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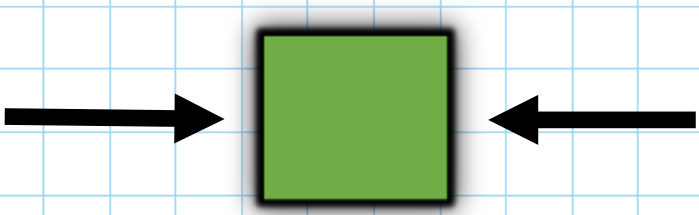
MOBILE REVISION

CNC – CAM – CAD – 3D PRINTING
LASER CUTTERS – VINYL CUTTERS

This mobile revision pdf is based on detailed work found in the 'CNC' section. Tap on the green link button below to go to the complete website section



Tap the blue button to view CAD/CAM covered by this Revision PDF

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CAD and CAM

1. CAD – COMPUTER AIDED DESIGN

2. WHAT IS CNC / CAM?

3. ADVANTAGES OF CAD AND CAM

4. MANUFACTURE OF PRINTED CIRCUIT BOARDS BY CNC/CAM MACHINES

5. 3D PRINTING

6. LASER CUTTERS, STEREOLITHOGRAPHY AND LASER SINTERING

7. VINYL CUTTERS

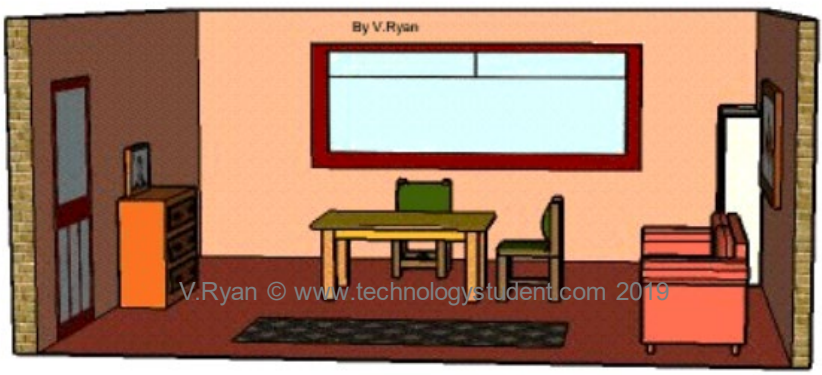
8. WATER JET CUTTERS

9. CNC CENTRES

COMPUTER GENERATED MODELS (CAD)

The model below has been generated using CAD (Computer Aided Design) software. The furniture has been drawn individually and placed inside the computer generated room. The room can be rotated to almost every possible angle. This design can be shown to potential customers or a client and changes made according to his/her likes and dislikes. This saves time and money as the model can be altered using the software which is far more efficient than making a real model using materials.

Tap the image for more information and examples



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COMPUTER GENERATED MODELS (CAD)

CAD plays an important role in the design and manufacturing process. Designing usually starts with sketches, simple models and CAD AND then leads to the manufacture of the product, as seen below.

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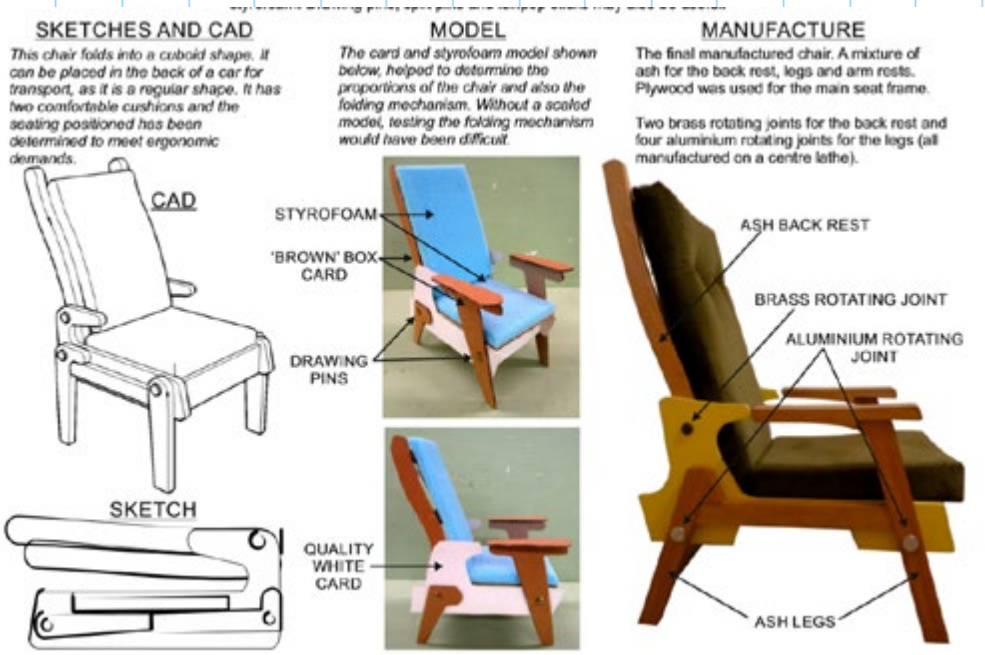

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WHAT DOES CNC and CAM MEAN?

CNC means 'Computer Numerical Control'.
CAM means 'Computer Aided Design'.

This means a computer converts the design produced by Computer Aided Design software (CAD), into numbers. The numbers can be considered to be the coordinates of a graph and they control the movement of the cutter. In this way the computer controls the cutting and shaping of the material.

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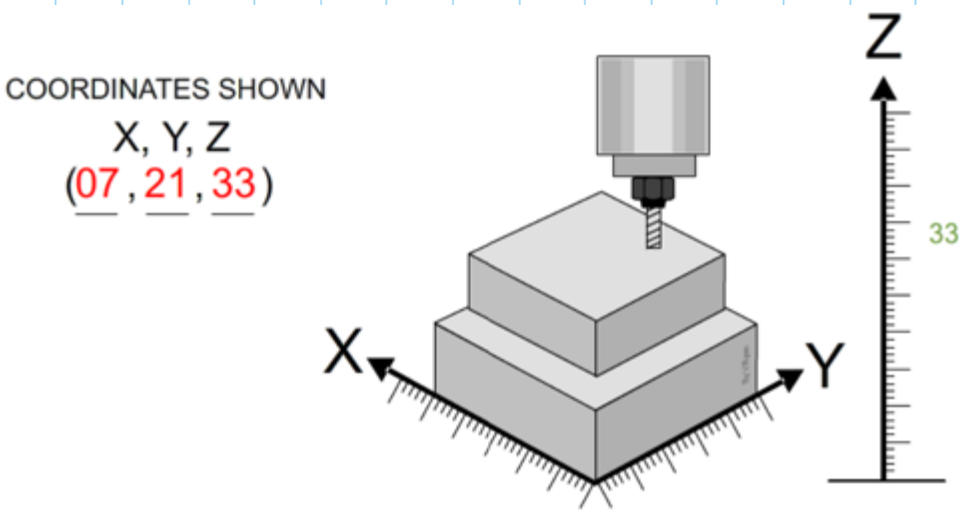

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FROM CAD TO MANUFACTURE ON A CNC/CAM MACHINE

CAD software such as AutoCAD or even Sketchup, allows the designer to create a 3D model. The model is then converted into coordinates, ready for manufacture on a CNC Router or a 3D printer. This type of machine allows the manufacture of 3D products/items. 2D products / items are often manufactured by a laser cutter.

