



Sustainable Design is the philosophy of designing and making physical objects and products to cause the least possible damage to the environment and our planet.

Exam expectations

Paper/card is the compulsory material so always expect questions in exam to relate to this topic. Questions on printing usually link to packaging.

SECTION A



What do you need to know?

- At the very least you should be able to name a commercial printing process and explain why it would be chosen.
 - It also links to other manufacturing questions.
-

Commercial manufacturing & Production Methods.

Typical order of work:

- **Finishing** – print, varnish, emboss, smart inks
- **Wastage/separation** – die-cut/crease
- **Forming** - folding
- **Assembling** – glue, inserts...

- Die cutting
- Letter press
- Rotary press
- Screen printing
- Lithography
- Printing effects

- One off
- Continuous
 - Mass
 - Batch

The material the flat-packed charity packaging will be manufactured out will be likely to be card/paper.



- Easy to print on
- Cheap to produce
- Biodegradable
- Recyclable
- Can be moulded/shaped
- Can be coated/finish applied
- Lightweight



Q – What does biodegradable mean?

Q – What sort of coat/finish is applied and why?

Environmentally Friendly Packaging

There are three types:

- **Reusable** packaging can be cleaned and re-used. For example card can be cleaned and reused.
- **Recyclable** packaging is made of materials that can be used again, usually after processing. Recyclable materials include glass, metal, card and paper.
- **Biodegradable** packaging will easily break down (degrade) in the soil or the atmosphere.
- **Recyclable** packaging should carry standard symbols that show what the product is made from and how it can be recycled.

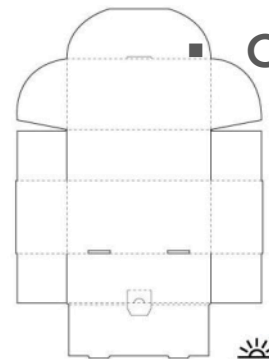


Q – Can you draw the recycling symbols which would feature on the packaging?

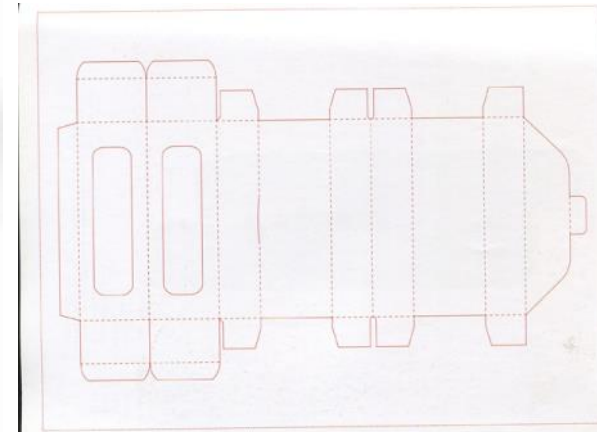
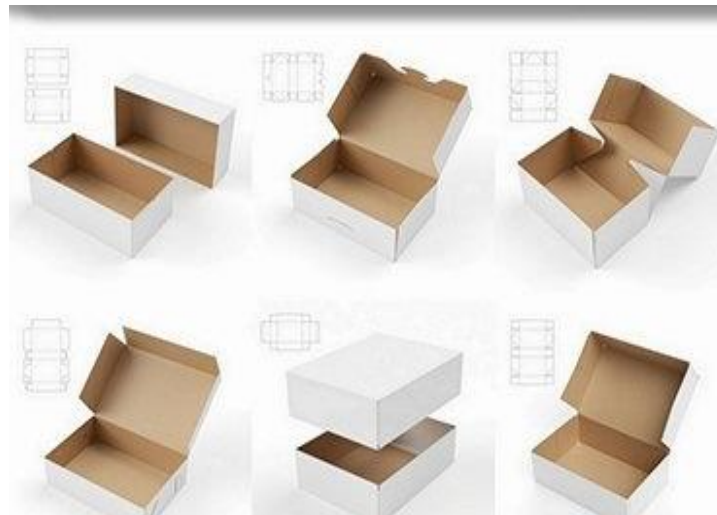


Charity boxes can be created by:

- Designing a NET by hand OR by using a CAD program such as Corel Draw.
 - Printing the surface using OFFSET LITHOGRAPHIC PRINTING.
- Cutting out the net using a DIE CUTTER, adding CREASES for bending.
 - Folding together by hand or by folding machine.
- Gluing the TABS into place OR using a CRASH LOCK SYSTEM.



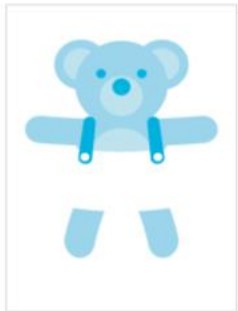
ALLDAY.RU



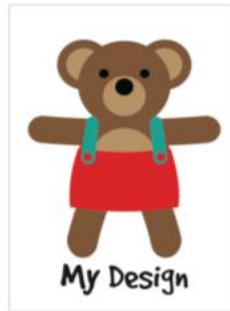
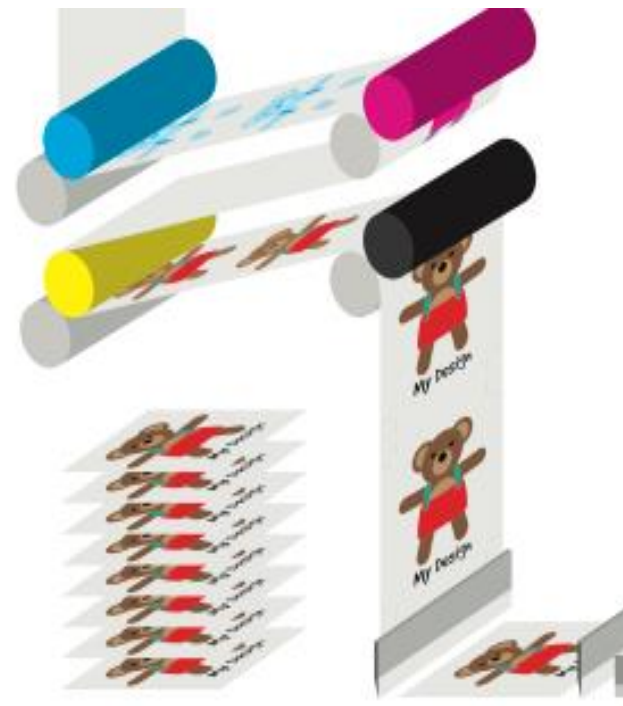
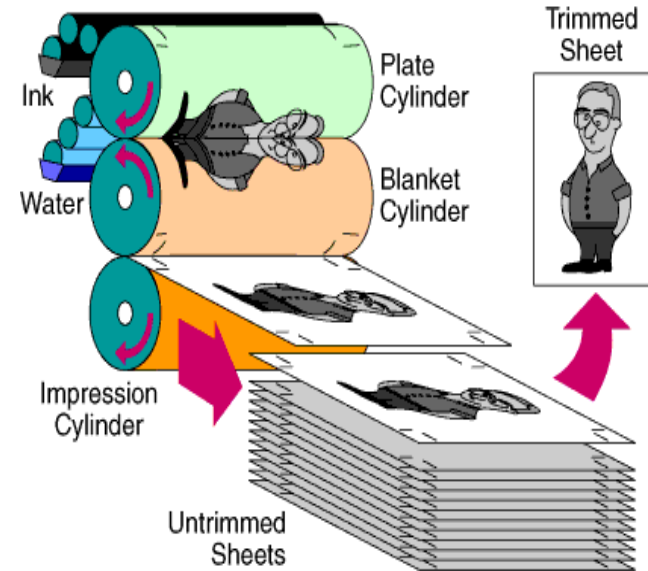
Offset Lithographic Printing (CMYK Process)

Is a fast, accurate printing process used in the mass production of card boxes and packaging, newspapers, magazines, catalogues and other publications.

