Permanent and temporary joints

Permanent joints are intended to stay put. They may make use of adhesives, nails, rivets, or one of the heat processes of brazing, soldering or welding. Assembly jigs are often used to hold components in place while they are being joined. For example, the parts of a steel roof frame can be put into the jig and then welded together.

Temporary fixings usually involve components with a screw thread, such as screws, nuts and bolts, or one of the many knock down fixings on the market.

Adhesives

There are many types of adhesives to suit different materials. When you are choosing the right one for your product you will have to take into consideration the type of material, the strength of the bond required and the environment the product will work in - for example if you are gluing timber for outdoor use, you would not use polyvinyl acetate (PVA), because it is water soluble.

Double-sided tape will join almost anything to anything. It is widely used in industry, for example, many parts of aircraft are held together with double-sided tape!

Joining wood 1: screws, nails, glues and knock-downs

There are many different ways of making joints in wood. The method used will depend on the function of the product, the strength required and the quality of the product. Temporary fixings will often be done using fastening components such screws or bolts. More permanent joints can be achieved with glue, or with nails - though these may lack strength and be rough-and-ready in appearance.

Screws

All screwing needs two sizes of hole. The clearance hole must be very slightly bigger than the shank of the screw, so that the shank can move freely in the clearance hole. The pilot hole must be smaller - slightly smaller than the core of the screw - so that the core fits tightly into it.

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36 **Screw thread**: The projecting spiral rib of a screw or bolt.
37 **Shank**: smooth, narrow part between the head and core of a screw.
38 **Core**: working part of a screw in which the screw-thread is cut
Screws come with different types of head. They can be flat or round-headed, and be fitted with a slot (for traditional screwdrivers), crosses (for Phillips or Posidrive screwdrivers) or square holes (for square drivers). If the screw head is to lie flush with the surface of the wood, the hole must be enlarged or **countersunk**.

**Self-tapping screws** are made from very hard steel. They have a thread which goes all the way up to the head, and cut an internal thread as they are screwed in. They can be used in metal and plastic as well as wood. Machine screws are used for joining metal and plastic components.

**Nails**

Nails come in different shapes and sizes. Nails are much cheaper than screws and quick to put in. You do not need to drill holes in the wood first, except sometimes when using hard wood or to prevent the wood splitting.

**Glues**

When using wood glue, make sure you:

- Get the surfaces to be glued to fit well - no gaps!
- Don't put any finish on the surfaces to be glued.
- Make sure the surfaces are clean.
- Get everything ready before you start - glue, brush, damp cloth, clamps and blocks to protect your work.
- Don't start to glue up unless you are sure you have enough time - you can't stop halfway through!

**Types of hinges**

A large variety of hinges are available from most hardware stores. The type bought depends on how it is to be used and what it is to be fitted to. For example, when selecting a hinge for a jewellery box, a small brass butt hinge is likely to be used rather than a concealed hinge. Furthermore, brass hinges are more expensive than steel ones and they give a quality look to the completed product. Below are some of the more popular hinges that are available.

**BUTT HINGE:** Comes in a range of sizes from 13mm to 150mm and is normally used for cabinet doors. They are very strong but cannot be adjusted once they are fitted.

**BUTTERFLY HINGE:** This is often used on light-weight doors and different shapes and patterns are available. They are generally easy to fit.

**FLUSH HINGE:** This type of hinge does not require a recess to be cut. They are not as strong as butt hinges but can be used for light-weight doors and small box construction.
BARREL HINGE: This comes in two parts. The threaded part of the hinge is screwed into a pre-drilled hole. They are easy to fit and the hinge can be dismantled.

CONCEALED HINGE: These normally come in two sizes (25mm and 36mm. The hinge is adjustable once fitted and is designed with chipboard and MDF in mind.

CONTINUOUS or PIANO HINGE: This is a hinge that comes in different lengths and can be bought in brass or steel. It is ideal where a long hinge is required such as a desk top or a cupboard door. Small countersink screws are normally used to fix it in position.

Knock-down (k/d) joints

Much furniture is sold in flat packs. This makes it easy to transport and store. The customer then has to assemble it at home. Usually knock-down (KD) fittings are used. Most KD fittings consist of corner blocks or bloc-joint fittings. Usually these are made from a plastic such as nylon.

Knock-down fittings are those that can be put together easily, normally using only a screwdriver, a drill, a mallet/hammer and other basic tools. They are temporary joints although many are used to permanently join together items such as cabinets and other pieces of furniture that are purchased in a flat pack.

PLASTIC CORNER BLOCK (FIXIT BLOCKS):

The corner block is pressed against the two pieces of material (normally wood based). Screws are used to fix the block into position. This type of joint is used to fit modern cabinets such as those found in a kitchen. It is a relatively strong joint although it has the advantage that it can be dismantled using a screwdriver.

NATURAL WOOD FITTING (SQUARE SECTION BATTEN):

A piece of material such as pine can be drilled and screws can be passed through these holes. This gives a cheap and effective knock-down joint. The screws are normally countersunk into the knock-down fitting.
RIGID JOINT:

These are normally moulded in plastic which makes them strong. Screws pass through the four holes which hold the sides at each corner firmly together.

SCAN FITTINGS:

These are strong enough to be either permanent or temporary joints. The cylinder is inserted into the first side of a cabinet in a pre-drilled hole. The screw is then pushed through the hole in the second side until it meets the cylinder. It can then be tightened with a screwdriver until both sides of the cabinet pull together.

TWO BLOCK FITTING (LOK-JOINTS): These are made from plastic. A bolt passes through the first fitting into the thread of the second. As the bolt is tightened it draws the two fittings together. The pins help keep the fitting straight. This gives a very strong joint and it can be dismantled using a screwdriver.

