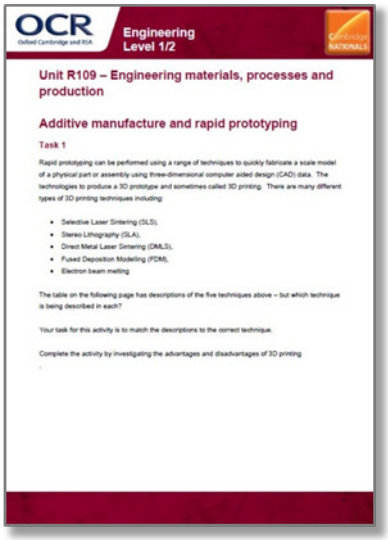
Unit R109 – Engineering materials, processes and production

Additive manufacture and rapid prototyping

Instructions and answers for teachers

These instructions should accompany the OCR resource ***'Additive manufacture and rapid prototyping'*** *activity which supports OCR Cambridge Nationals in Engineering.*



The Activity:

This resource comprises of 1 task.

This activity offers an opportunity for English skills development.

Associated materials:

'Additive manufacture and rapid prototyping' activity sheet

Suggested timings:

Task 1: 1 hour

Learning outcome 3 – Know about developments in engineering processes

Task 1

In this activity learners are required to research a range of 3D printing techniques used in rapid prototyping and to match the appropriate description to the technique being described.

Learners will require access to information in order to complete the activity which could be from the internet. The activity could be undertaken individually, in pairs or in groups. It could be undertaken as a teacher-guided classroom activity.

Solutions to the activity are given in the table on the following page.

Learners are asked to complete the activity by investigating the advantages and disadvantages of 3D printing. These include, but are not limited to:

Advantages	Disadvantages
Manufacturing of customised products – Easy creation of customised 3D designs	Counterfeiting – Possible to copy other peoples designs (infringing copyrights)
Rapid prototyping – Short time for designs to be converted into prototypes	Manufacturing dangerous items – Possible to quickly manufacture dangerous items
Low cost production – Less cost to manufacture prototypes and products than using traditional processes	Size limitations – 3D printers presently have limitations in the size of item they can produce
Elimination of storage costs – Eliminates need for mass production and storage of finished items	Raw material limitations – Currently only viable for items made from a single raw material – and range of materials that can be used is limited

Description	Rapid prototyping technique?
• The prototyping machine uses a high powered laser. • The design model is 'sliced' into the layer thickness the machine will build in. • The technology is an additive method that fuses metal powder into a solid part using the laser. • Inside the build chamber there is a material dispensing platform and a build platform. • A recoater blade moves new powder over the build platform. • Parts are built up additively layer by layer.	Direct Metal Laser Sintering (DMLS)
• This process works on an additive principle laying down material in layers. • The material used to make the model (plastic or metal) is a filament or wire wound onto a drum. • The filament or wire is unwound to a heated extrusion nozzle that moves to deposit the material layer by layer onto the model.	Fused Deposition Modelling (FDM)
• The prototyping machine uses a high powered laser. • It is an additive process. • Small particles of plastic, metal, ceramic or glass power are fused into a mass that has the desired shape (the model). • The laser selectively fuses the powdered material on the surface of a bed of powder. • After each layer is fused the bed is lowered by one layer thickness and the next layer fused.	Selective Laser Sintering (SLS)

Description	Rapid prototyping technique?
• This process is an additive technique based on selective polymerization of a photosensitive resin using ultraviolet light. • In this system, an ultraviolet laser beam is focused on the top layer of photo sensitive resin contained in a vat. • The beam is moved in horizontal X and Y directions to polymerize the resin. • The cured layer of polymer is lowered by a platform so that a fresh layer of liquid resin covers the cured layer.	Stereo Lithography (SLA)
• This is an additive prototyping process. • It uses an electron beam as its power source. • The technology manufactures parts by melting metal powder layer by layer with an electron beam in a high vacuum. • The machine reads data from a 3D CAD model and lays down successive layers of powdered material. • These layers are melted together utilizing a computer controlled electron beam.	Electron beam melting