CMYK stands for Cyan-Magenta-Yellow-Black. CMYK is a colour model in which all colours are described as a mixture of these four process colours. CMYK is the standard colour model used in offset printing for full-colour documents. It is often called four-colour printing.

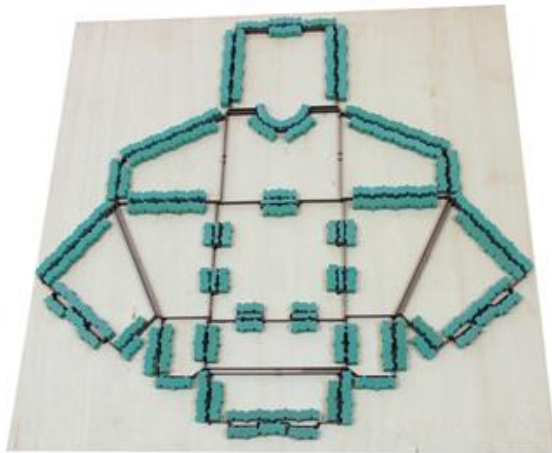


Cyan

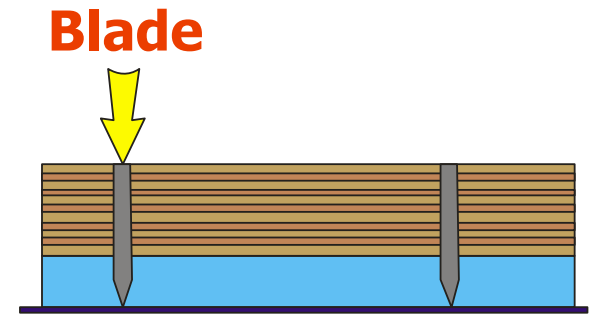
Cyan
+MagentaCyan
+Magenta
+YellowCyan
+Magenta
+Yellow
+Black

Commercial Manufacturing – Die cutting.

Die-cutting is the method cartons are cut out. In the packaging industry the cutter is known as a **cutting forme**. A rounded blade creases where the carton will be folded.



Plywood
Foam layer
Card to be cut

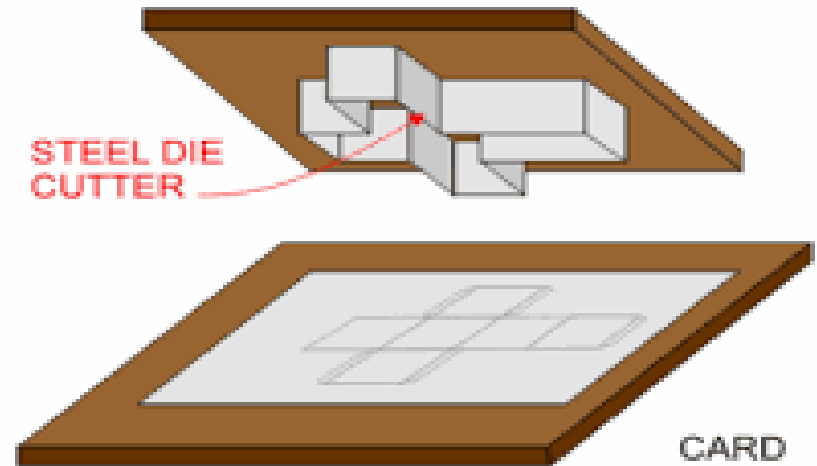
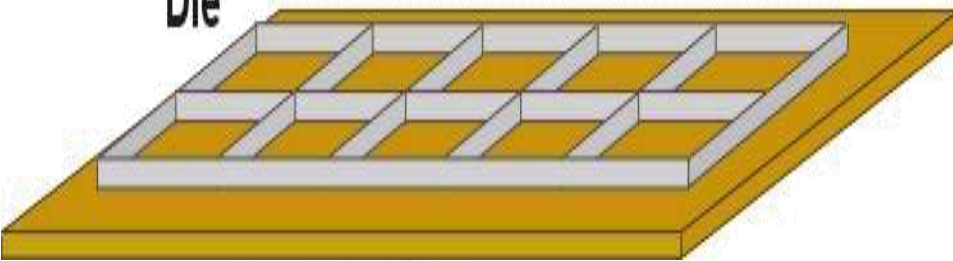


Die cutting uses a system similar to that you would use in cutting pastry with a pastry cutter. The outline of an object to be cut out will be made by inserting sharp blades called press knives into a sheet of thick plywood (called a press former). This is then placed on top of the card and it is pressed down to cut the shape out.

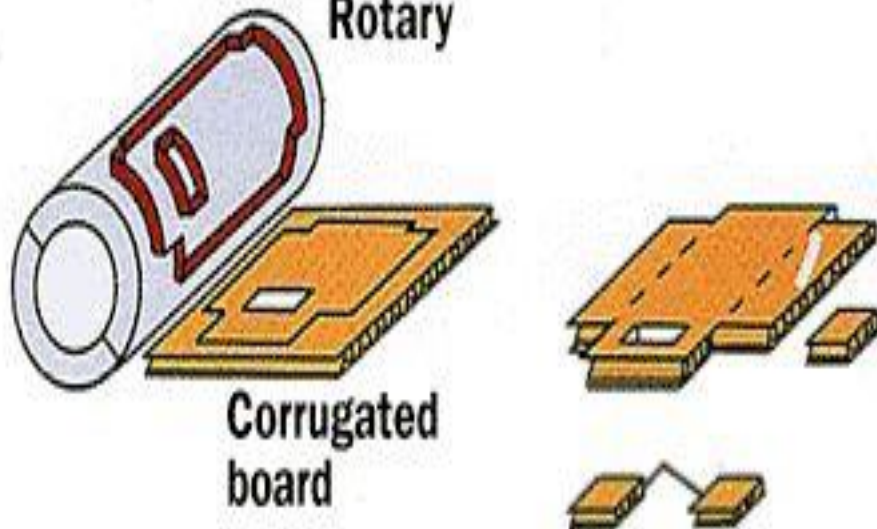
DIE CUTTERS

Are used to manufacture card packaging by cutting out net shapes with creased lines for bending. They can also be used to manufacture shapes, nets and developments from stronger materials. These include materials normally used for models.

