

Lecture 3: Materials - a practical guide



Last week's lecture

- History of EMG
- What EMG can be used for
- Measurement of an action potential - review (single cell)
- Measurement of an action potential in reality

This week (depending on time, may finish next week)

- Biomed “Workshop”
- Materials
- Some useful mechanical systems
- Coupling mechanical and electrical systems
- Fasteners

Tool list (biomed labs) - Open

Thurs Week 7

- Cross-cut saw (for wood)
- Hacksaw (for metals)
- Coping saw (jigsaw)
- Tin snips
- Hammer
- Square
- Tape measure
- Screwdrivers
- Cordless drill + bits
- Pliers
- Vise-grip pliers
- Vise
- Clamps
- Pop rivet tool + rivets
- Soldering iron
- Files
- Rasp
- 2 B&D work benches
- Other: If you would like other (hand) tools, ask us. We may be able to oblige.

Materials – some considerations

- Strength
 - How strong does it really have to be?
 - Don't over-design
- Workability
 - Do I have the tools and skill to make use of the material?
- Expense

Materials – Wood

- Hardwood
 - Strong
 - Can be difficult to work with
 - More likely to split when nailing or screwing if you are not careful
 - E.g. Tasmanian Oak, Jarrah, Merbau
 - Used for decking



Materials – Wood

- Softwood
 - Not as strong, but how strong does your prosthetic have to be?
 - Easier to work with and machine, and more forgiving
 - Can be light and soft
 - E.g Pine (although not all types of pine are equal).
 - Can be used for a range of applications e.g. Model making (Balsa Wood)

Wood – importance of grain



Wood – Grain in direction of load



Materials – Wood

- Plywood
 - Sheet material, made up of layers of thin sheets of wood (plies), which alternate in grain direction.
 - Strong in all directions
 - Resistant to splitting.
 - Good for curved components.
 - Easy to saw but hard to shape with hand tools. Glue is hard.

Plywood – layers with crossed grains

- We have some of this in the workshop – check before buying!



Materials - Acrylic

- Poly (methyl methacrylate)
- Known by many other names!
- Perspex, Plexiglass, Polyglass, Lucite
- Shatter-resistant alternative to glass
- Transparent, half as heavy as glass
- Difficult to work with by hand
 - CNC
 - Laser Cut
 - Makerspaces: MCIC/Willis Annexe



Materials - Aluminium

- Easy to work with.
- If thin, cut it with tin snips
- Otherwise, hacksaw
- How to make it stronger?



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Materials – Considerations

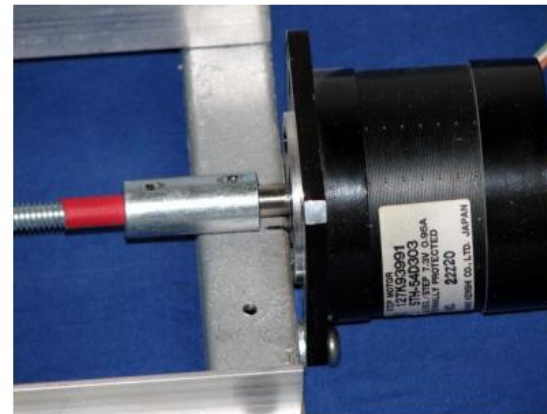
- How do you make a weak material into a strong component?
- Can you find “ready-made” components? Rubbish bins / piles?
- A consideration
 - Something that is about the right size/shape but of a lesser material may be better than a huge block of a better material that has to be cut down. Ease of construction is important!

Electrical to mechanical conversion

- How to connect onto the end of a DC motor shaft?
 - Shaft couplers



Shaft
(This is a DC servomotor)

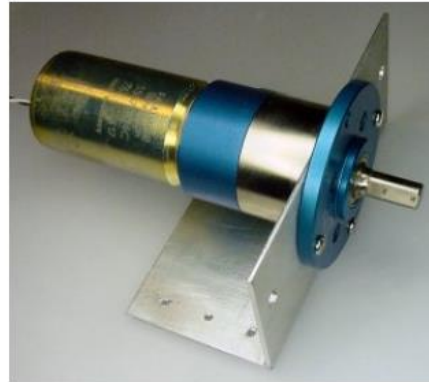


Electrical to mechanical conversion

- How to mount the motor on a chassis?
 - Mounting bracket



Bolt holes



Convert Rotational to Linear Motion?

