

Name:

Date:

Year 7

Knowledge organiser 1: Resistant Materials

There are many different tools for marking out timber:

- pencil - the most popular, can go blunt with use and needs to be kept sharp
- marking knife - produces a fine crisp line that can be cut to, will produce many lines on timber before it needs to be sharpened again

Marking tools

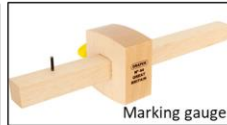
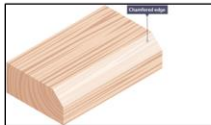
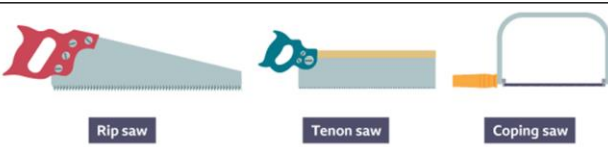
The measuring tools associated with timber are used to measure lengths and angles. The most common tools are:

- ruler - for measuring shorter lengths, widths and thicknesses
- tape measure - for measuring long distances, particularly in the building trade
- try square - for marking out angles that are 90 degrees to an edge
- mitre square - for marking out angles that are 45 degrees to an edge
- sliding bevel - to mark an angle that you set to an edge
- marking gauge - to scratch a line that is parallel to an edge
- mortise gauge - to scratch a set of parallel lines to an edge

Tools

There are a great many saws used to cut timber - some suit long straight cuts on thicker planks, and others suit curves and complex shapes:

- rip saw - for 'ripping' through and rough cutting thicker planks and boards
- tenon saw - for cutting straight lines with accuracy
- coping saws, jig saws and scroll saws - all for cutting thinner pieces of timber and they can cope with curves too



Key terms:

Aesthetic Relating to beauty and visual appearance



As well as marking, cutting and drilling, there are other skills to develop to shape timber:

- chiselling** - used to remove timber, usually up to a cut or between two cuts, eg in the production of wooden joints such as dovetails
- planing** - used to smooth the edge of a piece of timber by running a sharp blade in the direction of the grain, or can be used at an angle to produce a chamfered edge
- sanding** - used to achieve a profiled shape or smooth surface finish by removing fine particles, normally the final stage in shaping the timber and done by hand or with a machine (belt, disc or orbital)

Chisels

BEVEL edged chisels are slightly undercut making them easy to push into corners. They are normally used for finishing dovetail joints.

FIRMER chisels have a blade with a rectangular cross-section. This means that they are stronger and can be used for tougher/heavier work.

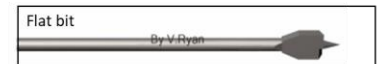
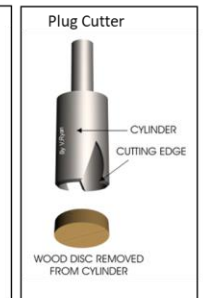
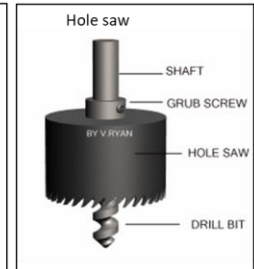
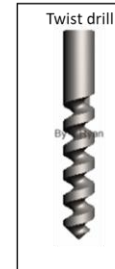
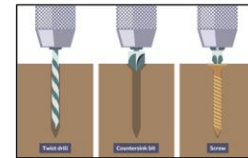
A **PARING** chisel is a longer, thinner chisel which can be pushed into long joints such as housing joints. It is used for cleaning up the joint and to make it an accurate fit.



Drill bits

Timber can also be drilled by using a variety of different drill bits, which work by twisting into a piece of timber:

- twist drills - used to simply drill a hole of a fixed diameter into a piece of timber
- countersink bits - used to profile a hole so that the top of a screw can sit flush with a surface

