# Year 11 Engineering

## Forming and moulding

Most materials need specialist tools and equipment to shape and form them. **Casing** and **housing** for electronic and mechanical products are shaped and formed to fit and protect products, making them more practical and aesthetically pleasing.

•**vacuum forming** - plastic casings can be vacuum formed over a form giving a thin casing that an electronic circuit can be hidden in

•**injection moulding** - molten plastic is injected into a mould giving an accurate form that can vary in thickness, ensures pieces fit together accurately, and can encase the electrical or mechanical parts, such as in children's toys

•**casting** - mechanical products, such as engine parts, can be made from metal and are formed by pouring molten metal into a mould to make a solid, strong and accurate shape

•**bending** - simple shapes can be formed by bending sheet metal or heating and bending plastic to provide a casing for products such as fuse boxes

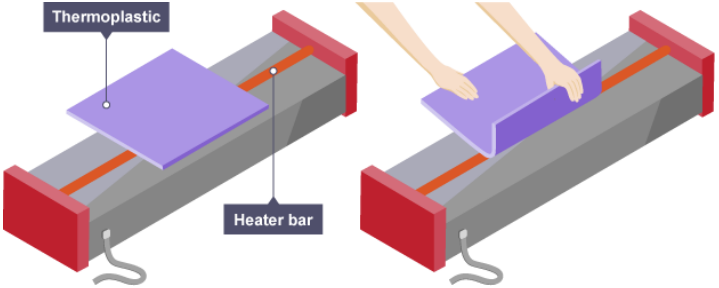
•drilling - printed circuit boards (PCBs) require drilled holes for the components to fit in to, which can be done by hand using a pillar drill, but is more commonly done through automation using a **computer numerical controlled (CNC)** machine

•3D printing - using new technology, **computer aided designs (CAD)** and hardwearing plastic, complex shapes can be produced

•laser cutting - accurate shapes can be cut and engraved, which can be utilised to produce casings or a decoration

**Bending plastics**

A **line bender** has a heated element that provides heat, concentrated to just a few millimetres wide, along the length of the long machine. These are used to heat polymers along this line so that they can be bent. Once the polymer softens, it will bend easily into shape around a **former** before being left to cool. It is a fast and easy process but can only form basic shapes. Heated polymers can be placed in a **cooling jig** so that the bend produced is the same each time.




**Bending metal**

Metal **sheet**, such as aluminium, steel and copper, can be bent using **jigs** with the metal clamped in place during bending. These examples can be bent in straight lines quite easily by hand or using a hammer

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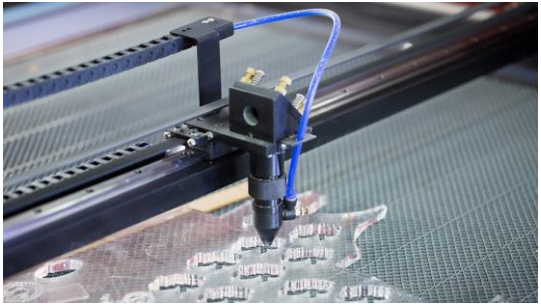
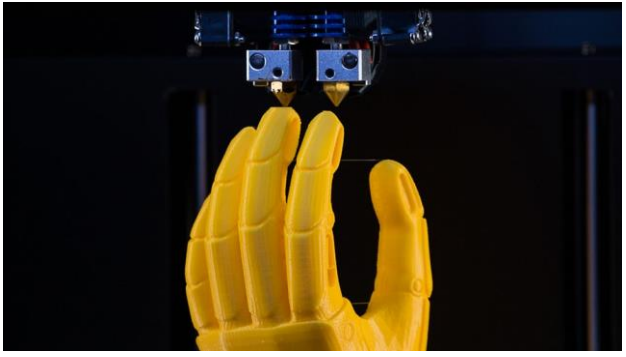
A **laser cutter** can use a **computer aided design (CAD)** to cut or engrave complex shapes out of card, wood, foam, plastic or circuit board.



| Advantages of laser cutting | Disadvantages of laser cutting |
|---|---|
| Precise and accurate | Equipment is expensive, as is maintenance |
| Can cut complex shapes | Training is needed |
| Engraves and cuts | Ventilation is needed |
| Leaves a smooth edge | |
| Quick | |

**3D printing**

**3D printing** is an additive **computer aided manufacture (CAM)** process that follows CAD designs to place layers on top of each other repeatedly and create a 3D object. A **filament** of plastic (Acrylonitrile butadiene styrene (ABS), polylactic acid (PLA), Nylon) is fed into the machine and heated so that it is softened and sticks to the previous layer. It has been utilised in many industries, including in the production of prosthetics, but can be utilised in electronics also.



| Advantages of 3D printing | Disadvantages of 3D printing |
|---|---|
| No moulds or formers are needed | Equipment is expensive, as is maintenance |
| Alterations can be made to the design digitally before wasting materials | Training is needed |
| It uses hardwearing, durable, waterproof and lightweight plastics | Can only use plastics |
| Can create complex shapes | The layering process is slow |