

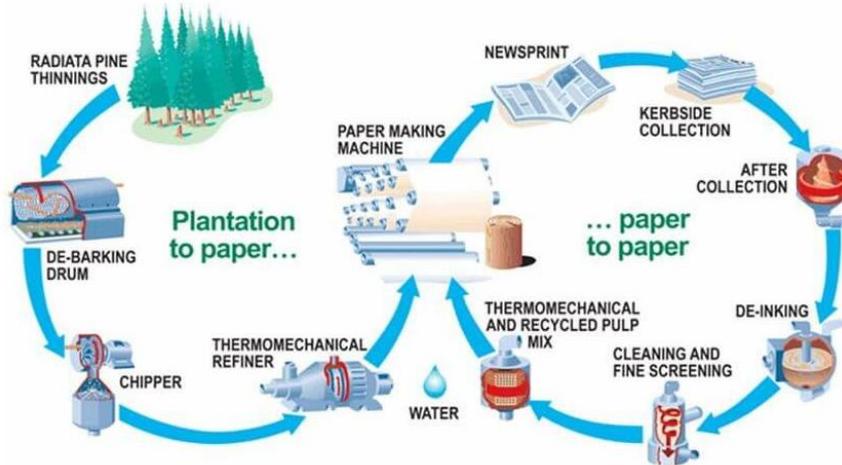
# GCSE DESIGN & TECHNOLOGY

Materials, components,  
processes & techniques

REVISION CARDS

# Paper and card

## Paper:



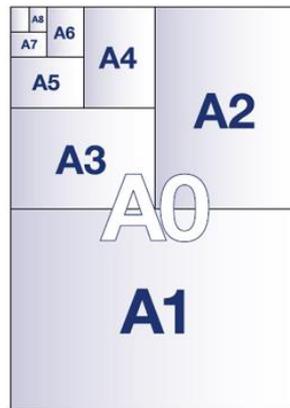
**Manufacture:** Plantation/de-barking/  
pulp/chemicals added/poured over fine  
mesh/rolling & drying

**Paper sizes:** A4, A3, A2

**Weights:**

Units: Grams per square  
meter (e.g 70g/m<sup>2</sup> paper)

Thickness: Microns  
(Thousandth of a mm)



## Paper & Board...

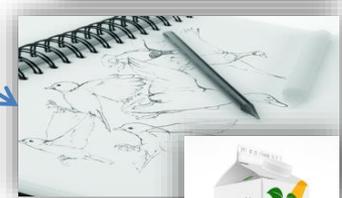
**-Layout & tracing paper**

-Use: *designing*



**-Cartridge paper**

-Use: *general drawing*



**-Carton/duplex board**

-Use: *food packaging*



**-Solid white board**

-Use: *high quality packaging*



**-Foil-lined board**

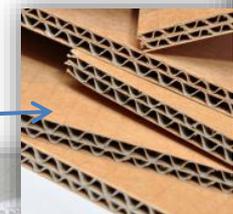
-Reflect heat

-Use: *takeaway containers*



**-Corrugated board**

-Use: *packaging for transportation*



**-Foam core**

-Use: *Architectural models*

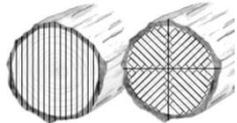


# Timber based materials



## Hardwoods

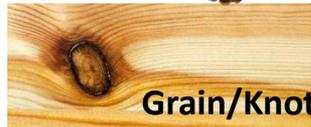
-Slow growing/  
deciduous/  
tighter grain/  
denser



Slab sawn Quarter sawn

## Softwoods

-Fast growing/  
needles/ cones/  
evergreen



Grain/Knot

## Softwoods:

**Scots Pine:** Use: Construction

**Parana pine:** Use: Furniture



## Hardwoods:

**Beech**

Use: Furniture/toys/tool handles

**Oak**

Use: High quality furniture

**Ash**

Use: Tool handles

**Mahogany**

Use: Good quality furniture

**Teak**

Use: Outdoor furniture



## Manufactured board...

**MDF** (Medium Density Fibreboard)

-Use: Interior panelling / low cost furniture



**Hardboard** (Similar to MDF)

-Use: Furniture/ picture frame backs



**Chip board**

-Use: Laminated table tops/ low cost furniture/ flooring



**Plywood**

(Layered veneers at 90 degrees)

-Use: General construction



**Blockboard**

(Strips of wood sandwiched  
Between two veneers)

-Use: Furniture (where strength  
Is needed)