Lead Screw



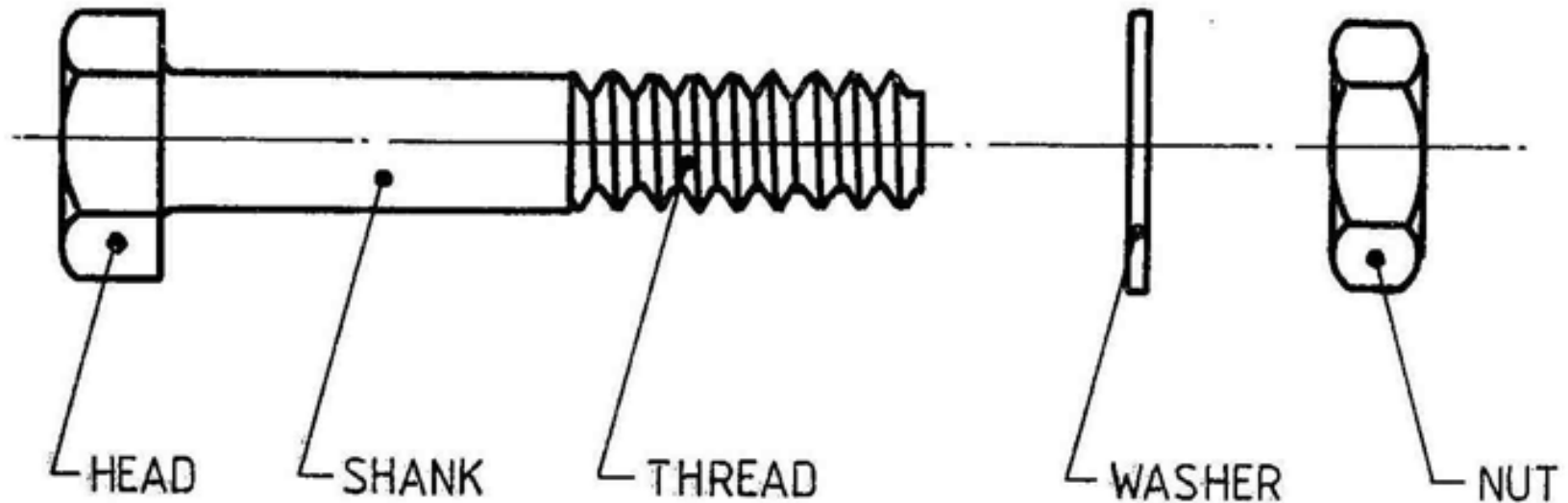
Fasteners

- How do I fix part A to part B?
 - Screws
 - Bolts
 - Glues
 - Solder
 - Pop rivets
 - Welding
 - Duct tape
- Sources of info:
 - Dym & Little Appendix A
 - Check with your mechanical engineering teammates

Bolts

Figure 2-1: A hexagonal bolt, a flat washer and a hexagonal nut.