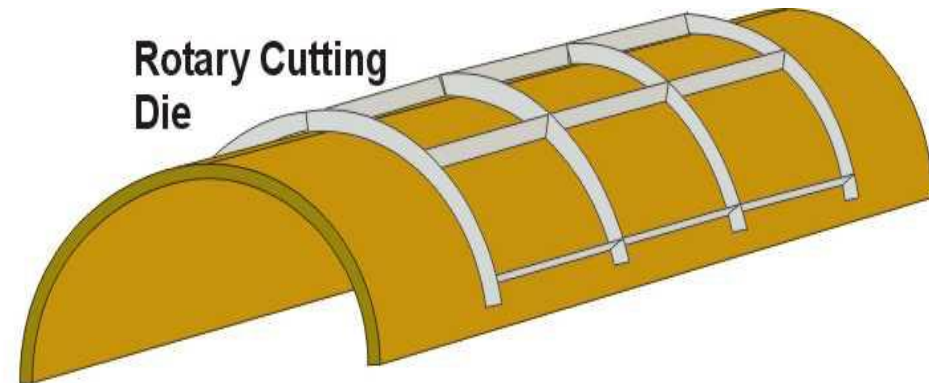
Flat Cutting
Die



Rotary



Rotary Cutting
Die

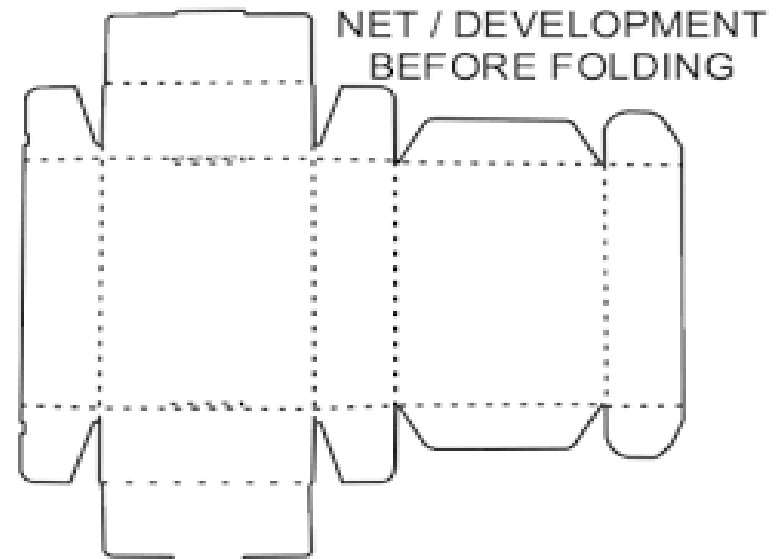
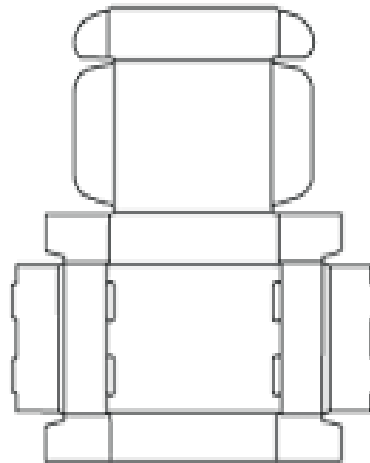
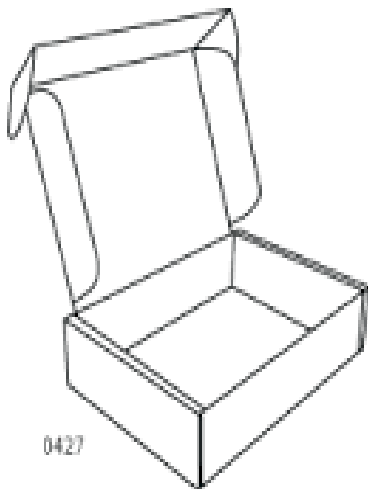


A NET is a two-dimensional (2-D) shape, which when scored, folded and glued together, makes a three-dimensional (3-D) package, box or carton.

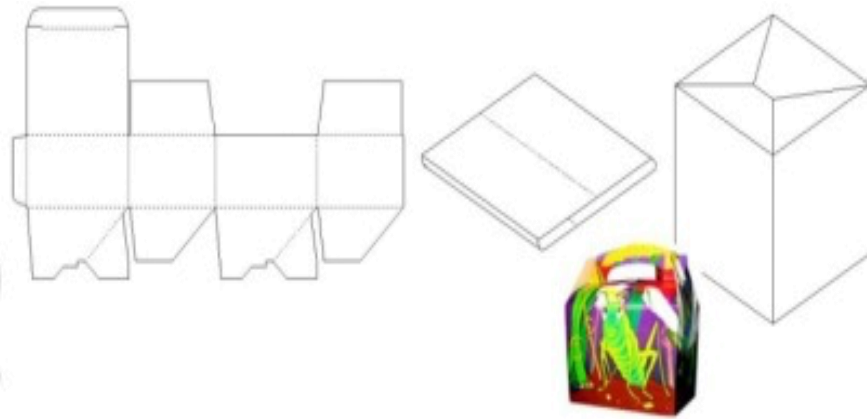
- It must be made ACURATELY so that all sides fit together perfectly.
- The design must be printed the correct way up so that when the box is constructed, everything is the right way up.
- A standard set of line types are used to draw NETS.

Nets are flat card folded into 3d products

Dotted lines = Crease or fold lines
Solid lines = cut out



Crash Lock Systems



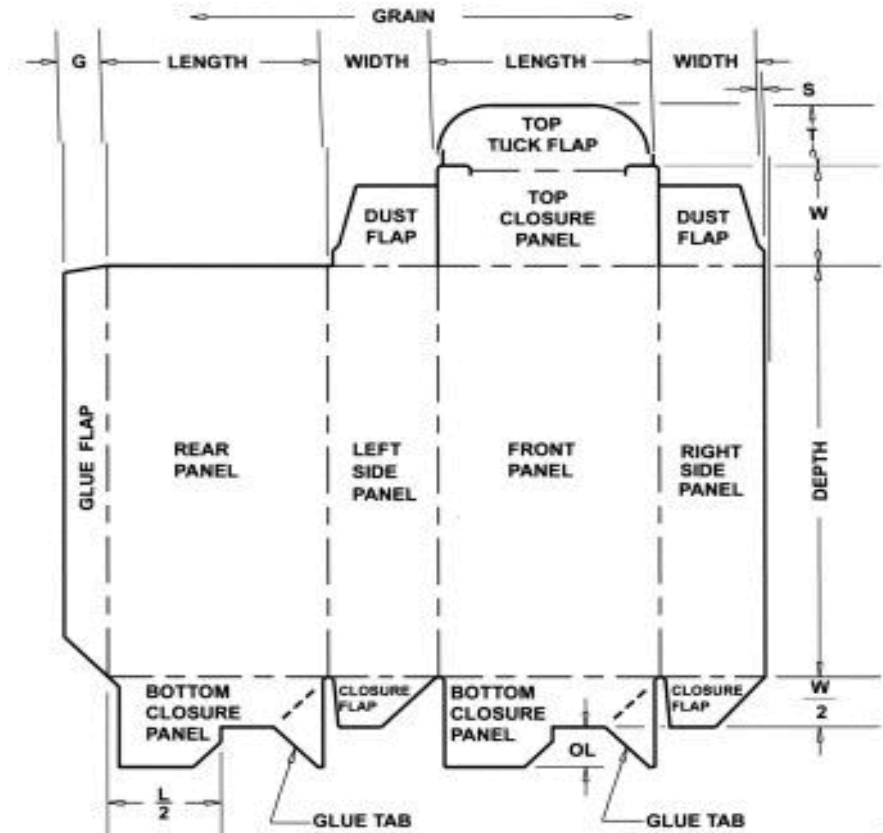
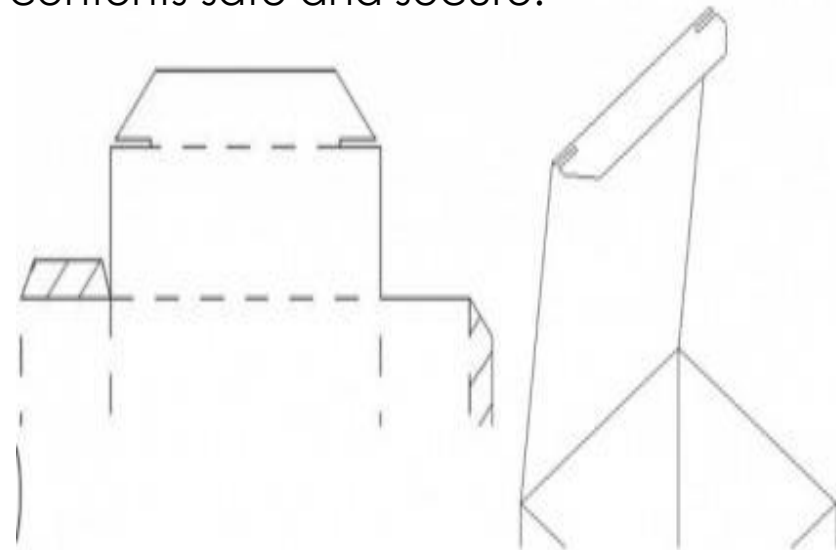
Crash Lock systems

