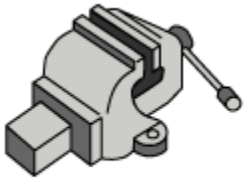
Shaping processes

Holding work and using jigs

Any piece of wood, metal or plastic that you are working on is called your *work*. Any part of something you are making, which has to be joined to another part or parts, is called a *component*.

When you are working on a piece of wood, metal or plastic, you need to stop it moving. You can hold it up against something solid and grip it with friction by using a vice or stop.



Vice

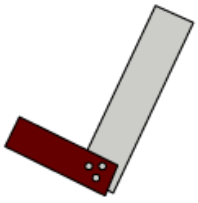
If you have to make lots of identical things, use a jig. This device for holding work is made specifically to suit a single component. Using jigs saves having to mark out each piece of work separately before cutting or drilling. The jig holds your piece of wood (or metal, plastic) in exactly the right place for drilling or sawing. Sometimes a jig is called a fixture.

Activity

Find the jigs in your school workshop. Ask the teacher to show you any jigs they use.

Marking out and templates

Wood is marked out with a try-square and marking knife or sharp pencil. You should always mark out from an edge that you have planed up square. Use a marking gauge to mark out parallel lines.



Try-square

Mark out metal for cutting with an engineer's square, scriber, odd leg callipers, spring dividers or a drawing compass.

For marking out acrylic use a semi-permanent marker or waxy crayon.

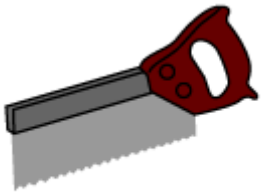
Mark holes for drilling with a punch.

If you have lots of identical things to mark out, use a template so you only have to measure once.

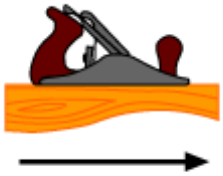
Wasting (by hand)

Wasting is getting the shape you want by removing the bits you don't want. You can use hand tools, or machinery. The most common hand tools for wasting are:

- saws
- planes
- chisels
- drills
- tin snips.



Saw



Plane

Tin snips

Wasting (by machine)

There are three main types of machine for shaping materials by wasting:

- lathes
- milling machines
- drills.

Lathes

The centre lathe spins the work around and a tool or cutter is brought up to it. The process is called *turning*.

- Parallel turning produces cylindrical forms.
- Facing produces a flat surface.
- You can also use a centre lathe can to cut a screw or a thread.

Some centre lathes are controlled by a computer. This gives greater accuracy and enables boring, repetitive work to be done by machine. A system

controlled by someone typing figures into a computer is called a computer numerically controlled (CNC) system.

You can use a wood turning lathe for turning a spindle or making a bowl. Again, the work spins round and you shape the wood with a chisel.

Milling machines

In a milling machine or mill the cutter spins round, and you move the work past it. There are horizontal mills and vertical mills. CNC milling machines are widely used in industry.

Drills

- You use the pillar drill for drilling accurate holes. Many factories use multi-axis machines. These might have a selection of cutters and drills that can be used in turn, so that the work can be shaped in a number of ways in one machine. Usually these are controlled by computers. This is called computer aided manufacturing (CAM). If this is linked to computer aided designing (CAD), the whole system is called CAD/CAM.

Additional methods of wasting metals:

- Eroding: Very accurate wasting can be done through spark erosion. This is also suitable for wasting very hard metals.
- Ultrasonic machining: Very accurate and suitable for very hard materials such as glass, ceramics and precious stone.

Forming, deforming and reforming processes

You may not have met many of these processes in the school workshop. Ask your teachers if they have any videos showing these processes being used in industry.

- **Forming** means shaping a material.
- **Deforming** means bringing about a change of shape without loss of material.
- **Reforming** involves a change of state of the material (usually from liquid to solid) as in casting.

Many of these processes below are used in manufacturing processes. See how many you know. To check out the key facts for these processes look at the Revision Bite**:** *Forming, deforming and reforming processes*.

Moulding	Calendering
Blow moulding	Drop forging
Injection moulding	Presswork
Rotational moulding	Extrusion
Cold forming of metal	Hot forming of metal
Casting	Die casting
Laminating	Sheet metalwork

Computer controlled manufacturing

We have already mentioned CNC lathes and mills, and CAD/CAM systems.

Computer aided engineering is a general name for using computers in designing and manufacturing. CAD systems both save time and allow great accuracy. They also allow the designer to model a product (to see what it looks like) or run a computer simulation of a process. This can prevent costly mistakes. CAD/CAM systems allow a direct transfer from the design of a product to the machinery used to make the product.

Computers can also be used to control robots. Robots are used for handling materials, moving them about to different machines, and to perform dangerous or repetitive tasks such as welding large numbers of components.

The term flexible manufacturing system (FMS) refers to complex production processes, controlled by computers, which allow the same machines to be used for different jobs at different times. This is particularly useful when a limited number of the product is required, before the machinery is switched to producing another product.

The term computer integrated systems (CIS) refers to a whole automated production system which is controlled by computers.

Further things to do

It is useful for exams to describe the equipment and processes you used in your project. Can you do this? Do you know the names of all the tools?
Before you hand in your project portfolio, create a sheet describing each stage of manufacture. Fill in a table using the headings below.

Stage of making	Tools, equipment, process used	Reason for choice