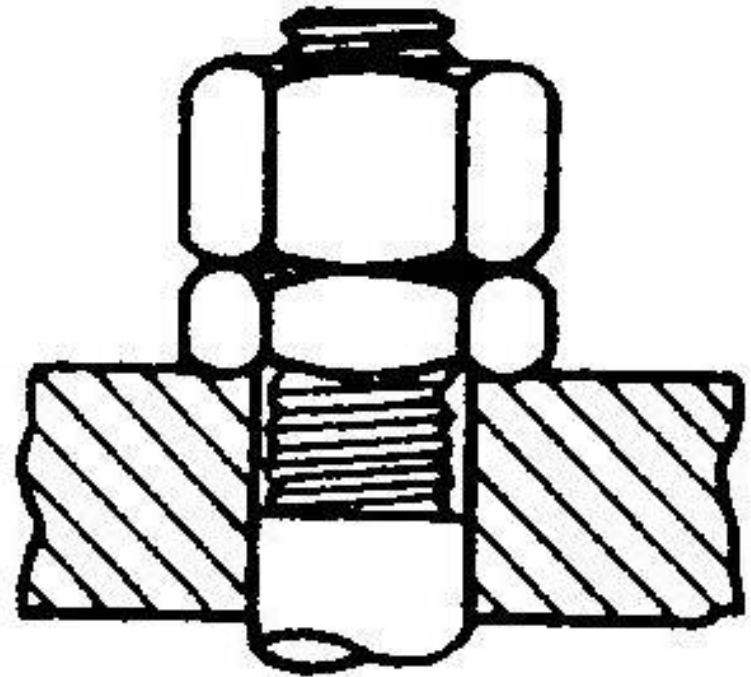
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