**Forestry Stewardship**

**Council (FSC)**

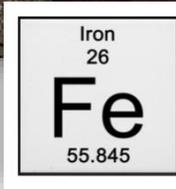
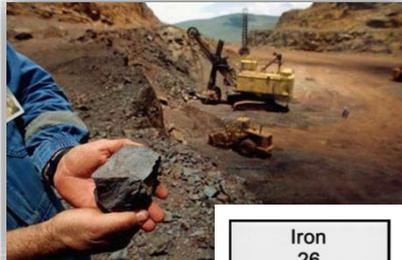
-Sustainable forests



# Ferrous metals

## -Ferrous metals:

- Mined from the ground (ore)
- Consist of iron



- Prone to rusting



## Examples...

### **-Cast iron**

- Use: Metalwork vices, drain covers



### **-Mild steel**

- Use: Nuts, bolts, car bodies



### **-Tool steel**

- Use: Hand tools, garden tools, springs



## **-High speed steel**

- Use: Drill bits, lathe tools, cutters



## **-Stainless steel (Alloy)**

- Use: Kitchen sinks, cutlery, surgical instruments



## Stock forms:



Sheet



Tube



Rod/bar



Ingot

# Non Ferrous metals

## Non-Ferrous metals:

- Don't contain iron
- Not magnetic
- Don't rust

## Aluminium

*Use: Cooking foil, saucepans*



## Copper

*Use: Plumbing pipes, electrical wire*



## Tin

*Use: coating on food cans*



## Zinc

*Use: Coating on buckets, screws, roofing sheets.*



## Silver

*Use: Jewellery*



## Alloys:

- Two or more elements
- Improved properties

## Brass

*Use: Door handles, plumbing fittings*



## Pewter:

*Use: Jewellery, picture frames, decorative ornaments*



## Stainless steel:

*Use: Sink/cutlery*



# Polymers

## Source

- Crude oil (synthetic)
- Non-renewable
- Not sustainable



## Thermoplastics (Soften when heated)



PETE

**Polyethylene Terephthalate**  
Use: Drinks bottles



HDPE

**High density polyethylene**  
Use: Detergent bottles



V

**Polyvinyl chloride**  
Use: Wire insulation



LDPE

**Low density polyethylene**  
Use: Plastic bags



PP

**Polypropylene**

Use: Folders



PS

**Polystyrene**

**HIPs (High Impact)**

Use: Packaging inserts

**Expanded Polystyrene**

Use: Packaging inserts



OTHER

e.g. **ABS - Acrylonitrile Butadiene Styrene**

Use: Hard hat



## Thermosetting plastics (Cannot be re-heated)

**Urea formaldehyde (UF)**

Use: Electrical sockets



**Melamine formaldehyde (MF)**

Use: Worktop laminates



**Epoxy Resin**

Use: Printed Circuit Boards (PCB's), Araldite glue

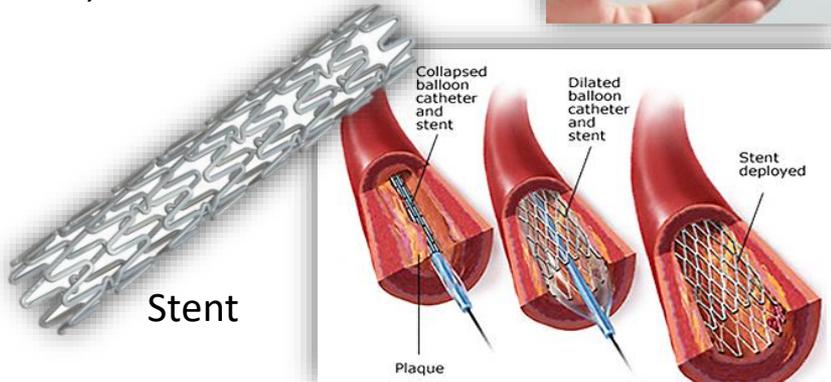


-Thermosetting plastics cannot be recycled

# Smart materials

## -Shape Memory Alloy (SMA)

- Nitinol (Nickel-Titanium alloy)
- Heat/movement
- Use: flexible spectacles (super-elastic wire), stent, muscle wires



## -Polymorph:

- Low melting point thermoplastic
- Melts in hot water
- Use: Modelling prototypes i.e. for hand grips.