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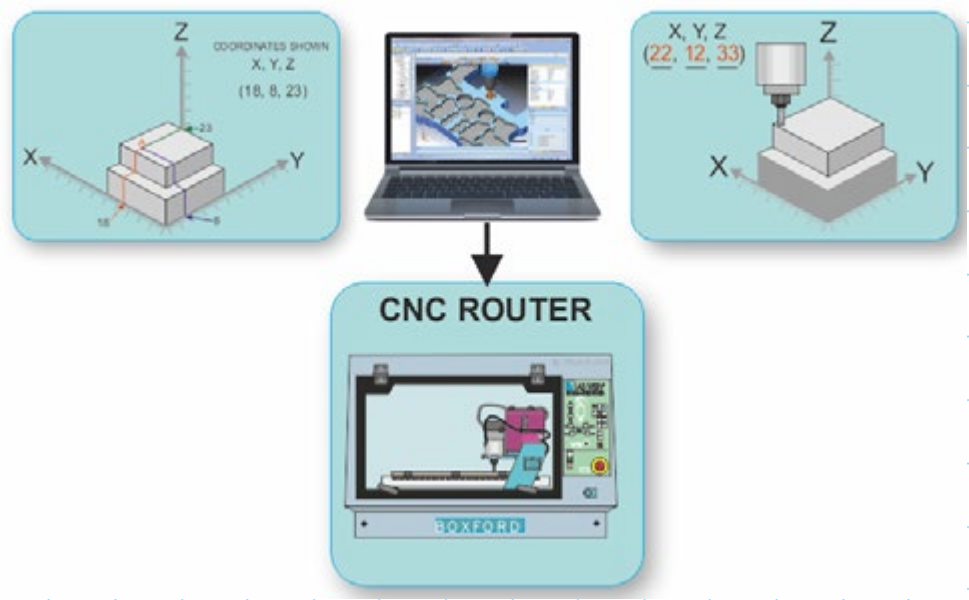

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ADVANTAGES CAD

CAD designs can be changed / updated continuously, with ease, unlike hand drawn designs.

3D CAD designs can be shown to clients, from every possible angle, helping the design process.

CAD saves time and money as the model can be altered using the software, which is far more efficient than making a real model using materials.

A product can often be simulated by CAD, on the computer screen. before manufacture.

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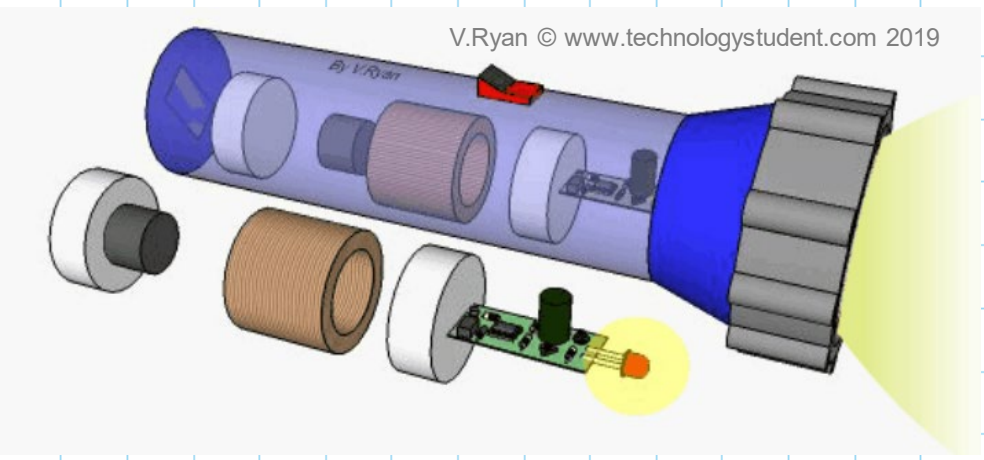

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ADVANTAGES CAM

CNC / CAM machines can be used continuously 24 hours a day, 365 days a year and only need to be switched off for occasional maintenance.

A design can then be manufactured hundreds or even thousands of times. Each manufactured product will be exactly the same.

One person can supervise many CNC machines.

Less skilled/trained people can operate CNCs / CAM machines.

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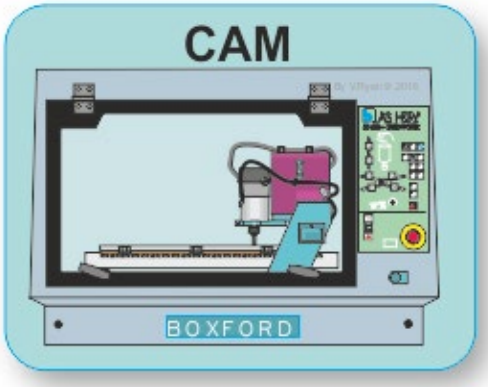

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MANUFACTURE OF PRINTED CIRCUIT BOARDS (PCBs) CNC MACHINES

PCBs are normally etched using 'clear etchant' or 'ferric chloride'. These are dangerous chemicals and if contact is made with the skin or especially the eyes, the medical consequences can be serious. Many people, especially in schools, prefer to use software such as Real PCB, to export PCB designs, so that they can be cut to shape on a CNC / CAM router.

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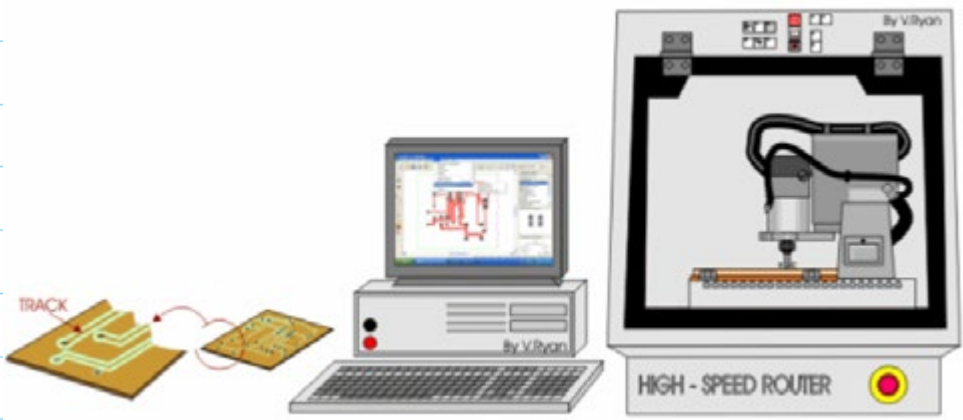

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FILAMENT SPOOL 3D PRINTERS

3D printing is already important as an industrial process, in the production of some tools, textiles, toys, jewellery and a range of components. The technology also has been used in the medical world, in the manufacture of custom made prosthetic limbs and hearing aids. It even has a practical application in the world of dentistry. Research has been taking place for several years on 'bioprinters'. These are complex 3D printers, capable of printing bio-structures, used in surgery.