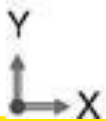
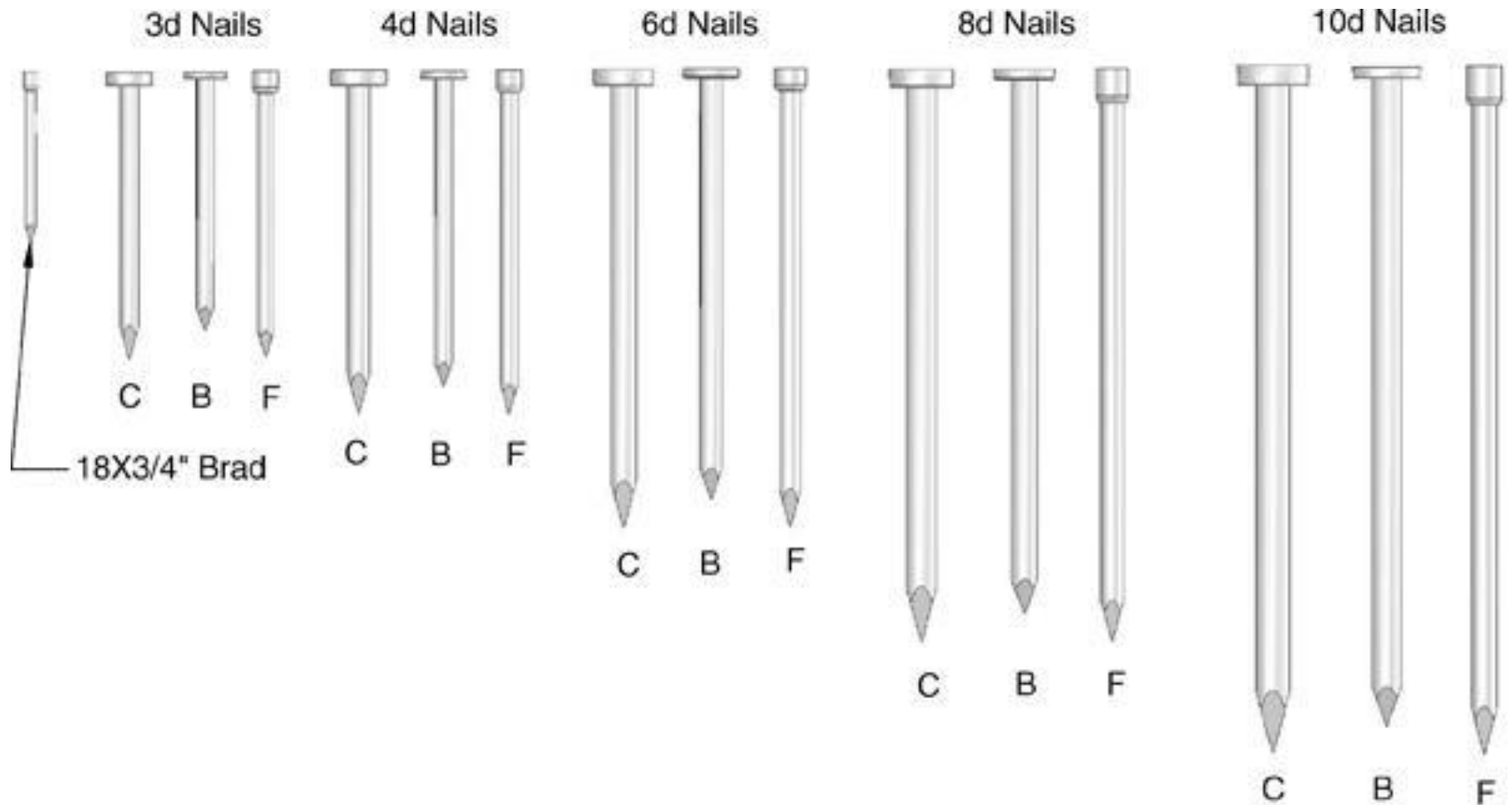
Bolts