## Photochromic materials

- Change colour with changes in light
- Use: Reacta-light glasses



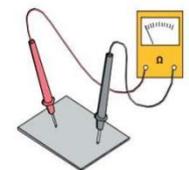
## Thermochromic Materials

- Change colour in response to heat.
- Use: forehead thermometer



## Quantum tunnelling composite (QTC)

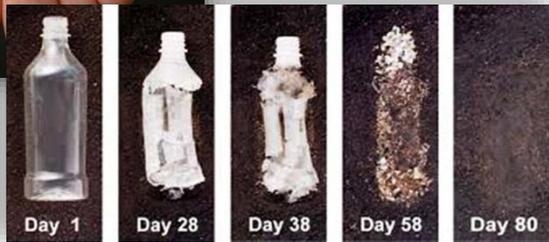
- Changes from an insulator to a conductor when squeezed
- Use: Scales, Smart textiles with touch sensitive fabrics



# New materials / Composites

## Corn starch polymers

- Made from corn or potato starch
- Biodegradable
- Renewable / sustainable
- Safer for food packaging
- use: biodegradable packaging materials, medication capsules, dissolvable stitches.*



## -Precious metal clays

- Contains particles of metal
  - Easy to work by hand
  - Heated to fuse together
- Use: jewellery*

## Composites: Fibre Reinforced Polymers...

### Glass reinforced plastic (GRP)

- Glass fibres with resin
- Laid up in a mould
- Use: boat building*



### Carbon Fibre reinforced plastic (CFRP)

- Woven carbon fibre sheets combined / laid up with resin.
- Use: racing bike, sports cars.*



### Kevlar

- High strength synthetic fibres
- Woven into fabric sheets
- Use: body armour*



### Fibre reinforced concrete



# Manufacturing

## Scale of production

### One-offs

- Time consuming
- Expensive

*i.e. sculptures, wedding dress*



### Batch

- Series of identical products
- i.e. furniture, bread*



### Mass

- Large numbers
  - Production line
  - High set-up costs
- i.e. cars, electrical goods*



### Continuous

- 24hr production lines
- i.e. soft drinks, oil, electricity*

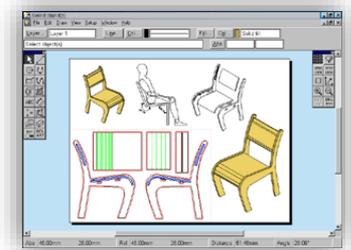
### Just in time

- Well timed delivery of stock
- Less warehouse space needed
- Computer stock management



## Computer Aided Design (CAD)

- Accuracy/ Ease of editing
- Ease of communication (i.e. email)



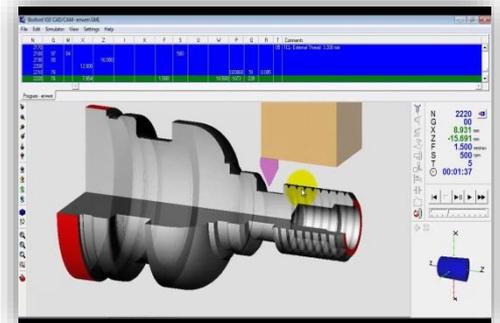
## Computer Aided Manufacture (CAM)

- Repeat manufacture
- Identical components
- Accuracy
- Low labour costs



## Computer Numerical Control (CNC)

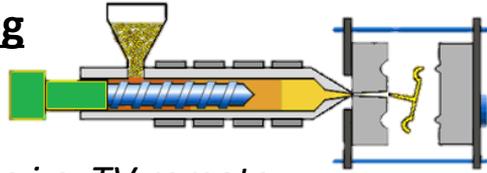
- Machinery controlled by computer data
- Data transfer



