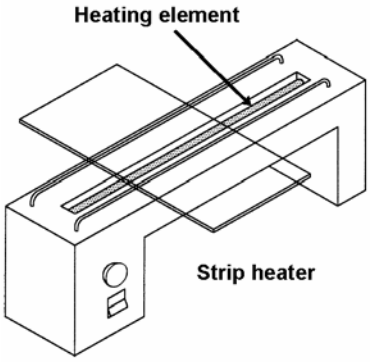
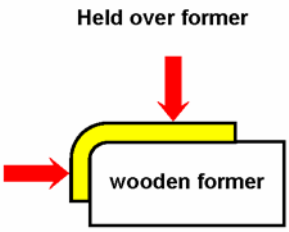
SHAPING PLASTICS – FORMING

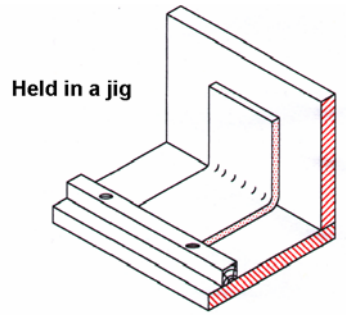
Bending

Thermoplastics in sheet form can be heated gently to between 160°C and 180°C and then bent into shape. If the sheet is held in position while it cools it will remain in its new shape while it is at room temperature or below. If the plastic sheet is re-heated then it will try to return to its original shape of a flat sheet. This property is known as **plastic memory**.

To bend a straight line use a **strip heater**. A heating element will heat the plastic only along the area held above it. When the plastic in the heated area becomes soft it can be removed and held over a former, or in a jig, to hold it in shape until it cools.



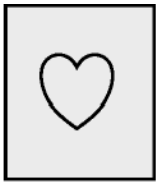




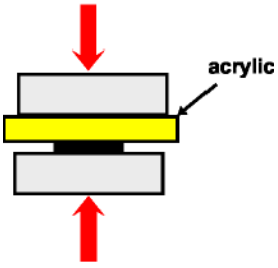
Relief Patterns

Plastic memory can be used to create patterns that stick out from the surface of the sheet. Acrylic has the best memory effect for this process.

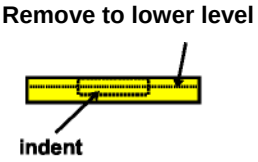
1. Place a shape made from steel wire or brazing rod on a sheet of MDF.



2. Place a plastic sheet, heated in an oven until it is soft, between the shape and a second sheet of MDF. The sandwich is then pressed together so the shape makes an indent in the plastic. Leave to cool. Acrylic



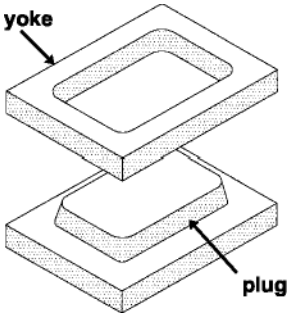
3. Remove the top surface by filing, milling or rubbing over an emery board. Some of the indent must be left. Remove to lower level indent



4. Re-heat in the oven until the indented plastic returns to its memorised height. The surrounding plastic has been partly removed and therefore cannot return to its original height.

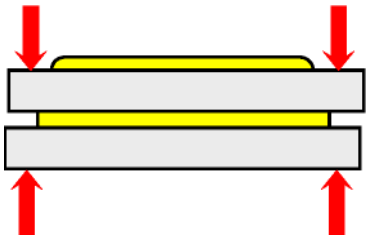
Press Forming

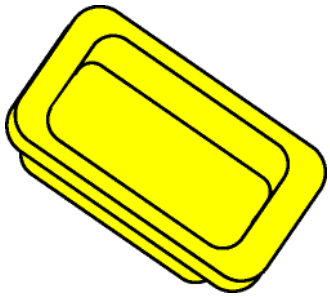
Press forming is also known as **Plug and Yoke** forming. This process is useful for making three dimensional hollow shapes such as a shallow tray. A two part mould is used to shape a heated sheet of plastic.



The mould can be made from plywood or MDF. The shape that is the plug is smaller than the hole in the yoke. The difference is the same as the thickness of the plastic to be formed, all the way round.

The soft sheet of hot plastic is sandwiched between the plug and yoke. G-clamps are used to force the plug and yoke together.



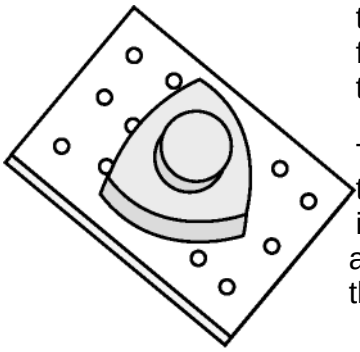


When the plastic has cooled to room temperature it can be removed and will be the required tray shape.

Vacuum Forming

Most thermoplastics are suitable for vacuum forming. This process is useful for making shaped packaging trays, such as those that hold a layer of chocolates in a box. Other items made by this process are face masks, the shelving on the inside of refrigerator doors and plastic baths.