These boxes have a specific base design that allows the box to be supplied flat to the customer, and then popped back to shape when required.

This makes it much **cheaper to transport and store as it takes up less space.**

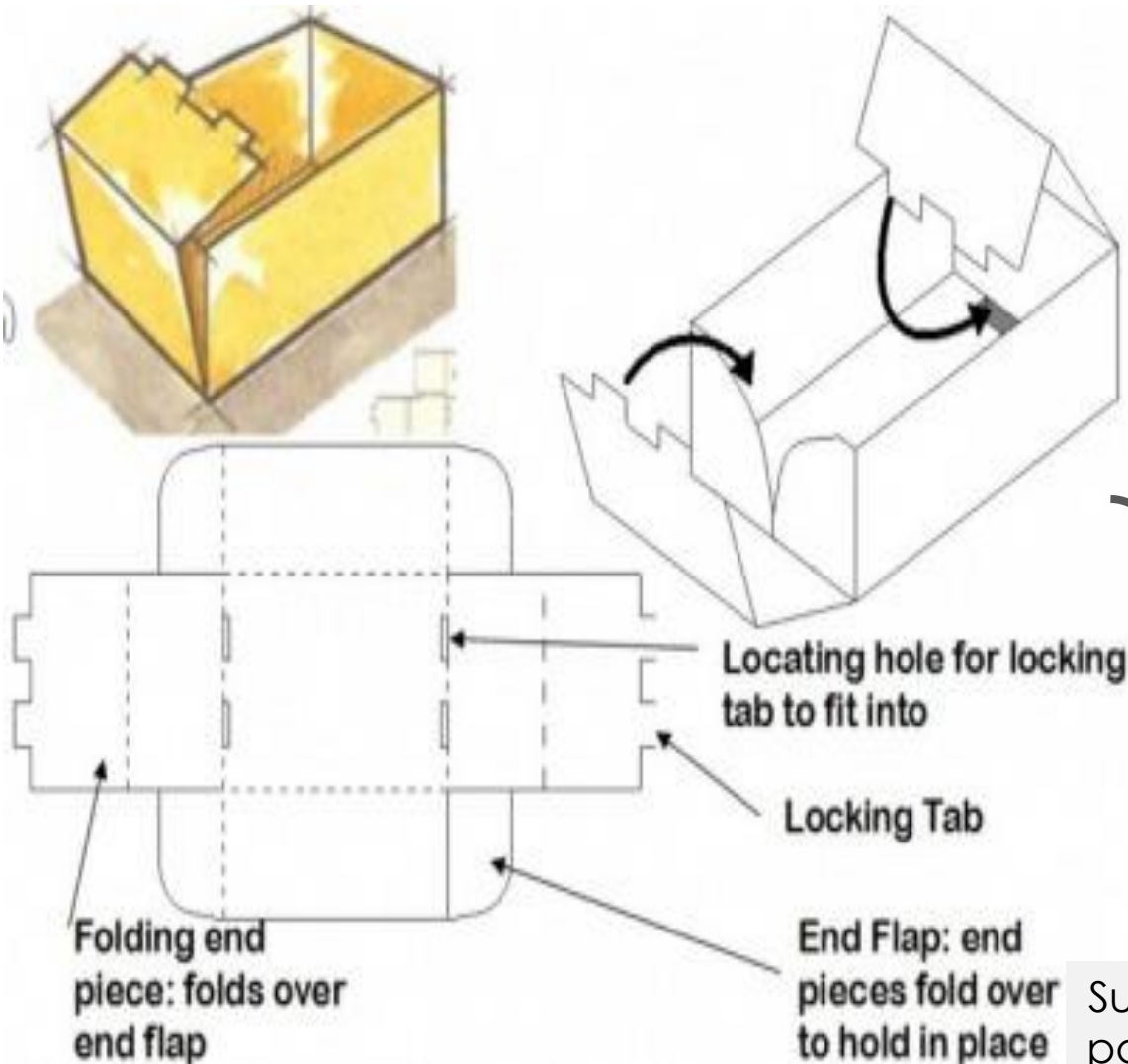
Tuck In Tabs

Mass manufactured packaging has small slits cut into the lid tabs, which help the lid to 'lock' in place, and keep the box contents safe and secure.



Inner Trays

These come manufactured from both plastic and board. They are used to hold multiple (lots of) things securely inside a packaging's outer box, e.g. a money tray in a charity collection box.



These are manufactured from **CORRUGATED CARDBOARD**

- They are delivered to the customer in **FLAT PACK**: reducing transport costs and saving space when being stored before use.

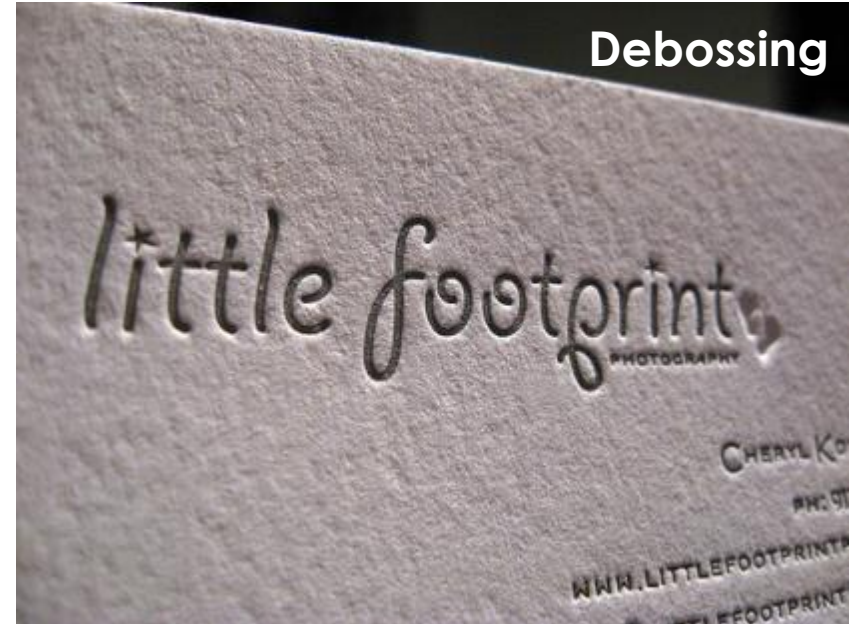


Such net could be used in the charity packaging which holds items for sale.