# Plastic processes

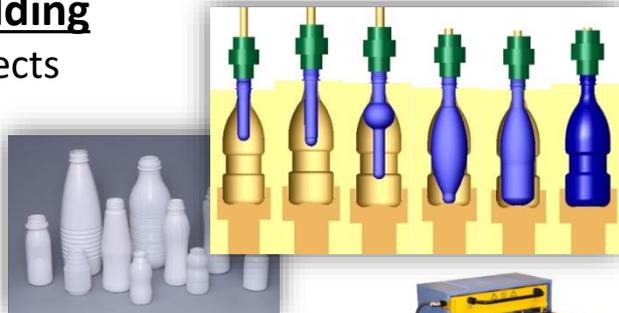
## Injection moulding

- Complex 3D shapes
- High volumes
- Use: Product casings i.e. TV remote



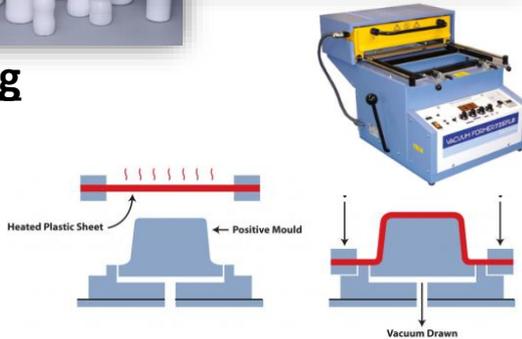
## Blow moulding

- Hollow objects
- Use: drinks bottles



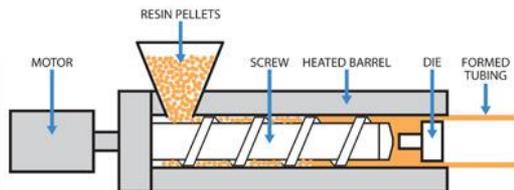
## Vacuum forming

- Use: packaging



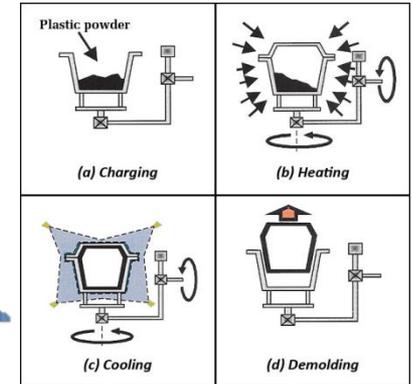
## Extrusion

- Use: Tubes



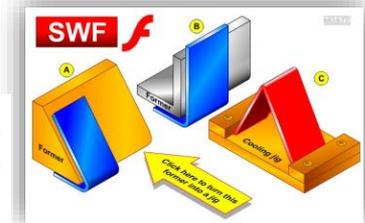
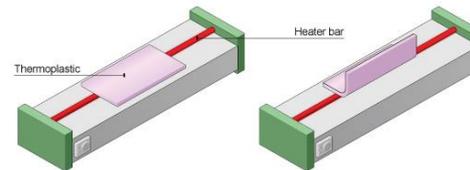
## Rotational Moulding

- Use...
- Enclosed objects
- Large objects i.e. ball



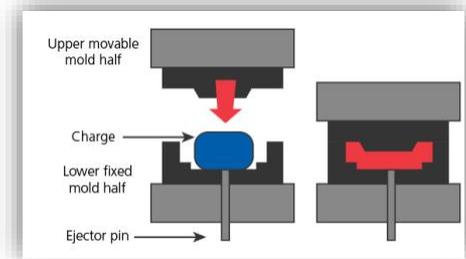
## Line bender/strip heater

- Bending Acrylic
- Use: leaflet holder



## Compression moulding

- Thermosetting polymers
- Use: Electrical sockets

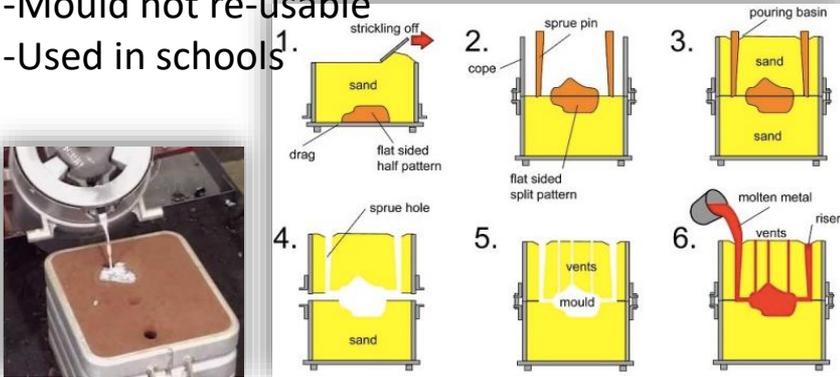


# Metal processes

## Sand casting (Cast iron, aluminium, brass etc.)

Use: Large components i.e. train wheels

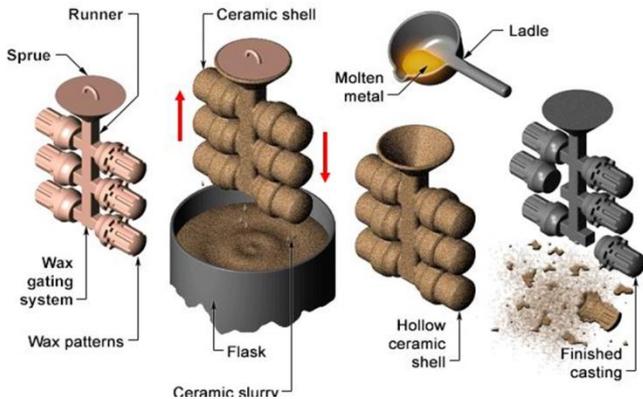
- Lower quality finish
- Mould not re-usable
- Used in schools<sup>1</sup>