If you want your joint to move, tighten 2 nuts together. The joined parts will be able to move but the nuts won't come off the bolt.

Figure 2-39: Alternative locking methods include: *The use of LOCKNUTS (or JAM NUTS), in which the first nut is used to tighten the bolt in the normal way, then a second nut is screwed onto the bolt and the second nut tightened hard up against the first.*

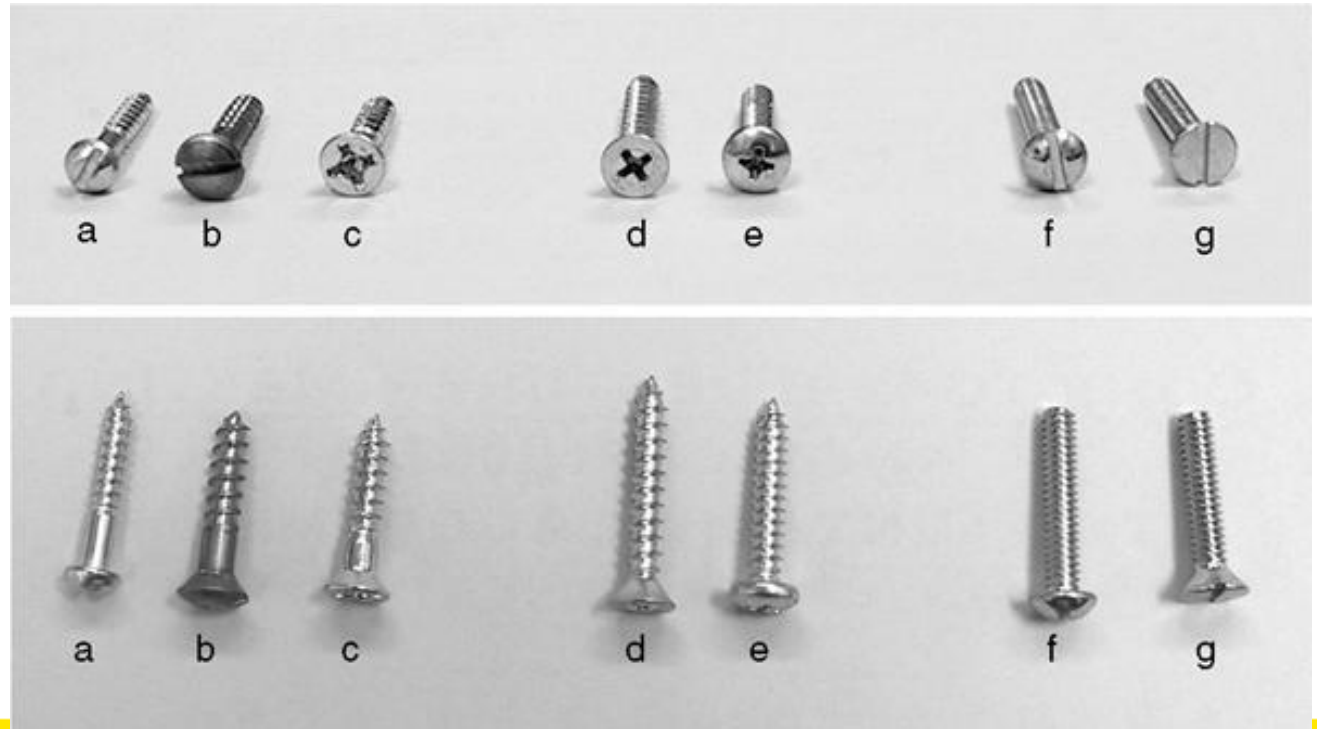


Nails



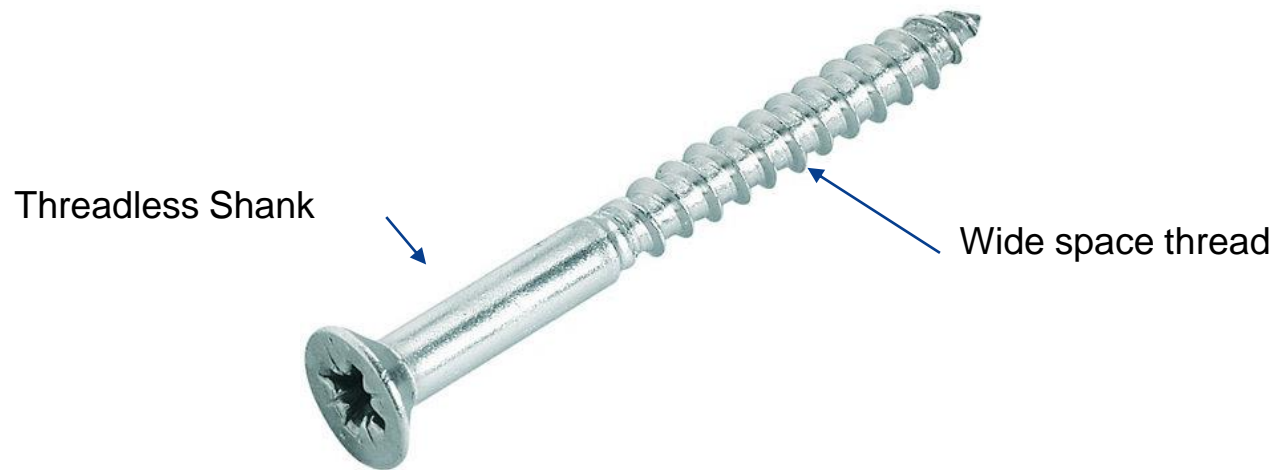
Screws

- Wood to wood
- Sheet metal to wood
- Metal to metal
- Know the difference!



