

Material removal

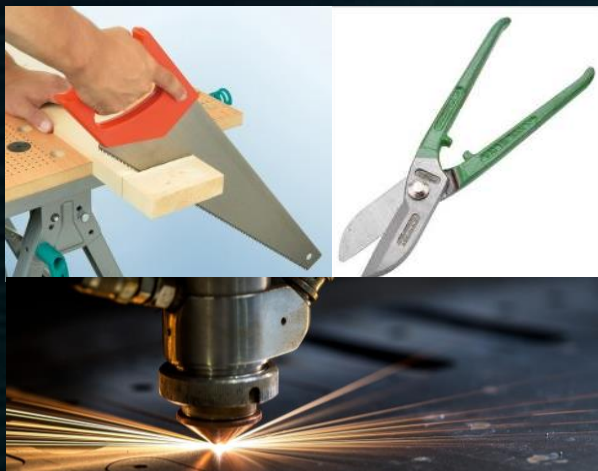
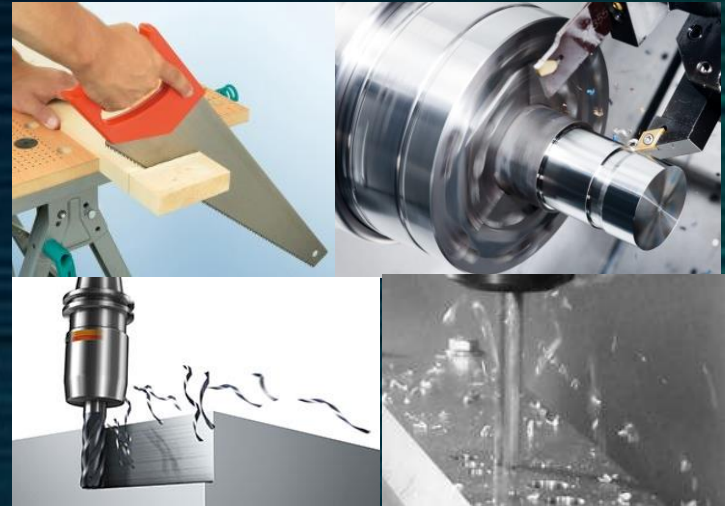
SECTION 2.2

What is Material removal?

This is a process whereby material is removed from a larger block of material to produce the shape of a product.

Material can be removed by:

- Cutting
- Turning
- Milling
- Drilling
- Chemical etching



Cutting

Cutting is a process used to reduce the length of a piece of material.

Different types of cutting processes are:

- Sawing
- Shearing
- Laser cutting

Other industrial include:

- Thermal cutting
- Abrasive water jet

Sawing

Sawing is a process of movement progressively cutting away material. Each saw tooth with cut a small groove into a material it moves against.

The saw teeth are angled slightly out from the blade so this will cut a groove slightly wider than the saw blade reducing friction.

Saw dust is removed from the cut as the saw emerges from the edges of the material, this needs to happen in order for the saw to cut.

Different types of saws have different sizes of teeth allowing different materials to be cut i.e. Small teeth – cutting metals, Large teeth – cutting softer materials like timbers.

Example saws

Junior hacksaw



Hacksaw



Coping saw



Tenon saw



Rip saw



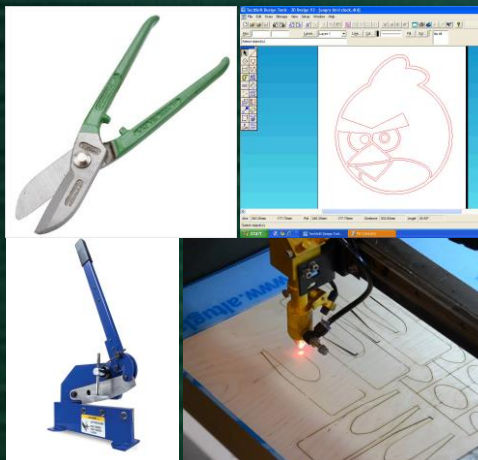
Jigsaw



Shearing

This process involves applying a force to both sides of a material, this then causes the material to separate between the two points. The force needed is determined by the thickness and strength of material.

Tin snips and bench shears are used to cut thin sheets with Guillotines used to cut thicker sheets.



