

A LEVEL

**Processes &
Manufacture**

REVISION CARDS

Processing: Polymers

Thermoplastic moulding processes...

- Injection moulding:** complex 3D shapes, self finishing/coloured
- Blow moulding:** hollow, narrow neck, app: *bottles, containers*
- Rotational moulding:** 3D hollow products, app: *footballs, road cones, large storage tanks*
- Extrusion:** continuous cross-section, app: *curtain rails, window frame sections, electrical conduit*
- Calendering:** thin film, sheet, app: *shopping bags*

Thermosetting plastic processes...

- Compression moulding:** powder, slug, cured, app: *electrical fittings*

Thermoplastic forming processes...

- Vacuum forming
- Thermoforming
- Line bending

Thermoplastic joining processes...

- Screw fixings
- Integral snap fixings
- Captive nuts
- Adhesives
- Thermal welding
- Ultrasonic welding

Thermosetting plastics joining processes...

- Screw fixings
- Adhesives

Common wasting processes (CAM):

- drilling, turning, milling, laser cutting, profile cutting

Processing: Joining metals

-Permanent joining methods...

-Heat processes

-Welding

-**Oxy-acetylene:** gas flame, oxygen, acetylene

-**Electric arc:** consumable electrode

-**MIG (metal inert gas):** steel, consumable wire, electric arc

-**TIG (tungsten inert gas):**

app: stainless steel, aluminium

-**Spot:** electric, *app: car body panels*

-**Seam:** electric, *app: tubes, drink cans*

-**Aluminium welding**

-**Brazing** (oxy-acetylene)

-**Soldering:** Flux

-**Hard** (silver solder) *app: jewellery*

-**Soft:** low temp, *app: circuits*

-Forming/mechanical processes

-**Riveting** (pop/solid)

-**Rolled/crimped seam**

app: biscuit/sweet tins, cans

-**Adhesives:** epoxy resin

Temporary joining methods...

-Screws (Machine)

-Thread cutting (tap/die)

-Nuts and bolts

-Captive nut

-Self-tapping screws

Processing: Printing processes

-Letterpress (relief printing): raised letters, small quantities

app: specialist printing, i.e. wedding invitations

-Flexography (relief printing):, raised image etched onto rubber material, poor non- absorbent materials,

app: food packaging, carrier bags, waxed boards, cellophane.

-Gravure: High volume, high quality, engraved stainless steel cylinder, cells (holes), doctor blade, web-fed, expensive

app: postage stamps, bank notes, catalogues, wrapping paper

-Screen printing: silk screen mesh, mask, flat material surface,

App: paper, fabrics, ceramics, PCBs

-Offset lithography: 1000 items or more, photosensitive aluminium plates, dampening roller, oil based inks, sheet or web-fed

-Electrostatic printing processes: photocopier, laser printer

-Digital printing: economical, short print runs (1000), on-demand printing

-Inkjet, Microcapsule, Thermal subliminal/wax transfer

-Process colours: Cyan, Magenta, Yellow & Black (CMYK)

-registration marks, pantone colour

-Die cutting: cutting, creasing, perforating, embossing

app: packaging nets, surface developments

Processing: Heat treating metals`

Annealing:

- reverses internal stresses
- heating (crystals grow)
- “soak”
- slow cooling

Hardening:

- heating (cherry red)
- quenching
- brittleness

Tempering:

- Follows hardening
- Reduces brittleness “relax”
- Heating: specific tempering colour
- Quenching
- app: lathe tools, drills, taps, dies*

Quenching: rapid cooling (quenching media: brine, water, oil, air)

Normalising:

- Crystal structure made uniform
- Similar size crystals
- Temperature maintained “soaked”
- Air cooled

Age hardening: duralumins

Case hardening (carburising): mild steels, addition of carbon layer, outer casing, soft core, *app: cams*

Nitriding: case hardening, immersed in nitrogen, heated *app: aircraft components*

Processing: Forming/shaping metals

Press forming: (Punch and die tools)

-**Blanking, piercing:** *app: computer casings, colander*

-**Cupping:** (before deep drawing)

-**Deep drawing:** *app: drinks can*

-**Embossing:** 3D shape, decorative
app: jewellery, sweet tins etc.

