LEARN-IT: Fasteners

Fasteners for wood

	Wood screw	Drywall screw	Nail
When to use this fastener	Joining wood to wood	Joining wood to wood	Joining wood to wood Joining thin material to wood
Composition	Steel or brass	Steel	Steel
Required preparation	**First layer:** Clearance hole and countersink **Second layer:** Pilot hole	None	None
Key characteristics	**Stronger hold** than a drywall screw or nail **Slower install** because of required preparation **More expensive** than drywall screw	**Fast install** because no preparation is required (however, pre-drilling is always a good idea) **Cheaper** than a wood screw **Weaker than a wood screw** Not as aesthetically pleasing as a wood screw Not as common in developing countries	**Fastest install** Can be **installed with anything** similar to a hammer **Weakest fastener in tension** **Difficult to uninstall** without damaging the material

Preparatory holes in wood

Pilot hole

A hole that is **a bit smaller** than the fastener shank; the threads **grip the wood**, but **do not split** it apart

Protip

The pilot hole **should not be larger than the inner diameter** of the fastener's threads. **Do not drill the pilot hole all the way through**; leave a little bit of material for the fastener tip to dig into at the base of the hole

Clearance hole

A hole that is **a bit bigger** than the fastener so the **threads can slip past** the hole

Countersink

An **enlarged rim** of a pilot or clearance hole so the fastener **can be flush** with the wood

Protip

Make sure your fastener head and the bit angle match.

Fasteners have **different head angles:**

90° countersink: **Metric** fasteners

82° countersink: **Standard** (Fractional and Numbered) fasteners

Protip

***Center drills* should NOT be used for countersinking.**

These are designed to make 60° holes which are used as centers of rotation for lathes

How do I make pilot and clearance holes?

Use a drill. There are many kinds:

- **Brace:** manual, for large holes
- **Hand drill:** manual, for small holes
- **Power drill:** portable, for table-top work, for awkward locations
- **Drill press:** large machine, precise, for small parts

How do I countersink holes?

Use one of these **countersink bits, drilling VERY slowly:**

Zero flute countersink

Countersink/pilot

Single flute countersink

6-flute countersink

Fasteners for metal

	Sheet metal screw	Pop rivet	Machine screw	Hex bolt
When to use this fastener	When not using a nut for joining thin-to-thin Joining thin to thick materials	Joining relatively thin metal	General assembly of **medium** pieces of **metal or wood**	General assembly of **larger** pieces of **metal or wood**
Composition	Steel	Aluminum or steel (Use with similar metal to reduce corrosion)	Steel	Steel
Required preparation	Clearance hole through the first layer, pilot hole in the second layer	Clearance hole	Tapped hole	Clearance hole
Key characteristics	Self-tapping tip **No countersink** required **Repeated assembly wears** the hole	Semi-permanent *the rivet must be **destroyed to remove** it* Very **low head profile** **Access to other side is** not required	Typically **fully** threaded Uses a **threaded hole** *or a nut – **can be used as a bolt***	Some not fully threaded Uses a **nut** *or a threaded hole – **can be used as a machine screw*** **Sizes vary immensely**

Preparatory holes in metal

Pilot hole

A small hole that is drilled into the metal **in preparation for a larger hole** - this way, the larger drill bit will not slip on the metal piece and drill in the wrong location
(slightly different definition than wood)

Step 1. Use a **center punch**, a pointed tool which dings a small indent in the metal. Line it up with your mark and hit it with a hammer.

Step 2. Use a **spotting drill**, a tiny, sharp, rigid bit that drills a small hole which prevents the next drill bit from "walking" off the target.

If the **"web"** of your drill bit fits within the hole made with the spotting drill, then move to Step 4 and drill your hole.

Step 3. (if applicable) If you are making a particularly large hole, you may need to expand the small spotting drill pilot hole by drilling with an intermediate drill bit size.

Step 4. Use your **drill bit**.