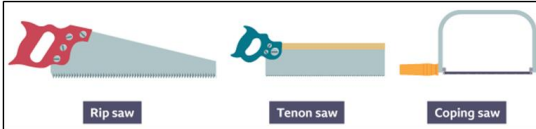


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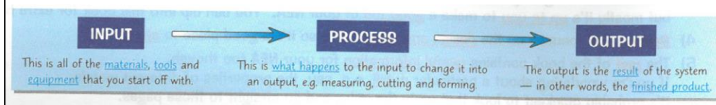
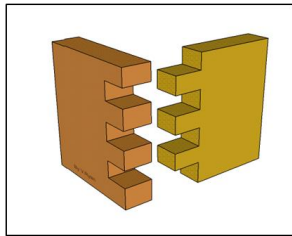
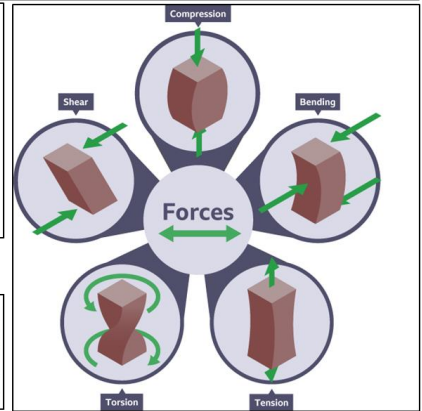


This is a good example of a 'finger' or 'comb' joint. It is ideal for box constructions and is suitable for use with natural woods such as pine and mahogany or even manmade boards such as plywood and MDF. The joint is strong especially when used with a good quality glue such as PVA (woodworkers adhesive) or Cascamite.

Batch production: Where one group of identical products is made at the same time, before moving onto producing the next group.

Forces act on materials all the time - even if a material appears stationary it still has a force acting on it. There are five terms used to describe what type of force can act on a material:

- **tension** - a pulling force
- **compression** - a pushing force
- **bending** - forces at an angle to the material
- **torsion** - a twisting force
- **shear** - forces acting across the material



Assembly line: A series of workers and machines in a factory by which a succession of similar items is progressively assembled.

Compressed: Made smaller by squeezing together.

Safety is Really Important

Power tools are **hand-held motorised tools**. You need to use them **safely**...

- 1) Before using power tools, do a **visual check** for any loose connections and run your **hand** along the **lead** to check for any **cuts** in the insulation (when it's not plugged in, of course). Check that the **blade** or **drill bit** or whatever is attached **correctly** and **tightly**.
- 2) You can use an **RCD (Residual Current Device)** to help prevent **electric shocks**. The power tool **plugs into** the RCD, which you **plug into** the **socket**. If you accidentally **cut through** the **lead** of the power tool, the RCD **cuts off** the electricity supply straight away.
- 3) Wear a **mask** or fit an **extraction hose** if the tool's going to produce a lot of **dust**. Always wear **safety glasses** and make sure **clothing** can't get **caught**.
- 4) **Clamp** your work down **firmly** so it can't **slip** or **move**.
- 5) Make sure you know where the **stop buttons** are **before** you start.
- 6) When you've finished, make sure the tool has **stopped moving** before you put it down.

Working property	Usage example
Strength - how a solid material behaves when stress and strain are applied, eg compressive, tensile and shear strength	Steel is used for cables in suspension bridges as it has high tensile strength to support the weight of the bridge and vehicles
Hardness - ability to withstand indentations (dents) or abrasions (scratches)	A tunnelling drill can be encrusted with synthetic diamonds to ensure it stays sharp while drilling through rocks
Durability - ability to maintain functionality without requiring excessive repair or maintenance	Most plastics are durable - eg acrylonitrile butadiene styrene (ABS) is used to make safety helmets for builders and toy building blocks
Strength to weight ratio - strength divided by its density	Carbon fibre is used to make the bodies of racing cars as it is both lightweight and able to withstand the aerodynamic forces on it in a race
Stiffness - ability to withstand deformation (change in shape) when a force is applied	When constructing a frame of a building, steel will be used for its stiffness, preventing the building from deflecting (moving under the load)
Elasticity - ability to return to original shape after a force is applied	Silicone rubber is often used in swimming caps as it is extremely flexible
Impact resistance (toughness) - ability to withstand a sudden high force or shock	Polycarbonate is used in motorcycle visors for its impact resistance as it will not shatter if hit by a stone when at high speed
Plasticity - ability to be shaped or moulded	When heated, thermoplastics like ABS can be injection moulded into a variety of products