Embossing



Debossing



Embossing and Debossing

These are the processes of creating either raised or recessed relief images and designs in paper and other materials.

An embossed pattern is raised against the background.

A debossed pattern is sunken into the surface of the material

Laminating

This produces a high gloss finish on card.

The printed card is placed inside a plastic film/sleeve. The

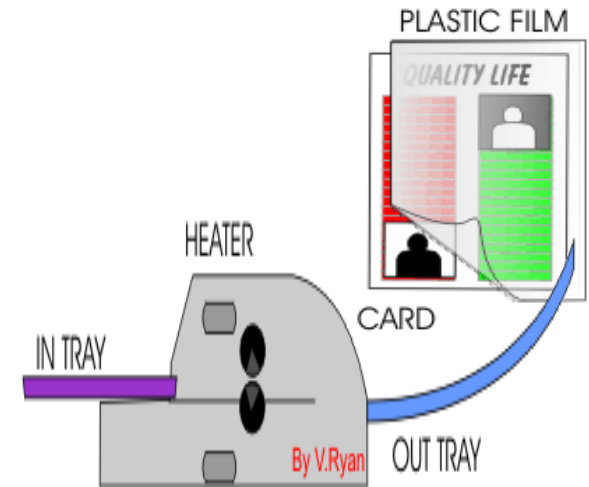
heater warms up the film almost to melting point and the

rollers press the film sleeve until it is sealed. When the card

reappears in the 'out tray', the finished item looks glossy and

professional.

FINISHING & HOT FOILING



SPECIAL EFFECT?

What factors should be taken into account when considering a special effect?

When is a special effect necessary?

What is the cost to the item to be printed?

What are the requirements for quality products?

What is the manufacturing time to production of a product?

What are the most suitable materials for the product?

What are the most suitable finishes for the product?

HOT FOIL BLOCKING

This is where a design is applied to card or paper in a metallic foil.

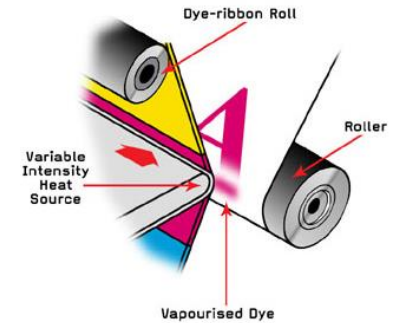
It is done using a metal die (stamp), which is heated up and then used to press the foil onto the package.



Dye Sublimation Printing

Sublimation printing is a process whereby full colour images, text and other graphics can be transferred into a receptive item. The process relies on a specialised 'dye sublimation' ink, which when heated changes from being a solid dye to being a gas, without passing through a liquid stage. Taking this a step further, if this gas encounters polymer fibres as it moves, it will penetrate those fibres, permanently dyeing them.

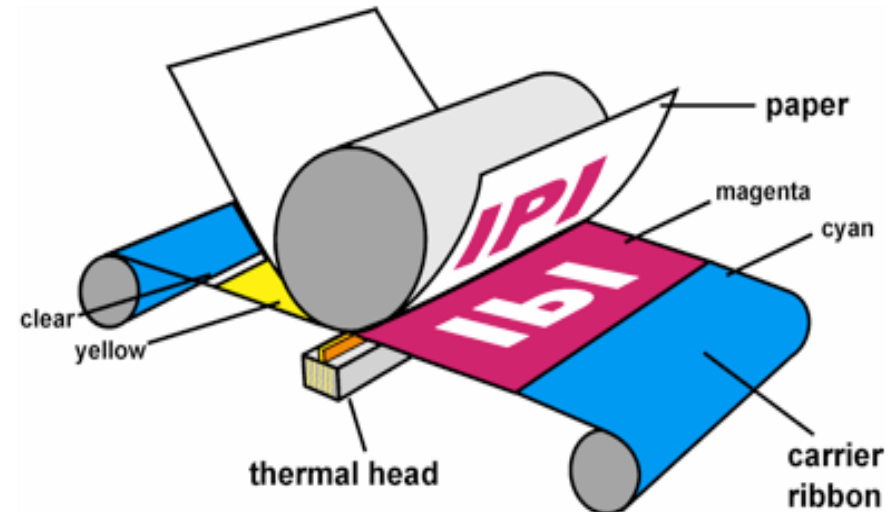
Dye Sublimation Printing



Using the CMYK Color group, known as 4-color process we create full color printing using blends of each primary color.

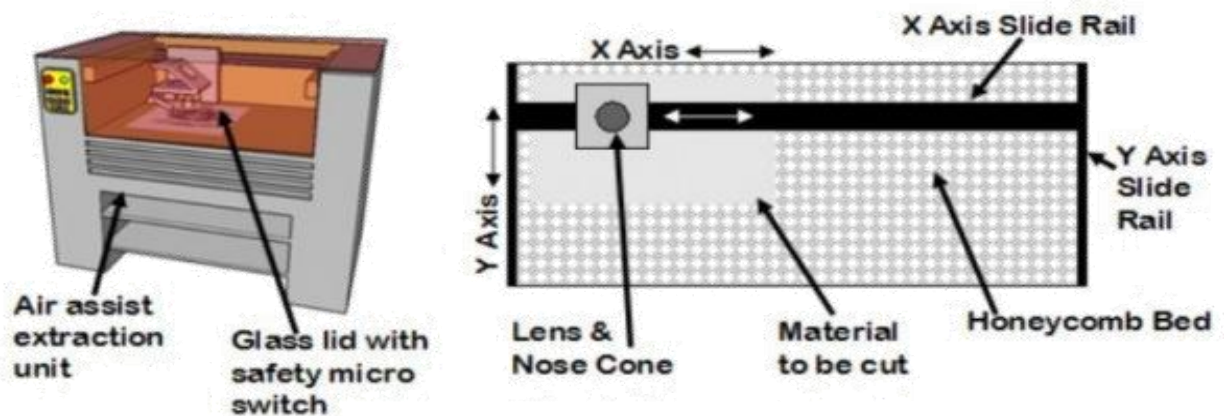
In your coursework you used this process to transfer an image onto both wood and acrylic.

Your image was attached to the material, placed in a Teflon sheet and pressed in the sublimation heat press.



Laser Cutter

- Great for quick manufacturing of NETS for prototyping of designs.
- Large bed enables many tessellated NETS to be cut out
- Is difficult to align printed NETS for cutting perfectly.



