surface area under the head.
 - *Application and uses:*
 - *Truss heads has low profile, which makes it unobtrusive.*
 - *Does not interfere with placement of other parts or attachments*



SPECIAL SCREW HEADS



(a) Slotted, (b) Phillips, (c) Pozidriv, (d) Torx, (e) Hex, (f) Robertson, (g) Tri-Wing, (h) Torq-Set, (i) Spanner

- **Slot head** has a single slot, and is driven by a flat-bladed screwdriver. The slotted screw is common in woodworking applications, but is not often seen in applications where a power driver would be used, due to the tendency of a power driver to slip out of the head and potentially damage the surrounding material.
- **Cross-head, cross-point or Phillips screw** has a "+"-shaped slot and is driven by a cross-head screwdriver, designed originally for use with mechanical screwing machines. The Phillips screw drive has slightly rounded corners in the tool recess, and was designed so the driver will slip out, or *cam out*, under strain to prevent over-tightening. The Phillips Screw Company was founded in Oregon in 1933 by [Henry F. Phillips](#), who bought the design from J. P. Thompson. Phillips was unable to manufacture the design, so he passed the patent to the American Screw Company, who were the first to manufacture it.

- *Pozidriv* is patented, similar to cross-head but designed not to slip, or cam out. It has four additional points of contact, and does not have the rounded corners that the Phillips screw drive has. Phillips screwdrivers will usually work in Pozidriv screws, but Pozidriv screwdrivers are likely to slip or tear out the screw head when used in Phillips screws. Pozidriv was jointly patented by the Phillips Screw Company and American Screw Company.
- [Torx](#) is a star-shaped or splined bit with six rounded points.
- *Hexagonal or hex* screw head has a hexagonal hole and is driven by a hexagonal wrench, sometimes called an [Allen key](#), or by a power tool with a hexagonal bit.
- *Robertson* drive head has a square hole and is driven by a special power-tool bit or screwdriver. The screw is designed to maximize torque transferred from the driver, and will not slip, or cam out. It is possible to hold a Robertson screw on a driver bit horizontally, due to the close fit. Commonly found in [Canada](#) in carpentry and woodworking applications.
- *Tri-Wing* screws have a triangular slotted configuration. They are used by [Nintendo](#) on its [Game Boys](#) to discourage home repair, as well as cellular phone manufacturers to prevent unauthorized tampering with phones.
- *Torq-Set* is an uncommon screw drive that may be confused with Phillips; however, the four legs of the contact area are offset in this drive type.
- *Spanner* drive uses two round holes opposite each other, and is designed to prevent tampering.

Many screw drives, including Phillips, Torx, and Hexagonal, are also manufactured in tamper-resistant form. These typically have a pin protruding in the center of the bit, necessitating a special tool for extraction. The slotted screw drive also comes in a tamper-resistant one-way design with sloped edges; the screw can be driven in, but the bit slips out in the reverse direction.

CHOOSE YOUR MATERIAL

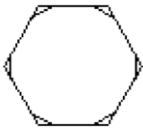
Self-tapping screws, machine screws and bolts are made of several different materials that are specific to the purpose, which they are going to be used for:


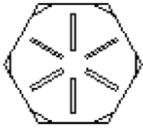


- Zinc Plated Steel – This provides for moderate protection against rust
- Stainless Steel 18-8 – Stainless Steel 18-8 is an alloy of steel with high corrosion resistance. Stainless has become the material of choice for exterior and most marine applications.
- Silicon Bronze – Bronze is an alloy of copper with greater strength and corrosion resistance than brass. Most commonly used in wood boat building and restoration.
- Brass – An alloy of copper with good corrosion resistance. Once common for marine use, it has been replaced by stainless steel. Used mostly in decorative applications.
- Hot Dipped Galvanized. Hot dipped galvanized bolts are much more corrosion resistant than zinc plated bolts. Used for exterior and coastal area uses.