To find out more:
<https://www.bbc.co.uk/bitesize/guides/zh4g4qt/revision/1>

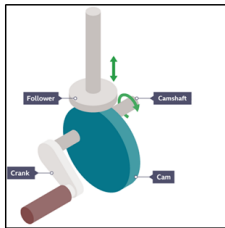
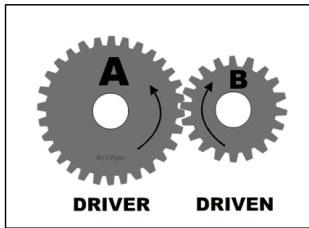
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Physical property	Usage example
Density - amount of matter a material has to its volume	Low-density foams, eg low density polyethylene (LDPE), can be used as low-weight, shock absorbing packaging materials to protect fragile items
Absorbency - ability to retain heat, light or water in a structure	Paper towels are absorbent and are used to soak up liquid spills or dry wet hands
Conductivity - ability of heat (thermal) or an electric charge (electrical) to pass through	Wooden handles are used on saucepans as they are poor thermal (heat) conductors, and copper is used for wires in power cables as they are good electrical conductors
Corrosive resistance - ability to withstand chemicals, water and weather conditions, eg snow	Glass is used in external windows as it maintains its transparency for a long time in most weather conditions
Flammability - ability to ignite (catch on fire) or combust (burn)	Specially engineered ceramics are used in brake pads for high-performance motorbikes as they have low flammability, and can be used in places where high-friction occurs

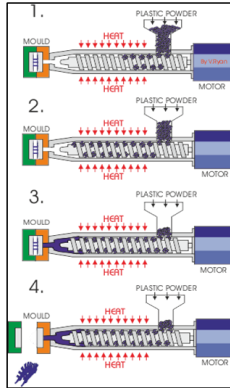


The gears shown below are called spur gears because they mesh together. Gear 'A' is called the 'driver' because this is turned by a motor. As gear 'A' turns it meshes with gear 'B' and it begins to turn as well. Gear 'B' is called the 'driven' gear.

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Injection moulding



Injection moulding

Injection moulding is used in industry to produce most **mass-produced** polymer parts using the following process:

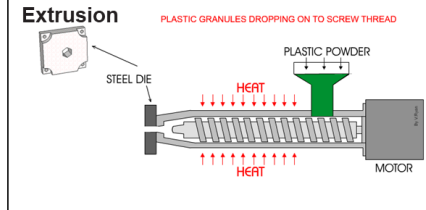
1. granular plastic is held in a hopper
2. it is moved via an **Archimedeian screw** along a heated tube, called the heating chamber
3. once the polymer has been melted, it is pushed **into a mould** with a **hydraulic ram** - the use of the hydraulic ram ensures just enough material is injected into the mould each time
4. the mould is then cooled so that the moulded plastic can be removed

Extrusion

Extrusion works in a very similar way to injection moulding:

1. granular plastic is held in a hopper
2. it is moved by Archimedeian screw along a heated tube, called the heating chamber
3. once the polymer has been melted it is pushed **through a die mould**, which will form the shape of the extrusion
4. because there is no hydraulic ram in this process, molten plastic can be fed through the die continuously

Extrusion



Thermosetting: Also called 'thermoset'. Can only be formed once as it cannot be reheated and therefore cannot be recycled.

Thermofforming: Also called 'thermoplastic'. Can be reformed when heated, and therefore can often be recycled.

Scales of production

Prototype and one-off production

In one-off production an individual item is designed and made to meet a client's specification. At this level both time and material costs are high, and a high level of design and manufacturing skills is required. An example of a one-off product is a specialist powered wheelchair for a user with specific disabilities, which may require skills like the **soldering** of switches to allow for operation of the controls for specific movements.

Batch production

Batch production is where many items of the same product are produced. It will involve the use of some **automation** to reduce labour costs and will require the design engineer to consider how materials can be used efficiently and how samples can be tested to ensure quality. An example of a batch produced product would be the **etching** of a printed circuit board (PCB) for a small team of specialist racing drones.

Mass production

Manufacturing in huge numbers is categorised as mass production. This level of production involves standardised production methods, **production lines** and the extensive use of automation. Because of the high set-up costs, mass production systems tend to be inflexible. An example of a mass produced item would be a polyethylene terephthalate (PET) drinks bottle made using a blow moulding system.