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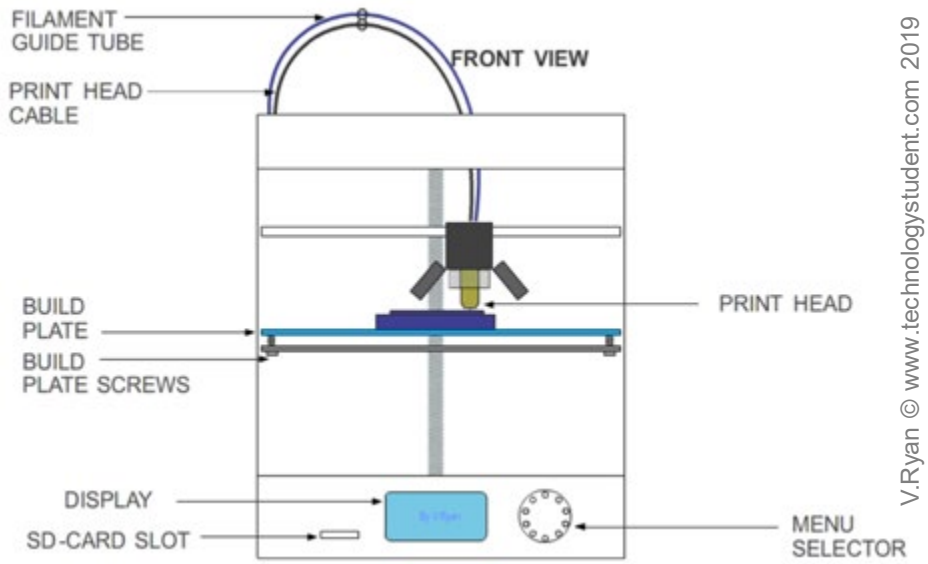

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HOW FILAMENT SPOOL 3D PRINTERS WORK

3D printers construct a ‘model’ by building up layer upon layer of PLA, Nylon or ABS, fed from spool, usually at the back of the printer. Each layer is a fraction of a millimetre and building even a small model can take sometime. The PLA / ABS is purchased in the form of filaments on open spools Filaments tend to be 2.85mm diameter (known as 3mm filament), rolled on to a spool. The spool fits on a roller, normally on the back of the 3D printer.

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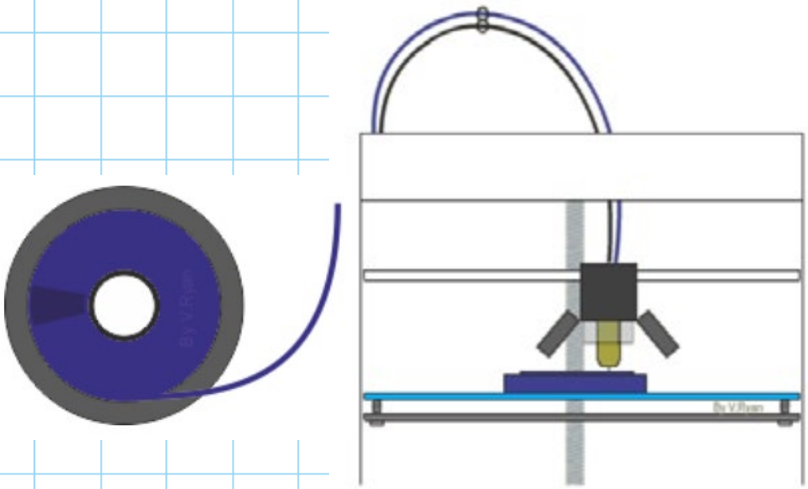

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RAPID PROTOTYPING - THE 3D PRINTER

Industrial 3D printers use a powder and a resin / laser to build a layer at a time. A layer of powder is automatically deposited in the model tray. The print head then applies resin in the shape of the model. The layer dries solid almost immediately. The model tray then moves down the distance of a layer and another layer of power is deposited in position, in the model tray. This sequence occurs one layer at a time until the model is complete.

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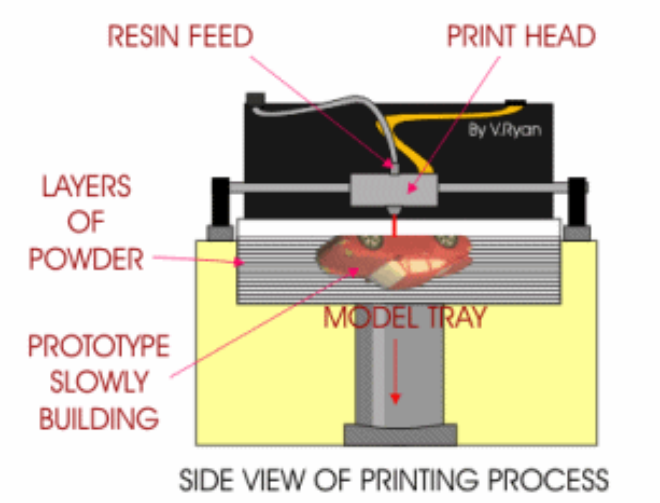

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LINKS TO DETAILED PAGES REGARDING 3D PRINTING

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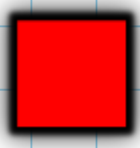
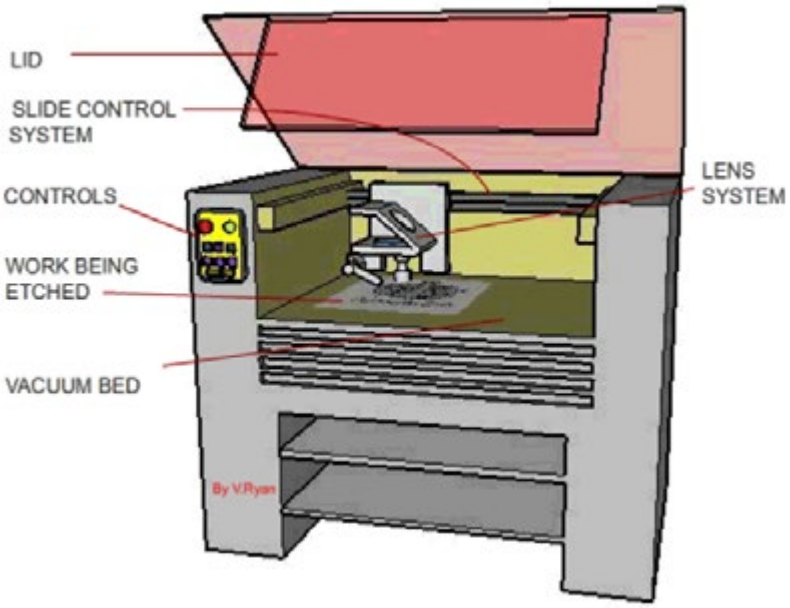


LASER CUTTING / ETCHING MACHINES

Laser cutting / etching machines are quite simple in the way they work. The lens system that controls the position of the laser, is moved by a motorised slide control system. This allows movement in any direction. The control system moves according to the software being used by the machine. The diagram shows the LID open - however, the laser will not operate unless the lid is closed, a safety feature.

Tap the image for more detail.