Wood Screws

- Wide spaced thread
- Threadless shank



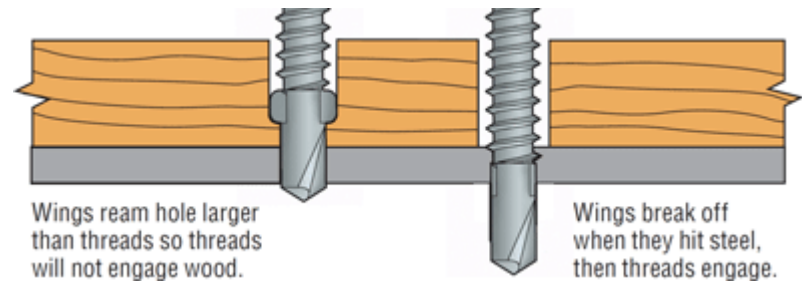
Metal Screws

- Threads are closer together
- The whole shaft is threaded



Threads are close together, and along whole shaft

Wood to metal screws

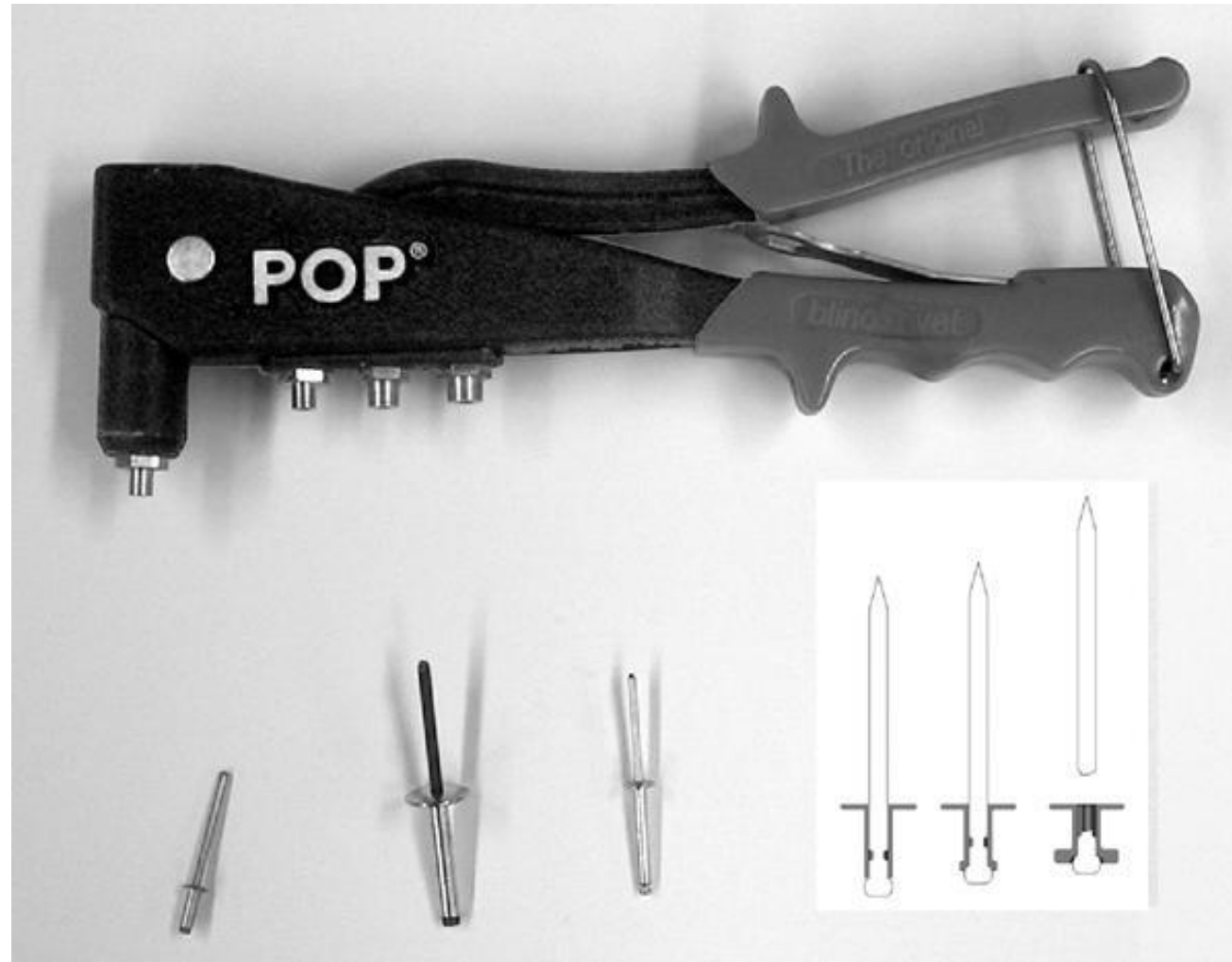


Wings prevent screw from tapping into wood.