ADVANTAGES

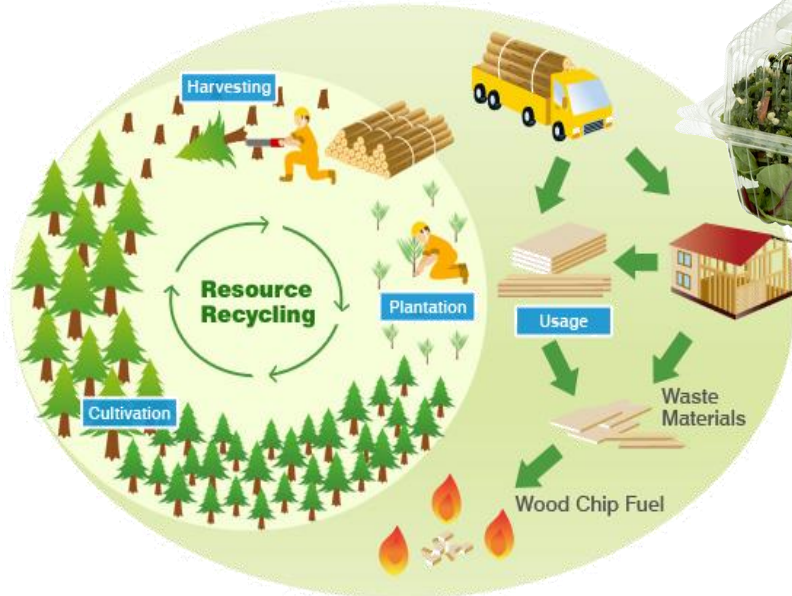
- Quick production of prototypes (models)
- Can cut paper, card, acrylic, polypropylene sheet, textiles
- Quick & easy to set up

DISADVANTAGES

- Can't cut plastics containing polystyrene (gives off dangerous fumes)
- Can't be aligned with pre printed NETS

What is a RENEWABLE material?

Renewable materials are materials that can be reproduced / grown. A good example of a renewable material is wood. Forests can be replanted and so wood can be grown replacing the wood that has been used by manufacturing industry.



What is a NON-RENEWABLE material?

A good example of a non-renewable material is oil. Oil cannot be replaced because it takes millions of years for it to form below the surface of the earth.

Once it has been used it is gone for ever.

What is a Modern Material?

Modern materials are developed through the invention of new or improved processes, for example, as a result of 'man' made materials ingredients or human intervention. They are altered to perform a particular function.



Compostable Plastics

Compostable Plastics are a new generation of plastics which are biodegradable through composting. They come from renewable raw materials like starch (e.g. corn, potato, tapioca etc).

Corn Starch Based Materials

Instead of using packaging materials made from synthetic polymers, a new material has been developed using polylactic acid (PLA), which is made from fermented sugars, usually from corn starch.



These "green" materials fall into one of two categories: biodegradable materials and recyclable materials.



The best biodegradable packing materials on the market are made from starch-based plastics. These materials use plant starches to make a thermoplastic.

Plant starch-based materials also absorb humidity, which is a bonus in packaging.

THERMOCHROMIC INKS

HYDROCHROMIC INKS

- These react to MOISTURE.
- There are two layers of ink on top of each other. When moisture/water is applied, the top hydro chromic layer goes CLEAR revealing the colour underneath.
- Often used for applications where the product will get wet, e.g. umbrellas.

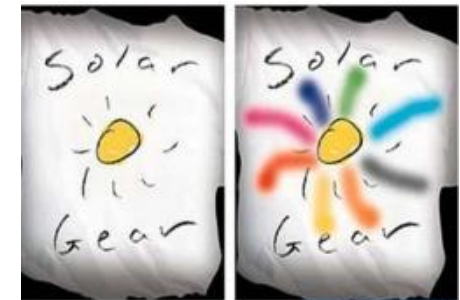









WHAT IS A SMART MATERIAL?

A smart material is one that reacts to its surroundings, for example by changing colour.

PHOTOCHROMIC INKS

- These react to LIGHT.
- There are two layers of ink on top of each other. When light is applied, the top photochromic layer goes CLEAR revealing the colour underneath.
- They are most commonly seen on screen printed textiles, but their use is limited as the ink only withstands approximately 20 washes.
- They are also used in light sensitive sunglasses.



Type of Plastic	Sample Items Made from This Type of Plastic	This Plastic Can Be Recycled Into:
PET Polyethylene Terephthalate 	<ul style="list-style-type: none"> • water bottles • soda, liquor & juice bottles • mouthwash bottles • boil-in-bag pouches • peanut butter jars 	PET can be recycled into new bottles and containers, carpet, backpacks and clothing (such as fleece jackets). It can also be spun into a fibre that looks like candyfloss and is used as a filling for quilts or jackets.
HDPE High Density Polyethylene 	<ul style="list-style-type: none"> • milk jugs • trash bags • detergent bottles • motor oil containers 	Recycled HDPE appears in everything from pens and drainage pipes to park benches and doghouses. It can be turned into plant pots, car parts, and toys.
PVC Polyvinyl Chloride 	<ul style="list-style-type: none"> • shampoo bottles • cooking oil bottles • windows & doors • shower curtains 	PVC can be recycled into fencing, sewer pipes and garden hoses.
LDPE Low Density Polyethylene 	<ul style="list-style-type: none"> • grocery bags • produce bags • cellophane food wrap • bread bags 	LDPE gets recycled into trash bags, trash cans and compost bins.
PP Polypropylene 	<ul style="list-style-type: none"> • margarine tubs • yogurt containers • straws • diapers 	This plastic is recycled into furniture, carpet and auto parts.
PS Polystyrene (also know as Styrofoam) 	<ul style="list-style-type: none"> • egg cartons • hot beverage cups • plastic cutlery • protective packaging for electronic goods & toys • meal take out boxes • CD cases 	Recycled polystyrene finds its way into egg cartons, concrete, plastic wood, packing peanuts, and desk accessories.
OTHER 	All other types of plastics or packaging made from more than one type of plastic	These plastics are difficult to recycle because they are made from more than one type of plastic.



A thermoplastic is a material which becomes soft when heated and hard when cooled. Thermoplastic materials can be cooled and heated several times. They can be recycled.

PLASTICS...KNOWN AS **POLYMERS**

Polymers are very common materials used for a wide range of products...Properties include:

- Lightweight.....some can be recycled
- Easily moulded by using heat (THERMO PLASTICS)
- Easily moulded by pressure (Injection moulded, Blow moulded and Vacuum formed, Extruded)
- Available in lots of colours and thicknesses
- They are self finishing (they don't need a surface finish eg, paint/varnish)

PLASTIC RESIN CODES



PETE



HDPE



V



LDPE



PP



PS



OTHER

Polyethylene Terephthalate

soda bottles
water bottles
shampoo bottles
mouthwash bottles
peanut butter jars

High Density Polyethylene

milk, water and juice jugs
detergent bottles
yogurt and margarine tubs
grocery bags

Vinyl

clear food packaging
shampoo bottles

Low Density Polyethylene

bread bags
frozen food bags
squeezeable bottles (mustard, honey)

Polypropylene

ketchup bottles
yogurt and margarine tubs

Polystyrene

meat trays
egg cartons
cups and plates

Other

ketchup
3 & 5 gallon water bottles
some juice bottles

PVC

Poly Vinyl Chloride

Blister Packaging & Inner Trays



Juice & Shampoo Bottles

HDPE

High Density Polythene



Detergent bottles



Milk Cartons



Bottle lids

LDPE

Low Density Polythene



Carrier Bags



Squeezy Bottles

PS

Polystyrene



Yoghurt Pots & Food Trays

Expanded PS: Egg & takeaway cartons, protective packaging





Biggest disadvantages of plastic:

Plastic can survive many centuries before nature is able to degrade it (some degrade into basic ingredients and some only divide into very small pieces). This troublesome ability of plastic doesn't have great immediate impact on our environment, but its continuous dumping into seas and land will eventually create problems for future generations.