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HOW A LASER CUTTER WORKS

The laser is focused through a lens system. The position of the lens system is controlled by motors. The laser either cuts through the material or etches its surface. The lens system is controlled by software and follows the design being cut / etched.

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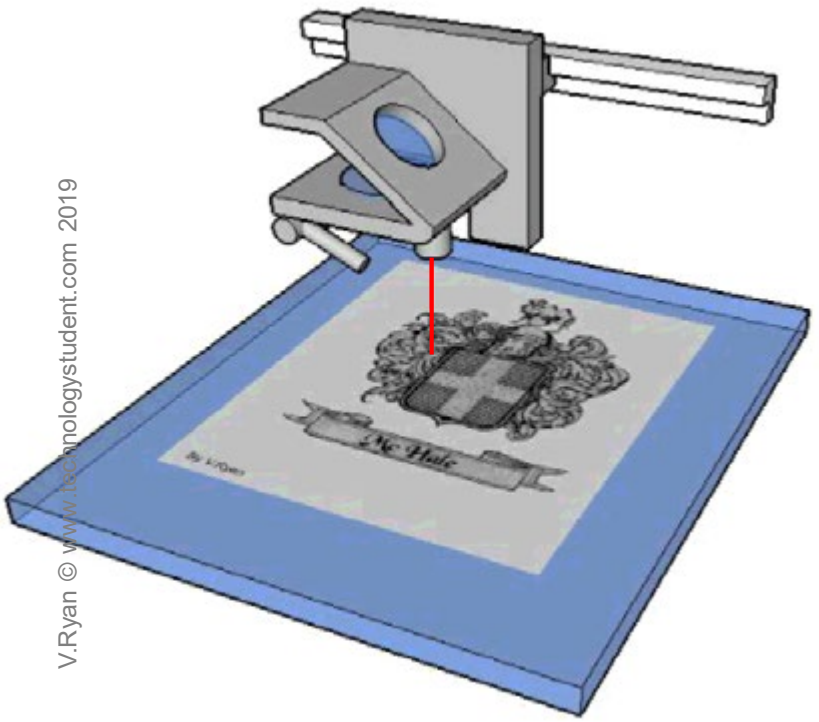

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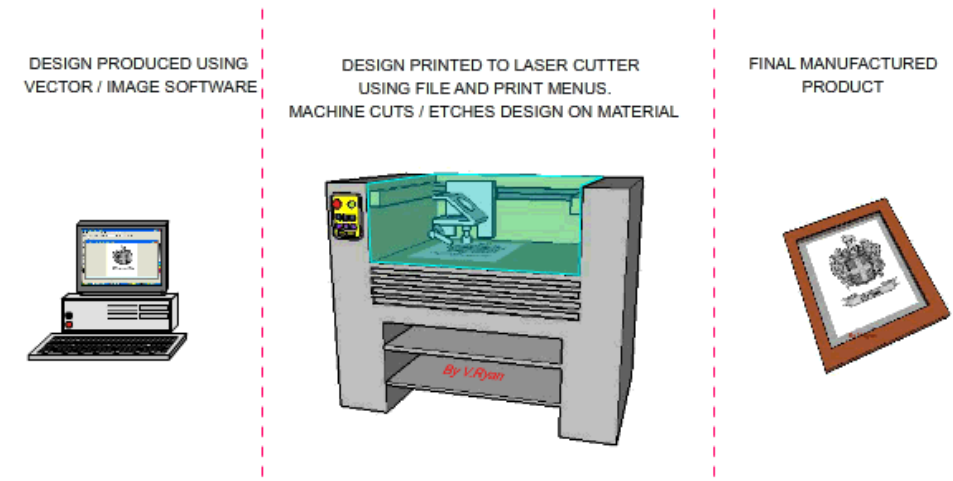
LASER CUTTING / ETCHING MACHINES
FROM DESIGN TO MANUFACTURE

Tap the image for more detail regarding the stages involved in design to laser cutting / etching.



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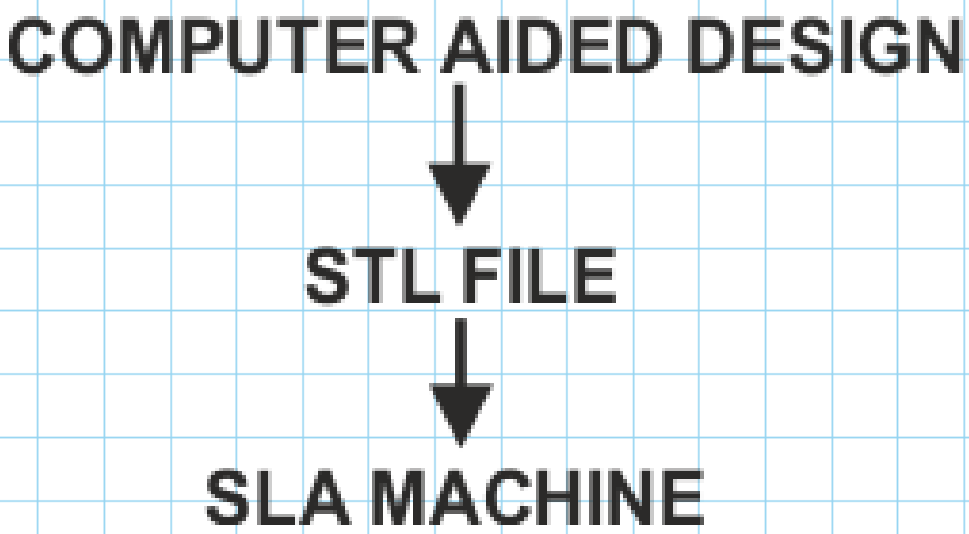
WHAT IS STEREOLITHOGRAPHY?

Stereolithography starts with a design produced through the use of CAD software. The 3D design is exported as a STL file (Standard Tessellation Language). It is this file, that is used to drive the SLA (StereoLithographic Apparatus) machine, which manufactures the product / component.

Tap the image for information / exercise



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HOW STEREOLITHOGRAPHY WORKS

The component is 'built' on a platform, which moves down microns (a micron = one thousandth of a millimetre) at a time. The laser solidifies a layer of resin before the platform moves down, and solidifies the next layer. This process continues until the component is complete.