Casting:

-**Sand casting:** pattern, complex 3D shapes, small production runs

-**Die casting:** gravity die casting, pressure die casting, aluminium, low temperature, large scale production

-**Investment casting:** wax pattern, sprayed clay layer, fired in kiln

-**Spinning:** Sheet metal, cold (Aluminium, brass, copper) *App: Saucepans*

-**Forging:** (wrought iron), drop forging/hot pressing, hammered, die, large forces, refined grain/structure
app: spanners

-**Cermets:** metal & ceramic, sintering, tungsten carbide, cobalt, high melting point, *app: cutting tool tips*

-**Common wasting processes:**

-sawing/filing

-drilling/milling

-grinding/sanding

-**CAM Processing:**

-CNC (Computer Numerical Control)

-flame cutting

-Plasma cutting: electric arc, inert gas (argon), compressed air

-laser cutting

-Milling/engraving

Processing: Woods

-Conversion: (trunk to usable timber),
sawing, slab, quarter, stock forms
(sheet, mouldings, dowel etc.)

-Seasoning: controlled drying, kiln
drying, moisture content

-Wood defects: splits, shrinkage,
warping, bowing, twisting, cupping,
dry/wet rot, insect attack

Traditional joining methods:

-Wood joints: mortise and tenon,
dowel, dovetail, comb etc.
(permanent)

-Knock down fixing methods...

-Barrel nut/bolt, corner plates, block
connectors, dowels, cam lock etc.
app: flat-pack furniture (temporary)

-Steam bending: ply, steam chest
app: wooden jewellery, boat hull

Wood finishes...

-Natural barriers: Teak oil

-Preservatives: Water/oil based

-Tanalising: (pressure treatment)

-Varnishes: Yacht varnish,
polyurethane varnish, oil based

-Other coatings: Gloss paints, stains
colour wash, wax, exterior stains

-Laminating: Supporting material
(MDF), printed/real wood layer, clear
resin overlay, melamine
formaldehyde (formica)

-Veneers: Thin layer, shaved off trunk,
decorative surface, paper/foil backed

-Wasting processes: Drilling, sawing,
profile cutting and routing

-CAM Processing: CNC routing

Processing: Composites & Ceramics

'Lay-up' resin techniques:

- GRP (Glass Reinforced Plastic)
- Carbon fibre
- glass fibre matt, polyester resin
- Layers at 90 degrees
- integral fixings/inserts/mounting plates
- app: racing bike frames, high performance car body shells*
- Casting resin

-Plastic laminates: *app: kitchen worktops*

Concrete:

- Reinforced concrete, fibre reinforced
- Casting concrete

Ceramics: *clay app: house bricks, electrical insulators for pylons*

Metal oxide ceramics

- Alumina:** *app; spark plugs*
- Beryllia:** *app: crucibles*
- Magnesia:** *app: furnace linings*
- Zirconia:** *app: rocket liners*

Slip casting: slip, jiggering

Joining ceramics: Wet clay, "green" state, before firing, *app: teapot handle, cups, mugs etc.*

CAM Processing

Computer Aided Manufacture

2D – Laser cutting, engraving

CNC processes...

- Turning:** (lathe)
- Routing:** Block and sheet materials
- Milling:** Plastics and metals
- Plasma cutting:** electric arc, inert gas (argon), compressed air

Rapid prototyping

- Stereo lithography**
- 3D Printing**

Finishing processes

Function: protection (corrosion/rot), water repellent, wear resistance, reflect heat, insulate etc.

Wood finishes...

- Natural barriers:** Teak oil
- Preservatives:** Water based, tanalising (pressure treatment)
- Varnishes:** Yacht varnish, Polyurethane varnish, oil based
- Other coatings:** Gloss paints, stains colour wash, wax, exterior stains
- Laminate coverings**

Metal finishes...

- Primers:** Zinc oxide, red oxide
- Paints:** Acrylic, cellulose, oil based
- Application:** brush, spray, dip, powder
- Electrostatic spray painting**

-**Plating:** chrome, silver, tin etc.

app: taps, kitchen equipment

Galvanising: Zinc/tin plating (molten)

-**Anodising:** Aluminium, oxide layer, coloured

-**Plastic dip coating:** Polymer layer

-**Powder coating:** static charge, dry powder, sprayed, heated *app: white goods*

-**Polished/brushed finish:** Stainless steel /deburring/ trimming

-**Enamelling:** Glass layer, decorative, jewellery

Polymer finishes...

-**Pigments** (self coloured)

-**Textured** (during moulding)

-**Stabilisers/Acrylic paints/Chrome effects**