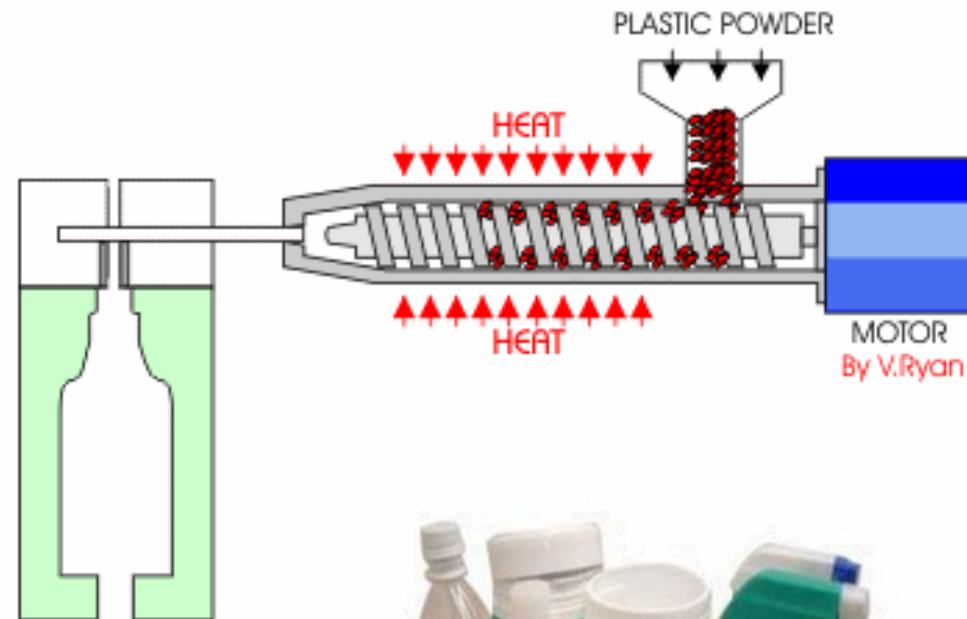
Even with all this durability, plastic products are not indestructible and it cannot be used as a basic building block for everything we need.

BLOW MOULDING

This is virtually the same process as injection moulding, but with the addition of air. This air pushes the plastic to the outside of the mould making a HOLLOW product, e.g. a bottle.

The process is similar to injection moulding and extrusion.

1. The plastic is fed in granular form into a 'hopper' that stores it.
2. A large thread is turned by a motor which feeds the granules through a heated section.
3. In this heated section the granules melt and become a liquid and the liquid is fed into a mould.
4. Air is forced into the mould which forces the plastic to the sides, giving the shape of the bottle.
5. The mould is then cooled and is removed.

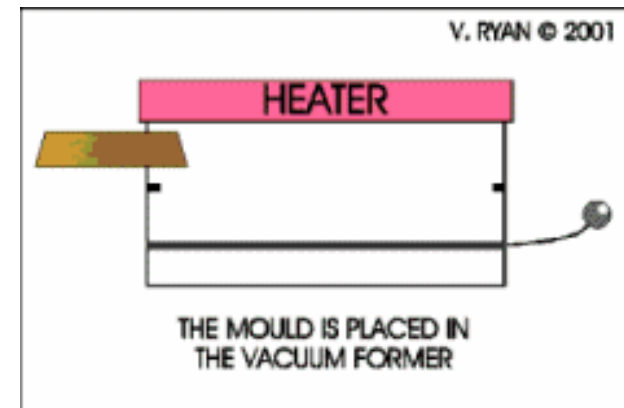
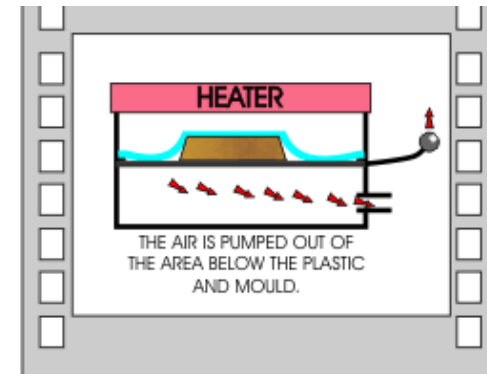
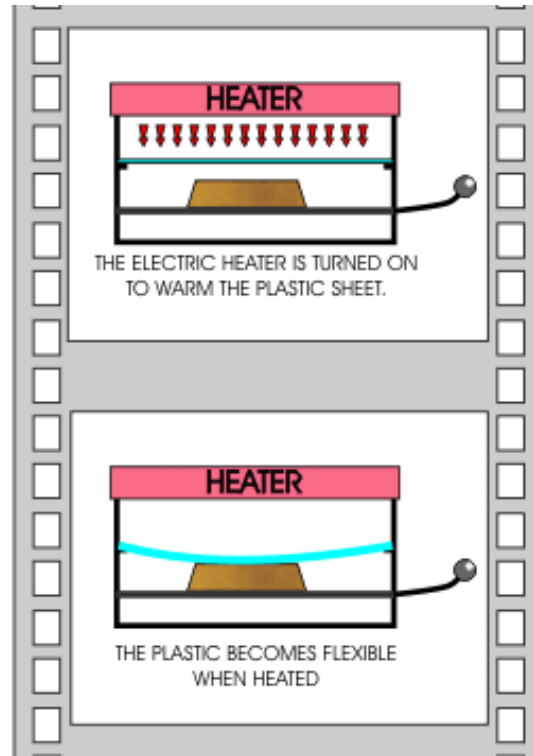
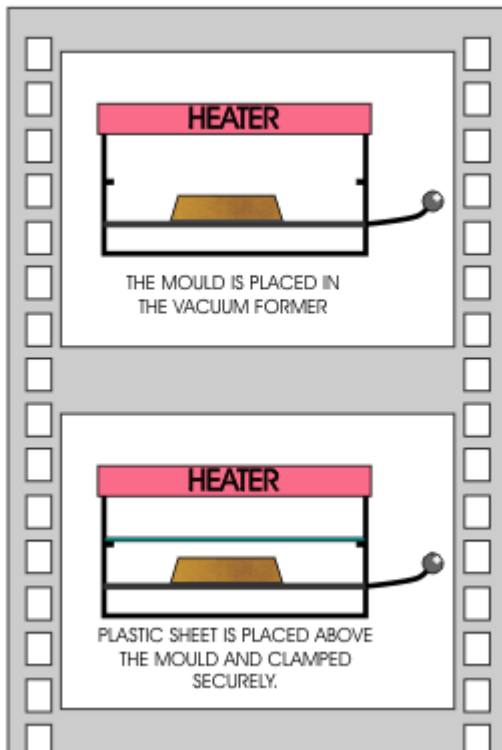


Examples of Blow Moulded Products

VACUUM FORMING & MOULDS

Vacuum forming is used both in school and industry to form THERMOSETTING PLASTICS such as PS (Polystyrene) & HIPS (High Impact Polystyrene Sheet)

It is used to make INNER TRAYS to contain multiple things inside packaging, and for BLISTER PACKAGING.