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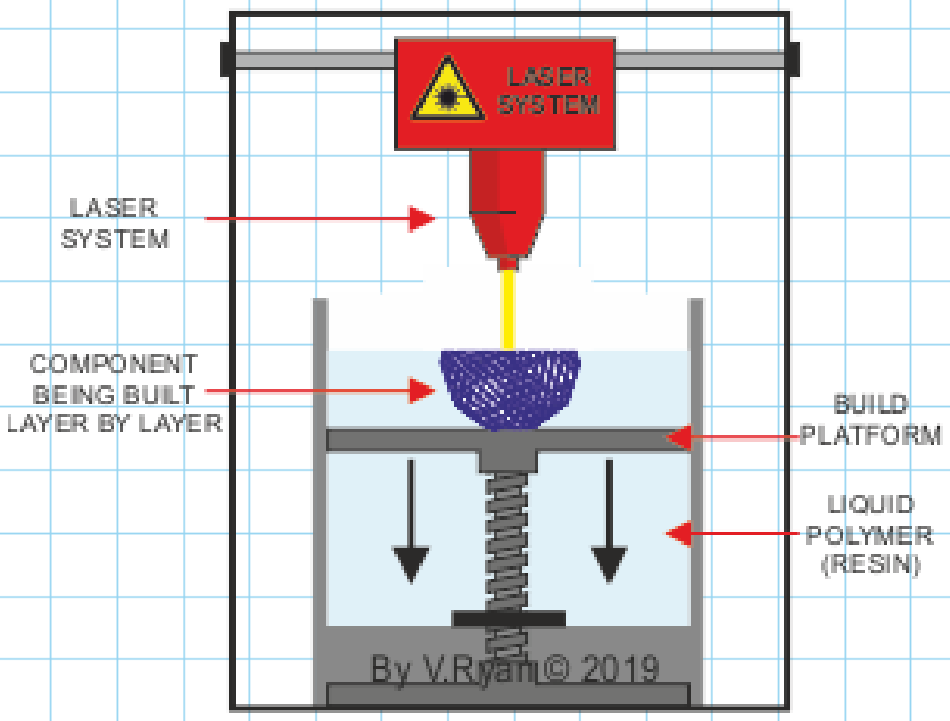

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ADVANTAGES OF STEREOLITHOGRAPHY

Ideal for the manufacture of prototypes.

Efficient use of materials - no waste.

Cost effective for one-offs and low production numbers.

Solid and flexible components / products can be manufactured through this process.

Produces a smooth surface finish.

Can produce clear / transparent or opaque components.

A number of resin based components can be manufactured in the same tank, at the same time.

This process can manufacture products that cannot be manufactured through traditional engineering methods

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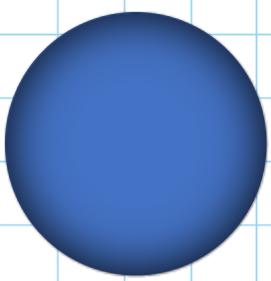

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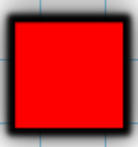

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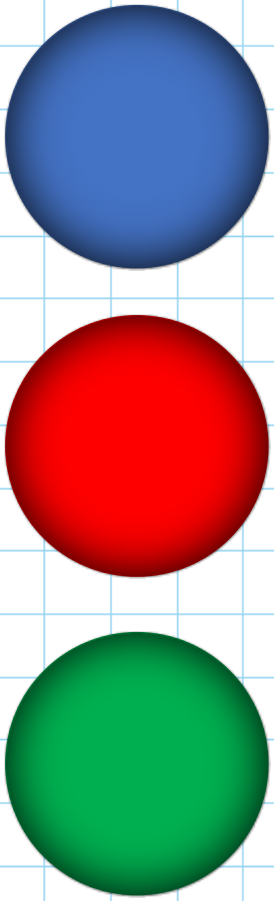
LINKS TO EXERCISES / INFORMATION ON STEREOLITHOGRAPHY

Tap the link buttons for information / exercise



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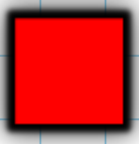

METAL 3D PRINTING - LASER SINTERING

How it works: The feed tank moves upwards by a distance equal to a layer of powder. The slide arm pushes the layer of metal powder from the feed tank and deposits it equally across the build tank. A laser fuses the powder, forming one layer of the product. The build tank drops down the distance of another layer. This process is repeated continually, until the 3D product is complete

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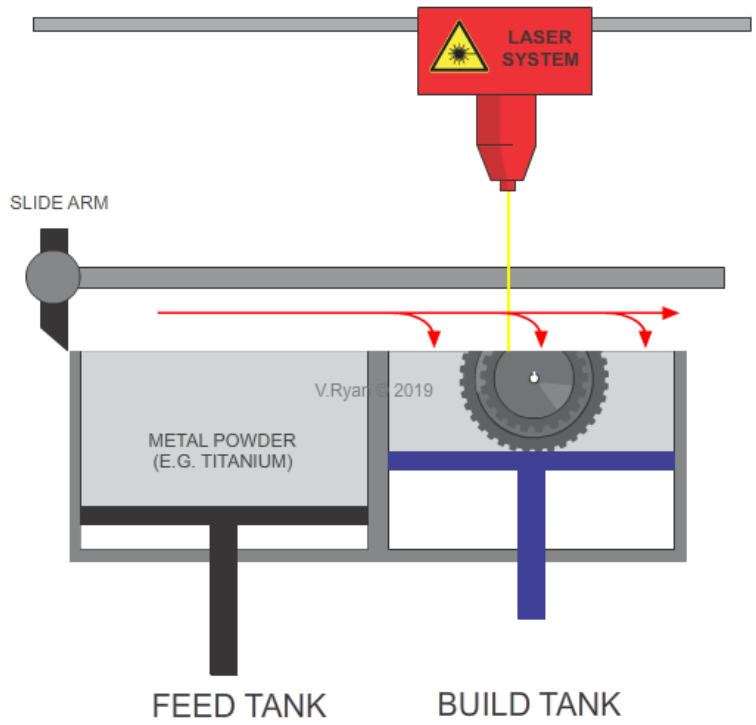

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METAL LASER SINTERED COMPONENTS

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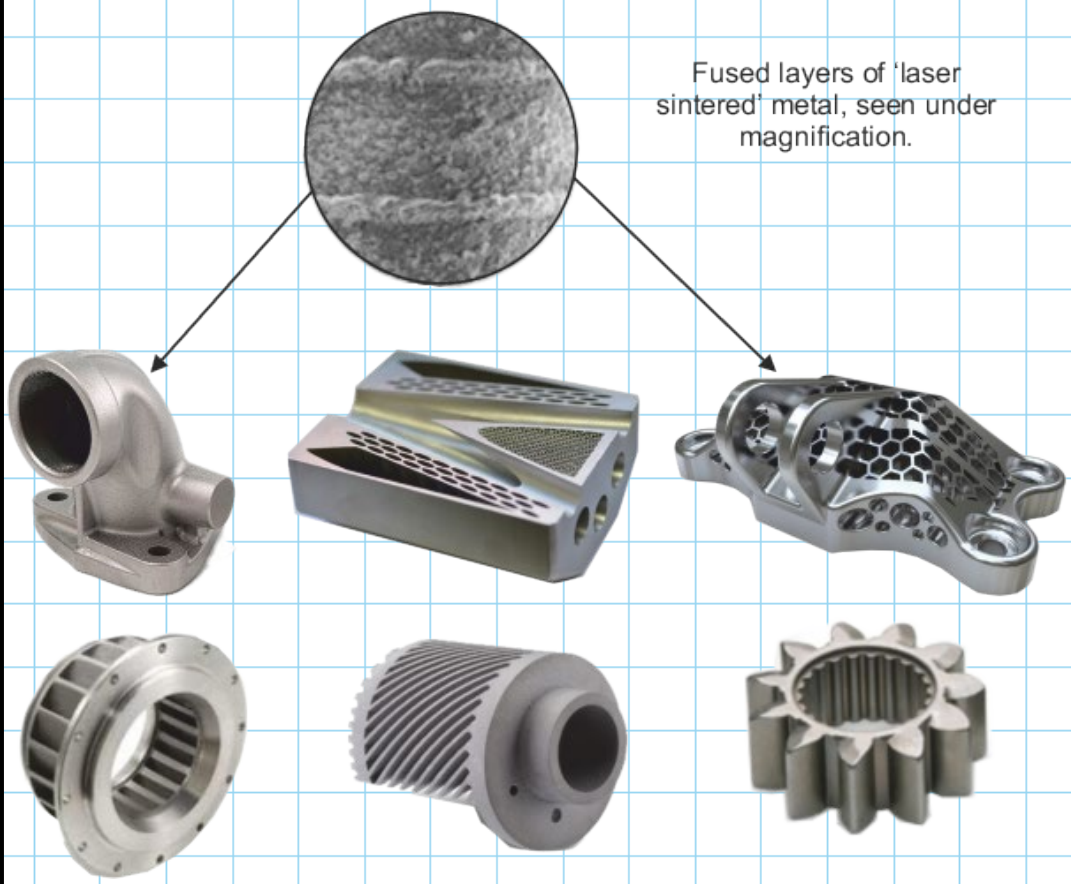