Laser cutting

This process involves using a beam of light to vaporise material. The material to be vaporised is determined by a CAD drawing, the laser follows the line on the drawing and can be used to cut thin sheets of wood, plastic and metal. The vaporised material is then sucked from the machine via ventilation.

The main issue with laser cutting is that it is an expensive form of cutting but it is very flexible and accurate to make a number of small parts.

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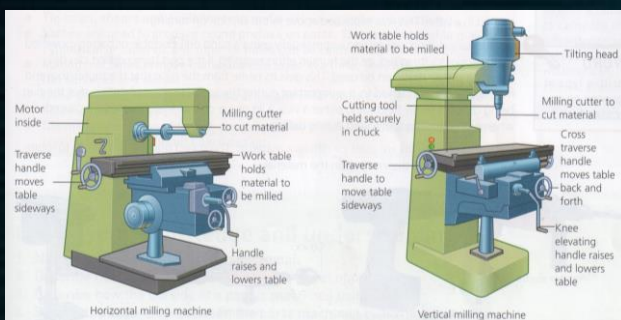
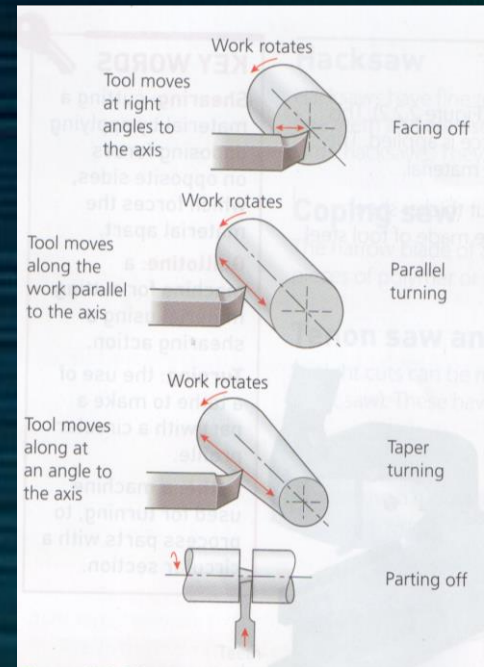
Turning

This is a process involves using a machine to make parts round, in this process the material moves and the cutter remains still. The cutting tool then passes across the material removing material. The cutting tool needs to be set to the correct height so that it cuts efficiently.

The process that can be completed using a lathe are:

- Facing off – late used to make the face flat (90 degrees to edge)
- Cylindrical turning – Removes material creating the same diameter all the way along the material.
- Taper turning – Removes material at an angle
- Drilling and boring – Used to make holes in the material.

CNC lathes are controlled by a computer which has been programmed to perform a number of processes (Taper, facing off, drilling and parting)..



Milling

This is a process uses a rotating tool to remove metal one layer at a time. These can be used to make a piece of material flat or to create a slot in a piece of material. This can be done from the edge of the material or by plunging it into the material and then moving it along (this will leave a circular end). There are two types of Milling machines, Vertical and horizontal milling machines.

Drilling

This is a process involves using a rotary tools to progressively remove material.

This process started out as a hand drilling process but now the process is completed using a pillar drill, hand held electric or battery drill.

When drilling the material needs to be clamped down to stop it from rotating and causing injury and the speed of rotation of a drill needs to be set depending on the material you are drilling.

Drills

Portable electric drill



Cordless rechargeable drill



Hand held drill



Pillar drill



Chemical etching

Chemical etching

This is a process involves using chemicals to remove material from a board. PCBs are often made using this process.

Photo etching is one way that this process can be completed using a material coated with a light sensitive film on top of a copper coated board.

- A mask is made using acetate of a PCB design
- Mask placed over copper board ready to be exposed to ultra violet light
- Board exposed to light, mask stops light from reaching parts of the board.
- Mask removed, board placed in photo developer
- Board placed in chemical bath – chemical eats away exposed bits of board
- Board rinsed with water, chemical etching completed.

Material removal

Explain how the process of sawing removes material

Name two types of saw used to cut metal

1,

2,

Explain how shearing can separate material

Describe how a laser produces a cut in a sheet of polymer

Name and describe the four actions that can be completed on a Lathe

1, _____

2, _____

3, _____

4, _____

Describe how the outside of a part is machined using a lathe

Explain the difference between milling and turning

Other than on a lathe, name two other ways of drilling

1,

2,