Quality control

QC

Quality Assurance

QA

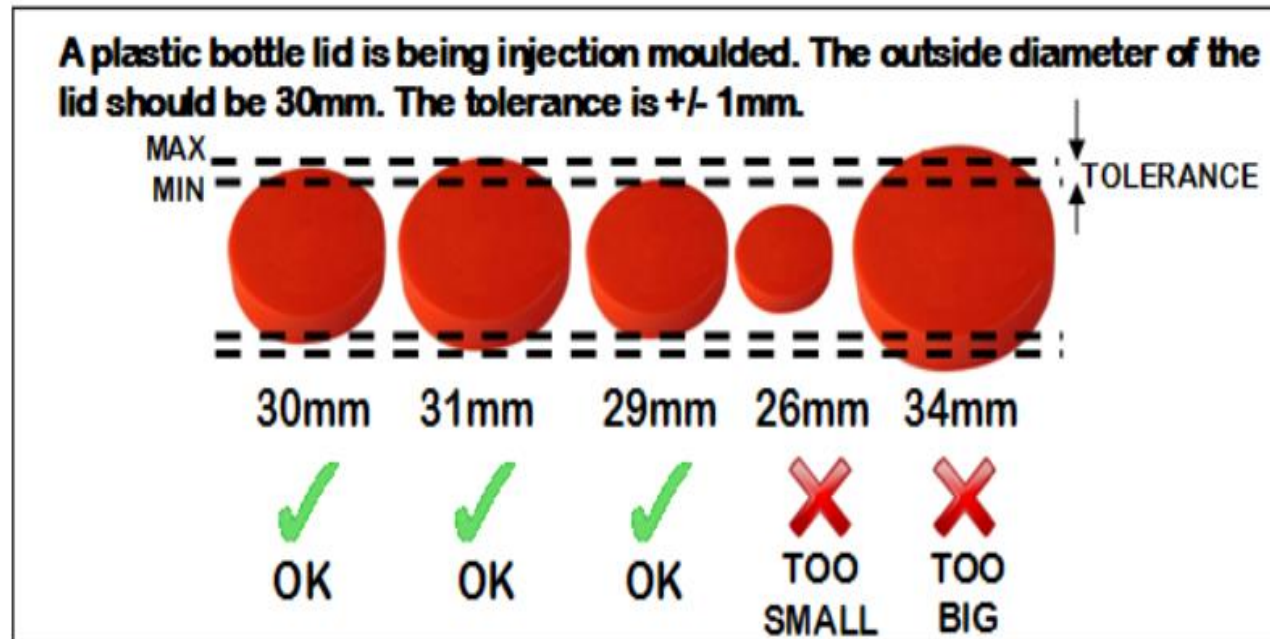
Critical Control Points

CCP

QUALITY CONTROL (QC)

These are the series of checks that are carried out when making a product

- They check that each step of the manufacturing is to a specific **STANDARD**
- **A SAMPLE** is taken to be tested by **QUALITY CONTROL** for example, 1 item in every 100 made.
- Things such as **SIZE, COLOUR, WEIGHT or FORM/SHAPE** are checked
- **A TOLERANCE** is the maximum and minimum size allowed for an item, for example:

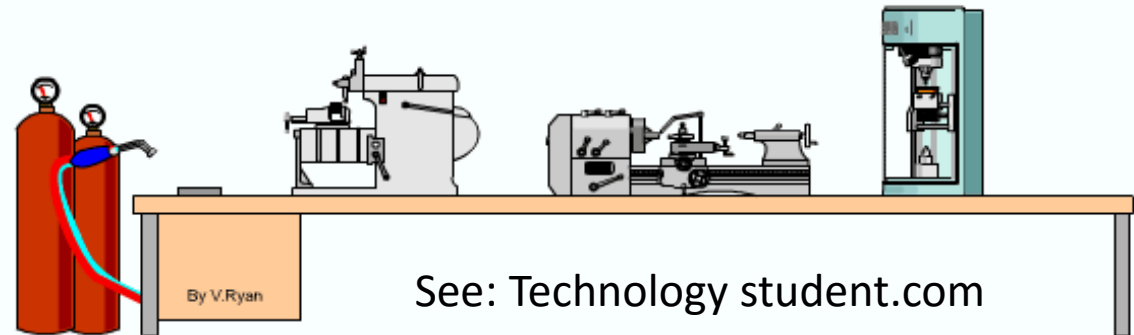


QUALITY ASSURANCE

Quality assurance (QA) is a system of checks designed to ensure that products are free of faults.

A quality assurance system involves regular quality control inspections that test and monitor the quality, accuracy and fitness for purpose of the product, from the design stage through to manufacture.





The Quality Assurance Manager checks all the machines are set and maintained to the highest possible standard.

CRITICAL CONTROL POINTS

Quality control checks take place at critical control points (CCPs) in a product's manufacture.

- Raw materials are tested to make sure they are the correct width, colour, weight
- The product may be tested for strength, durability,
- Prototype
- The prototype is a mock-up of the product used to trial a design or pattern, see how materials and components behave, try out an assembly process, work out costs and test fitness for purpose in everyday use.
- Production
- During production there will be checks to test to ensure they meet the tolerance stated in the manufacturing specification.

QUALITY CONTROL IN PRINTING

- When items are printed in **INDUSTRY** the following quality checks are carried out:

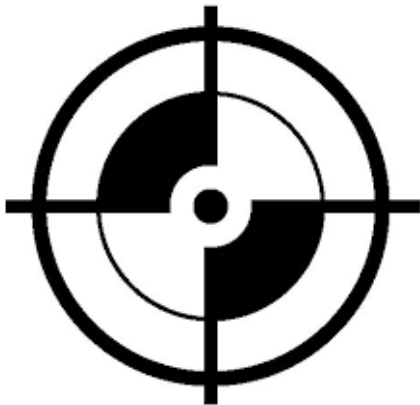
COLOUR BARS

These are printed down the side of sheets. The colour consistency and density is checked using a **DENSITOMETER**.



REGISTRATION MARKS

These ensure that the colours (CMYK) are correctly aligned. They should appear solid black.



VISUAL CHECKS

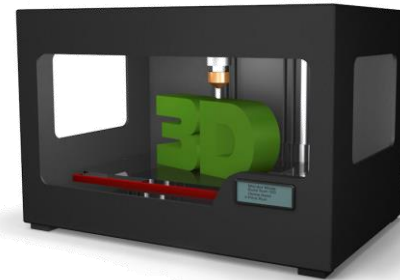
The typeface and text is checked for breaks (gaps) and that it is clear & readable. The colours are checked against a proof (the original document).



COMPUTER AIDED MANUFACTURE. This is when you convert your CAD drawing into co-ordinates for a machine to follow and OUTPUT. The machine then manufactures your product following your **CAD** drawing exactly.

Advantages of using CAD/CAM

- Quicker than traditional drawing & manufacturing techniques.
- Gives a much higher degree of accuracy (tolerance) on manufactured products.
- Easier to make changes, e.g. update the design, change the dimensions as you just alter the CAD drawing which controls the CAM machinery.
- Reduced staff costs as less workers needed to operate machinery.
- Better standard of Quality Assurance as the manufacturing process is identical every time.



Disadvantages of using CAD/CAM

- Very high cost initially to buy the machinery
- Need to employ highly skilled staff to operate CAD & CAM
- If the machinery breaks down, the entire production line grinds to a halt, losing the company money
- Disadvantages to local community surrounding the factory as there will be less low skilled jobs on offer