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ADVANTAGES OF LASER SINTERING

An STL file can be processed and exported for manufacturing, direct from a computer.

No need to manufacture a complex and expensive mould.

Capable of manufacturing extremely complex designs / components, not capable of being manufactured in any other way.

A self contained manufacturing process.

Ideal for final prototyping and one-off or short batch manufacture.

Does not require continual supervision by a skilled technician / engineer.

The design does not require the addition of supporting parts, as the powder supports the layers as they are produced.

A wide range of metal powders are available and can be used with this industrial process.

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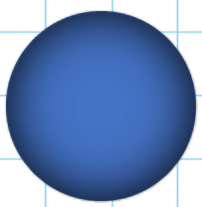

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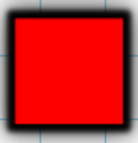

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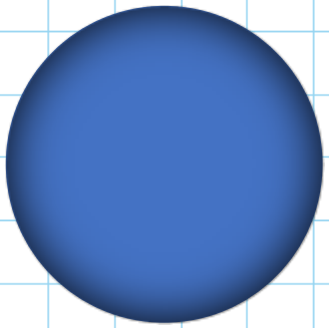
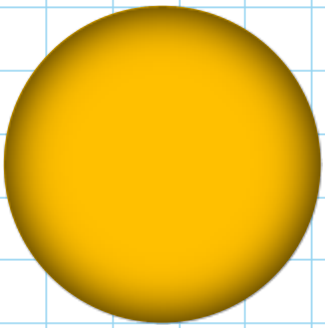
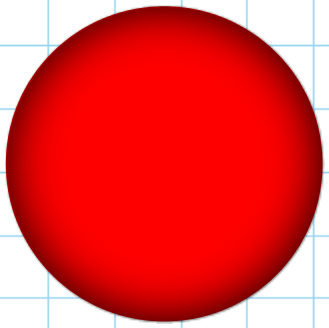
LINKS TO EXERCISES / INFORMATION ON LASER SINTERING

Tap the link buttons for information / exercises







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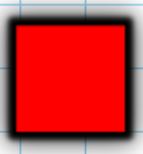
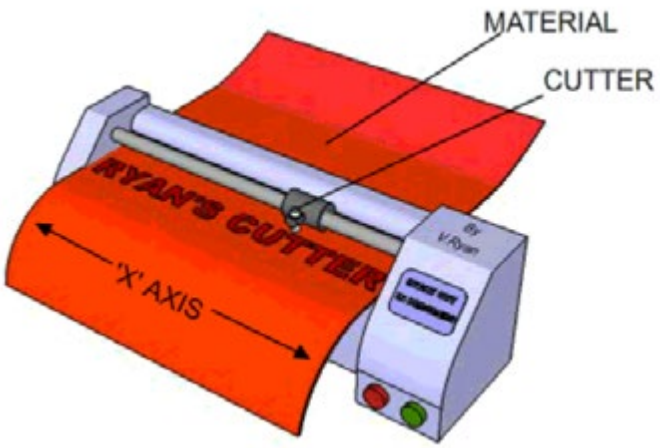


VINYL CUTTERS

These are used for cutting out adhesive backed lettering for signs and logos and other shapes (the material is often called 'sticky backed vinyl'). However, larger versions can be used to cut out nets / developments from a range of card. The small hardened steel cutter is held firmly in a tool holder. The tool holder moves up and down a slide, following the design. The paper/adhesive laminate is fed into the machine automatically. As the tool holder moves the cutting tool is pressed into the material, cutting the desired shape

Tap the image for more detail.



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VINYL CUTTERS

Tap the LINK BUTTONS for more information and exercises on vinyl cutters.

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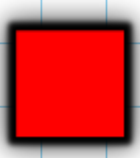

WATER JET CUTTERS

Water jet cutters are used, for the precise cutting and shaping of a range of materials. Water is focussed, to a narrow beam of high pressure water. The jet of water, can cut and shape soft materials such as rubber. If a fine abrasive material, such as sand, aluminium oxide or granite are added, highly resistant materials including steel and ceramics, can be cut and shaped.

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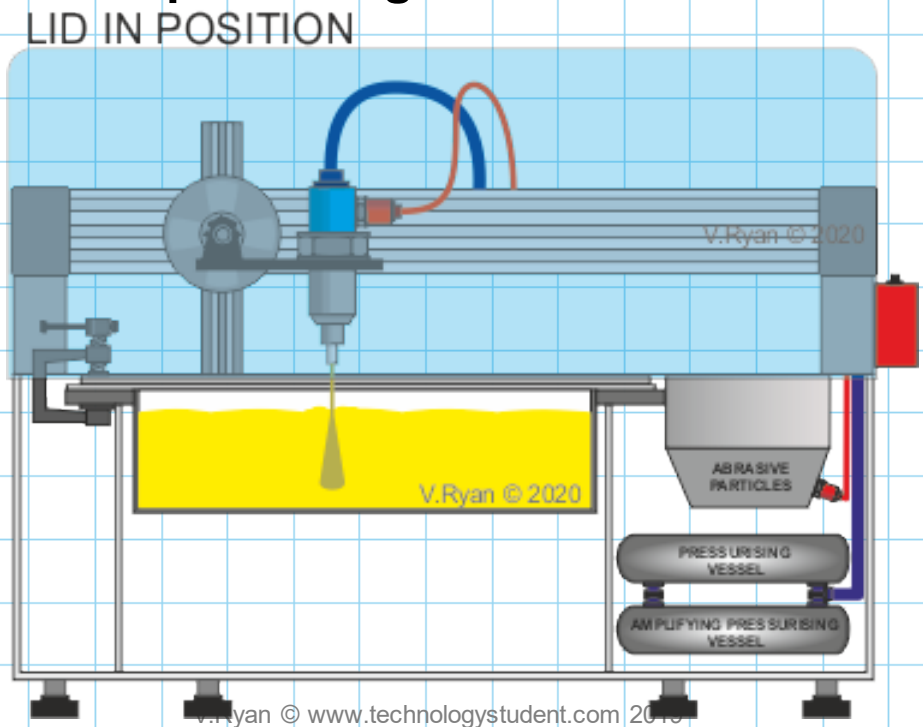

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WATER JET CUTTERS

The nozzle is a complex piece of engineering. It typically needs changing every 500 hours, although this varies, depending on the pressure of the water / particle mix, the material being cut and the speed of movement. The main parts of the nozzle are manufactured from tungsten carbide.