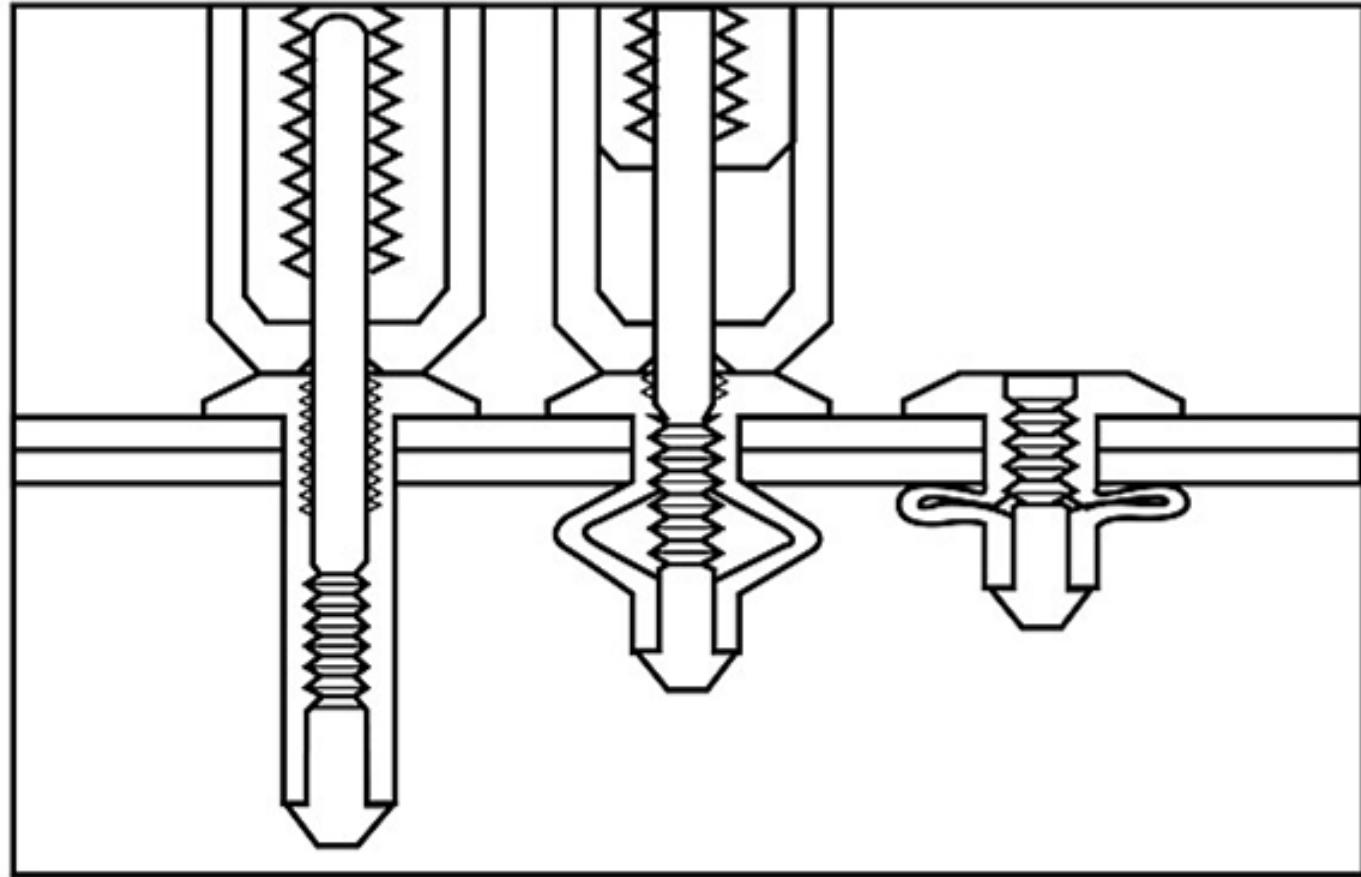
Wings break off in contact with metal, allowing thread to move into the metal.

Pop rivet

- Very good for sheet metal
- Not very good for plastic
- Must have the correct size drill



Pop rivet



Glue / adhesives

- White glue
 - Joining wood to wood in joints (dovetail, mortise and tenon). Requires skill, relatively tight fit.
- Many epoxy-type adhesives (Araldite).
 - 2-parts, mix and apply. 5-minute type is handy
 - (Be careful where you do it!)
- Superglue. May not be useful. Take care



Superglue.

**Be careful
with it...**