## Lost pattern casting (Investment casting)

-Sophisticated process

Use: Complex shapes i.e. Jewellery

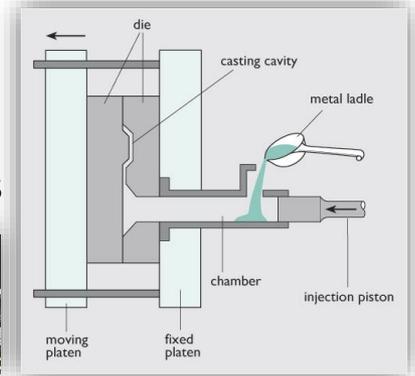


## Die casting

-Similar to injection moulding

-Low melting point alloys

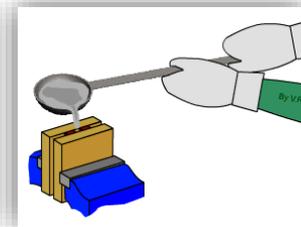
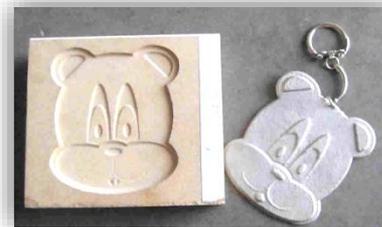
Use: Engine parts



## Die casting in schools

- Pewter casting (Low melting point)
- MDF moulds (CNC cut)

Use: Jewellery, pendant, key tag



## Turning, Milling, Drilling etc.



# Finishing processes

## Finishes on materials

- Protect from deterioration
- i.e. rusting, oxidation, rot etc.
- Improve appearance



## Paints

- Oil-based
- Water based
- Solvent based



## Varnishes and lacquers

- Clear coat

## Oils and polishes

- Garden furniture



## Wood stains

- Enhance the colour of timber



## Enamelling

- Powdered glass coating
- Baked on in oven
- Use: jewellery



## Plastic dip coating

- Polymer layer
- Use: tool handles



## Electroplating

- Layer applied through electrolysis
- Chrome layer
- Use: Taps, bathroom rails



## Galvanising

- Steel dipped into molten zinc
- Protect from rusting
- Exterior use
- Use: Railings

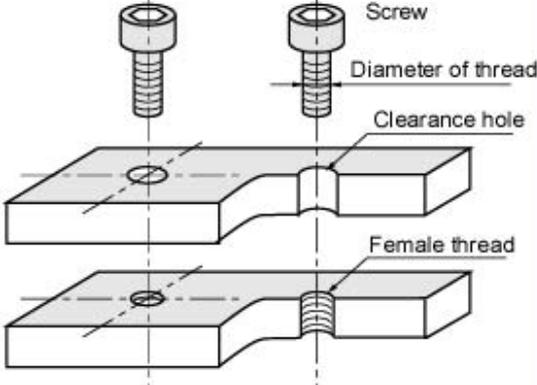
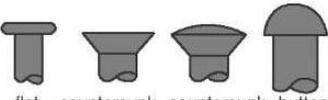


## Polishing

- Buffing to remove oxide
- Use: Taps, bathroom rails

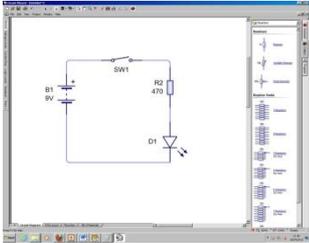


# Fixing components

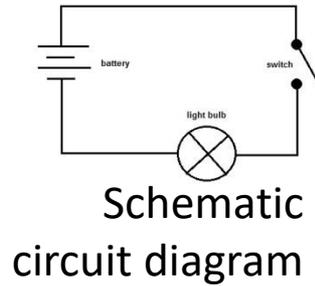
<b>Bolt</b>		<b>Tap</b>	
<b>Machine screw</b>		<b>Die</b>	
<b>Round head screw</b>		<b>Tap wrench</b>	
<b>Countersunk machine screw</b>		<b>Die stock</b>	
<b>Studding – Threaded rod</b>		<b>Thread sizes</b>	<b>M3, M4, M6 etc.</b>
<b>Nut</b>		<b>Clearance hole</b>	
<b>Rivet</b>	 <p>flat    countersunk flat    countersunk round    button</p>	<b>Pilot hole</b>	
<b>Pop-rivet</b>		<b>Tapping size</b>	