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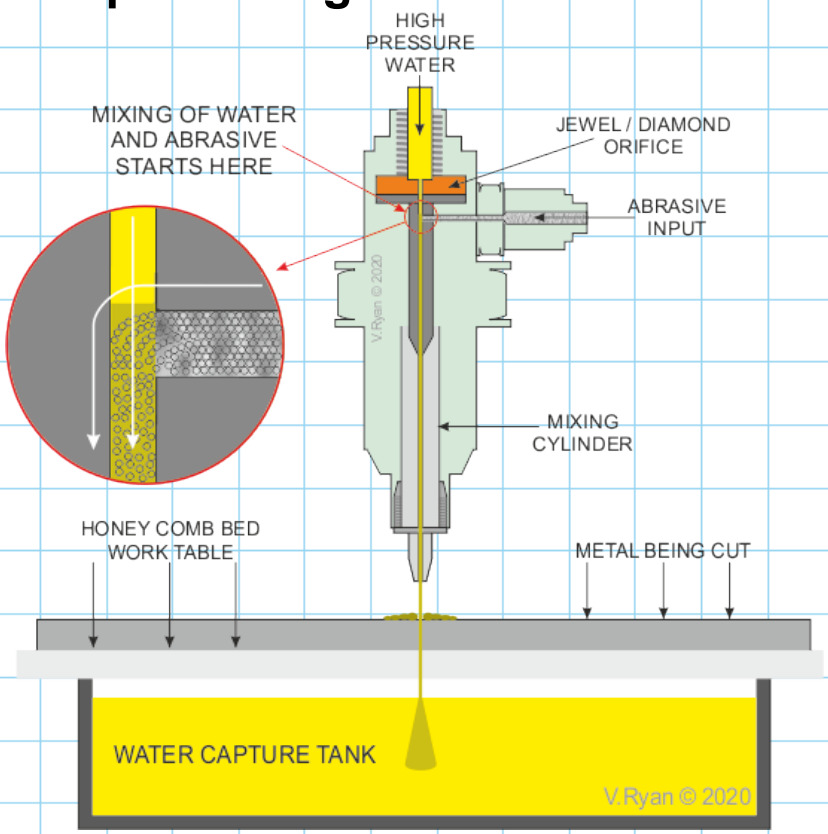

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ADVANTAGES OF WATER JET CUTTERS

This type of cutter can cut and shape a large range of materials accurately.

The water and abrasive 'grit' are captured and recycled for further use.

The material being cut, does not distort due to the effects of heat, as it would on other types of cutter.

Tap the image for more detail.

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INTRODUCTION TO THE CNC TURNING CENTRE

A CNC Turning Centre is a complex machine, capable of lathe and milling processes. It is computer controlled with designs starting on CAD software, which are exported as CAM files. These files are used to drive the motors of the turret tool post, chuck and machine bed, allowing for manufacturing complexity as well as precision engineering.

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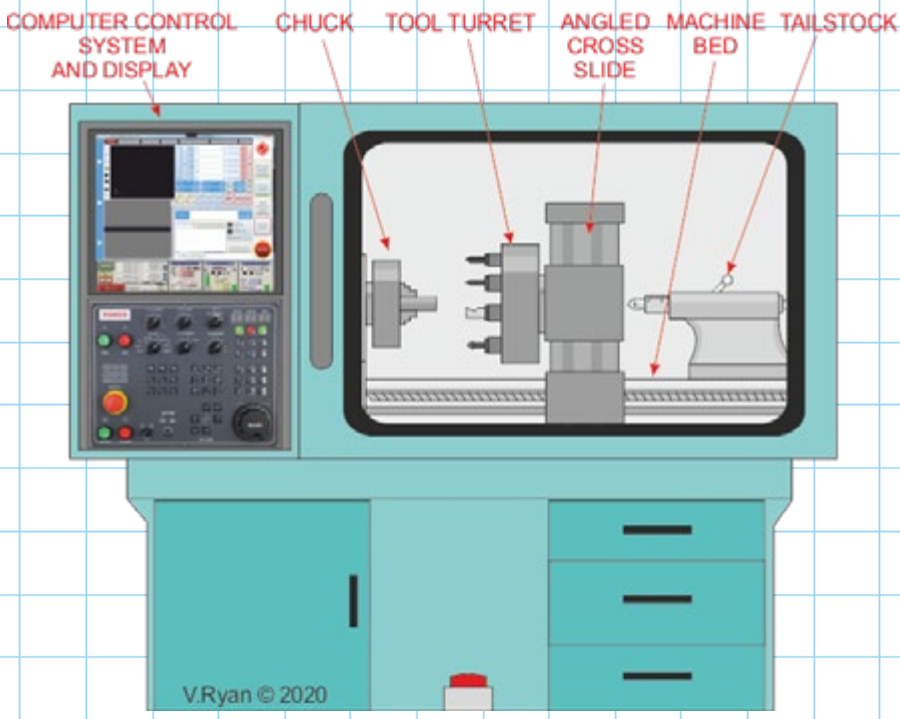

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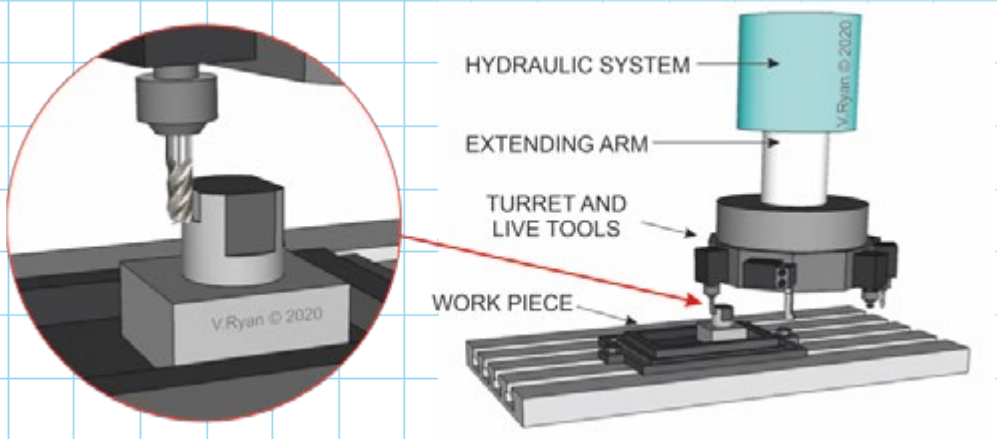
VERTICAL AXIS CNC CENTRES

A typical Vertical CNC Centre can be fitted with live tools, revolving on a motorised turret. Below the vertical CNC Centre has been set up to operate a turret and live tools. The milling attachment is seen removing excess steel. The live tools revolve with the turret and carry out different machining processes.

Tap the image for more detail.