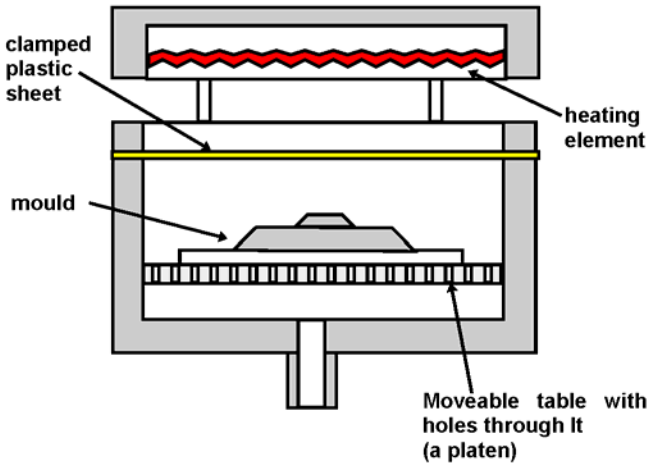
The mould can be made from MDF and is attached to a baseboard made from drilled hardboard or thin plywood.

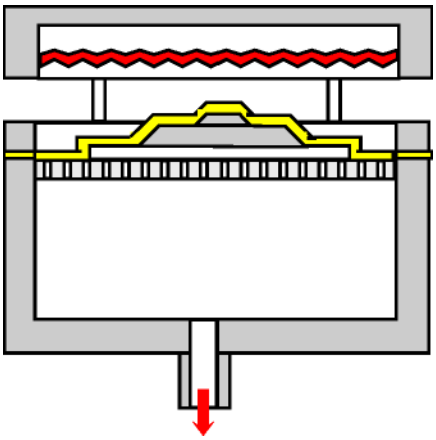


The sides should be tapered (draft), to make it easier for the plastic and mould to separate at the end.

Draft

Vacuum forming machine

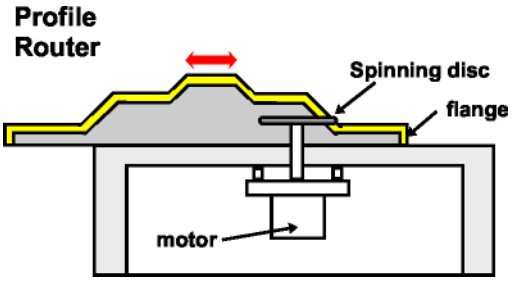




The table with the mould is raised into the plastic and the vacuum pump is switched on. The plastic sheet is then sucked tightly over the mould. The mould can be removed from the plastic moulding when the plastic has cooled.

Air sucked out by vacuum pump

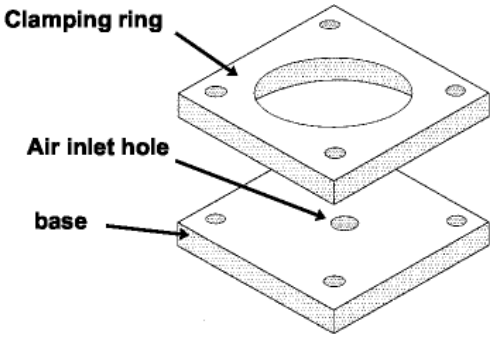
The waste can be trimmed from the base of the moulding by using a **profile router**. This machine uses a spinning abrasive disc that can be set at different heights, to cut away the waste flange.

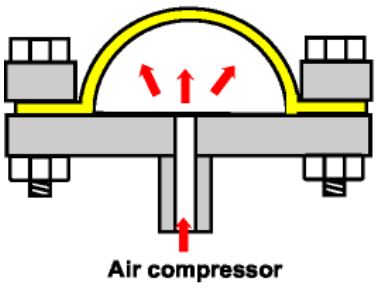


Blow Moulding

Blow moulding is a process that can produce hemispherical shapes (half a sphere).

The blow moulding clamp can be made from plywood or MDF.





The heated, soft plastic sheet is blown up like a balloon. The air used to blow the hemisphere also cools the plastic so it quickly becomes rigid.