Clearance hole

A hole that is **a bit bigger** than the fastener so the **threads can slip past** the hole
(same definition as with wood)

Tapped hole

A hole that has threads cut into its sides so the fastener grips the metal directly **instead of onto a nut**

How do I tap a hole?

A tap cuts threads in the hole, cutting the soft metal.

A die cuts the threads onto the blank shaft.

*Please **ask someone** to show you first, but here are the key steps:*

1.Identify your fastener's thread count and diameter.
2.Identify the corresponding tap drill size using a *Tap Drill Chart* (one is on the door to the welding room).
3.Slowly, applying little pressure, begin to screw the tap into the hole. Don't forget oil!
4.Screw in **2 half turns, unscrew 1 half turn** (this helps clear chips and makes sure the tapped hole is cut properly).

What else should I know?

Drive types and tools

Phillips head

Protip

Use the right bit size!

Flat/slotted head

This screwdriver type is **NOT recommended** – it tends to slide off and the fasteners are often made of a lower quality metal

Hex head

Protip

Do NOT use pliers to tighten nuts or bolts

Socket head

Protip

It is more **difficult for people to walk up and steal parts** which are fastened with socket head fasteners since an allen key is required

Fastener materials

Steel (uncoated)
Strong, pliable

Steel (zinc-plated)
Standard, strong, Corrosion-resistant

Steel (black oxide-plated)
Mildly corrosion-resistant

Brass
Aesthetically nice, corrosion-resistant

Aluminum
Softer than steel

Stainless steel
Excellent corrosion-resistance

Washers

Washers **distribute the force** of the fastener and **prevent damage** to the material being fastened

Washers typically go **under the bolt head & under the nut**

Main washer types

A **flat washer** distributes the force of the fastener.

A **lock washer** acts like a really short spring, applying tension between the nut and bolt. This prevents the nut from loosening, which often occurs because of vibration or shaking.

A **fender washer** distributes loads more widely, for use on softer materials.

Sizing a washer

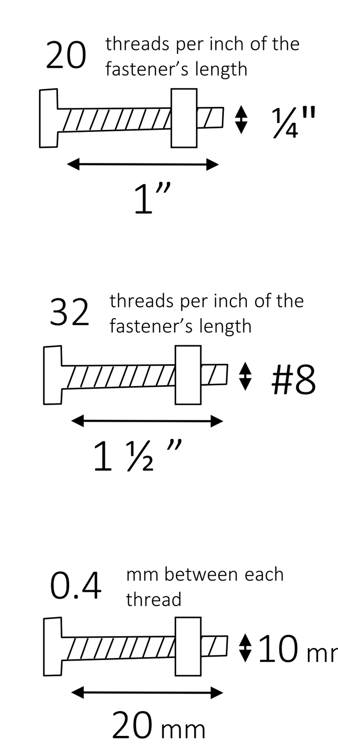
Washer sizes are not one-size-fits-all – a fastener is meant to use a particular washer size.

The fastener shaft should slip through the washer; the fastener head catches the washer.

Protip

Washers can be used as spacers.
Just beware if they will be difficult to put in or out when you adjust/disassemble your parts.

Machine screw notation



Fractional

¼" – 20 x 1"

Diameter *(inches)* · Thread count *(threads per inch, TPI)* · Length *(inches)*

Numbered

#8 – 32 x 1"

Diameter *(gague)* · Thread count *(threads per inch, TPI)* · Length *(inches)*

Metric

M10 – 0.4 x 20

Diameter *(millimeters)* · Thread pitch *(mm between threads)* · Length *(millimeters)*

Oops!

Wood is composed of fibers which can split apart and splinter your piece

Don't place a fastener too **close to the edge** – it could split the wood!

Don't **nail into the end grain** of a wooden board – it could split the wood!

Medium or hard woods may require a pilot hole, even with drywall screws – otherwise, it may split the wood!

D-Lab

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