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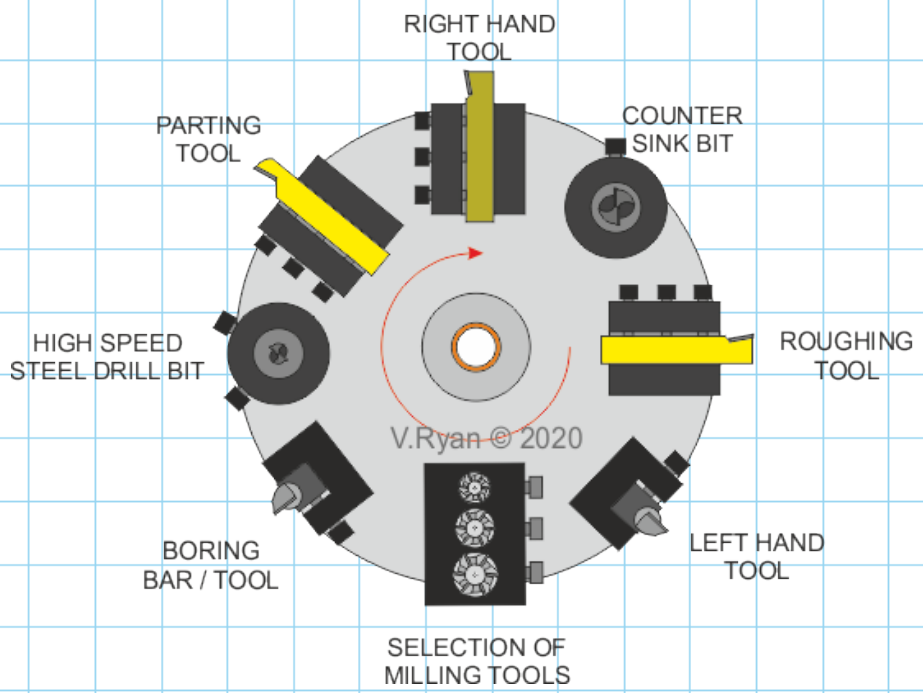
TURRET TOOLING

A turret tool system is seen below. A variety of tools are set up on a rotating turret. This means that a variety of machining processes can be carried out. For example, a straight lathe tool may be needed for facing a piece of round section mild steel, followed by drilling. The CNC machine is programmed to carry out the facing off first, then to rotate the turret, so that drilling can follow.

Tap the image for more detail.



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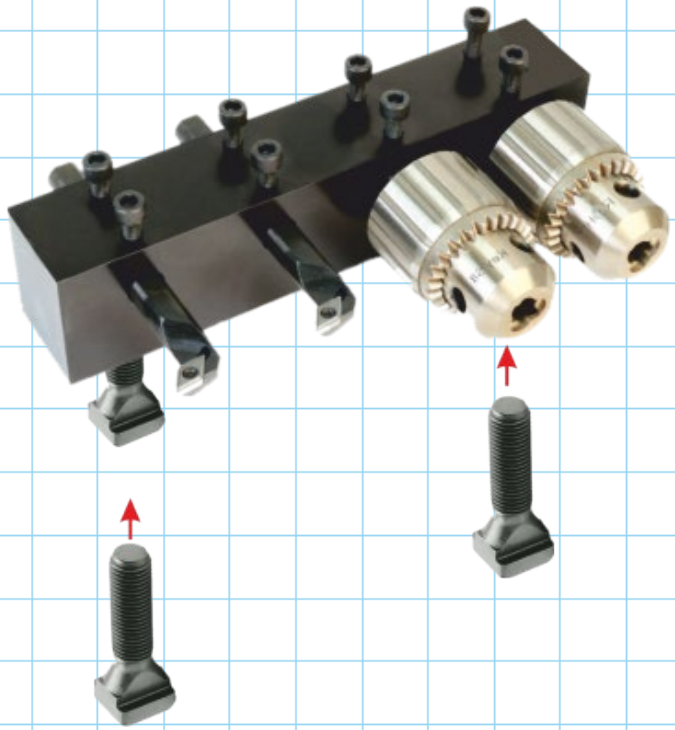
GANG TOOLING

Gang tooling requires the use of an extended tool post, which is secured to the cross slide of the lathe, with slotted bolts (see opposite). The tool post holds a range of lathe tools. The cross slide moves the tool post and consequently each tool, into position, as needed for each machining process.

Tap the image for more detail.

INTERCHANGEABLE TOOLS IN TOOL POST



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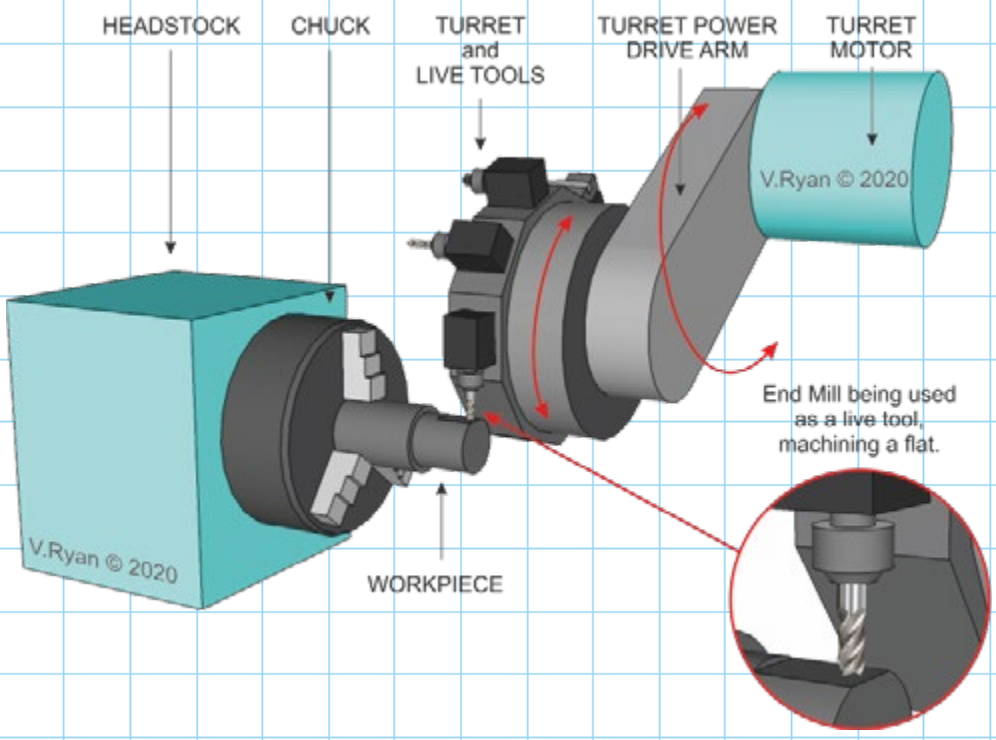
LIVE TOOLING

On first sight, ‘Live Tooling’ looks the same as the turret system. However with this system, each tool can have its own motor. This means that milling processes can be applied to the metal being machined. Live tooling often takes place without the metal being machined moving, or even rotating in the chuck. Live tooling is ideal for milling type operations.

Tap the image for more detail.



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