KEY WORDS Plastic memory: Plug & Yoke: Vacuum forming: draft flange

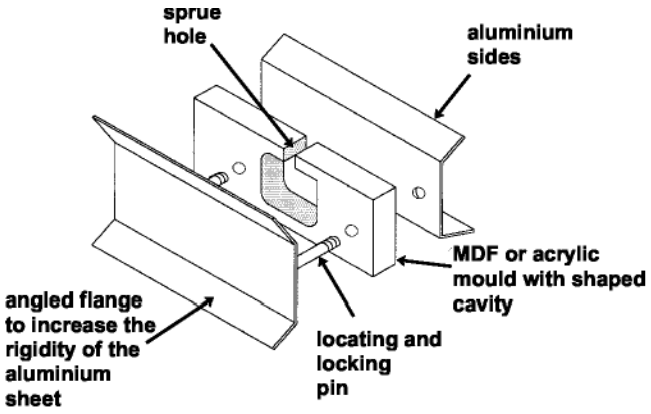
1. Explain the term ‘plastic memory’.
2. Illustrate how a straight line, 90° bend, can be made in a 3mm thick sheet of PVC.
3. How can a relief pattern be made in a square of acrylic? Use annotated diagrams.
4. A small tray is required to hold salt & pepper shakers. How would you make the tray in rigid polystyrene?
5. Why are vacuum forming moulds made with drafted edges?
6. Illustrate the vacuum forming process.
7. How can the flange be cut away from a moulding?
8. What are the three ways in which a hemispherical shape can be produced from a plastic sheet?
9. Explain, with diagrams, how compressed air can be used to create a half balloon shape in sheet plastic.

Injection Moulding

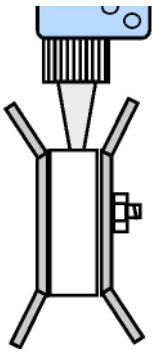
In industry, injection moulding is one of the most common methods of producing products in thermoplastic plastics. e.g. school chairs, TV cases, toothpaste tube caps etc. Thermoset plastics cannot be injection moulded because any plastic left in the machine would set hard permanently and block the nozzle.

Glue Gun Moulding

In school, simple small injection moulded products such as plastic feet for a jewellery box and knobs for drawers in the box can be made by using coloured glue stick

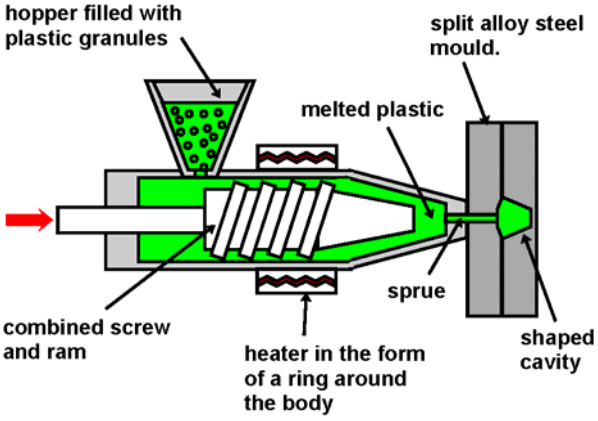


Glue gun



Coloured glue sticks can be used to fill the cavity in the mould through the sprue. If MDF is used for the mould the walls of the cavity need to be thickly pencilled over. The graphite in the pencil lead prevents the hardened glue from sticking to the MDF.

Section view of an Injection Moulding machine



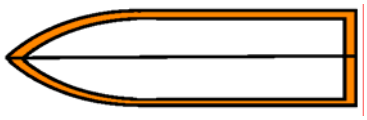
1. Plastic granules from the hopper are forced by the combined screw and ram into the heated area.
2. The plastic melts and is then forced under high pressure through the sprue hole into the split mould.
3. The mould is cold and the plastic cools and sets quickly.
4. The mould is opened and the product is ejected.
5. The sprue is cut away. The product is now ready for use.

Glass Reinforced Plastics (GRP)

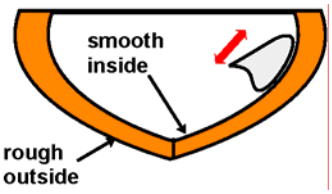
Fibres of glass are mixed with the thermoset plastic called **Polyester**, in liquid (resin) form. The resulting material, after the resin has set, is very tough because any crack that starts in the polyester stops getting longer and larger when it reaches a glass fibre.

Making a model boat hull in GRP (the lay-up process)

Plan view

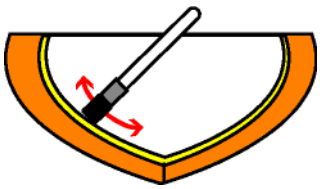


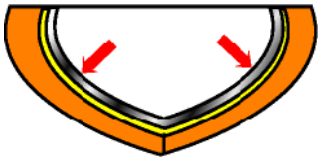
enlarged section view of split mould



A. A layer of release agent is applied to the inner surface to stop the new GRP from sticking to the mould. The release agent can be in wax form.

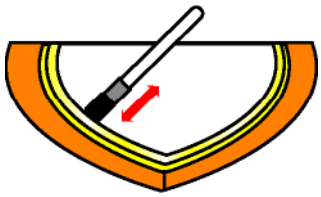
B. A thick layer of coloured gellcoat resin is painted over the release agent.





C. A sheet of glassfibre is laid by hand over the dry but sticky gell coat layer.

D. Polyester resin, the same colour as the gellcoat, is stippled onto the glassfibre until it is covered with resin. This is then allowed to set before the hull is taken out of the mould.



1. How can a glue gun be used to create six identical plastic counters for a board game?
2. Why cannot thermoset plastics be used in an injection moulding machine?
3. How does an injection moulding machine work?
4. Explain the stages used in the lay-up process, when making a product from GRP.

Worksheet 36c