# Electronics & circuit manufacture

## Circuit design (Computer Aided Design - CAD)



Circuit Wizard

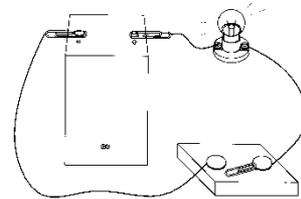


## PCB Milling

(Computer Aided Manufacture - CAM)

## Advantages...

- Circuit simulation
- On screen testing
- Accuracy
- Ability to edit circuit
- Batch/mass production
- Identical copies

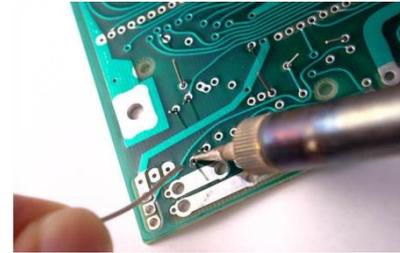


Circuit drawing



PCB Etching

## Soldering



## Soldering Iron and stand



Eye protection /  
Ventilation?

Solder  
(Flux)

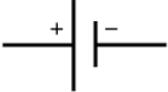
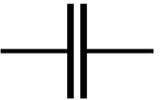
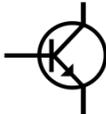
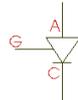
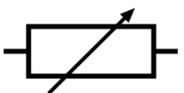
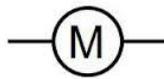
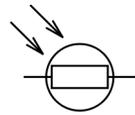
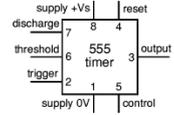
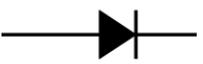


Tinning the  
connections?



Copper wire  
(Good conductor of  
electricity)

# Electronic components

Cell		Buzzer	
Battery		Switch	
Capacitor		Transistor	
Resistor		Thyristor	
Variable resistor		Motor	
Light Dependent Resistor (LDR)		555 Timer	
Light Emitting Diode (LED)			
Diode			

# Printing

## Process colours

Used in commercial printing

## Colour registration marks

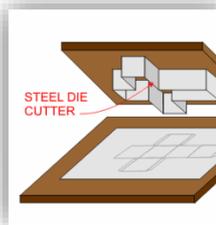
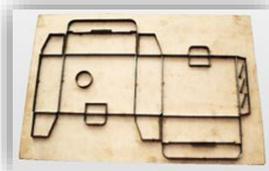
Alignment of process colours



## Cutting die

Cutting, creasing, perforating

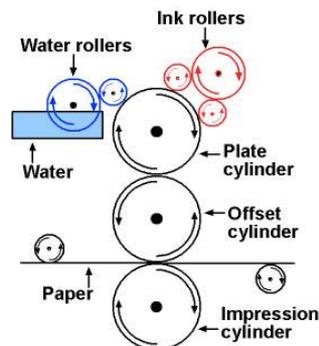
Use: packaging



## Block printing

-Simple process  
-Similar to potato printing

Use: Printing decorative fabrics



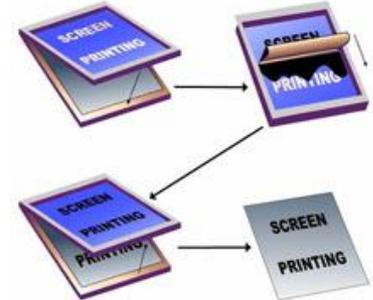
## Offset Lithography

-Oil(ink) & water don't mix

Use: Commercial printing on paper & card

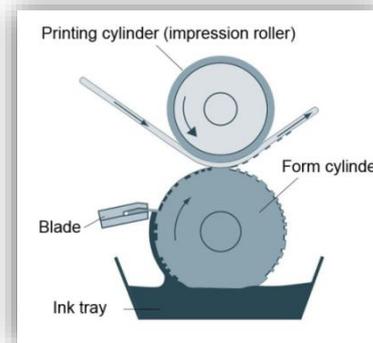
## Screen printing

Use: Fabric  
i.e. "T" shirts



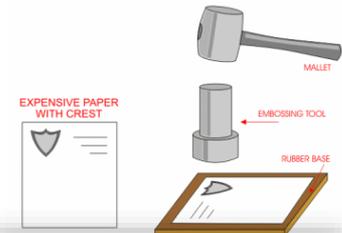
## Flexography

Use: Printing plastic bags



## Embossing

Use: Greetings cards



## Dye sublimation

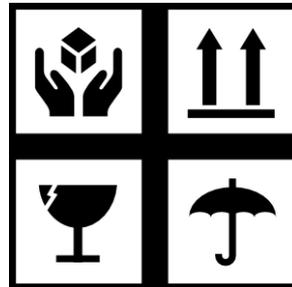
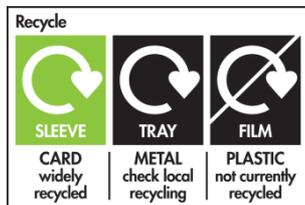
-Heat transfer  
Use: T Shirts