CAM LOCKS: The disk fits into a recess in the first side of the cabinet. It rotates by inserting a screwdriver into the slot in its side. The shaft is screwed into the second side of the cabinet. The collar of the shaft is passed through the hole in the second slot in the disk. When the disk rotates the shaft is locked in position. This keeps both sides of the cabinet locked together.

ACTIVITY

Sketch one of the knock-down fittings above and explain how it is used. Look at a kitchen unit or similar unit and examine the knock-down fittings that have been used to fix it together. Sketch the fitting and explain how it works.

The table plate

A traditional table is fixed permanently together using mortise and tenon joints. These joints are strong but have a disadvantage - they cannot be used for modern ‘knockdown furniture’. Modern furniture is normally flat-packed, this means it is delivered to the home, in pieces, arranged in a flat package. It has to be assembled in the home. Usually instructions are supplied but they can be difficult to follow. The ‘table plate’ fitting is ideal for this type of furniture because it can be set up quite easily with the use of a
The diagram shows a typical table which has been permanently fixed together using mortise and tenon joints. The highlighted area shows an alternative way of fixing the parts together, using a table plate.

**ACTIVITY**
1. Draw a typical mortise and tenon joint and explain when this type of joint should be used.
2. Draw a knockdown fitting that can be used to replace traditional mortise and tenon joints. Describe the circumstances when a knockdown fitting should be used.

**Joining wood 2: frame joints**

Strong, permanent and neat-looking joints in timber are achieved using one of the many types of **frame joint** - so called because right-angled jointed frames are common in furniture, boxes and many other types of assembly.

**Simple frame joints**

The simplest frame joint is a **butt joint**. It is easy to make, but weak. You can strengthen a butt joint by fixing a reinforcing plate over the joint.

A butt joint can also be strengthened by gluing dowel into both parts - making a **dowelled joint**. Dowelled joints are good for joining man-made boards (modified timbers) which might split easily if screwed or nailed.

**Corner halving joints** are stronger than butt joints, as there is more contact for gluing, and the **shoulder**\(^{39}\) gives extra mechanical strength. **Through housing joints** are used for shelves.

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\(^{39}\) **Shoulder**: flat surface at right angles to the projecting in a joint.
More complex frame joints

**Mortise and tenon** joints, though more difficult to cut, are very strong, because of the shoulders. If your joint is close to the end of a piece of wood, use a haunched\(^{40}\) mortise and tenon joint.

**Dovetail joints** are very strong and look good - but are complex and difficult to cut. They are often used in high-quality furniture.

**Comb or box joints** are easier to make - especially by machine - and offer good contact for gluing. They are often used in wooden boxes.

**Edging**
When pieces of wood are joined along their edges, the joint may need to be supported in some way to reinforce or make it look neater. Sometimes a strip of wood is glued or pinned over the joint, called lipping. Sometimes - e.g. with floorboards or timber cladding - a thin strip projecting from one edge slots into a slot in the other edge. This is called a tongue and groove joint.

**Joining metal**
As with wood, there are many ways of joining metal permanently. The method used will depend on the function of the product, the strength needed and the quality of the product.

**Brazing and soldering**
Brazing is a way of bonding materials (usually metals) by melting a filler metal or alloy between the components you want to join. The filler metals used in brazing usually have melting points between 450°C and 1000°C, but must have a lower melting point than the material being joined. Brazing forms very strong, permanent joints.

Soldering is a type of brazing which works at lower temperatures. **Soft soldering** is used to make permanent joints between copper, brass, tinplate or light steelwork, and is the normal way of joining electronic circuit components. Soft solder melts at about 200°C. The solder flows into the heated metal along the joint, distributes itself by capillary action, and grips the two

\(^{40}\) **Haunched**: with a reduced projecting part or tenon.
pieces together when it all cools. **Hard solder** melts at 625°C, and is used for stronger joints.

**Welding**

Welding is different from soldering in that the two pieces of metal are themselves melted along the joints, fusing together as they cool. In **oxy-acetylene welding** a very hot flame is used. In **electric arc welding** a spark is used to heat the metal. In both processes a **filler rod** may used as well to get a really strong joint.

**Machine screws and rivets**

**Machine screws** are special screws for joining metal components, which unlike wood screws do not have a tapering core (like bolts, but smaller). Machine screws have to go into a pre-drilled hole in the component which is the right size and which has the correct internal thread.

**Rivets** are components used for joining metal (and sometimes plastics and plywood). A hole is drilled through both pieces of work, the rivet placed through it, and its end beaten into a dome. A tool called a **rivet set** or **rivet snap** is used to finish the joint off neatly. Some rivets are **countersunk**.

With most rivets you need to get at both sides of the work to make the joint. **Pop rivets** enable you to complete the joint while only having access to one side of the work. They are usually used for joining thin sheets together.

**Joining plastics**

Plastic products are often moulded so they just snap together. If you have to make permanent joint, a specialist **adhesive** is often the best choice.

**Plastic adhesives**

- **Plastic weld** is a multi-purpose plastic adhesive that joins most types of plastics (do not use it in on foamed plastics).
- **Tensol 12** is good for acrylic. It is quick and easy to use. But if spilt it marks the work. It is not very strong.
- **Tensol 70** is much stronger. It is acrylic based. It comes in two parts. It is not easy to use, as it takes 1.5 hours to harden and contracts.

Rivets, nuts, bolts and machine screws can also be used for joining plastics.

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41 **Adhesive**: a substance which bonds the surfaces of materials together.