BOLTS

- *Standard Bolts/Cap Screws* – A standard bolt has a hex head and a smooth shoulder area beyond the standard amount of threading. Shorter lengths are fully threaded.
 - *Applications and uses:*
 - *Attachment of two metal members together such as ladder racks, ice bridges structural members or cable ladders*
 - *Maybe used to crew into a tapped hole or with a nut and washer.*
- *Full Thread Tap Bolts*- Tap bolts are fully threaded hex head bolts, usually available in different grades.
 - *Applications and uses:*

- *Attachment of two metal members together such as ladder racks, ice bridges structural members or cable ladders*
 - *Maybe used to crew into a tapped hole or with a nut and washer.*
- **Lag Bolts** – Often called a lag screw Hex lag bolts are for fastening in wood and available in a variety of materials.
 - *Applications and uses:*
 - *Used for fastening to wood where a through hole is not needed*
 - *Ideal for fastening antenna and masts to wooden buildings*
- **U-Bolts** - A bolt shaped like the letter U, fitted with threads and a nut at each end. Usually used to clamp round members, such as mast, poles, etc
 - *Applications and uses:*
 - *Used to attach antennas to masts or structures to round hardware.*
- **J-Bolts** - A threaded rod having the unthreaded end reverse bent to approximately a semicircle. Used in applications where a formed shank shape rather than a standard head is desired for assembly purposes.
 - *Applications and uses:*
 - *Used to secure hardware to angled steel on towers and other structures*
- **Anchor Bolts**- A bolt with an angled hook that is typically cast in concrete. Used for fabrication and construction.
 - *Applications and uses:*
 - *Used to mount towers to concrete bases.*
 - *An ideal way to permanently attach shelters to concrete slabs*

Bolt Grade Markings and Strength						
Head Markings	Grade or Class	Material	Nominal Size Range (Inches)	Mechanical Properties		
				Proof Load (psi)	Minimum Yield Strength (psi)	Minimum Tensile Strength (psi)
American						
 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
	Grade 5	Medium Carbon Steel,	1/4 thru 1	85,000	92,000	120,000

 3 Radial Lines	Grade 5	Quenched and Tempered	1/4 thru 1	85,000	92,000	120,000
 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		80,000 – 90,000	100,000 – 125,000
			3/4 thru 1		45,000 – 70,000	100,000
			Above 1			80,000 – 90,000
Metric						
 8.8	Class 8.8	Medium Carbon Steel, Quenched and Tempered	All Sizes thru 1-1/2	85,000	92,000	120,000
 10.9	Class 10.9	Alloy Steel, Quenched and Tempered	All Sizes thru 1-1/2	120,000	130,000	150,000
Stainless markings vary. Most stainless is non-magnetic	A-2 Stainless	Steel alloy with 17-19% Chromium and 8-13% Nickel	1/4 thru 5/8		80,000 – 90,000	100,000 – 125,000
			3/4 thru 1		45,000 – 70,000	100,000
			Above 1			80,000 – 90,000
<p>Tensile Strength: The maximum load in tension (pulling apart) which a material can withstand before breaking or fracturing. Yield Strength: The maximum 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.</p>						

WASHERS

- *Flat Washers* – Flat washers are used under the head of a bolt or nut to distribute the forces applied when tightening.
- *Fender Washers* - Fender washers are similar to flat washers except that they have a larger outside diameter to distribute the forces over.
- *Lock Washers* – Lock washers place tension against a nut after tightening to help prevent the nut from loosening.
- *External Tooth Lock Washers* – Uses external teeth for aggressive locking and tension. Has a larger outside diameter.
- *Internal Tooth Lock Washer* – Uses internal teeth for locking and tension. Less aggressive than an external tooth washer. Has a smaller outside diameter.
- *Finishing Washer* – Made to give flat or oval head screws a finished look.
- *Dock Washers* – Used to distribute the forces while tightening. Dock washers have a larger outside diameter and are thicker than standard washers. Also come in *Square* as well as round.

NUTS

- *Hex Nuts* – Used for fastening to a bolt or machine screw when mechanically joining materials together. Also know as finished full.
- *Hex Machine Screw Nuts* - Used for fastening to a bolt when mechanically joining materials together. This type refers to nuts used with smaller machine screw sizes under ¼”
- *Hex Nuts with Nylon Inserts* – Used for fastening to a bolt when mechanically joining materials together. The bolt threads into a nylon material located at the top of the nut. This helps prevent loosening from vibration.
- *Cap Nuts* - A nut with a finished (closed) top. Bolts must be proper length in order to apply these.
- *Square Nuts* – Hex nuts mostly replaced square nuts, once very common. They can also be used in a channel or welded into place.
- *K-Lock Nuts* – A nut with an attached free spinning external tooth lock washer. This configuration speeds installation.
- *Flange Nut Serrated* - This is a nut with a built in washer, which is serrated to resist vibration.

Now that you have all the information you need to determine your application and needs, let TESSCO be your source for the hardware. TESSCO offers hardware and components from manufacturers such as Tower Structures, Rohn Tower, Source Supply, Rockford Products, and Wireless Solutions. TESSCO further offers a full line of Zinc, Stainless Steel and Galvanized fasteners available in various grades as well.