# Packaging and labelling

## Packaging

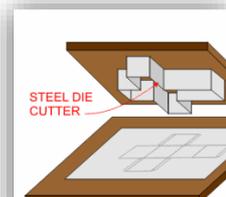
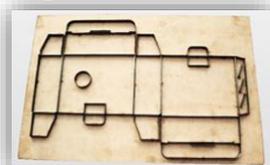
- Protect:** during transit
- Inform:** i.e. contents/ingredients
- Display:** in store
- Transport:** ease of stacking or moving
- Contain:** keep together
- Preserve:** against bacteria, weather

## Packaging symbols



## Manufacturing packaging

- Cutting die
- Surface development (net)
- Creasing, perforating



## Symbols

- International standards/codes
- Pictograms to inform the user



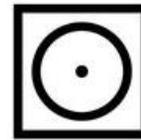
Machine wash on 30°



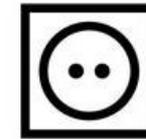
Machine wash on 40°



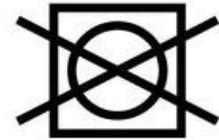
Machine wash on 60°



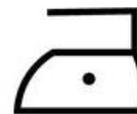
Tumble Dry, Normal  
Low Heat



Tumble Dry, Normal  
Medium Heat



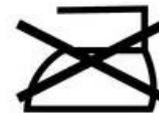
Do Not Tumble Dry



Iron Low Heat



Iron Medium Heat



Do not iron

# Hand tools

## Common hand tools...

Combination  
pliers



Pointed  
nosed pliers



Side cutters

Hacksaw



Junior hacksaw



Coping saw



Needle files



Hand file



Ball-pein hammer

## Clamping tools...



Machine vice



Hand vice

G Clamp



Bench vice

## Marking out tools...

Scriber



Centre punch



Engineers  
try square



Engineers blue



Micrometer

Vernier caliper



# Common machine tools

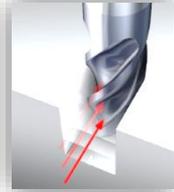
## Manual machinery



Centre lathe



Milling machine



Strip heater



Vacuum former



Power hacksaw



Linisher



Profile cutter



Disc sander



Pillar drill



## CAD: Computer Aided Design



## CAM: Computer Aided Manufacture

CNC Router



Vinyl cutter



CNC Lathe

(Computer Numerical Control)



Laser cutter

3D Printer



# Health & Safety

## PPE – Personal Protective Equipment

- Eye protection (goggles/visor/safety glasses)
- Appropriate footwear
- Dust mask
- Gloves
- Guards

## Risk assessment

- Identifying the hazards
- Calculating the risk/probability
- Control measures in place

## Hazards...

- Trapping clothing/limbs
- Dust inhalation
- Swarf being thrown during cutting
- Workpiece coming loose

## Risk assessment



# Drawing conventions

## Scale:

2:1 (double size)

1:1 (actual size)

1:2 (Half scale)

**Tolerance:** i.e. 12mm +/- 0.2mm

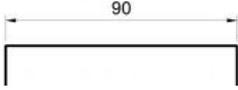
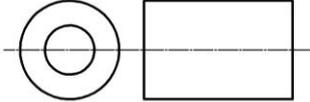
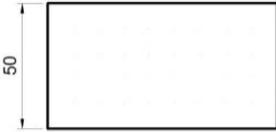
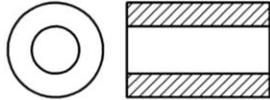
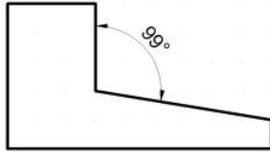
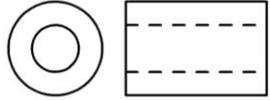
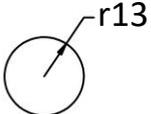
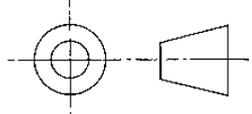
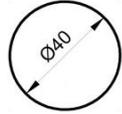
## Computer Aided Design (CAM)

-2D Designer

-3D Solidworks

**British standard conventions**

**3<sup>rd</sup> Angle Orthographic projection**

<b>Horizontal dimension</b>		<b>Centre line</b>	
<b>Vertical dimension</b>		<b>Cross section</b>	
<b>Angular measurements</b>		<b>Hidden detail</b>	
<b>Radius dimension</b>		<b>3<sup>rd</sup> Angle Orthographic projection</b>	
<b>Diameter measurement</b>			

# Human factors

## User safety

British Standards  
(Kitemark)



European  
standards



Age restriction  
(Unsuitable products)

## British toy and hobby association

- Manufacturer membership
- High standards / safety ensured



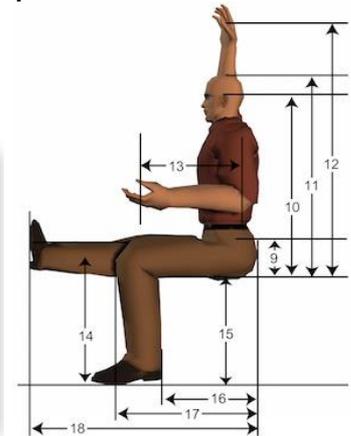
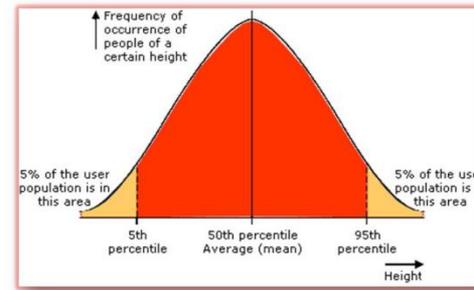
## Ergonomics

- Designing products with usability  
In mind (e.g. size, shape, texture, colour, layout)
- Ease of use / comfort etc.
- Using anthropometric data



## Anthropometric data

- Human body measurements
- 5<sup>th</sup>/50<sup>th</sup>/95<sup>th</sup> percentile
- One size fits all ... 5<sup>th</sup> to 95<sup>th</sup> percentile
- Smaller (5<sup>th</sup> percentile)
- Bigger (95<sup>th</sup> percentile)



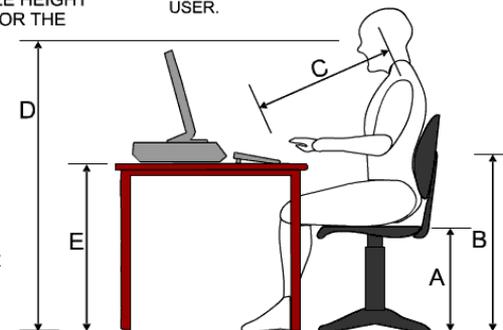
## COMPUTER WORKSTATION

D. THE MONITOR IS AT A COMFORTABLE HEIGHT AND ANGLE FOR THE USER.

C. THE TABLE IS THE CORRECT WIDTH, AVOIDING OVER-STRETCHING BY THE USER.

B. THE BACK OF THE CHAIR SUPPORTS THE USERS LOWER BACK. IT IS IN THE CORRECT POSITION.

E. THE HEIGHT OF THE TABLE TOP, ENSURES THAT THE KEYBOARD IS WITHIN COMFORTABLE REACH.



A. THE SEAT OF THE CHAIR IS FIXED AT A COMFORTABLE HEIGHT. IT CAN BE ADJUSTED FOR USERS OF DIFFERENT HEIGHTS.

# Social, moral & Environmental

## Product labelling

Environmental Hazard (i.e. oil)



European standards



Made from recyclable materials



Identifying plastics...



**Forestry Stewardship Council (FSC)**  
-Sustainable forests



Corrosive Liquids (i.e. bleach)



Irritant (i.e. cleaning products)



Toxic substances



British Standards (Kitemark)



Highly Flammable (petrol)



## Reduce

-The amount of material used



## Re-use

-Instead of throwing away



## Refuse

-To accept unethical or wasteful designs



## Re-think

-Our attitude to environmental impact

## Carbon Footprint

-Production of carbon dioxide  
-(units of CO2)  
-Transportation



## Product miles

-Source-factory-retailer-end user

## Product Life Cycle



## Recycle

-The materials already used  
-Safe disposal



## Repair

-Products that have broken



# End of topic assessments

Topics...	Complete	Topics...	Complete
<b>Metals</b>		<b>Printing processes</b>	
<b>Plastics</b>		<b>Design styles</b>	
<b>Plastics 2</b>		<b>Design styles 2</b>	
<b>Woods</b>		<b>Tools &amp; Equipment</b>	
<b>Smart &amp; Modern materials</b>		<b>Considering the needs of the user</b>	
<b>Plastic processes</b>		<b>Environmental issues</b>	
<b>Plastic properties &amp; processes</b>		<b>Inspiration from nature</b>	
<b>Packaging manufacture</b>			